German Guideline Program in Oncology (GGPO)

Perioperative Management of Gastrointestinal Tumours (POMGAT)

1.0 – November 2023
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Guideline (Long Version)

DKG KREBSGESELLSCHAFT · Deutsche Krebshilfe HELFEN. FORSCHEN. INFORMIEREN. · AWMF

Table of Contents

1 Information about this Guideline 6

1.1 Editors 6

1.2 Leading Scientific Societies 6

1.3 Funding of the Guideline 6

1.4 Contact 6

1.5 How to cite 6

1.6 Special Comment 7

1.7 Objectives of the Guideline Program for Oncology 7

1.8 Additional Documents relating to this Guideline 8

1.9 Composition of the Guideline Group 9

1.9.1 Guideline Coordination 9

1.9.2 Involved Professional Societies and Organisations 9

1.9.3 Workgroups 12

1.9.4 Patient Involvement 13

1.9.5 Methodological Support 13

1.10 Abbreviations Used 13

2 Introduction 17

2.1 Scope and Purpose 17

2.1.1 Objective and Key Questions 17

2.1.2 Target Audience 17

2.1.3 Validity and Update Process 17

2.2 Methodology 17

2.2.1 Levels of Evidence (LoE) 18

2.2.2 Grades of Recommendation (GoR) 19

2.2.3 Statements 20

2.2.4 Expert Consensus (EC) 20

2.2.5 Independence and Disclosure of Possible Conflicts of Interest 20

3 Background and history of modern perioperative medicine 22

4 Pre-hospital management 25

4.1 Perioperative administration of cardiac drugs 25
4.1.1 Statins 27
4.1.2 ACE inhibitors/angiotensin receptor antagonists 29

4.2 Preoperative and intraoperative single dose of corticosteroids 31

4.3 Prehabilitation 33

4.4 Patient training and advice regarding perioperative interventions / optimization options 35

4.5 Preoperative evaluation and risk assessment 36

5 Preoperative, inpatient management 38

5.1 PONV prophylaxis 38
5.1.1 Drug-based 38
5.1.2 Propofol-based total intravenous anesthesia (TIVA) 40

5.2 Hair removal in the surgical area 41

5.3 Skin disinfection of the operating field 42

5.4 Perioperative intravenous antibiotic prophylaxis 44

5.5 Preoperative bowel preparation 45
5.5.1 Colorectal operations 45
5.5.2 For non-colorectal procedures 48

5.6 Perioperative selective digestive decontamination (SDD) 50
5.6.1 Operations on the upper GI tract 50
5.6.2 Operations on the lower GI tract 52
5.6.3 Hepato-pancreato-biliary surgery 53

5.7 Sedative premedication 53

6 Intraoperative management 56

6.1 Intraoperative insertion of a drain into the surgical field 56
6.1.1 Esophagus 56
6.1.2 Stomach 58
6.1.3 Pancreas 59
6.1.4 Liver 63
6.1.5 Colon 65
6.1.6 Rectum (transanal) 66

6.2 Intraoperative anastomosis testing ... 68
6.2.1 Esophageal resections ... 68
6.2.2 Colorectal resections ... 69

7 Postoperative management ... 73

7.1 Postoperative use of gastric tubes ... 73
7.1.1 Esophageal resections ... 73
7.1.2 Gastric resections ... 75
7.1.3 Pancreatic resections ... 76
7.1.4 Liver resections ... 77
7.1.5 Colorectal resections ... 78

7.2 Leaving the bladder catheter in place beyond the intraoperative phase ... 79

7.3 Postoperative pain therapy ... 81
7.3.1 Systemic pain therapy versus epidural analgesia ... 81
7.3.2 Epidural analgesia versus peripheral regional analgesia procedures ... 83
7.3.3 Systemic pain therapy versus peripheral regional analgesia procedures ... 87

7.4 Prevention and treatment of postoperative gastrointestinal motility disorders ... 89
7.4.1 Pharmacological prevention and therapy ... 89
7.4.2 Adjuvant interventions ... 100

7.5 Postoperative mobilization ... 104

7.6 Postoperative respiratory therapy ... 106

7.7 Abdominal binder after median laparotomy ... 108

8 Multimodal perioperative management concept (mPOM) as an overall measure ... 109

8.1 Care as part of a multimodal perioperative management concept (mPOM) ... 109
8.1.1 Esophageal resections ... 109
8.1.2 Gastric resections ... 110
8.1.3 Pancreatic resections ... 112
8.1.4 Liver resections ... 113
8.1.5 Colorectal resections ... 115

8.2 Perioperative support from specialists in perioperative interventions ... 117

9 Quality indicators ... 119

10 List of Tables 121

11 List of Figures 121

12 Literature References 122

1 Information about this Guideline

1.1 Editors

The German Guideline Program in Oncology of the Association of the Scientific Medical Societies in Germany (AWMF), the German Cancer Society (DKG), and the German Cancer Aid Foundation (DKH).

1.2 Leading Scientific Societies

Deutsche Gesellschaft für Allgemein- und Viszeralchirurgie (DGAV)

Deutsche Gesellschaft für Koloproktologie (DGK)

1.3 Funding of the Guideline

This guideline was funded by the German Cancer Aid as part of the German Guideline Program in Oncology (GGPO).

1.4 Contact

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1.5 How to cite

German Guideline Program in Oncology (German Cancer Society, German Cancer Aid, AWMF): Perioperative Management of Gastrointestinal Tumours (POMGAT), Long version 1.0, 2023, AWMF Registration Number: 088-010OL https://www.leitlinienprogramm-onkologie.de/leitlinien/perioperatives-management-bei-gastrointestinalen-tumouren-pomgat/; Accessed [tt.mm.jjj]

1.6 Special Comment

The field of medicine is subject to a continuous process of further development, so that all details provided here, and in particular those on diagnostic and therapeutic procedures, can always only represent the state of knowledge at the time when the medical care guideline was printed. The greatest possible care has been taken with regard to the treatment recommendations given and to the choice and dosage of drugs. However, users are requested to check by referring to the patient package inserts and specialist information provided by the manufacturers, and in cases of doubt to consult a specialist. In the general interest of the guideline editors, readers are requested to draw attention to any questionable points or inconsistencies found.

Users themselves remain responsible for all diagnostic and therapeutic applications, medications, and dosages.

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1.7 Objectives of the Guideline Program for Oncology

The aim of the Association of the Scientific Medical Societies in Germany (AWMF), the German Cancer Society (DKG), and the German Cancer Aid Foundation (Stiftung Deutsche Krebshilfe) in implementing the German Guideline Program in Oncology (GGPO) is to jointly promote and support the development, updating, and use of scientifically based and practicable guidelines in oncology. The program is based on medical and scientific findings established by the specialist societies and the DKG, consensus among medical experts, users and patients, as well as the AMWF's regulations for guideline development. The program receives specialist support and financing from the German Cancer Aid. In order to reflect the current state of medical knowledge and to take account of medical progress, guidelines have to be regularly checked and updated. The use of the AWMF regulations is intended to provide a basis for developing of high-quality oncological guidelines in this framework. As guidelines represent an important instrument for quality assurance and quality management in oncology, they are intended to be used in a targeted and sustained way in everyday medical care. Active implementation measures and also evaluation programs are therefore important components of the support provided by the German Guideline Program in Oncology. The aim of the program is to create professional preconditions, with secure medium-term financing, for the development and provision of high-quality guidelines in Germany. High-quality guidelines of this type not only serve for structured knowledge transfer but can also be used in the design of health-care structures. Relevant aspects of this include evidence-based guidelines as a basis for establishing and updating disease management programs, and the use of quality

indicators derived from guidelines in the context of certification procedures for organ tumour centers.

1.8 Additional Documents relating to this Guideline

This long version of the evidence- and consensus-based S3 guideline on perioperative management of gastrointestinal tumours (POMGAT), which is evidence- and consensus-based, contains an overview of the methodological approach that was used to develop the guideline. It also contains recommendations with background texts on various aspects of multimodal perioperative management (mPOM) for elective gastrointestinal tumour resections.

In addition to the long version, the following documents are available (in German):

- Short version of the guideline with a clear presentation of the clinically relevant content
- Guideline report with a detailed description of the methodological approach used to develop the guideline
- Evidence report with a detailed presentation of the methodology and results of the evidence research and evaluation
- Patient guideline

This guideline and all supporting documents are available from the following websites:

German Guideline Program in Oncology (https://www.leitlinienprogramm-onkologie.de/leitlinien/perioperatives-management-bei-gastrointestinalen-tumouren-pomgat/)

- AWMF (https://register.awmf.org/de/leitlinien/detail/088-010OL)
- Guidelines International Network (http://g-i-n.net)

The guideline will also be available in the German Guideline Program in Oncology's mobile app.
For more information, see: https://www.leitlinienprogramm-onkologie.de/app/

iOS App

Android App

1.9 Composition of the Guideline Group

1.9.1 Guideline Coordination

Koordination
Prof. Dr. med. Tim Vilz, Clinic and Polyclinic for General, Visceral, Thoracic and Vascular Surgery, University Hospital Bonn, Venusberg-Campus 1, D-53127 Bonn

Professor Dr. Stefan Post, Schwarzwaldstrasse 102, D-68163 Mannheim

Methodological coordination
Clinic and Polyclinic for General, Visceral, Thoracic and Vascular Surgery, University Hospital Bonn.

The following table provides an overview of the persons responsible:

- Dr. med. Maria Kröplin - Methodological coordination in the Guideline Secretariat, support to Working Group Leaders in the preparation of draft recommendations and background texts, and preparation of the evidence report.
- Sophia Soltau - - Assistance in preparing the evidence report, preparation of evidence tables, narrative summaries
- Xenia Zoller - Organising kick-off meetings and consensus conferences, technical support, communication, administrative support.

1.9.2 Involved Professional Societies and Organisations

Table 1: Participating professional associations and organizations (alphabetical)

Participating professional associations and organizations (alphabetical)	Representative(s)
AIO Arbeitsgruppe Kolon-Rektum-Dünndarmtumouren in der DKG	Prof Dr. Gunnar Folprecht
AIO Arbeitsgruppe Pankreaskarzinom in der DKG	Dr. Dirk Waldschmidt
AIO Arbeitsgruppe Ösophagus- /Magenkarzinom in der DKG	Prof. Dr. Markus Möhler
Arbeitsgemeinschaft Deutscher Darmkrebszentren (AddZ)	Prof. Dr. Stephan Benz
Arbeitsgemeinschaft Onkologische Rehabilitation und Sozialmedizin in der DKG (AGORS)	PD Dr. Reiner Caspari
Arbeitsgemeinschaft Palliativmedizin in der DKG (APM)	PD Dr. Stefan Wirz
Arbeitsgemeinschaft Prävention und integrative Medizin in der Onkologie in der DKG (PRiO)	Prof. Dr. Arved Weimann
Arbeitsgemeinschaft Supportive Maßnahmen in der Onkologie in der DKG (AGSMO)	Timo Niels

Participating professional associations and organizations (alphabetical)	Representative(s)
Arbeitskreis Regionalanästhesie der DGAI	Prof. Dr. Thomas Standl
Arbeitskreis Schmerzmedizin der DGAI	PD Dr. Dr. Hans Gerbershagen
Assoziation Chirurgische Onkologie (ACO) der DGAV	Prof. Dr. Jörg Kalff
Chirurgische Arbeitsgemeinschaft Akutschmerz (CAAS) der DGCH	Prof. Dr. Stephan Freys
Chirurgische Arbeitsgemeinschaft für Colo-Proktologie (CACP) der DGAV	Prof. Dr. Stefan Fichtner-Feigl
Chirurgische Arbeitsgemeinschaft für Leber-, Galle- und Pankreas (CALGP) der DGAV	Prof. Dr. Christiane Bruns
Chirurgische Arbeitsgemeinschaft für Minimal Invasive Chirurgie (CAMIC) der DGAV	Dr. Alexander Buia
Chirurgische Arbeitsgemeinschaft für perioperative Medizin (CAPM) der DGCH	Prof. Dr. Benno Stinner
Chirurgische Arbeitsgemeinschaft oberer Gastrointestinaltrakt (CAOGI) der DGAV	Prof. Dr. Ines Gockel
Chirurgischen Arbeitsgemeinschaft Intensivmedizin und Notfallmedizin (CAIN) der DGCH	Dr. Rene Wildenauer
Deutsche Gesellschaft für Allgemein- und Viszeralchirurgie (DGAV)	Prof. Dr. Christian Eckmann
Deutsche Gesellschaft für Anästhesiologie und Intensivmedizin (DGAI)	Prof. Dr. Peter Kienbaum
Deutsche Gesellschaft für Ernährungsmedizin (DGEM)	Prof. Dr. Marc Martignoni
Deutsche Gesellschaft für Gastroenterologie, Verdauungs- und Stoffwechselkrankheiten (DGVS)	PD Dr. Henrike Lenzen
Deutsche Gesellschaft für Hämatologie und Medizinische Onkologie (DGHO)	Prof. Dr. Dirk Arnold
Deutsche Gesellschaft für Koloproktologie (DGK)	Prof. Dr. Julia Hardt
Deutsche Gesellschaft für Physiotherapiewissenschaft (DGPTW)	Prof. Dr. Bernhard Elsner

Participating professional associations and organizations (alphabetical)	Representative(s)
Deutsche ILCO	Erich Grohmann
Deutsche Interdisziplinäre Vereinigung für Intensiv- und Notfallmedizin (DIVI)	Prof. Dr. Wolfgang Hartl
Deutsche Schmerzgesellschaft	Prof. Dr. Esther Pogatzki-Zahn
Eingeladenen Fachexperten ohne Mandat	PD Dr. Viola Andresen Dr. Esther Biesel Prof. Mark Coburn Prof. Dr. Jörg Glatzle Dr. Oliver Haase PD Dr. Andreas Hecker Prof. Dr. Martin Hübner Prof. Dr. Bettina Jungwirth PD Dr. Simone Kagerbauer Prof. Dr. Matthias Leschke Dr. Franziska Peters Dr. Martin Reichert Prof. Dr. Christoph Reißfelder Prof. Dr. Jörg-Peter Ritz Dr. Benedikt Schick PD Dr. Rosa Schmuck Prof. Dr. Wolfgang Schröder Prof. Dr. Martin Söhle Prof. Dr. Dirk Weyhe Dr. Maria Kröplin Dr. Konstantinos Zarras
Konferenz Onkologischer Kranken- und Kinderkrankenpflege in der DKG (KOK)	Kerstin Paradies
Selbsthilfegruppe Ratgeber Magenkrebs/Speiseröhrenkrebs	Barbara Kade
Selbsthilfegruppe Semi-Colon	Nicola Reents Simone Widhalm

The following professional societies/organizations were also contacted for the guideline process:

- German Society of Geriatrics (DGG)
- German Society for Physical Medicine and Rehabilitation (DGPMR)
- German Society for Sports Medicine and Prevention (DGSP)
- Medical service of the Statutory Health Insurance Funds
- German Society for General Practice and Family Medicine (DEGAM)

- German Society for Social Medicine and Prevention (DGSMP)

However, they either did not respond to the request or declined to participate due to lack of resources.

In contrast to other S3 guidelines, a considerable number of national experts participated in the guideline development process. This phenomenon can be attributed to the nature of perioperative medicine as an interdisciplinary and interprofessional subject, necessitating the involvement of multiple specialties in the treatment process. Additionally, the perioperative recommendations exhibit significant variations among visceral oncology interventions, contingent on the operative organ. To address this variability, contributions were solicited from individuals possessing specialised expertise in the surgery of the respective visceral organs.

1.9.3 Workgroups

Table 2: Composition of Guideline Workgroups

Workgroup	Composition of Workgroup
WG 1: Preoperative drug-based interventions	**Prof. Dr. Bettina Jungwirth, Prof. Dr. Matthias Leschke** Prof. Dr. Dirk Arnold, Prof. Dr. Wolfgang Hartl, PD Dr. Simone Kagerbauer, Dr. Benedikt Schick, Prof. Dr. Martin Söhle, Dr. Rene Wildenauer
WG 2: Preoperative non-drug interventions	**Prof. Dr. Bernhard Elsner, Timo Niels, Prof. Dr. Benno Stinner** Prof. Mark Coburn, Prof. Dr. Ines Gockel, Barbara Kade, Prof. Dr. Arved Weimann
WG 3: Antibiotic treatment and digestive preparation	**Prof. Dr. Christian Eckmann, Dr. Oliver Haase, Dr. Maria Kröplin** Prof. Dr. Stephan Benz, Prof Dr. Gunnar Folprecht, Prof. Dr. Julia Hardt, Prof. Dr. Jörg Kalff, PD Dr. Henrike Lenzen, Prof. Dr. Marc Martignoni, PD Dr. Rosa Schmuck
WG 4: Non-drug intraoperative and postoperative measures	**Dr. Esther Biesel, Prof. Dr. Wolfgang Schröder** Prof. Dr. Christiane Bruns, PD Dr. Reiner Caspari, Prof. Dr. Stefan Fichtner-Feigl, Kerstin Paradies, Prof. Dr. Dirk Weyhe, Dr. Konstantinos Zarras
WG 5: Analgesia and atonic colon	**Prof. Dr. Stephan Freys, Prof. Dr. Esther Pogatzki-Zahn** PD Dr. Viola Andresen, PD Dr. Dr. Hans Gerbershagen, Prof. Dr. Jörg Glatzle, PD Dr. Andreas Hecker, Prof. Dr. Peter Kienbaum, Prof. Dr. Frank Kullmann, Dr. Martin Reichert, Prof. Dr. Thomas Standl, Dr. Dirk Waldschmidt, PD Dr. Stefan Wirz
WG 6: Significance and organization of multimodal treatment	**Prof. Dr. Julia Hardt, Dr. Franziska Peters** Erich Grohmann, Prof. Dr. Martin Hübner, Prof. Dr. Markus Möhler, Nicola Reents, Prof. Dr. Christoph Reißfelder, Prof. Dr. Jörg-Peter Ritz
Workgroup managers are marked in bold.	

1.9.4 Patient Involvement

Three self-help groups, with the corresponding patient representatives, have been actively involved in the guideline development process (Barbara Kade [self-help group for esophageal diseases], Nicola Reents and Simone Widhalm [Semicolon self-help group] and Erich Grohmann [German ILCO]). These groups have voting rights in order to adequately represent the patient perspective. All three self-help groups are also involved in the development and final approval of the patient guideline.

1.9.5 Methodological Support

- Dr. Monika Nothacker, MPH (AWMF, Institute for Medical Knowledge Management)
- Dr. Markus Follmann, MPH, MSc (German Guideline Program in Oncology, c/o Deutsche Krebsgesellschaft e.V.)
- Dipl.-Soz. Wiss. Thomas Langer (German Guideline Program in Oncology, c/o Deutsche Krebsgesellschaft e.V.)
- Gregor Wenzel (German Guideline Program in Oncology, c/o Deutsche Krebsgesellschaft e.V.)

1.10 Abbreviations Used

Table 3: Abbreviations Used

Abbreviation	Explanation
ACE	Angiotensin-converting enzyme
AI	Anastomotic insufficiency
ARNI	Angiotensin receptor-neprilysin inhibitors
ASA	American Society of Anesthesiologists
AWMF	Arbeitsgemeinschaft der Wissenschaftlichen Medizinischen Fachgesellschaften
CD	Clavien-Dindo
CI	Confidence interval
CPAP	Continuous positive Airway Pressure
CPET	Cardio-pulmonary exercise testing
d	Tage (days)
DGCE	delayed gastric conduit emptying
DKC	Daikenchuto
DKG	German Cancer Society

Abbreviation	Explanation
E-PASS	Estimation of Physiologic Ability and Surgical Stress
EA	Epidural analgesia
ESC	European Society of Cardiology
FEV1	Forced expiratory volume in one second
GGPO	German Guideline Program in Oncology
GI	gastrointestinal
GRADE	Grading of Recommendations, Assessment, Development and Evaluation
HCC	Hepatocellular carcinoma (Hepatozelluläres Karzinom)
HMG-CoA	3-Hydroxy-3-Methylglutaryl-CoA
ICG	Indocyanine green
KRINKO	Commission for Hospital Hygiene and Infectious Disease Prevention *(Kommission für Krankenhaushygiene und Infektionsprävention)*
MACE	major adverse cardiac event
MBP	Mechanical bowel preparation
MD	mean difference
MINS	Myocardial Injury in Non-Cardiac Surgery
MPH	Master of Public Health
mPOM	Multimodal perioperative management concept
NG	NICE Guideline (National Institute for Health and Care Excellence, UK)
NICE	National Institute for Health and Care Excellence
NK1-RA	Neurokinin-1 receptor antagonist
NNH	number needed to harm
NNT	number needed to treat
NSAR	Non-steroidal anti-inflammatory drug(s)

Abbreviation	Explanation
NSQIP	National Surgical Quality Improvement Program
oAB	Oral antibiotics
OP	Operation
OR	Odds Ratio
P-POSSUM	Portsmouth-POSSUM
PAP	Peri-operative antimicrobial prophylaxis
PICO	Population, Intervention, Comparison, Outcome
POI	Postoperative (paralytic) ileus
PONV	Postoperative nausea and vomiting
POPF	Postoperative pancreatic fistulas
POSE	Peri-interventional Outcome Study in the Elderly
POSSUM	Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity
PRA	Peripheral regional analgesia
PROs	Patient Reported Outcomes
RCRI	Revised Cardiac Risk Index
RR	Relative Risk
SA	Systemic analgesics
SAE	Serious Adverse Event
SDD	Selective digestive decontamination
SMD	standardized mean difference
SORT	Surgical Outcome Risk Tool
SPICE	Survival and prognosis investigation of Crataegus extract
SR	Systematic review

Abbreviation	Explanation
SRS	Surgical Risk Score
SSI	surgical side infection
TAP	Transversus abdominis plane
TCM	Traditional Chinese medicine
TIVA	Total intravenous anesthesia
UICC	Union Internationale Contre le Cancer (eng.: Union for International Cancer Control)
VC	Vital capacity
vs.	versus
WHO	World Health Organization
EC	Expert Consensus

2 Introduction

2.1 Scope and Purpose

2.1.1 Objective and Key Questions

The S3 guideline "Perioperative management of gastrointestinal tumours (POMGAT)" with its recommendations for action is intended to improve pre-, intra- and postoperative management in the resection of gastrointestinal tumours and, in particular, to standardise and simplify interdisciplinary and multiprofessional collaboration. This objective is pursued by the establishment of multimodal perioperative treatment concepts, stratified according to organ system and the nature of the surgical intervention. The primary objectives are to formulate consistent recommendations that have been demonstrated to reduce morbidity and mortality following gastrointestinal tumour resections, thereby also impacting survival outcomes.

The recommendations are to be incorporated into the patient guidelines based on the guideline, which are comprehensible to laypersons. The development of quality indicators is also recommended, with a view to measuring improvements in the perioperative care of patients with gastrointestinal tumours.

2.1.2 Target Audience

The target patient group is defined as all adult patients who have to undergo elective surgery for a gastrointestinal or hepatopancreatobiliary malignancy. The specific intent of the procedure, whether curative or palliative, is not relevant.

The S3 guideline is intended for medical and non-physician healthcare providers who treat and care for patients with gastrointestinal tumours perioperatively. These professionals include physicians specialising in general and visceral surgery, anaesthesia, pain therapy, oncology, nutritional medicine, rehabilitation medicine and sports medicine. Furthermore, the guideline is intended for all professions and disciplines involved in the perioperative management of patients with gastrointestinal tumours, including therapy and support (e.g. stoma therapy, palliative medicine, nursing staff, especially mPOM specialists, physiotherapists). The guideline also provides information for all other specialties and disciplines involved in the treatment of patients during the perioperative course. Furthermore, the POMGAT guideline can serve as a valuable resource for cost bearers and decision makers, as well as for quality assurance institutions.

2.1.3 Validity and Update Process

The S3 guideline is valid until the next update, the validity period is set at a maximum of 5 years (November 2028). Comments and suggestions for the update process are expressly welcome and can be sent to the guideline's address:pomgat@leitlinienprogramm-onkologie.de

2.2 Methodology

In order to ensure the greatest possible transparency, a methodological protocol for the evidence review for the guideline was published in advance. Detailed information

on the methodological procedure for preparing the guideline is presented in the guideline report and the evidence report. These are freely accessible, for example on the website of the Guideline in Oncology Program and on the AWMF's website.

2.2.1 Levels of Evidence (LoE)

The GRADE (Grading of Recommendations, Assessment, Development and Evaluation) scheme was utilised to evaluate the reliability of the evidence. This approach offers a consistent and transparent system, with criteria for assessing the certainty of the evidence for each outcome that are clearly defined [1].

The following criteria are considered in the assessment of the evidence, with the first five potentially resulting in a downgrading of confidence in the evidence, while the last three can potentially increase confidence:

- Risk of bias
- Inconsistency
- Indirectness
- Insufficient precision of the estimated effects
- Indication of publication bias
- Evidence of a particularly large effect
- Evidence of a dose-response relationship
- Presence of plausible confounders or other biases

This assessment leads to an evaluation of the certainty of the evidence, which is expressed in a four-level system:

- High confidence: We are very confident that the true effect lies close to that of the estimate of the effect.
- Moderate confidence: We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
- Low confidence: Our confidence in the effect estimate is limited: The true effect may be substantially different from the estimate of the effect.
- Very low confidence: We have very little confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of effect

Quality of Evidence Grades according to GRADE
(http://www.gradeworkinggroup.org)

Grade	Definition	Symbol
High	We are very confident that the true effect lies close to that of the estimate of the effect.	⊕⊕⊕⊕
Moderate	We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.	⊕⊕⊕⊖
Low	Our confidence in the effect estimate is limited: The true effect may be substantially different from the estimate of the effect.	⊕⊕⊖⊖
Very low	We have very little confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of effect	⊕⊖⊖⊖

2.2.2 Grades of Recommendation (GoR)

The methodology of the German Guideline Program in Oncology provides for the assignment of recommendation grades by the guideline authors as part of a formal consensus process. Accordingly, moderated, nominal group processes and structured consensus conferences were carried out by the AWMF (see: https://www.awmf.org/leitlinien/awmf-regelwerk.html). As part of these processes, the recommendations were formally voted on by the voting mandate holders (see Chapter 1.9.2). The results of the respective votes (consensus strength) are assigned to the recommendations according to the categories in the table below.

The guideline employs a rating system known as GRADE (see 2.2.1) to evaluate all evidence-based statements and recommendations. In the case of recommendations, the GRADE system also quantifies the strength of the recommendation, also known as the degree of recommendation. With regard to the strength of the recommendation, this guideline distinguishes between three grades of recommendation (see table below), which are also reflected in the wording of the recommendations.

Table : Scheme of recommendation grading

Grade of Recommendation	Grade of Recommendation Description	Wording
A	Strong recommendation	shall
B	Recommendation	should
0	Open recommendation	can/may

Table: Consensus strength

Consensus strength	Percentage agreement
Strong consensus	>95% of eligible votes
Consensus	95-75% of eligible votes
Majority approval	50-75% of eligible votes
No majority approval	<50% of eligible votes

The decision criteria for determining the recommendation grades are elucidated in the guideline report for this guideline.

2.2.3 Statements

Statements are defined as descriptions or explanations of particular facts or questions, devoid of a direct call for action. Adopted as part of a formal consensus process, statements are similar to recommendations in that they are both based on study results or expert opinions.

2.2.4 Expert Consensus (EC)

Statements/recommendations that are not based on a systematic review of the available evidence but on an expert consensus of the guideline group are shown as expert consensus (EC). The stated consensus strength (percentage of agreement of the guideline group according to the table below) reflects the degree of agreement of the experts involved. For recommendations based on expert consensus, no symbols or letters are used to indicate the strength of the recommendation and the quality of the evidence. The strength of the recommendation is determined solely by the wording used (shall/should/can) according to the gradation in the table for grading recommendations.

2.2.5 Independence and Disclosure of Possible Conflicts of Interest

The financial resources were provided by the German Cancer Aid through the German Guideline Program in Oncology (GGPO). The disbursement of these funds was allocated for personnel costs, office supplies, literature procurement, and consensus conferences (covering room rental, technology, catering, moderator fees, and travel expenses for participants). The guideline was drafted independently of the funding organisation.

At the commencement or at the latest during the guideline process, all individuals involved in the development of the guideline submitted a written declaration of any existing conflicts of interest via the AWMF online platform provided for this purpose. These declarations were subsequently updated prior to the consensus conference. The declarations of interest, including the assessment result, are listed in the guideline report for this guideline.

The interests of all those involved in the development of the guideline were assessed by a working group consisting of Professor Stefan Post, Professor Tim Vilz, and Dr. Maria Kröplin, together with the DKG (Dr. Markus Follmann).

Conflicts of interest were handled in accordance with AWMF regulations:

- In order to ensure the greatest possible trustworthiness of the guideline recommendations, care was taken to ensure that the coordinators of the guideline project had no thematically relevant conflicts of interest.
- Members of the guideline group with minor conflicts of interest (e.g. receiving third-party funding from the industry for presentations or authorship) were not permitted to assume leadership roles, such as sole chairmanship of a working group or primary responsibility for the preparation of evidence on a research question. A leadership role may be assumed if a second person is also involved in leading the working group without any conflict of interest.
- Members of the guideline group with moderate conflicts of interest (advisory board or consultant activities and receiving third-party funding from the industry in a responsible position) may only participate in consensus-building as advisory, non-voting experts.
- Individuals with significant conflicts of interest (ownership interests) are precluded from participating in the guideline group's deliberations. However, they are permitted to contribute their knowledge through written comments, if they so choose.

The formal consensus-building process was subject to external, independent moderation, and the guideline was developed interdisciplinarily and reviewed publicly/professionally during the consultation phase. These measures were intended to reduce undesirable influence from conflicts of interest and to strengthen confidence in the recommendations made.

At this time, we would like to express our gratitude to all those involved for their voluntary contributions to the project!

3 Background and history of modern perioperative medicine

Malignancies represent a significant proportion of diseases, particularly among the elderly demographic, accounting for 25% of all deaths in Germany. Malignant neoplasms of the gastrointestinal tract are among the most prevalent tumour entities, with approximately 112,000 new cases per year. The standard of care for these cases typically involves visceral surgery, which involves the complete excision of the tumour and the surrounding lymph nodes. It is important to note that these figures do not yet include operations for liver metastases: In this context, too, the number of operations has been steadily increasing in recent years, and the indication for metastasectomy is becoming more and more widespread. The primary rationale for this phenomenon is that metastasectomy can achieve a cure in a significant proportion of colorectal carcinoma cases, even with synchronous liver metastases, as evidenced by the fact that metastasectomy is successful in 25% of these cases [2]. However, it should be noted that both primary surgery and the resection of liver metastases are frequently major operations that are associated with significant perioperative morbidity and mortality, as well as prolonged hospitalisation.

In 1995, Henrik Kehlet proposed a multimodal perioperative treatment concept for patients with colon carcinoma for the first time and dubbed it "fast track surgery" [3], [4], [5]. In contradistinction to the conventional perioperative treatment concept, which entailed a protracted preoperative fasting phase (>12 h), the novel approach permitted patients to remain in the hospital up to two hours prior to surgery. Intraoperatively, emphasis was placed on atraumatic surgical techniques and needs-based fluid substitution, and postoperatively on early mobilisation, rapid food build-up and optimised pain therapy. Intra-abdominal drains, central venous access and bladder catheters were completely avoided [5], [6]. Consequently, Kehlet was able to achieve a substantial reduction in postoperative complications, mortality and hospital stay, without any increase in readmission rate. Furthermore, the perioperative well-being of patients was increased [7].

Subsequent years have witnessed the refinement and expansion of the Kehlet concept, with successive modifications and additions to its components. For instance, it has been demonstrated that the implementation of intensified perioperative psycho-oncological care and physical activity not only enhances short-term perioperative outcomes but also impacts long-term oncological results following the resection of gastrointestinal malignancies [8], [9].

Initial studies have now been conducted in which various preoperative measures are subsumed under the term prehabilitation: These include, for example, intensive physiotherapy, treatment of existing malnutrition, as well as nicotine and alcohol abstinence, with the aim of preparing the patient as well as possible for the upcoming surgery [10].

The surgical approach adopted is also of significance in optimising the postoperative outcome [11]. Numerous studies have demonstrated that patients who undergo minimally invasive surgery experience a more favourable postoperative course, reduced perioperative stress, enhanced immune response, and a reduced hospital stay when compared to conventional surgery (via abdominal incision) [11], [12]. The results of the studies were particularly impressive when minimally invasive surgery was integrated into an mPOM [13].

The original five components of the fast-track concept have since been supplemented by further measures, so that up to 25 different mPOM elements can be described [14].

Numerous studies in patients undergoing major abdominal surgery have demonstrated a superior perioperative immune response with diminished immunosuppression in comparison to conventional perioperative concepts[11], [12], along with a more favourable short-term outcome, particularly with multimodal perioperative treatment pathways (or individual components). Furthermore, other immunomodulating factors (hypothermia, anxiety, etc.) have been shown to be positively influenced (Figure 1, [15]).

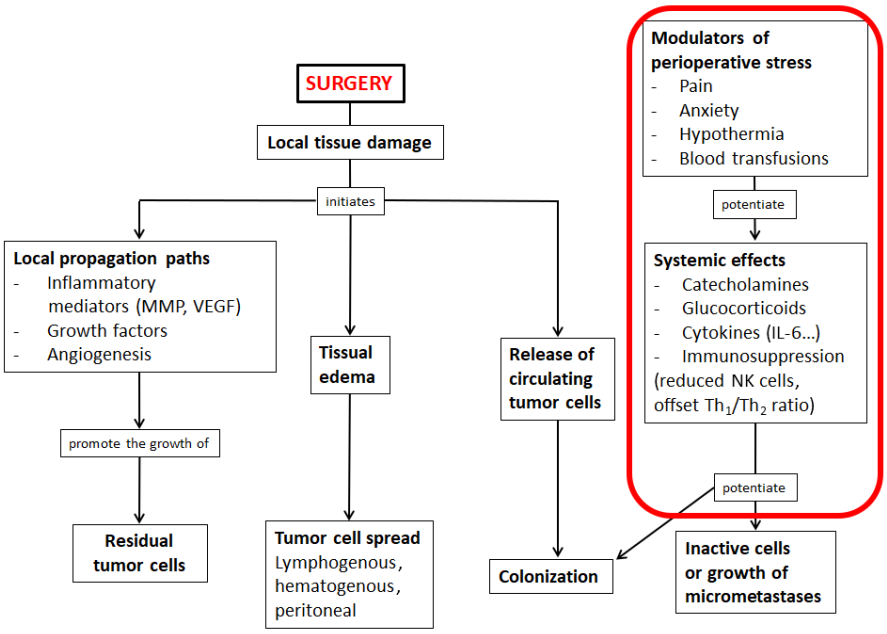

Figure 1: Surgical procedures lead to perioperative immunosuppression and increase the risk of metastasis

Source: [15]

When these factors are taken into consideration, it can be deduced that patients who require abdominal oncological surgery may experience a more favourable oncological outcome with optimised perioperative treatment concepts. Furthermore, it is established that the occurrence of a postoperative complication results in a diminished immune response and an exacerbated oncological outcome [16].

Consequently, the analyses conducted by Gustafsson and colleagues were deemed to be a rational course of action. These analyses encompassed a total of over 900 patients from a prospectively managed database, with the objective of ascertaining whether a high level of adherence to the treatment concept established by Kehlet is associated with enhanced 5-year survival outcomes following oncological colorectal surgery. The findings of this study demonstrated that compliance levels surpassing 70% were associated with a reduction in tumour-associated mortality exceeding 40%. The components "early diet build-up" and "intraoperative fluid restriction" were identified as independent predictors of a superior 5-year survival [17], [18]. An

improved oncological outcome after colorectal cancer surgery was also demonstrated in the prospective study published in 2019 by Pisarska et al. Patients with adherence > 80% (n=241) to mPOM were compared with those with adherence < 80% (n=109). Once again, reduced morbidity and mortality as well as a shorter hospital stay were demonstrated with high adherence. Furthermore, the 3-year survival rate was found to be enhanced. However, it is interesting to note that even in a hospital with a database that specifically queries the implementation of the individual components and thus "lives" the program, more than a third of patients have a compliance rate for the various perioperative measures of less than 80% [19].

However, it is challenging to ascertain whether the favourable outcomes observed in the studies can be entirely attributed to a reduction in perioperative stress and an ensuing enhancement in immune response (see Figure 1). Alternatively, the probability of a timely commencement of necessary adjuvant therapy (within eight weeks postoperatively according to the analysis of Nachiappan [20] and a higher probability of therapy completion could be postulated. Ultimately, however, the cause of the improved survival is of little relevance, the result is decisive.

While the advantages of perioperative treatment pathways have been recognised for some time in colorectal surgery and there are now standardised protocols available, their broad implementation for other abdominal surgical procedures has only begun in recent years. A seminal meta-analysis focusing on oncological esophageal surgery was published in 2017, and it also demonstrated a reduction in hospital length of stay and pulmonary complications [21]. The Enhanced Recovery after Surgery (ERAS) Society has recently published the first structured protocol for perioperative medicine in esophageal resections [22]. A similar situation is observed in the field of oncological gastric surgery, where larger meta-analyses published only in recent years have demonstrated a reduction in perioperative stress, lower morbidity, a shorter hospital stay and reduced costs with mPOM. The programme's success is contingent on its stringent implementation, with adherence levels exceeding 70% [23]. To date, however, no statements have been made on the potential oncological implications for the upper gastrointestinal tract.

In the field of oncological hepatopancreatobiliary (HPB) surgery, a parallel can be drawn with surgery of the upper gastrointestinal tract (UGI). The mPOM history is comparatively brief, yet numerous meta-analyses have been published in recent years, highlighting reduced morbidity, expedited recovery, reduced intensive care unit and overall length of stay, and subsequent cost reduction in both hepatobiliary surgery [24] and pancreatic surgery [25].

In conclusion, it can be stated that over the past 15 years, only a limited number of surgical disciplines have accumulated as robust a body of evidence as that which supports the mPOM principles. The level of awareness within the surgical community is now high, and the topic is being addressed at both national and international congresses. However, when assessing the dissemination and integration within clinical settings, it is evident that while the subject is being discussed and addressed by many, the concept is only implemented in 20-44% of cases[26], [27]. Consequently, despite the compelling evidence, mPOM programs are not or only inadequately implemented in up to 80% of clinics, which in turn exacerbates outcomes and increases treatment costs [28], [29], [30].

4 Pre-hospital management

4.1 Perioperative administration of cardiac drugs

4.1	Consensus-based Recommendation	2023
EC	Pre-operative resumption of beta-blockade **may** be considered for cardiological indications in high-risk cardiovascular patients with known coronary artery disease and manifest myocardial ischaemia, or in patients with 2 or more cardiac risk factors. Sufficient time should be allowed before the planned operation for beta-blocker therapy to be titrated according to heart rate and blood pressure. Preoperative beta-blocker therapy **should not** be restarted as a matter of principle. Existing beta-blocker therapy **shall** be continued pre-, peri- and postoperatively.	
	Strong Consensus	

4.2	Consensus-based Recommendation	2023
EC	Antianginal therapy with nitrates **should** be continued perioperatively, as discontinuation could promote myocardial ischemia.	
	Strong Consensus	

4.3	Consensus-based Statement	2023
EC	The paucity of literature data on the perioperative use of calcium antagonists in gastrointestinal tumours precludes the formulation of any recommendation.	
	Strong Consensus	

A general restart of preoperative beta-blocker therapy is not recommended. The POISE study demonstrated that the perioperative administration of metoprolol reduced the risk of perioperative myocardial infarction when compared to placebo, but increased the rate of strokes and deaths. A Cochrane analysis [31] reported low confidence in the evidence that pretreatment with beta-blockers reduces overall mortality at 30 days or the incidence of atrial fibrillation and myocardial infarction in patients who have undergone resection of a gastrointestinal tumour. The probability of cerebrovascular events and ventricular arrhythmias was comparable in patients with and without beta-blocker therapy. However, it should be noted that the analysis did not consider specific patient subgroups depending on tumour stage and type, nor on the location of surgery.

A retrospective database analysis of prospectively collected data was conducted, which demonstrated a significant association between pretreatment with beta-blockers and reduced 30-day mortality, as well as prolonged 1-year survival, in patients who underwent resection of a gastrointestinal tumour. Consequently, the hypothesis was formulated that the continuation of pre-existing beta-blocker therapy in patients prior to surgery for gastrointestinal tumours could be advantageous. The restart of beta-blockade prior to surgery can be contemplated on cardiological grounds for high-risk cardiovascular patients with known coronary heart disease and manifest myocardial ischemia, provided there is a sufficient interval – ideally one week – between surgery and the operation to ensure the titration of beta-blocker therapy according to the patient's resting heart rate (target 60-70/min) and blood pressure (RRsyst>100mmHg) [33]. Patients with at least two clinical risk factors (according to the Revised Cardiac Risk Index (RCRI) score: ischemic heart disease, cerebrovascular disease, renal insufficiency with a serum creatinine of >2mg/dl, or insulin-dependent diabetes mellitus), patients with an ASA status of at least 3 and patients with coronary heart disease or proven myocardial ischemia are considered high-risk cardiovascular patients [34]. In the absence of guaranteed dose titration, preoperative readjustment to beta-blocker therapy is generally not recommended. These recommendations apply to all planned operations, irrespective of the location of the gastrointestinal tumour. There is a paucity of compelling data from randomised studies that demonstrate the efficacy of beta-blocker therapy in reducing the incidence of MINS (myocardial injury in non-cardiac surgery), thromboembolic or vascular events, or cerebral insults and newly occurring atrial fibrillation.

The perioperative administration of beta blockers has been demonstrated to reduce the incidence of new-onset atrial fibrillation in small studies employing various intravenously administered beta blockers [35].

Nevertheless, given the limited number of patients and the associated uncertain evidence, the recommendation of such a prophylactic approach, outside of a cardiological indication, cannot be substantiated at this time.

The value of antianginal therapy with nitrates, which has decreased significantly in clinical practice, should be continued perioperatively, as discontinuation could promote myocardial ischemia.

The available evidence does not support the use of calcium antagonists to improve perioperative outcomes. Existing long-term therapy should be continued if there is an antianginal indication [36]**.** Conversely, if there is an antihypertensive indication to avoid intraoperative hypotension on the day of surgery, it should be discontinued preoperatively from a pragmatic point of view.

4.1.1 Statins

4.4	Consensus-based Recommendation	2023
EC	Statin therapy that has already been indicated and initiated preoperatively **shall** be continued peri- and postoperatively. In patients with a high cardiovascular risk who are undergoing elective abdominal surgery, the initiation of statin therapy **can** be commenced two weeks prior to surgery.	
	Strong Consensus	

The body's immune system can be stimulated by surgical trauma or surgical stress, which can contribute to postoperative complications. The extent of the operation determines the degree of stimulation. These postoperative complications, which are not necessarily surgical in origin, have been observed in up to 30% of patients [37].

It has been hypothesised that the utilisation of HMG-CoA inhibitors, otherwise known as statins, may also confer anti-inflammatory and protective immunomodulatory properties in addition to the well-documented lipid-lowering effects. In addition to the highly effective statins, such as atorvastatin and rosuvastatin, there are also low-acting statins, including fluvastatin, pravastatin, and simvastatin. Their coronary plaque-stabilising effects (e.g. vasodilation and endothelial modulation) are well-documented, and a reduction in cardiovascular events of up to 30% has been reported [38]. It is important to note, however, that the full therapeutic effect is only achieved after 4-6 weeks, with an effectiveness of 75% being described after just 2 weeks. The specific effects of cytokines on the cardiovascular system include the induction of myocardial toxicity, the impairment of myocardial function, and the activation of coagulation, resulting in consumption coagulopathy and subsequent microcirculatory disturbances. Myocardial damage after non-cardiac surgery (MINS) has been identified as a significant predictor of postoperative morbidity [39]. In contrast to MACE events with associated ischemic symptoms, MINS is characterised by a markedly elevated cardiac biomarker (troponin) within 30 days postoperatively [40].

The pleiotropic, endothelial-reparative and immunomodulatory effects of statins appear to have a greater impact on postoperative surgical stress, as these complications are both cardiovascular or inflammatory in nature. Recent studies have demonstrated that statins can reduce the levels of proinflammatory cytokines (IL-6 and 8, TNFα) within 24 hours [41].

A paucity of scientific data exists on the known side effects of statins, including muscle pain, gastrointestinal complaints, dry mouth, increased liver enzymes, and pruritus, in relation to this question. In terms of GCP, these should be observed and evaluated clinically when they occur; relief can often be achieved by changing the preparation or dosage.

In Germany, statins can only be prescribed at the expense of the statutory health insurance funds in cases of existing atheromatous vascular disease or high cardiovascular risk (>20% event rate based on a risk calculator such as ARRIBA).

The extant literature, albeit limited, identifies two areas of concern with regard to the efficacy of perioperative statin therapy. Firstly, statin use is indicated and initiated preoperatively due to a cardiovascular risk or event. Secondly, the data are inconsistent with regard to choice of preparation and dosage.

A paucity of studies describes a therapy initiated exclusively perioperatively: For instance, a recent study [42] demonstrated a reduction in myocardial ischemia markers following a single perioperative administration of 20 mg rosuvastatin, a more potent statin, in a small group of patients with cardiovascular risk factors.

Retrospective database analyses have indicated an association between statin application and a reduction in hospital mortality following propensity score matching. In 2004, Peter Lindenauer observed an improvement in 708,891 US patients (2.1% vs. 3.1%; OR 0.62). Analogous findings were identified in an analysis of the American Veterans Affairs (VA) database from 2017, encompassing over 96,000 patients, where hospital mortality was also reduced from 2.3% to 1.8%. The VISION study (2016) prospectively compared over 15,000 patients worldwide with regard to the 30-day incidence of MINS and hospital mortality, finding an absolute 2% risk reduction due to pre-existing statin therapy. However, a commonality across all three analyses is that the dosage and type of drug, as well as the preoperative duration of therapy, exhibited significant variation. It is noteworthy that the majority of patients had a history of cardiovascular disease and had already received statin therapy. Furthermore, the potential involvement of additional pharmaceutical agents, such as beta blockers or angiotensin receptor blockers (ARBs), in this specific patient demographic remains to be elucidated, as the present study was not designed to address this issue. Notwithstanding these limitations, the findings are compelling, particularly with respect to the prevention of cardiac events. However, due to the observational study design, the results regarding the prevention of perioperative cardiac events in statin-naïve patients without a cardiological indication for statin therapy should be considered conjectural.

The Brazilian LOAD study of 2017, which was conducted on 648 patients and published by the same authors as the VISION data analysis, sought to administer atorvastatin for the first time with a high priming dose and for seven days thereafter perioperatively to a selected patient population with an increased cardiovascular risk. However, no reduction in MACE or MINS was observed in this study, although a slightly reduced incidence of the endpoints was noted in the verum group (16.6%, 18.7%). A noteworthy finding emerged from the preliminary analysis of the primary endpoint, which encompassed mortality, stroke, and MINS, indicating a marked difference on Day 2.

The most recent data relevant to visceral surgery is derived from the Swedish Cancer Registry (2020): 11,966 patients who underwent surgery for rectal cancer demonstrated a significant reduction in 90-day mortality in the statin group following propensity score matching (0.7% vs. 5.5%). Subgroup analyses further corroborate these findings, demonstrating a reduced incidence of postoperative complications resulting in death, including sepsis, multi-organ failure, respiratory failure, and MACE, attributable to the surgical stress and subsequent immunosuppression

A systematic review published in 2015 analysed 16 randomised controlled trials (RCTs) involving 2,275 patients in order to consider statin-naïve patients and the occurrence of postoperative cardiac or thromboembolic complications. The majority of the studies focused on coronary artery surgery patients (only one non-vascular

study was included). The review revealed a reduction in mortality, major adverse cardiovascular events (MACE) and length of hospital stay, as has been shown in other older corresponding analyses. The subgroup analysis for non-cardiac interventions is of particular interest: In this analysis, too, the occurrence of myocardial ischemia or mortality was reduced. A further analysis of subgroups identified that the strongest effect of statin therapy was observed when it had been initiated more than one week prior to the surgical procedure.

A 2018 systematic review encompassing 35 RCTs and 8,200 patients included 10 studies (3,502 patients) in non-cardiac surgery, but therefore vascular patients, and 24 studies with 4,101 statin-naïve patients. The analysis revealed a high degree of heterogeneity within the data, attributable to varying treatment regimens, duration of preoperative statin therapy, choice of drug and its dosage. Notwithstanding the evident bias, a number of results merit particular attention: The rate of postoperative myocardial ischemia was lower in the non-cardiac surgery patients in the total statin group (odds ratio [OR] 0.44; 95% confidence interval [CI] 0.30 to 0.64; NNT=36). A further analysis revealed that this effect was observed irrespective of the patients' preoperative statin treatment status, whether they were chronically pretreated with statins (OR 0.37; 95% CI 0.21 to 0.67) or not (OR 0.49; 95% CI 0.30 to 0.81).

Conversely, no such improvement was observed in cardiac surgery patients following the initiation of statin therapy. Acute renal failure was more prevalent in cardiac surgery patients receiving statins (RR 1.15; 95% CI 1.00 to 1.31; NNH=40). However, an additional increase in mortality could only be identified when studies with low bias were analysed (NNH=181). Conversely, no discernible difference was observed in the primary endpoint.
The current ESC recommendations of 2022 align with previous American and European recommendations in discouraging the routine initiation of statin therapy. Conversely, the continuation of statin therapy during the perioperative period is endorsed. In cases where there is a corresponding (cardiovascular) indication, therapy should be initiated a minimum of two weeks in advance and continued postoperatively. [43].

4.1.2 ACE inhibitors/angiotensin receptor antagonists

4.5	Consensus-based Recommendation	2023
EC	Patients undergoing long-term therapy with ACE inhibitors or angiotension II receptor blockers (sartans) **should** continue this perioperatively with the following exception: he discontinuation of the aforementioned medication **should** be scheduled for the morning of the operation (or within the 24 hours preceding it), as intraoperative fluctuations in blood pressure are to be expected with greater frequency otherwise. In cardiac stable patients with newly diagnosed left ventricular heart failure (and no previous therapy with ACE inhibitors/sartans), it **may** be considered to postpone the operation for at least one week in order to initiate ACE inhibitors/sartans. This **should** be decided on a case-by-case basis.	
	Strong Consensus	

ACE inhibitors and angiotensin II receptor blockers (sartans) are established medications used to treat arterial hypertension and heart [44], [45], [33]. These medications are among the most commonly prescribed to patients prior to and during surgery, prompting the question of whether their discontinuation during this period is advisable. Hollmann et al. [46] have investigated this in a systematic review using the results of nine studies with a total of more than 6,000 patients. The patient population to which the POMGAT guideline refers was included in the systematic review by Hollmann et al. as part of the VISION study [47] and - due to the large number of patients - significantly influenced its results.

The study concluded that perioperative discontinuation of ACE inhibitors or sartans did not result in an elevated mortality or serious cardiac complication rate. Conversely, the transfer also led to a more frequent occurrence of intraoperative blood pressure drops on the day of surgery than in patients who had paused the intake in the 24 hours before surgery [46]. Consequently, the present recommendation, based on consensus, is to discontinue the intake of ACE inhibitors and sartans on the morning of surgery (or within the 24 hours preceding).

The use of ACE inhibitors and sartans is recommended in the relevant guidelines [44] due to their demonstrated efficacy in reducing mortality in patients with heart failure. Nevertheless, the question remains unresolved as to whether the perioperative discontinuation of ACE inhibitors or sartans exerts a detrimental effect on pre-existing heart failure. Hollmann et al. abstain from offering recommendations on this matter due to the paucity of available data [46]. The optimal approach for patients who have been diagnosed with heart failure for the first time during the preoperative evaluation and who are not yet on an ACE inhibitor/sartan remains unclear. In their joint guideline from 2014, the European Society of Cardiology (ESC) and the European Society of Anaesthesiology and Intensive Care (ESAIC) recommend considering the initiation of ACE inhibitors or sartans at least one week prior to surgery in cardiac stable patients with left ventricular dysfunction [48]. The recommendation is based on expert consensus, as opposed to on empirical evidence [43]. It is acknowledged that a case-by-case decision must be made as to whether postponement of surgery for the purpose of administering ACE inhibitors or sartans is justified in the case of newly diagnosed heart failure.

When administering angiotensin receptor neprilysin inhibitors (ARNI), the likelihood of occurrence of arterial hypotension is increased in comparison with ACE inhibitors [49]. At the present time, there is a paucity of data on the perioperative effects and side effects of ARNI.

4.2 Preoperative and intraoperative single dose of corticosteroids

4.6	Consensus-based Statement	2023
EC	It is not possible to recommend the perioperative administration of glucocorticoids in gastrointestinal tumour surgery in principle, due to the heterogeneous nature of the study situation, which is outside the indication for prophylaxis against postoperative nausea and vomiting (PONV).	
	Strong Consensus	

4.7	Consensus-based Recommendation	2023
EC	In liver and pancreatic surgery, perioperative administration of glucocorticoids **may** be considered.	
	Strong Consensus	

The literature on the subject of the negative effects of perioperative steroid administration is inconclusive. The only adverse outcome for which there is some evidence is that of an increased rate of anastomotic insufficiency in esophageal surgery. The current data does not provide a clear indication of the potential positive or negative impact of steroids on the incidence of recurrence and metastasis.

Overall, the use of low-dose steroids appears to be safe, provided that perioperative blood glucose levels are closely monitored and adjusted [50], [51].

The clinical effects of perioperative steroid administration for indications other than PONV prophylaxis, which is dealt with in a separate recommendation, are not clear due to an insufficient number of studies. However, a positive influence on inflammatory laboratory parameters has been described. Consequently, a general recommendation cannot be provided for the utilisation of perioperative glucocorticoids, particularly in esophageal and colorectal surgery. However, recent monocentric studies suggest a positive effect in liver and pancreatic surgery [52], [53].

Esophageal surgery:
A retrospective study of 980 patients revealed no significant difference in overall complications. However, following propensity score matching, a higher rate of anastomotic dehiscence was observed in patients who received hydrocortisone [54]. This finding is in contrast with the results of an earlier meta-analysis by Weijs et al., which found no differences in pulmonary complications, anastomotic insufficiencies or infections [55]. Another study by Engelman et al. found that the use of methylprednisolone resulted in even fewer anastomotic leaks and a lower rate of sepsis and infectious complications [56]. The conflicting nature of these results precludes the ability to make a definitive statement regarding the influence of steroid administration on the occurrence of anastomotic insufficiencies.

Colorectal surgery:
A general positive influence of preoperative steroid administration on systemic inflammation, as expressed by inflammatory laboratory parameters, in colorectal carcinoma has been reported by McSorley et al. [57], [58]. A meta-analysis revealed that steroid administration resulted in a reduced duration of hospitalisation [59]. However, this finding must be interpreted with caution due to the heterogeneity of the study conditions and the limited number of cases. In a smaller study, an increased rate of distant recurrence was observed after dexamethasone administration [60].

Liver surgery:
Liver resections have been demonstrated to exert a favourable influence on inflammatory and laboratory parameters. However, the impact on clinical outcomes remains inconclusive [61], [62]. The aforementioned meta-analysis by Srinivasa demonstrated a favourable impact on inflammation and a reduced complication rate, despite the limitations inherent to heterogeneous studies [59]. A monocentric, randomised, six-year review of 151 patients administered a 500 mg dose of methylprednisolone revealed a substantial reduction in postoperative complications in extended liver resections, among other outcomes [53].

Pancreatic surgery:
A number of monocentric studies have indicated the positive effects of perioperative administration of steroids in pancreatic surgery, including a survival advantage [63], [52], a reduction in infectious complications [63] and fewer pancreatic fistulas [64]. One study demonstrates a reduction in morbidity following hydrocortisone administration; however, it is limited to high-risk patients with more than 40% acini in the histological preparation along the transection line [65].

Despite the preponderance of reported benefits of glucocorticoids in hepatic and pancreatic surgery, the validity of the extant studies is constrained by the heterogeneity of the conditions with regard to the steroids utilised, dosages and study conditions, as well as divergent endpoints.

4.3 Prehabilitation

4.8	Evidence-based Recommendation	2023
GoR **0**	The recommendation to maintain and improve physical activity, adhere to a balanced diet, and abstain from nicotine and alcohol prior to tumour surgery is widely accepted as the international standard. A further intensified, resource-intensive prehabilitation with structured programs **may** be dispensed with.	
LoE ⊕⊕⊕⊖ ⊕⊕⊖⊖ ⊕⊕⊕⊖ ⊕⊕⊖⊖ ⊕⊕⊖⊖ ⊕⊕⊕⊖ ⊕⊕⊕⊖ ⊕⊕⊖⊖ ⊕⊕⊖⊖ ⊕⊕⊖⊖	[66], [67], [68], [69], [70], [71], [72], [73], [74], [75], [76] ⊕⊕⊕⊖: Mortality: no effect (OR 1.04; 95% CI 0.51 to 2.12) ⊕⊕⊖⊖: Complication rate (global): no effect (OR 0.79; 95% CI 0.60 to 1.02) ⊕⊕⊕⊖: Complication rate (pulmonary): questionable reduction (OR 0.59; 95% CI 0.33 to 1.06) ⊕⊕⊖⊖: Complications (Clavien-Dindo > 2): no effect (OR 0.79; 95% CI 0.44 to 1.40) ⊕⊕⊖⊖: Length of hospital stay: no effect (MD -0.07 days; 95% CI -0.57 to 0.44) ⊕⊕⊕⊖: Length of stay in intensive care unit: no effect (MD -0.02; 95% CI -0.54 to 0.49) ⊕⊕⊕⊖: Gait endurance: improvement in gait endurance (MD 36.08 m; 95% CI 20.95 to 51.20) ⊕⊕⊖⊖: Quality of life: no effect (SMD 0.34; 95% CI -0.54 to 1.21) ⊕⊕⊖⊖: Depression: no effect (MD 0.22 HADS points; 95% CI -1.41 to 1.85) ⊕⊕⊖⊖: Hospital-related anxiety: no effect (MD -0.15 HADS points; 95% CI -0.97 to 0.67)	
	Consensus	

Multimodal prehabilitation is a multifaceted intervention that frequently incorporates trimodal exercise and nutrition therapy, in addition to psychological intervention. A period of four to six weeks is frequently utilised for prehabilitation, particularly in cases where previous neoadjuvant treatment has been administered. The studies investigated revealed the utilisation of bespoke programmes in the intervention arm, wherein patients receive personalised guidance, utilising substantial human and material resources, encompassing individual exercise/physiotherapy, individual nutritional optimisation, and individual psychological support.

The present study is part of a wider research programme that has included four current systematic reviews, six current randomized trials and one umbrella review. The objective of this programme is to compare the effectiveness of intensified prehabilitation with standard therapy in patients with gastrointestinal tumours.

For the purpose of this study, the meta-analysis by Waterland et al. (2021) [70] was updated with the results of an additional search, which included six randomized trials [71], [72], [73], [74], [75], [76]. The original meta-analysis comprised 21 randomized trials conducted between 1991 and August 2020, with a total of 1,700 participants. A subgroup analysis was performed with targeted inclusion of high-risk patients, regardless of surgery and tumour entity. Molenaar et al. (2022) [67] included three Canadian RCTs published up to January 2021 with a total of 250 patients (prehabilitation n=130) in their current systematic Cochrane Review on prehabilitation in predominantly laparoscopically operated patients with non-metastatic colorectal

cancer. The control patients in the three Canadian studies included by Molenaar et al. did not receive the trimodal prehabilitation (diet, physical exercise and psychological intervention) lasting four weeks until after surgery ("prehabilitation versus rehabilitation"). However, the RCT by Berkel et al. 2022 is missin included three Canadian randomised controlled trials (RCTs) published up to January 2021 with a total of 250 patients (prehabilitation n=130) in their current systematic Cochrane Review on prehabilitation in predominantly laparoscopically operated patients with non-metastatic colorectal cancer. The control patients in the three Canadian studies included by Molenaar et al. did not receive the trimodal prehabilitation (diet, physical exercise and psychological intervention) lasting four weeks until after surgery ("prehabilitation versus rehabilitation"). However, the RCT by Berkel et al. (2022) is missing [71]. The results showed: Post-prehabilitation, a clinically significant functional enhancement was observed in 6-minute walking distance prior to surgery. The confidence in the evidence for the preoperative improvement in walking distance was rated as moderate, with a high risk of bias (RoB). Postoperatively, a functional improvement was found for prehabilitation in the 6-minute walk test after 4 and 8 weeks. The confidence in the evidence was also rated as low to very low with high RoB, lack of precision and inconsistency. The analysis revealed no statistically significant difference in the incidence of complications between the prehabilitation and control groups (RR 0.95; 95% CI 0.70 to 1.29; 3 studies; n=250) and no notable difference in emergency department presentations (RR 0.72; 95% CI 0.39 to 1.32; 3 studies; n=250). However, the study's methodological limitations, including high RoB and lack of precision, were identified as significant sources of uncertainty, thereby limiting the strength of the conclusions that can be drawn. The readmission rate after surgery was not affected (RR 1.20; 95% CI 0.54 to 2.65; 3 studies; n=250). The included studies did not report any significant differences in quality of life or length of hospital stay.

In the randomised study by Berkel et al. (2022) [71], patients aged ≥60 years with colorectal cancer and a VSAQ score ≤7 were randomised to prehabilitation or standard care. The study's inclusion criteria were based on a cardiopulmonary exercise test (CPET), with participants who had an oxygen uptake <11ml/kg/min being eligible (n=57). The participants were divided into two groups: those receiving prehabilitation (n=28) and those receiving standard care (n=29).The prehabilitation group underwent an individualised exercise programme over a period of three weeks, with sessions conducted on a weekly basis. The primary endpoint of postoperative complications was found to be lower in the prehabilitation group (n=12, 42.9%) compared to the standard group (n=21, 72.4%, RR 0.59; 95% CI 0.37 to 0.96, P=0.024).

The findings of this study prompted the guideline group to conduct a subgroup analysis of three identified studies, which included a dedicated selection of high-risk patients [77], [78], [71]. However, the effect observed in Berkel could not be replicated through the incorporation of the two other studies (see research question).

Consequently, the current data fails to demonstrate any benefit of intensified, resource-intensive prehabilitation for the defined outcomes evaluated.

The recommendation to abstain from nicotine and alcohol, to maintain a balanced diet and to increase physical activity was already standard in the control arm of the evaluated studies and is the minimum requirement for preoperative patient guidance. The working group has concluded that high-risk patients should be motivated to participate in a low-resource, individualised "prehabilitation" programme at home

(e.g. guidance through flyers, one-off dietary advice, exercise/physiotherapy) in preparation for major surgery, based on the standard of the control arm and the moderate evidence for improving the 6-minute walking distance.

Research question

The patient groups, interventions and duration of interventions were found to be heterogeneous. Therefore, further high-quality studies with a trimodal prehabilitation (optimisation of nutrition, psychological support, training plan) of defined duration should be conducted in comparable operations in the context of mPOM.The subgroup analysis demonstrated no effect of prehabilitation on the reduction of postoperative complications, even in high-risk patients. However, when the high-powered study by Carli et al. (2020) was omitted in the sensitivity analysis, an effect was certainly observed. Therefore, the current data situation raises the question of the possible effects of prehabilitation on the postoperative outcome of uniformly defined high-risk patients.The differentiation of the "prehabilitation" intervention according to open versus minimally invasive surgical procedures has not yet been made consistently.

4.4 Patient training and advice regarding perioperative interventions / optimization options

4.9	Consensus-based Recommendation	2023
EC	Patients **should** be routinely informed about multimodal perioperative treatment concepts prior to surgery.	
	Strong Consensus	

Despite the absence of definitive conclusions regarding the significance and weighting of individual components (items) of multimodal perioperative treatment concepts (mPOM) [79], [80], he extant evidence indicates that specific preoperative patient education results in enhanced compliance, early postoperative mobilisation, elevated patient satisfaction, and a reduced length of stay in comparison to the absence of patient education.

In a single-centre, non-randomised study (n=505) on the value of standardised telephone training as part of an mPOM programme for colorectal surgery, the 190 patients who received telephone training had a shorter hospital stay (3.0 ± 2.2 vs 3.7 ± 3.2 days; p=0.005) [81].

In other studies in colorectal surgery, patients who received training as part of an mPOM programme, which included two preoperative consultations with a specialist nurse, exhibited a reduced postoperative length of stay when compared to the control group (median 5 days [2 to 50] vs. median 8 days [2 to 48]; p=0.001) [82]. In a subsequent study, 80 patients who received mPOM training were compared with 84 patients who did not receive training. The former group demonstrated superior compliance with postoperative mobilisation and oral food intake, resulting in a median length of stay that was two days shorter (5 days [range 2-29] vs. 7 days [range 2-39], p<0.00) [83]. The same group reported virtually congruent results for 122 stoma patients with a significantly shorter length of stay after specific

preoperative stoma training: 6 days [2-21] vs 9 days [5-45]; $p < 0.001$ [84]. Conversely, a British study involving 65 patients following colorectal surgery found no evidence of a benefit associated with patient education delivered via video as opposed to patient leaflets [85]. Conversely, a Korean study (n = 118) examined the efficacy of a two-week mobile phone-based information programme for patients prior to scheduled colorectal surgery, highlighting benefits for the intervention group in terms of quality of life, anxiety, and depression [86].

A recently published review of three studies with audio-visual aids, three with mobile phone-based interventions and five with face-to-face education has summarised the heterogeneous data on preoperative patient education in colorectal surgery. The review describes a positive effect on quality of life when using online information tools or on length of stay with face-to-face education [87]. A further review of 14 studies reached similar conclusions for preoperative information before oncological surgery (not specific to mPOM): face-to-face education led to reduced anxiety (5 of 7 studies), higher satisfaction (1/1), better knowledge (3/3) and reduced healthcare costs (1/1). Audiovisual and multimedia interventions were found to enhance patient satisfaction (1/1) and knowledge (2/3), while patient leaflets alone did not demonstrate consistent benefits [88].

The Spanish practice guidelines also concluded from this data that patients should receive verbal and written information about perioperative care before major abdominal surgery to allay doubts and make the patient an active partner in their care [89]. The content of the information should be clearly formulated and agreed upon by the perioperative treatment team.

4.5 Preoperative evaluation and risk assessment

4.10	Evidence-based Recommendation	2023
GoR **B**	A validated risk stratification tool **should** be used to complement the clinical examination to plan the surgery. The results of the risk stratification **should** be discussed with the patient to enable participatory decision-making.	
LoE	[90]	
	Strong Consensus	

One of the primary objectives of NICE guideline NG180 is preoperative evaluation and risk assessment to identify and stratify patients at increased risk of mortality and morbidity. The NICE committee concluded that risk stratification tools such as POSSUM, P-POSSUM, NSQIP, E-PASS and the SRS* demonstrated a reasonable degree of accuracy in relation to mortality (median C-statistic of approximately 85%). However, the same tools were found to be less accurate in terms of morbidity. The informative value of these tools is limited due to the low to very low quality of the evidence supporting them, as well as the considerable to very considerable risk of bias present within the included studies. Moreover, given the heterogeneity of the study

populations, it is not possible to determine which of the aforementioned risk stratification tools should be employed [90].

The NICE committee reached a consensus that the ASA (American Society of Anaesthesiology) status can be utilised as a more streamlined instrument for less complex, lower-risk interventions, particularly given the association of more extensive instruments with a substantial data collection effort. The NICE committee has not yet defined which operations are classified as low-risk procedures.

Furthermore, preoperative risk stratification should take into account the ageing demographic of patients undergoing resection of gastrointestinal tumours. In 2018, the European Society of Anaesthesiology and Intensive Care revised the guideline entitled "Pre-operative evaluation of adults undergoing elective noncardiac surgery". This guideline provides recommendations for the preoperative evaluation of non-cardiac surgery patients. The "geriatric patient" section of the guideline includes ten Level 1B recommendations (Grade of Recommendation), which encompass the domains of functional status, degree of independence, co/multimorbidity, polypharmacy, cognitive status, depression, delirium, sensory status, malnutrition, and frailty. The authors of the guideline recommend that the above domains should be part of the preoperative evaluation of geriatric patients [91]. In a manner consistent with the NICE guideline, it is not possible to state which specific tests should be used to evaluate the individual domains due to the heterogeneity of the study populations.

However, it is stated that a validated risk stratification tool should be used for preoperative evaluation and risk assessment in complex operations. The purpose of this is to supplement the clinical examination for planning the operation, as well as to support patient education and empowerment.

5 Preoperative, inpatient management

5.1 PONV prophylaxis

5.1.1 Drug-based

5.1	Evidence-based Recommendation	2023
GoR **A/B**	PONV prophylaxis **shall** be given to patients with risk factors during abdominal tumour surgery. For this purpose, a combination therapy of different drug classes **should** be used for which there is high or at least moderate confidence in the evidence.	
LoE ⊕⊕⊕⊕ ⊕⊕⊕⊖ ⊕⊖⊖⊖ ⊕⊕⊕⊖ ⊕⊕⊖⊖ ⊕⊖⊖⊖ ⊕⊕⊕⊖ ⊕⊕⊕⊕	[92] ⊕⊕⊕⊕: The following individual drugs can reduce the occurrence of vomiting (ordered by decreasing efficacy): Aprepitant (RR 0.26; 95% CI 0.18 to 0.38); Ramosetron (RR 0.44; 95% CI 0.32 to 0.59); Granisetron (RR 0.45; 95% CI 0.38 to 0.54); Dexamethasone (RR 0.51; 95% CI 0.44 to 0.57); Ondansetron (RR 0.55; 95% CI 0.51 to 0.60) ⊕⊕⊕⊖: The following individual drugs can probably reduce the occurrence of vomiting: Fosaprepitant (RR 0.06; 95% CI 0.02 to 0.21)Droperidol (RR 0.61; 95% CI 0.54 to 0.69) ⊕⊖⊖⊖: Droperidol may reduce serious adverse events (SAEs) (RR 0.88; 95% CI 0.08 to 9.71). The effects of aprepitant (RR 1.39; 95% CI 0.26 to 7.36), ramosetron (RR 0.89; 95% CI 0.05 to 15.74), granisetron (RR 1.21; 95% CI 0.11 to 13.15), dexamethasone (RR 1.16; 95% CI 0.28 to 4.85) and ondansetron (RR 1.62; 95% CI 0.32 to 8.10) on SAEs are uncertain. No studies reporting SAEs are available for fosaprepitant. ⊕⊕⊕⊖: Granisetron probably has little or no effect on adverse events (AEs) within 7 days postoperatively (RR 0.92; 95% CI 0.80 to 1.05). ⊕⊕⊖⊖: Dexamethasone (RR 0.77; 95% CI 0.55 to 1.08, low safety, rank 2/15) and droperidol (RR 0.89; 95% CI 0.81 to 0.98, low safety, rank 6/15) may reduce AEs. Ondansetron (RR 0.95; 95% CI 0.88 to 1.01) may have little or no effect on the occurrence of AEs. ⊕⊖⊖⊖: The effects of aprepitant (RR 0.87; 95% CI 0.78 to 0.97) and ramosetron (RR 1.00; 95% CI 0.65 to 1.54) on the occurrence of AEs are uncertain. No studies were available for fosaprepitant that reported side effects. ⊕⊕⊕⊖: Ondansetron probably causes more headache (RR 1.16; 95% CI 1.06 to 1.28), but leads to less sedation (RR 0.87; 95% CI 0.79 to 0.96); droperidol probably leads to a reduction in headache (RR 0.76; 95% CI 0.67 to 0.86) ⊕⊕⊕⊕: Dexamethasone has no effect on sedation (RR 1.00; 95% CI 0.91 to 1.09)	
	Strong Consensus	

The recommendation is grounded in a Cochrane network meta-analysis from 2020 [92], which encompassed 567 RCTs and examined the efficacy of drug-based PONV prophylaxis in at-risk patients. A comprehensive literature search failed to identify any relevant newer RCTs. According to Apfel 1999 [93], risk factors include female gender, non-smoking status, a history of PONV or travel sickness, and postoperative opioid requirement; in addition, inhalation anesthesia or abdominal surgery can also be considered risk factors.

In the course of the network meta-analysis, the effectiveness of the individual substances and their combination therapies was evaluated. The most potent drug class was determined to be the group of NK1 receptor antagonists (including aprepitant, fosaprepitant, netupitant, rolapitant), which was already comparable to most combination therapies in terms of efficacy as a single medication. However, it should be noted that NK1 receptor antagonists are currently not approved for the treatment of PONV, meaning that they are used off-label. Conversely, the combination therapy exhibited superior efficacy in comparison to the individual substances.The evidence for the seven agents mentioned above is supported by high or moderate confidence. Conversely, the evidence for the remaining substances (tropisetron, dolasetron, casopitant) is of a lower confidence level, and there is a concomitant reduction in effectiveness when compared to the aforementioned agents (promethazine, amisulpride). In the case of rocapentine, palonosetron, haloperidol, metoclopramide and scopolamine, there is a combination of both lower confidence and reduced effectiveness [92].

In relation to single administration, a review was conducted of the aforementioned drugs with respect to the occurrence of adverse events (AEs) or serious adverse events (SAEs). For the majority of the substances, the confidence in the evidence regarding the safety of the medication is very low to low. However, a notable exception was observed for the substances granisetron and amisulpride, where a lack of significant difference was observed in AE/SAE occurrence when compared to the placebo group, with moderate confidence in the evidence. For the substances scopolamine and dimenhydrinate, there were indications of an increased rate of adverse events (AEs) compared to the placebo group, albeit with only low confidence in the evidence.

Furthermore, the evidence regarding possible substance-specific adverse events (e.g. cardiac arrhythmia, QT prolongation, headache, constipation, extrapyramidal symptoms, sedative effect, visual disturbances) was found to have only very low to low confidence [92]. In contrast, there is moderate confidence in the evidence for the side effects of the following substances compared with placebo:

- Ondansetron (limited to high doses): probably increased incidence of headache with less sedation compared to placebo
- Droperidol: probably less headache compared to placebo
- Dimenhydrinate: probably greater sedation than placebo

The influence of PONV prophylaxis, particularly when glucocorticoids are used, on the rate of postoperative infections has been the subject of controversy in the past. This endpoint could only be addressed in the network meta-analysis for dexamethasone and ondansetron, with very low confidence in the evidence. A recent randomised controlled trial involving 8,800 patients[51] demonstrated that dexamethasone does not result in an elevated infection rate when compared to placebo.

For fosapripant, a substance that has been identified as the most effective agent for the prevention of postoperative vomiting, no studies have been conducted on the potential side effects [92].

In actual clinical implementation, current guidelines recommend a risk-adapted approach with a combination of 2-4 different medications or measures [94].

Research question

The majority of studies examined patients with an elevated risk of PONV, predominantly including subjects with an ASA score of I or II. The extent to which the efficacy of the investigated substances is also evident in patients without risk factors or those with a higher ASA score remains uncertain. Additionally, the data situation regarding AEs/SAEs and the side effects of the substances remains to be fully elucidated, necessitating further high-quality studies with a substantial number of cases to detect even rare side effects.

5.1.2 Propofol-based total intravenous anesthesia (TIVA)

5.2	Evidence-based Recommendation	2023
GoR **B**	Propofol-based total intravenous anaesthesia (TIVA) **should** be utilised in lieu of volatile anaesthesia for abdominal tumour surgery, provided that no additional antiemetics are administered. However, if volatile anaesthesia is supplemented with an antiemetic, it should be considered equivalent to TIVA in terms of PONV risk.	
LoE ⊕⊕⊕⊖ ⊕⊕⊕⊖ ⊕⊖⊖⊖ ⊕⊖⊖⊖	[95], [96] ⊕⊕⊕⊖: Reduction of PONV risk: Propofol shows an effect compared to volatile anesthetics (RR 0.61; 95% CI 0.52 to 0.71) ⊕⊕⊕⊖: Reduction of PONV risk: early: no effect (RR 1.06; 95% CI 0.88 to 1.27); late: propofol shows an effect compared to volatile anesthetics in combination with antiemetic (RR 1.41; 95% CI 1.10 to 1.79) ⊕⊖⊖⊖: Severe side effects (CDC 3-4): No effect (RR 1.04; 95% CI 0.76 to 1.42) ⊕⊖⊖⊖: Patient satisfaction: No effect (RR 1.06; 95% CI 1.01 to 1.1)	
	Strong Consensus	

Postoperative nausea and vomiting (PONV) is one of the most common and unpleasant side effects of anaesthesia for the patient.

A plethora of studies have investigated the potential influence of the choice of anaesthetic agent on the incidence of PONV. However, given the paucity of data on gastrointestinal tumour surgery, this recommendation is based on data from adult patients from two extensive meta-analyses.

The meta-analysis by Schraag et al. [95] includes 229 RCTs with adult and paediatric patients and compares anaesthesia in which maintenance was performed with either propofol or volatile anaesthetics without the addition of antiemetics.

In the secondary analysis, the focus was exclusively on studies involving adult patients. The findings of this secondary analysis revealed a significant reduction in the incidence of PONV when TIVA was used as opposed to volatile anesthetics. Furthermore, patient satisfaction was marginally higher in the TIVA group. The two groups did not differ significantly in terms of the occurrence of serious complications.

In a systematic review [96] with meta-analysis published by Schaefer et al. in 2016, the PONV risk of TIVA (without additional antiemetic) was compared with volatile anaesthesia with additional administration of an antiemetic. A total of 14 randomised

controlled trials involving 2,051 patients were analysed, revealing no significant difference in PONV risk between the two regimens (RR 1.06; 95% CI 0.85 to 1.32). However, at a subsequent time point (up to 24 hours after the conclusion of surgery), TIVA was associated with an elevated risk of PONV (RR 1.41; 95% CI 1.10 to 1.79). This phenomenon can be adequately explained by the postoperative decline in propofol concentration in the absence of concurrent antiemetic medication.

Subsequent to the publication of the meta-analysis by Schraag et al., two RCTs were published that arrived at contradictory conclusions. Ahmadzadeh [97] found less nausea but no difference in postoperative vomiting when using propofol/remifentanil instead of isoflurane/fentanyl. Conversely, De Carli [98] observed no significant disparities between patients undergoing balanced anaesthesia and those subjected to TIVA with respect to the incidence of PONV. In this study, however, PONV in the recovery room and after 24 hours was only a secondary endpoint. Due to the limited number of patients in both RCTs and the methodological weaknesses inherent in both studies, the results do not alter the fundamental conclusions of the systematic reviews that informed this recommendation.

Research question

The antiemetic efficacy of propofol is well documented. However, there is a paucity of studies conducted on patients classified as ASA I/II, and as such, there is a significant absence of specific data pertaining to gastrointestinal tumour interventions. In particular, the efficacy of combination therapy of TIVA with antiemetics compared to balanced anaesthesia in combination with antiemetics is still insufficiently investigated in the context of gastrointestinal tumour procedures.

5.2 Hair removal in the surgical area

5.3	Consensus-based Recommendation	2023
EC	Preoperative hair removal **shall** be avoided. If (partial) hair removal is necessary for surgical reasons, electric hair clippers with disposable heads **should** be used. Preoperative shaving **shall** be avoided.	
	Strong Consensus	

A plethora of national and international reviews and guidelines are available for the purpose of evaluating preoperative hair removal. A distinction was made between three different interventions in the context of preoperative hair removal: preoperative shaving, electric hair clippers, and chemical depilation (depilatory creams, usually with mercaptoacetic acids and/or calcium/strontium hydroxide). Comparators were not preoperative hair removal or the aforementioned interventions among each other. The population and surgical procedures under scrutiny were found to be heterogeneous across the various reviews, a limitation that was also observed in the chemical depilation interventions. The primary outcome measure was postoperative wound infection (SSI, surgical-site infection).

In the 2018 WHO guideline, 15 randomised controlled trials (RCTs) included in a direct comparison demonstrated a lower risk of surgical site infection (SSI) with electrical hair removal (clipping) or no hair removal compared to preoperative shaving. The quality of the evidence was assessed as moderate. However, the study did not provide sufficient evidence to determine the optimal timing of hair removal, whether the procedure should be performed the evening before or immediately preoperatively, or its location, whether in the operating room or elsewhere. The analysis revealed no discernible disadvantages associated with hair removal, either through clipping or the absence of hair removal [99]. This finding is consistent with the results of the Cochrane Review (14 RCTs) from 2011[100], whereby the studies included here were largely identical [11 of 14 studies] with the WHO guideline analysis. No differences were identified in the comparison between chemical depilation and preoperative shaving. The NICE guideline "Surgical Site Infections: Prevention and treatment" [101] also does not recommend routine hair removal to reduce the risk of SSI (this chapter of the NICE guideline is also up to date in the 2020 version and does not allow evidence-based guideline adaptation).

The national guideline of the Commission for Hospital Hygiene and Infection Prevention (KRINKO) of the Robert Koch Institute from 2018 [102] and the NICE guidelines from 2008 both recommend avoiding preoperative hair removal. However, should this not be feasible, the use of an electric hair clipper is recommended, as preoperative shaving has been associated with an increased risk of SSI.

5.3 Skin disinfection of the operating field

5.4	Evidence-based Recommendation	2023
GoR **B/0**	Disinfection with alcoholic solutions containing chlorhexidine **should** be carried out before the skin incision. In case of intolerance or contraindications, the use of solutions containing povidone-iodine **can** be considered.	
LoE ⊕⊕⊕⊖	[90] ⊕⊕⊕⊖: Guideline adaptation: Evidence review for the effectiveness of skin antiseptics in the prevention of surgical site infection (National Institute of Health and Care Excellence)	
	Strong Consensus	

The National Institute for Health and Care Excellence (NICE) updated its evidence-based recommendations in 2019 with a final update 8/2020 [90]. This constitutes the foundation for the present recommendation. The NICE meta-analysis (meta-regression model) identified chlorhexidine in alcohol solution (2% chlorhexidine in 70% alcohol licensed for "disinfection of the skin prior to invasive medical procedures") as the primary treatment option, with moderate quality evidence derived from 20 RCTs involving 9,647 patients. In instances where contact with mucous membranes is a possibility, chlorhexidine in aqueous solution is the recommended alternative. In instances where chlorhexidine is contraindicated (e.g. allergies, infants/toddlers), povidone-iodine in alcoholic solution constitutes the primary alternative. Similarly, if chlorhexidine is contraindicated due to mucosa, povidone-iodine in aqueous solution

is recommended. A subgroup analysis of four RCTs (1,924 patients) confirms the superiority of chlorhexidine in alcohol in "clean-contaminated" operations, which most closely correspond to the population of this guideline (moderate quality of evidence). The incidence of skin irritation appears to be comparable between chlorhexidine/alcohol and povidone-iodine/water groups (1 RCT, 388 patients, low quality evidence). The current evidence base does not permit the formulation of a definitive action statement, but rather, it can be recommended that further study be undertaken to address the optimal application method (single/multiple/spray) and the most suitable chlorhexidine concentration. The NICE guideline highlights the risks associated with diathermy application and the use of alcohol. Alcohol is flammable and has the potential to cause explosions or burns when diathermy is applied. It is therefore essential to wait until the skin disinfection has dried completely, to limit the use of diathermy during this phase of the operation, and to remove soaked drapes after the application of alcohol. Furthermore, the NICE recommendation 1.3.11 emphasises the importance of avoiding electric current during skin incision, in order to mitigate the risk of wound infection.

In its somewhat older "World Surgical Site Infection Prevention Guidelines 2016/2018" [103], [99], the WHO recommends the combination of chlorhexidine in alcoholic solution (strong recommendation with low to moderate quality of evidence), but also points out that the recommendation only applies to adults and not when the surgical site comes into contact with mucosal surfaces. It is also important to note that chlorhexidine should not be used in contact with the brain, meninges, eye, or middle ear. A systematic analysis of 17 RCTs revealed that alcohol-based antiseptics were more effective than aqueous solutions. It is also important to note the potential risks associated with the use of diathermy streams and alcoholic solutions.

The "Centers of Disease Control and Prevention Guideline for the Prevention of Surgical Site Infection" from 2017 [104] corroborates the superiority of alcohol-based solutions, as evidenced by a systematic analysis. However, it does not substantiate the superiority of chlorhexidine over iodine-containing compounds. Peel et al. revisited this question in 2021 in a high-quality systematic review with meta-analysis based on RCTs, confirming the superiority of chlorhexidine in alcohol for caesarean sections, finding an inferior effect for orthopaedic procedures, and concluding that there was no difference for general and soft tissue surgery [105].

In 2020, Chen et al. conducted a meta-analysis that was subsequently expanded to include non-randomised studies [106]. The researchers confirmed the superiority of chlorhexidine, particularly in the subgroup analysis of the "clean contaminated" surgical group. The effect was more pronounced in the RCT analysis. The authors place a particular focus on the side effects of the solutions, but find no difference to povidone-iodine.

In Germany, the Commission for Hospital Hygiene and Infection Prevention (KRINKO) established regulations for the antisepsis of the surgical field in 2018 [102]. In German-speaking countries, operations in the target population "clean contaminated" and "contaminated" correspond to Group II "Operations in clean-contaminated regions" and Group III "Operations in contaminated regions". In alignment with the recommendations put forth by NICE, the KRINKO advocates the utilisation of alcohol-based substances as the primary choice due to their rapid and pronounced effect. Chlorhexidine (or alternatively octenidine hydrochloride) is suggested as an additive to increase remanence. The question of its superiority to povidone-iodine is left open, as is an indication of the concentration or assignment to the contamination classes of

the operations. The evaluation of disinfection with mucosal contact is exclusively conducted outside the scope of the population covered by this guideline. The KRINKO emphasises that preoperative skin antisepsis must be carried out in at least two stages and that the specified contact times must be strictly adhered to.

The KRINKO recommendation does not meet the methodological quality standard of an evidence-based guideline in its current dimensions.

5.4 Perioperative intravenous antibiotic prophylaxis

5.5	Consensus-based Recommendation	2023
EC	Preoperatively (60 minutes to shortly before the incision), intravenous perioperative antibiotic prophylaxis (iv PAP) **shall** be carried out as part of the resection of gastrointestinal tumours. The iv PAP **shall** be repeated intraoperatively according to the half-life of the substances used or in the event of severe blood loss. Postoperatively, iv PAP **shall not** be continued.	
	Strong Consensus	

The objective of intravenous perioperative antibiotic prophylaxis (PAP) is to minimise the incidence of postoperative wound infection (surgical site infection, SSI) attributable to bacteria that gain access to the surgical site during the operation or are already present there. Operations for resection of gastrointestinal tumours are categorised as 'clean contaminated' or 'contaminated' procedures, with postoperative wound infection rates ranging up to 15% [103]. The efficacy of PAP is well documented; the NNT for preventing wound infection in colorectal surgery, for example, is a mere 4 [103]. The predominant pathogens responsible for postoperative wound infection following resection of gastrointestinal tumours are enterobacterales (e.g. Escherichia coli, Klebsiella spp.), i.e. gram-negative bacteria. Depending on the surgical site, Gram-positive bacteria (e.g. enterococci in upper GI tract surgery) and anaerobes (e.g. Bacteroides spp. in colorectal surgery) can also be frequently detected in SSI [103], [107]). However, given that a polymicrobial pathogen spectrum is generally to be expected as the cause of an SSI in the resection of gastrointestinal tumours, this should be taken into account when selecting substances for PAP, regardless of the specific procedure and the possibly different frequency distribution of individual bacteria. The combination of a group 2 cephalosporin (e.g. cefuroxime) with metronidazole can therefore be used as a PAP in the resection of gastrointestinal tumours. Alternatively, the combination of a beta-lactam antibiotic with a beta-lactamase inhibitor (e.g. ampicillin/sulbactam) is also adequate. In the event of a beta-lactam allergy, the use of a group 2 fluoroquinolone (e.g. ciprofloxacin) in combination with metronidazole is appropriate. When administered in accordance with the stipulated dosage (see below), the toxicity potential of fluoroquinolones is minimal, yet their efficacy in preventing SSI is substantial, thus rendering their utilisation justifiable. A compendium of recommendations concerning the selection of substances can be located at [107]. The adjustment of PAP in 3MRGN (ESBL-) colonized patients (e.g. with ertapenem) has been demonstrated to result in a reduction in the SSI rate when compared to collectives in which standard prophylaxis is given [108], [107].

Ideally, prophylactic administration should take place within 1 h preoperatively, but at the latest shortly before the incision [109]. For all procedures lasting less than three hours, a single dose of the antibiotic (so-called single-shot) is usually sufficient. However, in cases where the operation is expected to exceed three hours, or in instances of significant blood loss (defined as >1.5 litres), a second dose should be administered during the procedure. The failure to administer this second dose can lead to a heightened risk of SSI, with a reported increase ranging from 1.5 to 4.5 times [103], [110], [102].
Postoperative continuation of PAP has been demonstrated to be ineffective in reducing the SSI rate in visceral surgery [109]. However, its utilisation has been associated with an increased incidence of resistance, toxicity (including renal failure), C. difficile infections [111] and financial expenditure. Consequently, its utilisation is not recommended.

5.5 Preoperative bowel preparation

5.5.1 Colorectal operations

5.6	Evidence-based Recommendation	2023
GoR **A/B**	If preoperative bowel preparation is performed prior to colorectal surgery, this **should** be carried out as a combined mechanical and oral antibiotic bowel preparation. A purely mechanical bowel preparation **shall not** be performed.	
LoE ⊕⊕⊕⊖ ⊕⊕⊕⊖ ⊕⊕⊕⊖ ⊕⊕⊕⊖ ⊕⊕⊖⊖ ⊕⊕⊕⊖ ⊕⊕⊖⊖	[112] ⊕⊕⊕⊖: Infections of the surgical site: the risk is reduced by combined bowel preparation (RR 0.56; 95% CI 0.42 to 0.74) ⊕⊕⊕⊖: Anastomotic insufficiency: the risk is reduced by combined bowel preparation (RR 0.59; 95% CI 0.36 to 0.99) ⊕⊕⊕⊖: Mortality: no effect (RR 0.87; 95% CI 0.27 to 2.82) ⊕⊕⊕⊖: Postoperative complications: no effect in terms of mild (Clavien-Dindo (I + II): RR 0.76; 95% CI 0.29 to 2.00) or serious (Clavien-Dindo (III + IV): RR 1.00; 95% CI 0.59 to 1.70) postoperative complications ⊕⊕⊖⊖: Postoperative ileus: no effect (RR 0.89; 95% CI 0.59 to 1.32) ⊕⊕⊕⊖: Length of hospital stay: no effect (MD -0.19 days; 95% CI -1.81 to 1.44) ⊕⊕⊖⊖: Side effects of the intervention: the risk of nausea/vomiting (RR 2.22, 95% CI 1.33 to 3.72) and abdominal pain (RR 1.79; 95% CI 0.67 to 4.82) is increased by the combined bowel preparation. No effect on the incidence of diarrhea associated with C. difficile (RR 0.89; 95% CI 0.24 to 3.34)	
	Strong Consensus	

5.7	Evidence-based Recommendation	2023
GoR **0**	Alternatively, purely oral antibiotic bowel preparation **can** be considered.	
LoE ⊕⊖⊖⊖ ⊕⊕⊖⊖ ⊕⊕⊖⊖ ⊕⊕⊖⊖	⊕⊖⊖⊖: Infections of the surgical site: evidence is very uncertain regarding an effect (RR 0.87; 95% CI 0.34 to 2.21) ⊕⊕⊖⊖: Anastomotic insufficiency: no effect (RR 0.84; 95% CI 0.21 to 3.45) ⊕⊕⊖⊖: Mortality: no effect (RR 1.02; 95% CI 0.30 to 3.50) ⊕⊕⊖⊖: Postoperative ileus: no effect (RR 1.25; 95% CI 0.68 to 2.33)	
	Strong Consensus	

Colorectal operations carry an increased risk of postoperative complications when compared with non-colorectal gastrointestinal procedures, with surgical site infections (SSI) and anastomotic insufficiencies being the most common [113], [114]. This heightened risk is attributable to various factors, including the physiological bacterial colonization of the colon, which can result in surgical site contamination when the intestinal lumen is opened intraoperatively.

Preoperative irrigation of the bowel (known as mechanical bowel preparation, MBP) has been a customary procedure for many years, with the objective of cleansing the bowel lumen of faecal impurities. However, a 2011 Cochrane review revealed that preoperative MBP alone had no positive effect on the wound infection rate (OR 1.16; 95% CI 0.95 to 1.42) or the incidence of anastomotic leakage (OR 0.99; 95% CI 0.74 to 1.31) [115]. This lack of benefit has led to several guidelines recommending against the performance of MBP [14], [101], [99].

However, a 2014 Cochrane review on antimicrobial prophylaxis in colorectal surgery demonstrated that the incorporation of preoperative oral antibiotics (oAB) into perioperative intravenous antibiotic prophylaxis for patients who had undergone mechanical bowel preparation can reduce the risk of SSI when compared to intravenous prophylaxis alone (RR 0.55; 95% CI 0.43 to 0.71) [116]. This effect is further corroborated by a large registry study encompassing more than 8,000 patients, which demonstrated a reduced incidence of postoperative wound infections and a reduced hospital stay with combined mechanical and oral antibiotic bowel preparation compared to no bowel preparation or monotherapy with MBP or oAB [117]. In light of these findings, the American Society of Colon and Rectal Surgeons has issued a recommendation in favour of combined mechanical and oral antibiotic bowel preparation prior to elective colon and rectal resections [114].

A recent Cochrane review corroborates the hypothesis that combined mechanical and oral antibiotic bowel preparation reduces the risk of surgical site infection (RR 0.56; 95% CI 0.42 to 0.74) and anastomotic leakage (RR 0.60; 95% CI 0.39 to 0.99) when compared with MBP alone [112]. In the included studies, a combination of metronidazole and an aminoglycoside, or erythromycin and an aminoglycoside was predominantly administered in two to three single doses after mechanical bowel

preparation on the day before surgery. However, differences in efficacy between different antibiotic combinations could not be determined [112].

However, the ORALEV study demonstrated that oral antibiotics (750 mg ciprofloxacin and 500 mg metronidazole at 6 p.m. and midnight on the day before surgery) can result in a significant reduction in wound infections, even without additional mechanical bowel preparation (RR 0.23; 95% CI 0.09 to 0.60) [118]. This prompts the question of whether mechanical irrigation in addition to oral antibiotics is necessary.

However, the available literature on this subject is currently limited, with only three randomised controlled trials (RCTs) comparing mechanical bowel preparation (MBP) with oral antibiotics (oAB) having been identified to date. The present Cochrane review identified only three RCTs that investigated this question. The calculated meta-analysis of these studies suggests, with only low confidence in the evidence, that there may be no difference in efficacy (SSI: RR 0.87; 95% CI 0.34 to 2.21; AI: RR 0.84; 95% CI 0.21 to 3.45), but further studies are needed to better assess this comparison [112].

Research question

In view of the current study situation, it is not possible to subdivide the recommendation depending on the type or location of the bowel resection performed. Given the physiologically lower stool contamination of the right colon, it appears feasible that mechanical bowel preparation can be dispensed with more readily in right-sided resections than in the left colon or rectum. Subgroup analyses of existing studies or further RCTs are necessary to generate separate recommendations depending on the localization of the resection.

Furthermore, based on the available evidence, no recommendations can be made regarding the substances to be used for mechanical and/or oral antibiotic bowel preparation. The efficacy of the different treatment regimens must be compared and further investigated in future studies.

5.5.2 For non-colorectal procedures

5.8	Consensus-based Recommendation	2023
EC	Preoperative mechanical bowel preparation **should not** be performed prior to surgical tumour resections of the upper gastrointestinal tract and pancreas.	
	Strong Consensus	

5.9	Evidence-based Recommendation	2023
GoR B	Preoperative mechanical bowel preparation **should not** be performed prior to liver resection for hepatocellular carcinoma.	
LoE ⊕⊖⊖⊖ ⊕⊖⊖⊖ ⊕⊖⊖⊖	[119] ⊕⊖⊖⊖: Liver failure: MBP most likely has no influence on the risk of postoperative liver failure (OR 1.55; 95% CI 0.76 to 3.15) ⊕⊖⊖⊖: Serious complications: MBP most likely has no effect on the likelihood of serious complications (OR 1.90; 95% CI 0.70 to 5.15) ⊕⊖⊖⊖: Mortality: MBP most likely has no effect on mortality (OR 0.26; 95% CI 0.01 to 6.34)	
	Strong Consensus	

5.10	Evidence-based Statement	2023
	In the absence of compelling evidence, it is not possible to formulate a recommendation for the utilisation of oral antibiotic bowel preparation prior to non-colorectal surgery.	
	keine Daten: No comparative studies available	
	Strong Consensus	

The primary objective of preoperative bowel preparation is to minimise the likelihood of infectious complications arising following abdominal surgery. It is also hypothesised that this preparation may offer several advantages, including enhanced visibility during laparoscopic procedures and a reduced likelihood and severity of postoperative ileus. Furthermore, it is hypothesised that preoperative bowel preparation for liver surgery reduces the risk of postoperative liver failure [119].

A Cochrane review from 2011 [115] already called into question the benefit of mechanical bowel preparation alone in colorectal surgery. More recent meta-analyses on laparoscopic procedures in gynaecology [120], [121] and a recent randomised controlled trial in bariatric surgery [122] also show no benefit of preoperative mechanical bowel irrigation for patients. A systematic literature search on operations

of the upper gastrointestinal tract or the pancreas was unable to identify any evidence in this regard. With regard to liver resections for hepatocellular carcinoma (HCC), one retrospective cohort study was identified [119]. The study concluded that MBP does not have a positive effect on wound infection rate (OR 1.75; 95% CI 0.78 to 3.90), the occurrence of postoperative liver failure (OR 1.55; 95% CI 0.76 to 3.15), or serious complications (OR 1.90; 95% CI 0.70 to 5.15) and mortality (OR 0.26; 95% CI 0.01 to 6.34) in patients with HCC. The authors therefore recommend against the routine use of MBP in liver resections.

In view of the unproven benefit of mechanical bowel preparation alone in colorectal surgery and the lack of evidence of benefit in liver resection, it may be reasonable to assume that mechanical bowel preparation alone prior to upper gastrointestinal or pancreatic surgery also provides no benefit and should therefore be avoided.

Additionally, the process of mechanical bowel preparation has the potential to induce adverse effects of varying severity. These include patient-specific effects (nausea, vomiting, abdominal pain). In a randomised controlled study by Bretagnol et al., these effects led to discontinuation of bowel preparation in 11% of patients [123]. Furthermore, electrolyte shifts, dehydration at the time of anesthesia induction, and acute phosphate nephropathy can occur when using sodium phosphate-containing irrigation solution [124].

The utilisation of oral antibiotics for preoperative bowel preparation (the administration of poorly absorbable oral antibiotics for 1-3 days prior to surgery) can also potentially result in adverse effects (e.g. idiosyncratic reaction with erythromycin). Moreover, the unintended risk of resistance development is associated with the administration of oral antibiotics for irrigation, particularly in cases of widespread use and inadequate postoperative use [125]. The absence of evidence-based protocols for the administration of certain antibiotics is also a matter of concern. In the absence of empirical evidence regarding the efficacy of oral antibiotic bowel preparation or combined oral-antibiotic and mechanical bowel preparation, it is not possible to formulate any recommendations in this regard.

5.6 Perioperative selective digestive decontamination (SDD)

5.6.1 Operations on the upper GI tract

5.11	Evidence-based Recommendation	2023
GoR **0**	Perioperative selective digestive decontamination prior to surgery on the upper gastrointestinal tract **may** be considered.	
LoE ⊕⊕⊕⊖ ⊕⊕⊕⊖ ⊕⊕⊖⊖ ⊕⊕⊖⊖	[126] ⊕⊕⊕⊖: Anastomotic insufficiency: the risk is reduced by perioperative selective digestive decontamination (RR 0.39; 95% CI 0.19 to 0.80) ⊕⊕⊕⊖: Pneumonia: the risk is reduced by perioperative selective digestive decontamination (RR 0.42; 95% CI 0.23 to 0.78) ⊕⊕⊖⊖: Mortality: no effect (RR 0.50; 95% CI 0.20 to 1.23) ⊕⊕⊖⊖: Surgical site infections: no effect (RR 0.89; 95% CI 0.43 to 1.82).	
	Strong Consensus	

Resection procedures on tumours of the upper gastrointestinal tract have an increased risk of postoperative complications, particularly surgical site infections (SSI) or anastomotic insufficiencies [127]. Esophageal resections, in particular, have been observed to be associated with a high incidence of pneumonia, which, in conjunction with local infectious complications, has been shown to result in elevated mortality rates following this procedure. These risks are attributed, among other things, to the physiological bacterial and fungal colonization of the oropharynx and esophagus, and in some cases also to tumor-induced malcolonization of the region. A recent study has shown that perioperative selective decontamination with antibiotics and antimycotics over several days can reduce infectious complications and the resulting mortality in intensive care patients [128]. This suggests that intervention in resections of the upper gastrointestinal tract may also be effective in reducing infectious complications and pneumonia.

There is no universally accepted standard for SDD, therefore the guideline was based on the definition [129] and multicentre study [130] by Plantinga and Bonten for intensive care patients, which used a combination of three substances including an antimycotic and an intravenous antibiotic for four days after ICU admission [129], [130]. In contradistinction to bowel preparation using preoperative oral antibiotics, the commencement of SDD should be initiated a minimum of three days prior to surgery. The study by Riedl [131] was the only one to fulfil this criterion, and consequently the selection criterion of the meta-analysis used [126] with preoperative onset (1st - 7th day preoperatively) was adopted. In all included studies, further postoperative administration took place at least until the third and at most until the seventh postoperative day, so that a duration of SDD of four days was always observed. In the case of postoperative administration, the observed effects on the endpoints could also be due to continued postoperative anti-infective therapy.

The two most significant endpoints of anastomotic insufficiency and pneumonia rate can be reduced by SDD. The risk reductions are relevant. However, it is noteworthy that only Schardey (1997) as a single study achieves a result for the endpoints and contributes significantly (42% and 63% respectively) to the overall conclusion of the systematic review. The total number of cases in the studies is low, so that the pooled meta-analysis only resulted in group sizes of 154 to 213 patients. However, utilising metadata-driven estimations yielded substantially higher case counts, ranging from 278 to 1,276 cases [126] . This approach is crucial for deriving valid conclusions, given the conventional probabilities of error (alpha = 5%, power = 80%).

The evolution of perioperative medicine and surgical techniques, marked by the emergence of minimally invasive procedures, has resulted in a substantial decline in morbidity and mortality rates in upper gastrointestinal surgery. The available data are the result of operations performed 15 (Roos) to 30 years ago (Schardey), and in some cases, the complication rate is significantly higher than the current results. The interpretation of the study effects achieved and the transformation into a current recommendation took this into account.

In the course of the studies, no methodical recording of side effects and patient-oriented criteria such as tolerability and tolerance of the intervention, quality of life, etc. was carried out. There is an indication of a relevant intolerance of the SDD solution in Farran, which led to exclusion from the study in approximately 8-10% of patients.

More recent scientific findings, such as changes in the intestinal flora and microbiome due to the intestinal preparation [132], could not be taken into account in the studies. The potential adverse consequences of the intensive influence on the natural flora of the site have not yet been sufficiently investigated and must be considered as potential negative consequences of the intervention in the future.

In individual studies, perioperative selective digestive decontamination has been shown to reduce the rate of anastomotic insufficiencies and pneumonia after resecting tumour operations on the upper gastrointestinal tract. However, the methodological variance in the implementation of SDD, the limited number of cases available for reliable conclusions regarding effect size, and the paucity of evidence on adverse effects preclude the ability to strongly recommend its implementation. However, its use can be considered to avoid infectious complications.

Research question

Postoperative infectious complications represent a significant clinical concern. Consequently, the evaluation of potentially effective preventive interventions, such as SDD, is imperative.

In addition to standardising the intervention, with consideration for the most recent microbiological and infectious disease findings, a prerequisite for valid statements and adequate risk assessment is, in particular, a sufficient number of cases to assess the effect size and the methodical recording of adverse effects and potential damage caused by the therapy.

5.6.2 Operations on the lower GI tract

5.12	Evidence-based Recommendation	2023
GoR **B**	Preoperative selective digestive decontamination prior to colorectal surgery **should not** be performed.	
LoE ⊕⊕⊕⊖ ⊕⊕⊕⊕ ⊕⊕⊖⊖ ⊕⊕⊖⊖ ⊕⊕⊕⊕ ⊕⊕⊕⊖	[133], [134], [135], [136] ⊕⊕⊕⊖: Anastomotic insufficiency: no effect (OR 0.68; 95% CI 0.36 to 1.30) ⊕⊕⊕⊕: Postoperative ileus: no effect (OR 0.91; 95% CI 0.39 to 2.1) ⊕⊕⊖⊖: Mortality: no effect (OR 1.22; 95% CI 0.23 to 6.47) ⊕⊕⊖⊖: Surgical-site infections: no effect (OR 0.91; 95% CI 0.21 to 3.98) ⊕⊕⊕⊕: Diarrhea: the risk is increased by perioperative selective digestive decontamination (OR 2.45; 95% CI 1.26 to 4.78) ⊕⊕⊕⊖: C. diff. associated diarrhea: no effect (OR 6.59; 95% CI 0.76 to 57.04)	
	Strong Consensus	

Preoperative selective digestive decontamination (SDD) with oral, non-absorbable antibiotics and/or antimycotics for 3-7 days preoperatively is intended to reduce postoperative infectious complications by reducing bacterial colonization. In contrast to colorectal surgery, this procedure is already used in surgery of the upper gastrointestinal tract (see Chapter 5.6.1).
A systematic literature review identified only four RCTs that investigated this question.

The SELECT trial, conducted by Abis et al. in 2019, demonstrated a reduction in surgical site infections (SSIs) with a constant AI rate due to SDD, as reported in [133]. The investigation was conducted with meticulous rigour, encompassing 455 patients. The Precaution trial, a large-scale study by Mulder et al., was prematurely terminated in 2018 [136]. The study group had declared SDD to be the clinical gold standard, based on a before-and-after study from the same institute.

It is noteworthy that only Abis et al. [133] administered perioperative intravenous antibiotic prophylaxis. However, as this is now considered the gold standard of infection prophylaxis, the results of the other included RCTs must be interpreted with caution.

In the present meta-analysis of all four RCTs, no effect of SDD on the rate of anastomotic insufficiency, surgical site infections, mortality, or the occurrence of postoperative ileus could be demonstrated. However, it is noteworthy that diarrhea occurred more frequently as a side effect of the intervention. One study describes an increased risk of C. difficile-associated diarrhea due to SDD.

The heterogeneity of the included RCTs, particularly in terms of perioperative antibiotic prophylaxis and mechanical bowel preparation, limits the reliability of the evidence, suggesting that the established effect of our meta-analysis may not be representative of the true effect. Consequently, in the absence of benefit and

potential harm from the intervention's side effects, SDD should be avoided prior to colorectal resections.

Research question

Infectious complications represent a significant problem, particularly in the context of colorectal surgery. Consequently, the evaluation of potentially efficacious preventive interventions, such as SDD, is imperative.

Of particular note is the need for further investigation into the impact on the intestinal microbiome and the potential for miscolonization with multi-resistant organisms. The conduction of primary studies, incorporating the examination of stool samples and serum analyses, would be a valuable next step in this research.

5.6.3 Hepato-pancreato-biliary surgery

5.13	Evidence-based Statement	2023
	The paucity of evidence for selective digestive decontamination in hepato-pancreato-biliary oncologic surgery precludes the formulation of any recommendation.	
	keine Daten: No valid comparative data available	
	Strong Consensus	

In accordance with the guideline, perioperative selective digestive decontamination should be administered for a period of 3-7 days preoperatively, with the option of continuation postoperatively. The objective of this intervention is to minimise anastomotic insufficiencies and other infectious complications, as well as the ensuing general morbidity and mortality.

However, it should be noted that there is an absence of valid comparative data concerning tumour surgery on the pancreas or liver. A notable exception is the study by Roos [137], which included a small subgroup of patients (31 SDD vs. 28 control) undergoing hepatobiliary resections. However, this study did not perform a selective evaluation of the data. A number of randomised studies have been conducted for liver transplants; however, due to the unique combination of immunosuppression, secondary diseases and general risk, these studies are not applicable to the guideline question. A comprehensive literature search yielded no additional evidence. Consequently, the present study concludes that the use of SDD for hepatobiliary tumour surgery cannot be recommended.

5.7 Sedative premedication

Despite the existence of two Cochrane reviews on the topic of sedative premedication and its effect on preoperative anxiety, discomfort, and patient satisfaction, the issue remains unresolved.Melatonin is likely to reduce preoperative anxiety in comparison with a placebo; however, its utilisation in the perioperative area in Germany is currently minimal.A recent systematic review with meta-analysis from 2021 [138] ound no difference between melatonin/ramelteon and placebo with regard to the

incidence and duration of delirium. A 2016 systematic review with meta-analysis revealed that administration of benzodiazepines did not result in a reduction in preoperative anxiety intensity compared to placebo [139]. A Cochrane review from 2016 examined patient satisfaction after i.v. administration of diazepam and midazolam and found no difference. Patient satisfaction with midazolam versus placebo was only examined in one study and found no difference [140].

A Cochrane review from 2020 [141] investigated the influence of melatonin on the intensity of anxiety experienced before and after surgery. The review concluded that melatonin exerts an effect on the reduction of preoperative anxiety in comparison with a placebo. However, when melatonin was compared with benzodiazepine, no significant differences were observed in the overall effect.

However, two studies not included in the meta-analyses yielded contradictory results regarding anxiety reduction. A randomised controlled trial involving 248 patients, in which anxiety reduction was not the primary endpoint, demonstrated the efficacy of benzodiazepine premedication [142]. Conversely, a separate randomised controlled trial involving 128 patients failed to demonstrate an anxiety-reducing effect of midazolam [143]. A further randomized controlled trial with 354 patients [144] and a secondary analysis of data from an observational study [145] did not find any difference in patient comfort after preoperative benzodiazepine administration. A secondary analysis of a further observational study (POSE study) with 9,497 geriatric patients [146] was possibly associated with a positive effect of benzodiazepine administration on mortality in patients over 80 years of age.

n light of the study's heterogeneous nature, it is not possible to ascertain a definitive benefit of sedative premedication with benzodiazepines over placebo. The data regarding anxiolysis and patient comfort is inconsistent. Consequently, the preoperative administration of benzodiazepines should be contemplated on an individual basis. Melatonin, an alternative to benzodiazepines, has been shown to have substance-specific adverse drug reactions (including gastrointestinal complaints and transaminase elevation), which must be taken into account in patients with gastrointestinal tumours. The recommendation of melatonin administration for the prophylaxis of postoperative delirium remains uncertain due to the inconclusive nature of the available data.

Further results

A Cochrane review from 2016 mentions a study of midazolam versus placebo with no difference in "anxiety reduction" [140]. The same meta-analysis reports a study with the endpoint "patient comfort" after administration of midazolam versus placebo, which shows higher patient comfort after benzodiazepine administration [147]. However, a multicentre study failed to demonstrate any significant difference in patient comfort between lorazepam and placebo [144]. A retrospective analysis revealed no association between midazolam premedication and patient satisfaction [145]. The subgroup analysis of the POSE study demonstrates the surprising effect of a possible mortality reduction by benzodiazepine premedication in patients over 80 years [146].

However, two studies not included in the meta-analyses yielded contradictory results regarding anxiety reduction (benzodiazepine versus placebo). While one study reported a reduction in anxiety [142], the other was unable to demonstrate any difference [143].

Research question

The extant evidence indicates a necessity for further research on premedication: The following research questions must be addressed:Does premedication have an impact on a) outcome, b) patient satisfaction, c) length of stay in the recovery room and d) in hospital, and e) delirium incidence in patients with gastrointestinal tumours and necessary surgery?

6 Intraoperative management

6.1 Intraoperative insertion of a drain into the surgical field

6.1.1 Esophagus

6.1	Consensus-based Recommendation	2023
EC	After transthoracic esophagectomy, a single intercostal drain with or without suction **should** be placed.	
	Strong Consensus	

A recent systematic review analysed the evidence for chest tube placement after oesophagectomy [148]. A total of 27 studies with 2,564 patients were included; the majority of the studies were retrospective and only 2 studies were RCTs. The overall level of evidence on this topic is therefore low.

As intercostal placement of a drain has been shown to increase postoperative pain, it is recommended that a single drain be placed rather than multiple drains (3 trials with 103 patients). Some research groups have also investigated transhiatal placement of the drain (6 trials with 425 patients), but this is not technically possible or practical in certain types of oesophagectomy.

A prospective randomised trial in 1998 investigated whether thoracic drainage should be performed postoperatively with or without suction (-15 mmHg) [149]. In a cohort of 110 patients, no difference was found for the two outcome parameters "pneumothorax" and "postoperative atelectasis". Therefore, there is no evidence to support the use of suction for thoracic drainage..

The question of the timing of drain removal was addressed in another RCT with 60 patients (early removal with flow rate <250 ml/24 hours, late removal < 50 ml/24 hours) [150]. No difference was found between the two groups for the primary endpoint "recurrent pleural effusion after drain removal", but the average length of hospital stay was 2.5 days shorter after early drain removal. Based on these data and the results of a second retrospective study, the removal of chest tubes is justified when the flow rate is <250 ml.

According to the present analysis of the systematic review, there is no evidence to support the routine testing of drainage secretions for elevated amylase levels as a diagnostic sign of anastomotic insufficiency, as the sensitivity is low and the cut-off values of the measured amylase to detect this complication vary in the retrospective studies.

6.2	Consensus-based Recommendation	2023
EC	A cervical drain **should not** be placed in the cervical compartment after oesophagectomy and gastric reconstruction.	
	Strong Consensus	

A prospective randomised trial was published in 1998 on the question of drain placement after cervical reconstruction (McKeown esophagectomy), which could not demonstrate a difference between the two study groups (cervical drainage versus no cervical drainage) with regard to postoperative haematoma and anastomotic insufficiency in a total of 40 included patients [151]. A study protocol on the same question was also published by an Asian study group in 2019 [152]. In a similar study design with a total of 55 patients, the primary endpoint was the rate of diagnosed anastomotic insufficiency. The results of this randomised trial have not yet been published. Based on these data and the clinical experience of the expert group, intraoperative placement should be avoided.

6.3	Consensus-based Recommendation	2023
EC	Abdominal drainage **should not be** inserted during transthoracic esophagectomy with gastric reconstruction.	
	Consensus	

Intraoperative placement of an abdominal drain after transthoracic or transhiatal esophagectomy has not been evaluated under the study conditions. As no intra-abdominal anastomoses are created during the procedure and no hollow organ is opened, an abdominal drain should not be placed intraoperatively, as with gastrectomy (see the corresponding recommendation in this guideline).

6.1.2 Stomach

6.4	Evidence-based Recommendation	2023
GoR **B**	An abdominal drain **should not** be inserted after a gastrectomy.	
LoE ⊕⊕⊕⊕ ⊕⊕⊕⊕	[153] ⊕⊕⊕⊕: Postoperative morbidity (3 RCTs): lower without abdominal drainage (RR 0.47; 95% CI 0.26 to 0.86) ⊕⊕⊕⊕: Length of hospital stay (3 RCTs): no difference (SMD -0.24; 95% CI -0.51 to 0.03)	
	Strong Consensus	

The assessment of the benefit of abdominal drainage after gastrectomy is based on a meta-analysis from 2020 that included a total of 3 RCTs with 330 patients and 7 cohort studies with 2,897 patients [153]. Seven of the published studies were conducted in Asia. The number of patients included in the 3 RCTs is small, but the quality of the individual studies is rated as high (Jadad scale). Due to the small number of cases, a subgroup analysis of different types of resection (gastrectomy, subtotal gastric resection) is not possible. In the meta-analysis, only two common outcomes from the individual trials can be examined, but these include clinically relevant postoperative morbidity. It should be noted that postoperative morbidity in the 7 included cohort studies was not different in the two groups. The risk of bias for individual studies is insufficiently reported in the meta-analysis.

The available evidence shows that abdominal drainage should not be performed after gastrectomy or subtotal gastric resection, as this procedure is associated with reduced postoperative morbidity. The length of hospital stay is not shorter in patients without abdominal drainage. No other outcomes are available to make an evidence-based recommendation.

From the patient's point of view, the omission of abdominal drainage after gastric resection is reasonable and desirable, because the absence of these invasive measures increases mobility in the early postoperative period, and because drains and their removal are often perceived as unpleasant.

6.1.3 Pancreas

6.5	Evidence-based Recommendation	2023
GoR **0**	After pancreatic resection, placement of an intra-abdominal drain **may** be considered.	
LoE ⊕⊕⊕⊖ ⊕⊕⊖⊖ ⊕⊕⊖⊖ ⊕⊖⊖⊖ ⊕⊕⊖⊖ ⊕⊕⊖⊖	[154] ⊕⊕⊕⊖: Postoperative morbidity (4 RCTs): no difference (RR 1.03; 95% CI 0.94 to 1.13) ⊕⊕⊖⊖: Postoperative 30-day mortality (4 RCTs): no difference (RR 0.78; 95% CI 0.31 to 1.99) ⊕⊕⊖⊖: Postoperative 90-day mortality (2 RCTs): lower with drainage (RR 0.23; 95% CI 0.06 to 0.90) ⊕⊖⊖⊖: Postoperative intra-abdominal infections (4 RCTs): no difference (RR 0.97; 95% CI 0.52 to 1.80) ⊕⊕⊖⊖: Postoperative wound infections (4 RCTs): no difference (RR 0.98; 95% CI 0.68 to 1.41) ⊕⊕⊖⊖: Length of hospital stay (4 RCTs): no difference (MD -0.14 days; 95% CI -0.79 to 0.51)	
	Strong Consensus	

The assessment of the benefit of abdominal drainage after pancreatic resection is based on a Cochrane analysis from 2021, which included a total of 4 RCTs (2002-2017) with 1,055 patients [154]. Postoperative morbidity/mortality was the primary outcome in all 4 RCTs. The certainty of the evidence (GRADE PRO) is moderate for the primary outcome of postoperative morbidity, because the level of evidence was downgraded in 3 of the 4 RCTs due to an incomplete data set (serious risk of bias). For all other outcomes assessed, the level of evidence is low. In 2 of the 4 RCTs, only pancreatic head or tail resections are included; the other 2 RCTs have mixed populations. A subgroup analysis of these two surgical procedures is not available.

With low overall confidence in the evidence, it has been shown that 90-day mortality is lower in patients treated with abdominal drainage after pancreatic head or tail resection. However, as all other relevant outcomes are unaffected by drain placement, a stronger recommendation for drainage is not justified. For all other primary and secondary outcomes studied (morbidity, 30-day mortality, postoperative intra-abdominal and wound infections, length of hospital stay), there was no difference between patients without an abdominal drainage and the control group with an abdominal drainage.

The results of this Cochrane review should be viewed critically, as no subgroup analyses were performed for pancreatic head resection with creation of a pancreatojejunostomy and pancreatic tail resection with blinded closure of the removed pancreas.

The rate of postoperative pancreatic fistula, and therefore morbidity, after these two surgical procedures is also dependent on the texture of the pancreas and the width of the pancreatic duct, which is not listed in the inclusion or exclusion criteria of the individual studies included. Therefore, in soft pancreas with a higher fistula rate,

abdominal drainage may be required to reduce the rate of postoperative interventional drainage.

6.6	Evidence-based Recommendation	2023
GoR **0**	After resection of the pancreatic head, a pancreatic duct drain with external drainage **may** be placed to prevent postoperative pancreatic fistula.	
LoE ⊕⊕⊕⊖ ⊕⊕⊕⊖ ⊕⊕⊕⊖	[154] ⊕⊕⊕⊖: Postoperative pancreatic fistula (7 RCTs): no difference (RR 0.85; 95% CI 0.57 to 1.26) ⊕⊕⊕⊖: Subgroup analysis pancreatic duct drainage with external drainage (4 RCTs): lower incidence after intervention (RR 0.61; 95% CI 0.43 to 0.86) ⊕⊕⊕⊖: Postoperative morbidity (7 RCTs): no difference (RR 0.79; 95% CI 0.37 to 1.66)	
	Strong Consensus	

The assessment of the benefit of intraductal pancreatic duct drainage after pancreatic head resection is based on a meta-analysis from 2022, which included a total of 7 RCTs (2006-2022) with 847 patients [155]. 3 of the 7 RCTs compared internal pancreatic duct drainage with no drainage, 4 RCTs compared pancreatic duct drainage with external drainage with no intervention.

The final recommendation used another meta-analysis from 2019 that directly compared pancreatic duct drainage after internal and external drainage [156]. This meta-analysis included 4 RCTs (individual studies published between 2008 and 2018) and 6 observational studies with a total of 2,101 patients. The RCT with the largest number of cases was published in 2016 with 328 randomised patients [157]. The overall heterogeneity of the studies can be considered low, as the incidence of postoperative pancreatic fistula (POPF) was selected as the primary endpoint in all RCTs and was defined according to the guidelines of the International Study Group on Pancreatic Fistula (ISGPF) in 10 out of 11 RCTS [158]. In addition, all RCTs included a pancreaticojejunostomy with a mucosa-to-duct anastomosis. The number of patients studied (>400) is considered adequate.

The available evidence shows that there is no difference between pancreatic duct drainage and no drainage for all outcomes studied, especially POPF, and therefore this intervention is not recommended per se. However, in the subgroup analysis, the insertion of a pancreatic stent drained externally through the abdominal wall was shown to reduce the incidence of POPF. The individual trials published on this topic are of sufficiently high quality.

However, the resulting recommendation for this subgroup is limited by the direct comparison between internal and external pancreatic drainage, which was examined in the 4 other RCTs in the second meta-analysis. No difference was found between these two types of drainage, neither in the incidence of clinically relevant POPF (OR 1.40; 95% CI 0.94 to 2.09), nor in the subgroup analysis of grade B (OR 1.34; 95% CI 0.81 to 2.21) and grade C fistulas (OR 1.68, 95% CI 0.22 to 12.87). In the largest RCT with 328 randomised patients, the rate of fistulas classified as clinically relevant was

even 5.5% higher after external drainage (external 24.4% vs. internal 18.9%), so the authors of this paper recommend internal stenting.

There are other clinical issues to consider when recommending pancreatic drainage with external diversion. The complexity of a pancreatic head resection (Whipple or Traverso procedure) is increased by the placement of a pancreatic stent with external drainage, and postoperative management is complicated by regular monitoring of the quality and quantity of secretions. Prolonged drainage of pancreatic enzymes can lead to gastrointestinal symptoms, including malabsorption on diet initiation, and removal of the drain poses a potential risk to the integrity of the anastomosis.

In conclusion, in the context of the available evidence and the clinical-practical aspects, it is justified to recommend the placement of an external pancreatic duct drain, especially in high-risk soft pancreas anastomoses, in order to avoid postoperative pancreatic fistulas.

6.7	Evidence-based Recommendation	2023
GoR **0**	After pancreatic resection, the abdominal drain **may** be removed in the early postoperative period (up to postoperative day 4) if the drainage secretion initially indicates a low risk of pancreatic fistula.	
LoE ⊕⊖⊖⊖ ⊕⊖⊖⊖ ⊕⊖⊖⊖ ⊕⊖⊖⊖ ⊕⊖⊖⊖ ⊕⊖⊖⊖	[154] ⊕⊖⊖⊖: Postoperative morbidity (2 RCTs): lower after early removal (RR 0.49; 95% CI 0.30 to 0.81) ⊕⊖⊖⊖: Postoperative 30-day mortality (3 RCTs): no effect (RR 0.99; 95% CI 0.06 to 15.45) ⊕⊖⊖⊖: Postoperative intra-abdominal infections (2 RCTs): lower after early removal (RR 0.44; 95% CI 0.22 to 0.89) ⊕⊖⊖⊖: Postoperative wound infections (2 RCTs): no difference (RR 1.32; 95% CI 0.45 to 3.85) ⊕⊖⊖⊖: Hospital length of stay (3 RCTs): lower after early removal (MD -2.2 days; 95% CI -3.52 to -0.87) ⊕⊖⊖⊖: Abdominal revision surgery (2 RCTs): no difference (RR 0.77; 95% CI 0.28 to 2.10)	
	Strong Consensus	

The assessment of the benefit of early removal of abdominal drainage after pancreatic resection (up to postoperative day 4) is based on a Cochrane analysis from 2021, which included a total of 3 RCTs (2010-2020) with 399 patients [154]. Another multicentre RCT published in 2022 with 312 randomised patients is also included in the review [159]. The selected inclusion criteria of these RCTs are not uniform, but in all studies they use drainage amylase in the early postoperative course as an indicator of a low risk of subsequent pancreatic fistula; in detail, these were either an amylase concentration in the drainage secretion below 5,000 U/L on the first postoperative day. These were either an amylase concentration in the drainage secretion below 5,000 U/L on postoperative day 1 or an amylase concentration in the drainage secretion below 5,000 U/L on postoperative day 1 and 3 and drainage volume below 5,000 U/L on postoperative day 3 [159]. Day 1 and 3 and drainage volume less than 300 ml/day [159], or amylase in the drainage secretion less than three times the serum concentration on Postop. Day 3 [161]. In all 4 RCTs, the primary endpoint examined was postoperative morbidity.

In the Cochrane analysis, the certainty of the evidence (GRADE PRO) was very low for all outcomes assessed. The downgrading was 1. due to an overall small number of patients analysed (<400) for the primary outcome morbidity, 2. due to substantial heterogeneity (I2=67%) and 3. due to a high risk of performance bias for all studies. In 2 of the 4 RCTs, only head or tail pancreatectomy was included; the other 2 RCTs had mixed populations.

Conclusion: The available data show that early removal of the abdominal drain reduces overall morbidity, the rate of intra-abdominal infections and the length of hospital stay. The other outcome parameters studied (30-day mortality, wound infection, abdominal revision surgery) were the same in both study groups. The RCT published in 2022 with 312 randomised patients shows that the rate of grade 2-4 complications (Clavien-Dindo classification) as primary endpoint was comparable in both groups (early removal 20.5% vs. late removal 26.3%, p=0.229). Length of hospital stay was shorter after early drain removal, but without clinical relevance for this endpoint (15 vs 16 days, p=0.01). Thus, it can be recommended to remove the abdominal drainage after pancreatic resection in the early postoperative period if the early postoperative drainage secretion indicates a low risk of subsequent pancreatic fistula.

Confidence in the evidence for this recommendation is limited by the heterogeneity of the populations studied (patients with head and tail pancreatectomy), different classifications of the primary endpoint, postoperative morbidity and the definition of early removal. In addition, clinically relevant, procedure-specific inclusion criteria (see above) and endpoints were defined differently. These are the risk of developing a post-operative pancreatic fistula (POPF) based on the tissue texture of the pancreas and the diameter of the pancreatic duct, and the classification of the post-operative pancreatic fistula (POPF) itself. Both factors are currently used to make the practical clinical decision to remove the drain and therefore influence the acceptance of this recommendation. It should be noted that definitions for both criteria have been developed in recent years by the International Study Group on Pancreatic Surgery (ISGPS), which are likely to reduce the heterogeneity of the populations to be studied in future studies [162], [163].

6.1.4 Liver

6.8	Evidence-based Recommendation	2023
GoR **A**	**No** prophylactic drainage **shall** be inserted for uncomplicated liver resections.	
LoE ⊕⊖⊖⊖ ⊕⊕⊕⊖ ⊕⊖⊖⊖ ⊕⊖⊖⊖ ⊕⊖⊖⊖ ⊕⊕⊖⊖	[164] ⊕⊖⊖⊖: Postoperative bile leak: more frequent with drainage (OR 2.32; 95% CI 1.18 to 4.55) ⊕⊕⊕⊖: Postoperative bleeding: no difference (OR 2.73; 95% CI 0.41 to 18.19) ⊕⊖⊖⊖: Secondary postoperative need for percutaneous drainage insertion: more frequent after intraoperative drainage insertion (OR 1.53; 95% CI 1.11 to 2.10) ⊕⊖⊖⊖: Wound infections: no difference (OR 1.14; 95% CI 0.52 to 2.50) ⊕⊖⊖⊖: Overall complications: increased after intraoperative drainage (OR 1.71; 95% CI 1.45 to 2.03) ⊕⊕⊖⊖: Length of hospital stay: prolonged with drainage (MD 1.01 days; 95% CI 0.47 to 1.56)	
	Strong Consensus	

6.9	Evidence-based Recommendation	2023
GoR **0**	A drain **may** be inserted for complex liver resections (with biliary and/or vascular reconstructions).	
LoE		
	Strong Consensus	

There is a recent meta-analysis from 2021[164] evaluating the benefit of prophylactic intra-abdominal drainage after liver resection, although the quality is somewhat limited. Three RCTs and five non-randomised studies with a total of 5,050 patients were included. The limited quality of the meta-analysis is partly due to an inadequate assessment of the risk of bias in the individual studies. In the group without prophylactic drains, there were benefits in terms of shorter hospital stay and lower rates of bile leakage, as well as a lower overall complication rate (GRADE: very low confidence in the effect estimates in each case). Patients in the prophylactic drain group were more likely to require re-drainage in the post-operative period, so there was no benefit from prophylactic drain placement for this endpoint either (GRADE: very low confidence in effect estimates). There was no difference in wound infections between the two groups (GRADE: very low confidence in effect estimates). It is unclear whether post-operative bleeding is more common with drainage; the evidence for this outcome is of moderate quality.

A recent randomized controlled trial from 2021 from Japan [165] with 400 included patients supports the omission of drain insertion in uncomplicated liver resections, as

both overall complications and bile leakage were increased in the drain group. The somewhat older Cochrane review from 2007 with five included RCTs and a total of 465 patients [166] also supports the drain-free procedure in uncomplicated liver resections, as no differences were found between the intervention and control groups.

In conclusion, despite the generally very low level of confidence in the evidence, there is a strong recommendation against prophylactic drain insertion in the context of uncomplicated liver resection, as none of the studies could demonstrate any benefit of drain insertion and drainage not only increases the overall complication rate, but is also perceived by patients as disruptive and stressful.

The situation is different for more complex liver resections with biliary and/or vascular reconstruction, which were not included in the studies cited above, or only in a very small number of cases, and for which no separate valid studies could be found. Because of the higher risk of intra-abdominal complications, particularly bile leakage, prophylactic drainage may be used in these cases.

6.1.5 Colon

6.10	Evidence-based Recommendation	2023
GoR **A**	Intra-abdominal drainage **shall not** be inserted for elective colorectal resections.	
LoE ⊕⊕⊕⊖ ⊕⊕⊕⊖ ⊕⊕⊕⊖ ⊕⊕⊕⊖ ⊕⊕⊕⊖	[167] ⊕⊕⊕⊖: Clinical anastomotic insufficiency: no difference (RR 1.40; 95% CI 0.45 to 4.40) ⊕⊕⊕⊖: Radiological anastomotic insufficiency: no difference (RR 0.85; 95% CI 0.39 to 1.83) ⊕⊕⊕⊖: Wound infection: no difference (RR 0.82; 95% CI 0.45 to 1.51) ⊕⊕⊕⊖: Reintervention: no difference (RR 1.11; 95% CI 0.67 to 1.82) ⊕⊕⊕⊖: Mortality: no difference (RR 0.77; 95% CI 0.41 to 1.45)	
	Strong Consensus	

To assess the benefit of prophylactic intra-abdominal drain placement after elective colorectal resection, a methodologically high-quality Cochrane review from 2004, updated in 2016 [167], is available with correspondingly high quality. Three RCTs with a total of 908 patients were included here.

On this basis, an evidence-based recommendation can be made regarding prophylactic intra-abdominal drain placement after elective colorectal resection.

In summary, there were no differences in the incidence of (clinical or radiological) anastomotic failure or wound infection, and no differences between the intervention and control groups in the need for re-intervention or mortality. According to GRADE, the level of confidence in the evidence is moderate for all outcomes. This Cochrane review also looked specifically at drainage for intraperitoneal anastomoses (two RCTs, 416 patients) as a subanalysis; again, there were no differences between the intervention and control groups in the outcomes studied. The Cochrane review does not include an analysis specifically for extraperitoneal drainage (e.g. in the context of deep rectal resection). Despite the high quality of this Cochrane review, one limitation is that the RCTs included are quite old (end of the 1980s to end of the 1990s), but the more recent meta-analyses are either of significantly lower quality or come to the same conclusion as the Cochrane review with lower quality [168], [169].

In the context of extraperitoneal drainage in patients undergoing deep rectal resections, an RCT from 2017 (GRECCAR 5 Randomized Trial, 469 patients [170]), also failed to demonstrate any advantages for prophylactic drain insertion in the setting of extraperitoneal anastomoses. A subsequent meta-analysis from 2018 [171], examined four RCTs involving 760 patients, focusing on drainage in patients with extraperitoneal anastomoses following rectal surgery. This analysis, too, failed to demonstrate any benefits from drain insertion, instead reporting an elevated risk of postoperative bowel obstruction in the intervention group. This slightly increased risk of postoperative bowel obstruction in patients with drainage is also described in the subgroup analysis of patients with extraperitoneal anastomoses in the meta-analysis by Podda (see above), but without reaching statistical significance.In summary, it can be concluded that prophylactic intra-abdominal drainage should be avoided in

elective colorectal resections. This recommendation extends beyond intraperitoneal anastomoses to include extraperitoneal anastomoses in rectal procedures, although the evidence supporting this approach is somewhat less robust.

6.1.6 Rectum (transanal)

6.11	Evidence-based Recommendation	2023
GoR **B**	Endoluminal (transanal) drainage **should not** be placed for deep anterior rectal resections.	
LoE ⊕⊕⊕⊖ ⊕⊕⊕⊕ ⊕⊕⊕⊕	[172], [173] ⊕⊕⊕⊖: Anastomotic insufficiency (2 RCTs): no effect (RR 0.65; 95% CI 0.29 to 1.46) ⊕⊕⊕⊕: Reoperations (1 RCT): fewer reoperations with transanal drainage (RR 0.12; 95% CI 0.03 to 0.53) ⊕⊕⊕⊕: Anastomotic bleeding (1 RCT): more bleeding with transanal drainage (RR 2.42; 95% CI 1.09 to 5.36)	
	Consensus	

The evaluation of the benefits of endoluminal (transanal) drainage is the subject of a meta-analysis by Chen [173], which is somewhat limited in terms of the quality of the studies included. The meta-analysis incorporated a randomised controlled trial (RCT) and ten cohort studies, encompassing a total of 2,432 patients. A more recent RCT from 2021[172], included a total of 560 patients.

In addition to the 2018 meta-analysis, which includes only one RCT but ten cohort studies, a current RCT from 2021 contradicts the results of the meta-analysis with regard to the endpoint anastomotic insufficiency. Consequently, a new meta-analysis was calculated from the only two existing RCTs [174], [172]. hese two RCTs, encompassing a total of 958 patients, were included for the outcome "anastomotic insufficiency"; no discrepancy was observed between the groups with regard to postoperative anastomotic insufficiency, and the evidence was deemed to have moderate reliability according to GRADE. With regard to the endpoints "reoperation" and "anastomotic bleeding", data are only available from the RCT by Xiao et al., which show fewer reoperations with transanal drainage, but a higher rate of perianastomotic bleeding, at least in the double-stapling technique subgroup in patients with transanal drains, whereby these bleedings did not require any further interventions. The RCT by Zhao (2021) merely states in the text that there were no bleeding complications or iatrogenic colonic perforations related to transanal drainage. According to GRADE, the confidence in the evidence is rated as high for the individual studies.

A limitation of both RCTs is that patients with preoperative radiotherapy or chemotherapy were excluded from the outset, meaning that this population cannot be fully compared with the usual patient population of patients with rectal cancer. Furthermore, the duration of transanal drainage in both RCTs is quite protracted at 3 and 5 to 7 days, respectively.

The meta-analysis by Chen (2018) [173] describes a lower rate of anastomotic insufficiency and a lower rate of revision surgery for patients with endoluminal drainage. According to GRADE, there is moderate confidence in each case. However, it is important to note that this meta-analysis is limited by the inclusion of only one RCT, while ten cohort studies were considered, which may compromise the overall quality of the analysis. With regard to anastomotic bleeding, there is at least a trend towards more bleeding in patients with endoluminal drainage. The underlying cause for this heightened occurrence of anastomotic bleeding may be attributed to the potential mechanical irritation of the anastomosis by the inserted drainage. However, the confidence in the effect estimates for this endpoint in this meta-analysis can only be rated as very low according to GRADE. With regard to mortality, Chen's meta-analysis shows no difference between the two groups and also only very low confidence in the effect estimates according to GRADE.

Another recent but methodologically inferior meta-analysis from 2020 [175], encompassing a total of 33 studies (predominantly observational), demonstrated a reduction in anastomotic insufficiency and reoperations for catheter-type transanal drains, while stent-type transanal drains exhibited no discernible benefit for patients. Another RCT demonstrated an advantage for the thicker catheter (32 Fr vs 24 Fr) with regard to the drainage effect and earlier defecation when comparing three different catheter-type drains [176]. A further RCT [177] on 157 patients, which was only published after the meta-analysis was completed, was also unable to demonstrate any influence of endoluminal transanal drainage on anastomotic insufficiency or overall morbidity.

In summary, the extant high-quality RCTs demonstrate no reduction in anastomotic insufficiency; this can only be seen in the meta-analyses, most of which included observational studies and can therefore be assessed as qualitatively inferior. The advantage of the lower rate of revision surgery described in the meta-analyses and also in Xiao's RCT is offset by a higher rate of anastomotic bleeding in the transanal drainage group. Furthermore, the insertion of a drain has the potential to cause irritation and discomfort to patients. In the RCT conducted by Zhao (2021), approximately half of the patients in the drainage group (46.4%) reported experiencing anal pain [172]. The two RCTs describe quite long durations of up to seven days for transanal drainage, which can lead to increased mechanical irritation in the anastomosis area and thus to bleeding and pain. Consequently, a shorter duration of these drains could presumably mitigate these adverse effects.

However, the current evidence base does not support the use of transanal drainage due to the potential adverse effects on anastomotic bleeding and pain. Consequently, endoluminal (transanal) drainage should not be employed following deep anterior rectal resections.

6.2 Intraoperative anastomosis testing

6.2.1 Esophageal resections

6.12	Consensus-based Recommendation	2023
EC	The vascularization of the gastric conduit as a reconstruction after esophagectomy **can** be checked intraoperatively by fluorescence angiography with indocyanine green dye.	
	Strong Consensus	

Following transthoracic esophagectomy, the reconstruction of the intestinal passage using a gastric tube with cervical or intrathoracic esophagogastrostomy is the surgical standard.It has been demonstrated that sufficient vascularization of the gastric tube is a decisive factor for undisturbed anastomotic healing. Intraoperative fluorescent angiography (FA) with the dye indocyanine green (ICG) allows for the visualisation of extragastric and intramural vascularization of the gastric tube. However, it is important to note that this procedure does not serve as a direct evaluation of the anastomosis' tightness. Rather, it should be regarded as an indirect method of assessing the risk of anastomotic insufficiency in the postoperative period.

A total of four systematic reviews and meta-analyses on the intraoperative ICG measurement of the gastric tube were published in 2019 and 2020. These analyses examined a range of eight to twenty-two individual studies from 2011 to 2018 [178], [179], [180], [181]. The included studies are exclusively retrospective or prospective observational in nature, with the absence of prospective randomized studies being a notable limitation.A salient finding of the meta-analyses is the considerable heterogeneity observed among the individual studies. These concerns relate to the technical systems utilised, the intraoperative assessment of adequate gastric perfusion, the subsequent intervention, and the postoperative definition of anastomotic insufficiency as the most frequently selected primary outcome parameter [178], [179], [180], [181]. The majority of individual studies fail to provide detailed information on these aspects.The published meta-analyses demonstrate, as a preliminary essential finding, that intraoperative ICG measurement is essentially a safe procedure. Furthermore, intraoperative visualization of the macro- and microcirculation using ICG has the potential to reduce the postoperative insufficiency rate of esophagogastrostomy by placing the anastomosis in a sufficiently vascularized area of the gastric tube. Slooter et al. [178] report that the use of ICG with a change in intraoperative management can reduce the pooled incidence of anastomotic insufficiency and interpositional necrosis (OR 0.30; 95% CI 0.14 to 0.63). Comparable results are documented by Van Daele et al. [179], who reported a lower insufficiency rate of 10% with ICG-guided anastomosis techniques compared to 20.5% in the control group ($p<0.001$). Ladak et al. [180] calculated a relative risk reduction of 69% for the event 'anastomotic insufficiency' with intraoperative use of ICG from six intervention studies.However, the value of intraoperative ICG measurement is currently limited by the lack of quantification of gastric perfusion. Consequently, individual studies are investigating the time interval from ICG application to perfusion of the anastomotic region in the interposition to determine cut-off values for the definition of sufficient perfusion and to correlate these with the occurrence of

anastomotic insufficiency or stricture [182]. However, a conclusive evaluation of the quantitative ICG measurement is not currently feasible.

6.2.2 Colorectal resections

6.2.2.1 Mechanical tightness

6.13	Consensus-based Recommendation	2023
EC	Following the creation of an anastomosis to the rectum (hand suture or stapler anastomosis), intraoperative checks for leaks **should** be conducted using the AirLeak test, methylene blue test, or endoscopy.	
	Strong Consensus	

A number of recent meta-analyses are available for the evaluation of the type and benefit of intraoperative anastomosis testing for leakage following colorectal resections with anastomosis to the rectum.

With regard to the intraoperative anastomosis testing, a distinction is made between testing the integrity of the anastomosis (e.g. AirLeak test, methylene blue, intraoperative endoscopy) and testing the vascularization of the anastomosis (ICG testing), whereby the tests can also be combined.

The AirLeak test is the most frequently used method to identify a mechanically insufficient anastomosis intraoperatively [183], [184], although the individual studies differ both in terms of how it is performed and the consequences derived in the event of a positive AirLeak test.

A systematic review by Nachappian et al. [183] demonstrated a lower incidence of anastomotic insufficiency in patients who underwent baseline testing for mechanical leakage (AirLeak test or methylene blue test) compared to those who did not undergo anastomotic testing. This finding was observed in the analysis of two randomised controlled trials (n=203; 5.8 vs 16.0%, p=0.024) and a larger cohort study (n=998; 4.1 vs 8.1%, p=0.03).

The meta-analysis by Wu et al. [184], which included 20 studies with a total of 5,283 patients, was able to confirm the aforementioned effect for the two RCTs mentioned above. However, it was unable to demonstrate any overall difference in terms of anastomotic insufficiency between patients with and without an intraoperative AirLeak test (OR 0.61; 95% CI 0.32 to 1.18). In the event of a positive AirLeak test, a greater incidence of anastomotic insufficiencies was observed postoperatively in comparison to the negative AirLeak test (OR 2.65; 95% CI 1.74 to 4.05). Consequently, the authors concluded that whilst the AirLeak test is recommended for the identification of high-risk anastomoses, the repair measures undertaken in the event of a positive test are evidently insufficient to prevent subsequent insufficiency.

There is also a meta-analysis by Rausa et al. [185] examines the different techniques of anastomosis testing in colorectal surgery. Notably, only a single RCT was incorporated into the analysis. The cohort studies, however, exhibited a moderate to significant bias in each instance. The meta-analysis demonstrated a lower risk of

anastomotic leakage in the ICG group compared to controls without testing (5 studies; n=1302; RR 0.44; 95% CI 0.14 to 0.87), but not for the AirLeak test (3 studies; n=1735; RR 0.53; 95% CI 0.21 to 1.30) or intraoperative endoscopy (3 studies; n=460; RR 0.49; 95% CI 0.10 to 1.80).

In summary, in order to identify high-risk anastomoses, it is imperative to perform a direct intraoperative check for leaks on a newly created anastomosis to the rectum. Depending on the hospital standard and the expertise of the surgeon, both the AirLeak test or methylene blue test and intraoperative endoscopy can be utilised for this purpose. The consequences of a positive test (additional sutures in the area of the anastomosis, resection, creation of a new anastomosis and/or creation of a protective stoma) must be left to individual surgical assessment due to a lack of evidence. With regard to ICG testing, please refer to the separate recommendation.

6.2.2.2 Perfusion control of the anastomosis

6.14	Consensus-based Recommendation	2023
EC	The perfusion of the anastomosis **shall** be checked after rectal and colonic resections.	
	Consensus	

6.15	Evidence-based Recommendation	2023
GoR **0**	Vascularization **can** be checked intraoperatively using fluorescein angiography with the dye indocyanine green (ICG).	
LoE ⊕⊕⊕⊖ ⊕⊖⊖⊖ ⊕⊖⊖⊖ ⊕⊖⊖⊖ ⊕⊖⊖⊖ ⊕⊖⊖⊖ ⊕⊖⊖⊖	[186] ⊕⊕⊕⊖: Anastomotic insufficiency: fewer anastomotic insufficiencies in the ICG group (overall collective RR 0.46; 95% CI 0.39 to 0.56 / RCTs only: RR 0.67; 95% CI 0.46 to 0.98) ⊕⊖⊖⊖: Wound infections: no effect (RR 0.72; 95% CI 0.47 to 1.09) ⊕⊖⊖⊖: Ileus: no effect (RR 0.90; 95% CI 0.67 to 1.23) ⊕⊖⊖⊖: Abdominal postoperative bleeding: no effect (RR 1.02; 95% CI 0.38 to 2.79) ⊕⊖⊖⊖: Intra-abdominal abscess: no effect (RR 0.83; 95% CI 0.36 to 1.92) ⊕⊖⊖⊖: Rate of reoperations: no effect (RR 0.73; 95% CI 0.47 to 1.12) ⊕⊖⊖⊖: Length of hospital stay: no effect (MD -0.39 days; 95% CI -0.84 to 0.05)	
	Consensus	

In addition to the verification of anastomosis tightness (see separate recommendation), there is a broad surgical consensus that the intraoperative checking of good perfusion on both sides of the anastomosis is also essential. In addition to visual inspection for pulsatile bleeding ("cold-steel test") and intraoperative second opinion, instrument-assisted procedures such as

photospectrometry, measurement of tissue oxygenation, and ICG fluorescence can be utilised for this purpose. However, sufficient studies for an evidence-based assessment are only available for the latter procedures.

A number of meta-analyses have been conducted in recent years to evaluate the benefits of intraoperative anastomosis testing with ICG in the context of colorectal tumour surgery. The most recent and largest study is that of Safiejko et al. from 2022 [186], which is of sufficient quality. The analysis encompassed three RCTs and 29 observational studies, collectively comprising a sample of 11,047 patients. This comprehensive evidence base facilitates the formulation of a robust and evidence-based recommendation. Intraoperative ICG testing has been shown to result in a lower rate of anastomotic insufficiency. The subgroup analysis of the three randomized controlled trials included also confirms this lower anastomotic insufficiency rate in the ICG group, although these three RCTs specifically examined anastomoses to the rectum. No statistically significant differences were observed between the intervention and control groups in the other endpoints examined, for which no separate analysis of the RCTs was performed (wound infections, ileus, abdominal postoperative bleeding, intra-abdominal abscesses, reoperations, and length of hospital stay).

The ICG test uses the fluorescent dye indocyanine green, whose absorption and fluorescence spectrum lies in the near-infrared range [187]. Indocyanine green is considered safe and is generally well tolerated [188], [189], [190], [191], but the risk of side effects is significantly increased in chronic renal insufficiency [192]. Allergic reactions or serious side effects to ICG have only been described in 0.05% of cases, mainly in patients with iodine allergy [190], [193]. A notable disadvantage of ICG testing is the subjective nature of the assessment of fluorescence intensity, and the lack of objective cut-off levels for interpretation. Nevertheless, there have been several proposals for ways to objectify ICG fluorescence [194], [195], with each of these utilising specialised software for quantification. Furthermore, the dosage of ICG also varies depending on the study: 0.2 to 0.25 mg/kg body weight or 5 to 10 mg.

In addition to the most recent meta-analysis by Safiejko, there are several other meta-analyses on intraoperative ICG testing from recent years. The most rigorous of these meta-analyses is that by Chan from 2020 [196], which also demonstrates a reduction in anastomotic insufficiency in the ICG group, and in particular in the high-risk subgroup of patients with deep anastomoses. The risk reduction observed in the ICG group is consistent in the analysis of the subgroup of prospective studies. The two meta-analyses by Lin (2021) [197] and Liu 2021 [198] also demonstrated a reduced incidence of anastomotic insufficiency following colorectal resection in the group of patients who underwent intraoperative ICG testing. These analyses also identified a lower rate of overall complications and reoperations in this group.

Consequently, the findings of this study indicate that ICG testing exerts a favourable and clinically significant effect in terms of reducing the incidence of postoperative anastomotic insufficiency. However, it must be mentioned that many of the individual studies included in the meta-analyses are industry-sponsored, so there is a potential bias here. Additional disadvantages include the substantial financial investment necessary for the acquisition of the requisite devices, in addition to the subjective nature of the assessment of fluorescence, attributable to the absence of objective cut-off levels. It is also important to emphasise that the evidence mentioned above relates to anastomoses to the rectum; the data situation for anastomoses to the colon (ileo-colonic or colo-colonic) is insufficient.

In summary, it is imperative to meticulously monitor the perfusion of a newly created anastomosis subsequent to rectal and colonic resections. Specifically, the use of fluorescence angiography with ICG has been recommended for this purpose.

The air leak test or intraoperative endoscopy can be used to assess anastomosis tightness; see separate recommendation.

7 Postoperative management

7.1 Postoperative use of gastric tubes

7.1.1 Esophageal resections

7.1	Consensus-based Recommendation	2023
EC	After transthoracic esophagectomy and gastric reconstruction, a double-lumen gastric tube **should** be inserted intraoperatively to decompress the raised stomach.	
	Strong Consensus	

7.2	Consensus-based Recommendation	2023
EC	The nasogastric tube **can** be removed in the early postoperative course within the first 48 hours.	
	Strong Consensus	

The assessment of nasogastric decompression of the elevated stomach post-transthoracic esophagectomy differs fundamentally from other abdominal surgical procedures, for which there is an increasing body of evidence supporting the omission of decompression. This discrepancy can be attributed to the bilateral truncal vagotomy performed in conjunction with esophagectomy, which results in delayed gastric conduit emptying (DGCE) in a significant proportion of patients postoperatively. Furthermore, esophagectomy necessitates the resection of the lower esophageal sphincter, which functions as a natural anti-reflux barrier. Two questions are of clinical interest. The first question pertains to the necessity of decompression of the elevated stomach postoperatively (esophagectomy/stomach pull-up with versus without nasogastric decompression). Secondly, the temporal aspect of the intraoperative insertion of the gastric tube during postoperative management is a pivotal consideration (early versus late removal). A total of five prospective randomized studies involving a total of 363 patients were published on both questions between 2006 and 2019 [199], [200], [201], [202], [203]. he first question was addressed in three of these studies and the second question in the two other studies. The first four published studies were summarised together with three comparative cohort studies in a systematic review/meta-analysis published in 2017 with a total of 608 patients [204]. In three of these seven studies, nasogastric decompression after esophagectomy was analysed as part of an mPOM protocol. The outcome parameters investigated in this SR/meta-analysis were pulmonary complications, anastomotic insufficiency and mortality [204].

The rate of pulmonary complications is of particular clinical interest. It is hypothesised that nasogastric decompression with delayed gastric emptying in the first postoperative days reduces the risk of aspiration pneumonia. However, a meta-

analysis of the four RCTs included found no evidence of an effect of nasogastric decompression on the overall rate of postoperative pneumonia [204]. A subsequent RCT, published in 2019, also failed to demonstrate a significant impact of nasogastric decompression on the incidence of postoperative pneumonia, with an occurrence of 21% in both study groups [203]. In this study, the gastric tube was removed on average after one day in the 'early' group and after seven days in the 'late' group. A notable finding was the increased frequency of tracheotomies in the 'late' group, which was attributed to a higher incidence of postoperative recurrent paresis following three-field lymphadenectomy. The authors conclude that early removal of the gastric tube is safely possible. The study by Shackcloth et al. utilised tracheal pH measurement to demonstrate that the amount of aspirated acid was lower with a double-lumen tube than with a single-lumen tube and that fewer cases of pneumonia occurred in these two groups than in patients without nasogastric decompression [199]. The largest randomized trial compared gastric tube removal after 2 days ('early' group) and 6-10 days ('late' group) in 75 patients each [201]. In this study, the primary endpoint ('major pulmonary complications') was comparable in both study groups. However, it was observed that due to delayed gastric emptying, up to 30% of the 'early' group patients required a re-insertion of a gastric tube in the subsequent postoperative period. These figures highlight the specific challenge posed by DGCE following gastric reconstruction. The question of whether this complication can be prevented or at least mitigated by prolonging the retention of the gastric tube remains unanswered, particularly given the diverse range of procedures employed to address pylorospasm, including pre- and post-operative endoscopic interventions employing balloon dilatation or Botox injection, and surgical pyloromytomy. In the growing corpus of published mPOM protocols, the practice of nasogastric decompression postoperatively has been eliminated entirely. In the SR cited above, this procedure is examined in two controlled observational studies and one RCT, without any conclusive treatment recommendations being derived from this [204].

7.1.2 Gastric resections

7.3	Evidence-based Recommendation	2023
GoR **A**	Following a gastrectomy or partial gastric resection, the intraoperatively inserted gastric tube **shall** be removed prior to the cessation of anaesthesia.	
LoE ⊕⊕⊕⊕ ⊕⊕⊕⊕ ⊕⊕⊕⊕ ⊕⊕⊕⊕ ⊕⊕⊕⊕ ⊕⊕⊕⊕	[205] ⊕⊕⊕⊕: Postoperative anastomotic insufficiency (8 RCTs): no effect (RR 1.25; 95% CI 0.68 to 2.27) ⊕⊕⊕⊕: Postoperative pulmonary complications (7 RCTs): no effect (RR 1.31; 95% CI 0.90 to 1.89) ⊕⊕⊕⊕: Postoperative morbidity (6 RCTs): no effect (RR 1.33; 95% CI 0.83 to 1.55) ⊕⊕⊕⊕: Postoperative mortality (8 RCTs): no effect (RR 1.27; 95% CI 0.34 to 4.78) ⊕⊕⊕⊕: Length of hospital stay (6 RCTs): longer hospital stay with placement of a transnasal tube (MD 0.48 days; 95% CI -0.01 to 0.98) ⊕⊕⊕⊕: Time to food intake (6 RCTs): shorter without placement of a transnasal tube (MD 0.45 days; 95% CI 0.29 to 0.61)	
	Strong Consensus	

The evaluation of the efficacy of the postoperative transnasal decompression tube following gastrectomy is informed by a meta-analysis conducted in 2015, which encompassed a total of eight RCTs involving 1,141 patients [205]. Of these studies, five were conducted in Asia. The risk of bias of the individual studies was systematically examined in the meta-analysis and assessed as sufficiently positive for an evidence-based guideline recommendation. A subsequent search was conducted from 2015 onwards, leading up to the creation of the guideline, but no additional RCTs were identified that could have been included in the meta-analysis.

The extant data demonstrate that the omission of decompression employing a transnasal tube following gastrectomy exerts no influence on the outcome parameters of anastomotic insufficiency, pulmonary complications, postoperative morbidity, and mortality. Although the length of hospital stay is reduced in patients who do not undergo transnasal decompression, the average difference of 0.49 days is not considered to be of clinical relevance. A similar observation can be made with regard to the endpoint of oral food intake, which commences earlier in patients without transnasal decompression. It is also noteworthy that the studies incorporated various forms of resection (e.g., gastrectomy and subtotal/distal gastric resection), leading to the implementation of distinct reconstruction methods. A further analysis of these smaller groups also shows no difference between the intervention and control groups for the primary endpoints. Consequently, as there is no clinical advantage to be gained from maintaining a transnasal endoluminal tube postoperatively, the intervention subsequent to gastrectomy and gastric resection, which patients perceive as subjectively stressful, should be avoided.

7.1.3 Pancreatic resections

7.4	Consensus-based Recommendation	2023
EC	After pancreatic head resection as a classic Whipple operation, the nasogastric tube **may** be removed at the end of the operation.	
	Strong Consensus	

A single randomised controlled trial (RCT) on the question of nasogastric decompression after pancreatic head or left pancreatic resection was published by a French working group in 2020 [206]. This single-centre study involved 111 patients who had undergone a pancreaticoduodenectomy (Whipple operation), and these patients were randomly allocated to either the intervention or the control group. The results of the study revealed that a gastric tube was placed in 52 patients following the completion of the reconstruction process, but was subsequently removed immediately after the conclusion of the operation. In 59 patients, a nasogastric tube was placed and removed after 3-5 postoperative days. The primary endpoint was the postoperative complication rate (Clavien-Dindo ≥ II). In demographically comparable groups, no postoperative differences were observed in terms of overall complications, pulmonary complications and gastric emptying. The authors conclude that the omission of a gastric tube is safe for this surgical procedure.

However, the authors also note that further research is required to draw firm conclusions regarding the safety of this approach in pancreatic head resections with pylorus preservation, reconstructions involving pancreato-gastrostomy, and pancreatic left resections. This is due to the current absence of sufficiently robust studies in this area.

7.1.4 Liver resections

7.5	Evidence-based Recommendation	2023
GoR **A**	For elective liver resections, an intraoperatively inserted gastric tube **shall** be removed prior to the cessation of anaesthesia.	
LoE ⊕⊕⊖⊖ ⊕⊕⊖⊖ ⊕⊕⊕⊖ ⊕⊕⊕⊕ ⊕⊕⊖⊖ ⊕⊕⊕⊕ ⊕⊕⊕⊖ ⊕⊕⊕⊕	[207] ⊕⊕⊖⊖: Postoperative nausea: no effect (OR 0.81; 95% CI 0.40 to 1.67) ⊕⊕⊖⊖: Vomiting postoperatively: no effect (OR 1.06; 95% CI 0.19 to 5.93) ⊕⊕⊕⊖: Abdominal distension: no effect (OR 0.87; 95% CI 0.60 to 1.25) ⊕⊕⊕⊕: Length of hospital stay: shorter hospital stay without feeding tube (MD -0.48 days; 95% CI -0.93 to -0.03) ⊕⊕⊖⊖: First flatus postoperatively: no effect (MD -0.34 days; 95% CI -0.86 to 0.18) ⊕⊕⊕⊕: First defecation: shorter time to first defecation without feeding tube (MD -0.95 days; 95% CI -0.79 to -0.39) ⊕⊕⊕⊖: Time to food build-up: shorter without feeding tube (MD -0.46 days; 95% CI -0.90 to -0.03) ⊕⊕⊕⊕: Repeated gastric tube insertion: more frequent in group without postoperative gastric tube (OR 6.88; 95% CI 1.77 to 26.72)	
	Strong Consensus	

A meta-analysis was conducted in 2019 to evaluate the benefits of postoperative nasogastric decompression following elective liver surgery [207]. This analysis incorporated seven RCTs, encompassing a total of 1,306 patients. Despite the meta-analysis exhibiting certain limitations in terms of quality, the risk of bias for each individual study was adequately addressed. The inclusion criteria were limited to randomised controlled individual studies, predominantly conducted in Asia. The meta-analysis evaluated the omission of a feeding tube as an intervention.

The results of the meta-analysis indicate that the omission of a feeding tube is associated with a reduced hospital stay and accelerated defecation in patients without a postoperative gastric tube (high certainty of evidence according to GRADE). Additionally, the time to resume eating is also shorter in patients without a gastric tube (moderate certainty of evidence). Conversely, in the cohort of patients who underwent nasogastric decompression following liver resection, there was an elevated risk of a postoperative requirement for a new gastric tube insertion (high confidence in the evidence). With regard to postoperative nausea and vomiting, abdominal distension and time to first postoperative flatus, there were no relevant differences between the groups, with only low or moderate confidence in the GRADE effect estimates.

Consequently, the utilisation of gastric tubes during hepatic resections is not associated with any discernible benefits. Moreover, the majority of patients report a high degree of discomfort associated with the presence of a gastric tube. Consequently, it is generally considered prudent to not leave a gastric tube in situ postoperatively following liver resection. In instances where gastrointestinal transit is delayed, and the patient is experiencing symptoms such as nausea and vomiting, the insertion of a nasogastric tube can be considered as a secondary measure for the purpose of nasogastric decompression.

7.1.5 Colorectal resections

7.6	Consensus-based Recommendation	2023
EC	In the case of elective colorectal surgery, a nasogastric tube **shall** be removed prior to the cessation of anaesthesia.	
	Strong Consensus	

For the assessment of the benefit of postoperative nasogastric decompression after colorectal surgery, the most recent meta-analysis is from 2011 [208], as well as a Cochrane Review from 2007 and 2010 [209], However, both of these are of limited quality according to the AMSTAR II criteria. Additionally, there are RCTs from 2011 and 2015.

The 2011 meta-analysis by Rao (seven studies, 1,416 patients) found that routine nasogastric decompression in colorectal surgery did not shorten the time to re-establishment of a sufficient gastrointestinal passage despite less postoperative vomiting. However, it did increase the rate of pharyngolaryngitis and respiratory infections, and therefore routine gastric tube insertion is not recommended for these patients [208]. The Cochrane Review also argues against the routine insertion of a gastric tube in the context of colorectal surgery, as there is no advantage in terms of pulmonary complications or the occurrence of anastomotic insufficiency, and the onset of gastrointestinal transit is faster in the control group without a gastric tube) [209]. The most recent available RCT from 2015 (100 patients) also shows no benefit for the routine insertion of a gastric tube [210]. The same applies to the older RCT from 2011, which also shows a better outcome with regard to elective rectal resection in terms of postoperative food intake and length of hospital stay in the control group without a gastric tube [211].

7.2 Leaving the bladder catheter in place beyond the intraoperative phase

7.7	Consensus-based Recommendation	2023
EC	The transurethral indwelling catheter **shall** be removed within the first 24 hours after colorectal resection. In the presence of risk factors for urinary retention, such as male gender, deep anterior rectal resection, or rectal extirpation, the drainage can be extended until the third postoperative day.	
	Strong Consensus	

7.8	Consensus-based Statement	2023
EC	It is not possible to make a recommendation on urinary diversion management in non-colorectal resections or on the placement of a suprapubic urinary diversion due to an absence of sufficient evidence.	
	Strong Consensus	

The perioperative insertion of an indwelling transurethral catheter is the surgical standard for colorectal resections. Urinary diversion is performed to prevent excessive bladder filling during prolonged surgery and to monitor renal function and intraoperative fluid management. The duration of postoperative indwelling catheter drainage has been shown to correlate with the risk of urinary tract infection and to hinder mobilisation as part of multimodal perioperative treatment concepts.

The two systematic reviews and meta-analyses ([212], [213]) analyze six individual studies with a total of 951 patients between January 1980 and February 2019 on the question of the optimal timing of postoperative catheter removal in relation to the rate of postoperative urinary tract infections and urinary retention after catheter removal. Both meta-analyses consistently showed that early removal of the transurethral indwelling catheter (POD 1 - POD 3) reduces the rate of postoperative urinary tract infections. Castelo M. et al [212] were unable to demonstrate any influence of the time of catheter removal on the rate of urinary retention, whereas Lee Y. et al [213] were able to show that late removal of the indwelling catheter (POD 5) is associated with a higher rate of urinary retention in contrast to removal by postoperative day 3.

The prospective observational study by Okraniec et al. [214] included 2,927 patients, of whom 1,897 (64.9%) underwent a large or small bowel resection and 1,030 (44%) a rectal resection. The study found that early removal of the indwelling catheter was associated with a reduction in the risk of urinary tract infection and a reduction in the length of hospital stay. The authors recommend early removal of the indwelling catheter within 24 hours postoperatively for colon resections and within 72 hours for

deep anterior rectal resections with an anastomosis <6 cm or abdominoperineal resection.

The question of whether an epidural analgesia catheter is a risk factor for postoperative urinary retention is answered differently in the literature. Coyle D. et al. [215] demonstrated in their prospective randomized single-center study (n=44) that male patients who underwent rectal resection and epidural analgesia exhibited an elevated risk of postoperative urinary retention, while Zaouter C. et al. [216] demonstrated in their prospective randomized study of 215 patients that early removal of the indwelling catheter is associated with a reduction in urinary tract infections, irrespective of the use of epidural analgesia, without increasing the rate of re-insertions (see the recommendations on postoperative pain therapy in this guideline).

n the context of the debate surrounding transurethral versus suprapubic urinary diversion, Kidd et al. [217] conducted a comprehensive Cochrane review, encompassing a total of 25 studies. Patients who underwent transurethral urinary diversion exhibited a higher prevalence of asymptomatic bacteriuria and reported experiencing more pain during a shorter duration of catheterisation. The evidence base is considered to be of low quality due to the significant heterogeneity of the data, which has resulted in a lack of confidence in the findings. Consequently, the value of perioperative suprapubic urinary diversion in colorectal resections remains unanswered.

7.3 Postoperative pain therapy

The generation of PICO questions has enabled this guideline to address specific topics in the context of perioperative management of gastrointestinal tumours. This also applies to the special aspects of perioperative pain therapy in connection with these operations. For aspects of perioperative pain therapy that are already mentioned in detail in the AWMF-S3 guideline on treatment of acute perioperative and post-traumatic pain, readers are referred to the recommendations of said guideline.

7.3.1 Systemic pain therapy versus epidural analgesia

7.9	Evidence-based Recommendation	2023
GoR **B**	Continuous epidural analgesia **should** be used intra- and postoperatively for perioperative analgesia in open visceral surgical oncological procedures.	
LoE ⊕⊕⊖⊖ ⊕⊕⊖⊖ ⊕⊖⊖⊖ ⊕⊖⊖⊖ ⊕⊕⊖⊖ ⊕⊖⊖⊖	[218], [219], [220], [221], [222], [223], [224], [225], [226], [227], [228], [229] ⊕⊕⊖⊖: Pain intensity at rest 24 hours after surgery: reduced pain at rest due to epidural anesthesia (MD 1.05; 95% CI -1.35 to -0.75) ⊕⊕⊖⊖: Pain intensity during exercise 24 hours after surgery: exercise pain possibly reduced by epidural anesthesia (MD -1.83; 95% CI -2.34 to -1.33) ⊕⊖⊖⊖: Postoperative ileus: no effect (RR 1.23; 95% CI -0.31 to 4.81) ⊕⊖⊖⊖: EA-associated adverse events: the risk of EA-associated adverse events was possibly increased in the EA group (RR 4.54; 95% CI 0.23 to 89.62) (SA: 0 to 0 vs EA: 0.54 to 37.99) ⊕⊕⊖⊖: Pain intensity during exertion 24 hours after surgery: exertional pain reduced by epidural anesthesia (MD -1.68; 95% CI -2.22 to -1.14) ⊕⊖⊖⊖: Nausea and vomiting: no effect (RR 0.72; 95% CI 0.47 to 1.09)	
	Consensus	

7.10	Consensus-based Recommendation	2023
EC	Epidural analgesia **can** be used in MIS procedures if its use promises success due to risk constellations (long operating times, expected high postoperative opioid consumption).	
	Consensus	

A total of 25 randomised controlled trials (RCTs) were included in the evidence-based analysis of this question. The studies were found to be highly heterogeneous with regard to the type of oncological visceral surgery and the surgical approach (open versus minimally invasive) (studies: Four studies focused on esophageal surgery, seven on stomach surgery, one on esophageal-gastric surgery, two on colon surgery, one on rectal surgery, eight on colorectal surgery, and two on mixed gastrointestinal surgery. Notably, all studies were consistent in that they exclusively included operations due to oncological diagnoses.

In comparison with systemic pain therapy, the utilisation of perioperative EA resulted in a decrease in exertional pain of -2.52 points on a scale ranging from 1 to 10; 95% CI -3.92 to 0.99, 2 hours following surgery, as well as -1.83 points on a scale of 1 to 10; 95% CI -2.34 to -1.33 24 hours after surgery, and -1.7 points on a scale of 1 to 10 48 hours following surgery. The clinical relevance of these effects is well-established [230]. This assertion is further substantiated by the observation that the utilisation of an EA results in a substantial reduction in pain levels at rest two hours following surgery, as evidenced by a decrease of -2.45 on a scale ranging from 1 to 10 (95% CI: -3.92 to -0.99). Moreover, a comparable decline of -1.05 on the same scale (95% CI: -1.35 to -0.75) is noted 24 hours post-surgery.

Opioid consumption is significantly reduced by the use of an EA (oral morphine equivalent dose in the first 24 hours after surgery with a saving of MD -99.46mg; 95% CI -111.90 to -87.01). However, the evidence regarding the reduction of pain intensity was of low to very low quality, which contributed to the weakening of the recommendation to a should recommendation. Opioid sparing has been demonstrated to result in a reduction in opioid-related side effects, including sedation (RR 0.49; 95% CI 0.26 to 0.94) and nausea (RR 0.53; 95% CI 0.14 to 2.03). 15; 95% CI 0.33 to 14.11), respiratory depression (RR 0.79; 95% CI 0.16 to 3.96), dizziness (RR 0.48; 95% CI 0.21 to 1.08) and delirium (RR 0.31; 95% CI 0.04 to 2.54) were comparable in the groups. Patients without EA have been shown to experience reduced itching (RR 2.70; 95% CI 1.11 to 6.52) and a lower risk of hypotension (RR 2.21; 95% CI 0.37 to 13.05) and urinary retention (RR 2.85; 95% CI 0.66 to 12.38) in comparison to patients with EA. These side effects can be attributed to the intervention. However, the paucity of evidence precludes any definitive conclusion regarding the potential impact of epidural anaesthesia on the incidence of blockade-associated adverse effects.

The risk of postoperative ileus was comparably low in both groups and could not be further reduced by EA (RR 1.23; 95% CI -0.31 to 4.81). The risk of anastomotic insufficiency was reduced in the group of patients who received EA (RR 0.20; 95% CI 0.09 to 0.92), while the rate of wound infections remained unchanged (RR 1.08; 95% CI 0.35 to 3.33; number of studies: 6). The length of hospitalisation can be reduced by almost two days through the use of EA (RR 1.80; 95% CI -2.77 to -0.83).

The risks associated with EA are counterbalanced by its numerous benefits, including its analgesic effect and its capacity to reduce morbidity and mortality. For instance, when utilising a thoracic EA, a consensus has been reached that epidural catheter placement can reduce postoperative pulmonary, cardiac and gastrointestinal morbidity (e. g. reduction of atelectasis, pneumonia, cardiac arrhythmia) [231], so that epidural catheter placement is also recommended in the current S3 guideline on treatment of acute perioperative and post-traumatic pain as the procedure of first choice for various operations (open colon surgery, thoracotomies). The updated S3 guideline on treatment of acute perioperative and post-traumatic pain also dealt with the assessment of the risk-benefit assessment of EA. The following recommendation is made with recommendation grade GoR A (highest recommendation grade): "In patients who have to undergo certain procedures, a lower mortality risk from the procedure shall also be included in the risk-benefit assessment for the choice of a neuraxial procedure".

From the perspective that EA has the potential to enhance the perioperative immune response, a Danish retrospective registry analysis investigated the impact of EA on the oncological outcome following colorectal surgery for malignancy. However, the

study revealed no correlation between the endpoint "recurrence" and the analgesia procedure [232].

In summary, these results confirm the beneficial effect of EA compared to systemic analgesia in other operations and support the use of EA in patients undergoing open oncologic-visceral surgery. The principal benefits identified in the meta-analysis conducted here are improved analgesia, reduced opioid consumption, and earlier discharge from hospital. The findings of the present meta-analysis demonstrate that EA is superior to systemic analgesia with regard to pain reduction, albeit with low confidence in the evidence.

It is imperative to emphasise that perioperative pain therapy should be administered in accordance with a balanced treatment concept. In this regard, we make reference to the general recommendations of the AWMF S3 guideline on treatment of acute perioperative and post-traumatic pain. This guideline advocates, inter alia, the administration of non-opioid analgesics as part of a balanced analgesia regime. It is important to note that these and other general recommendations in this guideline also apply to the treatment of patients following oncological visceral surgery.

Research question

In view of the substandard quality and elevated heterogeneity of the studies, there is ample scope for enhancement. The necessity for further randomised controlled trials is evident, with the objective of elucidating whether specific recommendations need to be made for certain visceral surgical procedures, particularly according to the type of surgery and surgical approach (open vs minimally invasive).

7.3.2 Epidural analgesia versus peripheral regional analgesia procedures

7.11	Evidence-based Statement	2023
LoE ⊕⊕⊖⊖ ⊕⊕⊖⊖ ⊕⊖⊖⊖ ⊕⊖⊖⊖	Compared to peripheral regional analgesia procedures, epidural analgesia is superior for visceral surgery and oncological procedures - not stratified according to organ systems and independent of the surgical approach.	
	[233], [234], [235], [236], [237], [238], [239], [240], [241] ⊕⊕⊖⊖: Pain intensity at rest 24 hours after surgery: no effect (MD -0.74 on a scale of 0 to 10; 95% CI -1.42 to -0.05) ⊕⊕⊖⊖: Pain intensity during exercise 24 hours after surgery: EA leads to a clinically relevant reduction in pain intensity compared to PRA (MD -1.07 on a scale of 0 to 10; 95% CI -1.78 to -0.35) ⊕⊖⊖⊖: Procedure-specific adverse events: there is probably no difference with regard to procedure-specific AEs. (RR 4.08; CI 0.48 to 34.81; number of studies: 3) ⊕⊖⊖⊖: Postoperative ileus: no effect (EA: 71 per 1,000; PRA: 71 per 1,000; RR 1.00; 95% CI 0.07 to 14.45)	
	Consensus	

In accordance with the stipulated guideline, an examination was conducted of the evidence-based question of whether there are differences between EA and PRA in the context of oncological visceral surgery that justify differentiated use. A new meta-analysis was conducted to address this PICO question, incorporating a total of nine studies. The studies included in the meta-analysis were found to be highly heterogeneous with regard to the type of visceral surgery (studies: 1x esophagus, 1x lung, 1x stomach, 1x liver, 2x mixed gastrointestinal, 3x colorectum); however, they exclusively included operations due to oncological diagnoses. The studies also differed with regard to the type of PRA. Specifically, one study involved a TAP block, four studies focused on wound infiltration, one study examined an intercostal block, and one study investigated a paravertebral block.

The heterogeneity of the measures included is considerable, as the number of studies available for individual procedures was insufficient. Consequently, direct comparisons of individual PRAs as part of the meta-analysis were not possible. This situation resulted in a downgrading of the quality of the evidence, which is a primary factor contributing to the low to very low confidence levels observed in the evidence.

In comparison to a PRA, an EA has been demonstrated to result in a clinically significant enhancement in the primary outcome, "pain intensity during exercise 24 hours after surgery". The evaluation of the four relevant studies was associated with a reduction in pain intensity of -1.07 (on a scale of 0-10; 95% CI -1.78 to -0.35). This clinically significant effect [230] was also observed in the comparison made here 48 hours after the operation (MD -1.04 on a scale of 0-10; 95% CI -1.59 to -0.50). The meta-analysis of the seven studies for the primary outcome "pain intensity at rest 24 hours after surgery" showed no differences between EA and PRA with a value of -0.74 (on a scale of 0-10; 95% CI -1.42 to -0.05).

The primary outcome, "number of patients with procedure-specific adverse events", was examined in three of the included studies, while the primary outcome, "number of patients with postoperative ileus", was examined in only one of the included studies. The data examined were not associated with any difference between the two procedures examined for either parameter. However, the fact that these studies were subject to significant concerns regarding risk of bias, inconsistency of results and publication bias is problematic in this context, resulting in an ongoing uncertainty regarding the proven effect. With regard to the outcome parameters "number of patients with pruritus" and "number of patients with hypotension", a clinically relevant increased risk for pruritus was identified in three studies (RR 5.66; 95% CI 1.03 to 30.99) and for hypotension in four studies (RR 3.11; 95% CI 1.57 to 6.14) in the EA group compared to the PRA group. No significant differences were observed in the secondary outcome parameters "number of patients with nausea" and "number of patients with nausea and vomiting".

With regard to the secondary outcome parameters "opioid consumption on the 1st and 2nd day after surgery" (two studies), no differences were found. There were no differences between EA and PRA in the secondary outcome parameters "Opioid consumption on the first and second day after surgery" (2 studies), "Time to first flatus" (2 studies), "Postoperative vomiting" (1 study), "Postoperative respiratory depression" (1 study), "Postoperative sedation" (1 study), "Postoperative dizziness" (1 study), "Anastomotic insufficiency" (2 studies), "Wound infection" (1 study), "Hospitalization" (MD 0. The median duration of the follow-up period was 93 days, with a confidence interval ranging from 0.17 to 1.70, and the analysis incorporated data from four studies.

In summary, the data collected demonstrated a clear advantage for the utilisation of an EA in oncological visceral surgery, with respect to pain on exertion for a minimum of 48 hours following surgery. However, it should be noted that the results of the "de novo" literature search do not allow for the calculation of a subgroup analysis according to organ system or surgical approach in the meta-analysis. Consequently, it is not feasible to propose specific recommendations for action for this PICO question. Consequently, it was decided to present the evidence in the form of an evidence-based statement, while refraining from formulating any recommendations.

As thoracic EA can reduce morbidity and mortality when a wide range of organ areas are considered in summary [231], this should also be taken into account when deciding for or against EA (see also 2 other S3 guidelines: 001-025 and 001-012). In the subgroup "abdominal surgery", there is a possible benefit for the use of EA with an OR of 0.73 with regard to mortality, although the confidence in the effect is low due to the high confidence interval (95% CI; 0.35 to 1.52) [231].

Research question

In view of the substandard quality and elevated heterogeneity of the extant studies, there is considerable scope for enhancement. Further studies are required to elucidate whether continuous PRA enhances the quality of analgesia and whether specific recommendations need to be formulated for particular visceral surgical procedures.

7.3.2.1 Minimally invasive colorectal surgery

7.12	Evidence-based Recommendation	2023
GoR **0**	For minimally invasive colon resections or (deep) anterior rectal resections, a TAP block (transversus abdominis plane block) **can** be used as an alternative to EA for perioperative analgesia.	
LoE ⊕⊕⊕⊖ ⊕⊕⊕⊖ ⊕⊕⊕⊖ ⊕⊖⊖⊖ ⊕⊕⊕⊖ ⊕⊕⊖⊖ ⊕⊕⊕⊖ ⊕⊕⊕⊖ ⊕⊕⊕⊖	[242], [243], [244], [245], [246] ⊕⊕⊕⊖: Pain at rest 24 hours postoperatively: no clinically relevant effect (VAS 1-10: MD 0.22; 95% CI 0.03 to 0.4) ⊕⊕⊕⊖: Pain on movement 24 hours postoperatively: no clinically relevant effect (VAS 1-10: MD 0.33; 95% CI 0.11 to 0.55) ⊕⊕⊕⊖: Pain during movement 48 hours postoperatively: no clinically relevant effect (VAS 1-10: MD 0.2; 95% CI 0.05 to 0.35) ⊕⊖⊖⊖: Opiate use within 48 hours postoperatively: no effect (VAS 1-10: MD 3.43; 95% CI -1.88 to 8.74) ⊕⊕⊕⊖: PONV incidence: reduced by TAP block (RR 0.40; 95% CI 0.21 to 0.73) ⊕⊕⊖⊖: Postoperative retention of the urinary catheter: with TAP blockade, earlier removal of the urinary catheter (MD -14.27 hours; 95% CI -21.66 to -6.87) ⊕⊕⊕⊖: Length of hospital stay: no effect (MD 0.4 days; 95% CI -0.96 to 1.75) ⊕⊕⊕⊖: Sensory disturbances: significant risk reduction with TAP block (RR 0.05; 95% CI 0.01 to 0.28) ⊕⊕⊕⊖: Postoperative hypotension after 48 hours: significant risk reduction with TAP block (RR 0.14; 95% CI 0.03 to 0.58)	
	Consensus	

Thoracic epidural analgesia is frequently employed in visceral surgery due to its favourable analgesic effect, with the potential to reduce opioid dosages and to prevent postoperative ileus through sympathicolysis, despite the recognised risks and side effects (e.g. hypotension or sensory disturbances) (see Chapter 7.3.1). The reduced surgical trauma associated with minimally invasive procedures leads to less pain and thus to a lower need for analgesics and a reduction in POI.

Consequently, alternative procedures, such as a peripheral nerve block, could be considered as potential alternatives. One procedure that is already being used in practice is the transversus abdominis plane (TAP) block. This technique involves the injection of a local anaesthetic agent beneath ultrasound guidance or during laparoscopy, between the internal oblique muscle and the transversus abdominis muscle, resulting in a peripheral nerve block of the anterolateral abdominal wall. This can be performed as a single injection or as a continuous infusion via the insertion of a pain catheter.

A high-quality systematic review compared the effect of perioperative analgesia using a TAP block versus thoracic epidural analgesia (EA) in laparoscopic colorectal resections in a subgroup analysis [242]. An update search could not identify any further RCTs on this question, so the evidence on this question is based on the meta-analysis of 4 RCTs [243], [245], [246], [240]. In all 4 studies, both a single injection and continuous local anesthesia application over 48 hours postoperatively were performed. In two of the studies, the TAP block was placed preoperatively [243], [245] and in the other two postoperatively [240], [246]. In all studies, EA was started immediately preoperatively and continued postoperatively.

The analgesic effect was defined as a clinically relevant difference of one point on a pain scale of 1 to 10. The results of the meta-analysis demonstrated a small effect in favour of EA both at rest and during movement after 24 and 48 hours, although this was not deemed to be clinically relevant [242]. Consequently, a TAP blockade with continuous infusion of a local anaesthetic for 48 hours postoperatively has been shown to have a clinically equivalent analgesic effect to EA. Furthermore, no significant disparities were observed in the effectiveness of these two analgesic procedures with respect to the additional opioid requirement within 48 hours postoperatively and the duration of hospital stay [242].
The TAP blockade has been demonstrated to offer several advantages over other treatment options, including a reduced duration of bladder catheterisation, a decreased time to ambulation (mean difference [MD] -3.33 hours; 95% confidence interval [CI] -5.32 to -1.35), an earlier occurrence of the first flatus (MD -2.72 hours; 95% CI -5.01 to -0.43), and a lower incidence of postoperative nausea and vomiting (PONV). With regard to possible side effects, the TAP block is also superior to EA; no block-specific complications were mentioned in the included RCTs, whereas EA was associated with an increased incidence of sensory disturbances and hypotension.

In view of the equivalent analgesic effect and the significant reduction in EA-associated side effects, a TAP blockade with continuous application of a local anaesthetic can therefore be used for minimally invasive colorectal procedures (exception: rectal extirpations).

Research question

The efficacy and safety of peripheral nerve blocks, such as the TAP block, in minimally invasive gastrointestinal tumour surgery have not been sufficiently

investigated. Apart from colorectal surgery, no high-quality studies could be found. Consequently, the necessity for well-designed, randomised controlled trials that directly compare the efficacy of abdominal blocks with epidural or peridural analgesia in minimally invasive upper gastrointestinal and hepatopancreatic surgery is paramount.

7.3.3 Systemic pain therapy versus peripheral regional analgesia procedures

7.13	Evidence-based Recommendation	2023
GoR **0**	A peripheral regional analgesia procedure **can** be used for perioperative analgesia in oncological visceral surgery.	
LoE ⊕⊕⊕⊖ ⊕⊕⊕⊖ -	[247], [248], [249], [250], [251], [252], [253], [254], [255], [256], [257], [258], [259], [260], [261], [262], [263], [264], [239], [244], [265], [266], [241], [267], [268], [269] ⊕⊕⊕⊖: Pain intensity at rest 24 hours after surgery: no clinically relevant effect (MD -0.75 on a scale of 1 to 10; 95% CI; -1.20 to -0.31; number of studies: 24) ⊕⊕⊕⊖: Pain intensity during exercise 24 hours after surgery: no clinically relevant effect (MD -0.93 on a scale of 1-10; 95% CI -1.34 to -0.53; number of studies: 17) -: "Critical endpoints" for which no data were available: mortality, cardiac complications, delirium, GI-II criteria	
	Strong Consensus	

A new meta-analysis was conducted in order to address this PICO question; the study incorporated a total of 26 studies. The studies included in the analysis were found to be highly heterogeneous with regard to the type of oncological visceral surgery (studies: Six studies focused on esophageal surgery, four on stomach surgery, three on colon surgery, one on rectal surgery, nine on colorectal surgery, and four on liver surgery. Notably, all studies were consistent in their inclusion criteria, namely that the operations were solely those performed due to oncological diagnoses. The interventions employed included intercostal nerve blocks (3 studies), transversus abdominis plane (TAP) block (14 studies), wound infusion (3 studies), paravertebral block (5 studies), erectus spinae plane (ESP) block (1 study), and quadratus lumborum muscle block (1 study).

The present study investigates the impact of perioperative PRA on post-surgical pain. The results demonstrate that PRA leads to a non-clinically relevant reduction in rest and exertional pain 24 hours and 48 hours after surgery (at rest: MD -0.36; 95% CI -0.66 to -0.06; number of studies: 19; during exertion: MD -0.78; 95% CI -1.22 to -0.33; number of studies: 14) in the context of oncological visceral surgery compared to systemic, opioid-based analgesia. When the studies were analysed separately for laparoscopic versus open surgery, the risk of pain on exertion 24 hours after surgery can be clinically relevantly reduced by a PRA for open surgery (MD -1.04; 95% CI -1.73 to -0.36; number of studies: 7), but not for laparoscopic oncologic-visceral surgery (MD -0.83; 95% CI -1.41 to -0.25; number of studies: 9). However, during rest periods, PRA has been observed to reduce pain for both open (MD -0.78; 95% CI -1.50 to -0.05; number of studies: 11) and laparoscopic surgery (MD -0.72; 95% CI -1.35 to -0.09; number of studies: 11). Nonetheless, these findings cannot be classified as

clinically relevant. However, a clinically relevant effect on pain intensity at rest and during exercise was observed only 2 hours after surgery (secondary endpoint) (pain at rest: MD -1.87; 95% CI -2.44 to -1.29). MD -1.79; 95% CI -2.24 to 1.34).

Opioid consumption (oral morphine equivalent) was reduced by the use of a PRA in the first 24 hours after surgery (MD -36.83; 95% CI -46.10 to -27.56). Consequently, this results in a reduction in opioid-related side effects post-surgery, including nausea (RR 0.55; 95% CI 0.40 to 0.76), vomiting (RR 0.55; 95% CI 0.32 to 0.97), nausea and vomiting (RR 0.52; 95% CI 0.33 to 0.83) and sedation (RR 0.68; 95% CI 0.48 to 0.95). The utilisation of a PRA does not impact the following opioid-related adverse effects: Respiratory depression (RR 0.14; 95% CI 0.02 to 1.11), pruritus (RR 0.44; 95% CI 0.17 to 1.10), hypotension (RR 1.00; 95% CI 0.11 to 9.30), urinary retention (RR 1.34; 95% CI 0.32 to 5.62) and dizziness (RR 0.65; 95% CI 0.36 to 1.18).

The incidence of postoperative ileus was comparable in both groups (SA: 76 per 1,000; PRA: 87 per 1,000; RR 1.14; 95% CI 0.44 to 2.94). However, the confidence intervals were found to be wide, and only four studies reported on this endpoint. The time to first flatus was found to be reduced by a PRA (RR 0.28; 95% CI 0.09 to 0.86), but not the time to first defecation (MD 8.06 hours; 95% CI -26.84 to 10.72). The length of hospital stay can be reduced by approximately half a day with the use of a PRA, although this is not deemed to be of clinical significance (MD -0.62 days; 95% CI -0.99 to -0.25).

With regard to pneumonia rate (RR 0.28; 95% CI 0.09 to 0.86; number of studies: 2) and incidence of wound infections (RR 0.46; 95% CI 0.17 to 1.29; number of studies: 4), the PRA leads to a reduction compared to systemic analgesia.

In summary, the results provide limited support for the use of a PRA in patients undergoing oncologic-visceral surgery; the effects on pain intensity in the studies are only clinically relevant in the short term (2 hours after surgery); later they are no longer clinically relevant. Conversely, a clinically significant reduction in opioids was observed, accompanied by a reduction in opioid-related adverse effects (nausea, vomiting, sedation), although to a lesser extent than in the comparison of EA with systemic opioids. Further potential benefits include a reduction in pneumonia, earlier first flatus, and earlier discharge from hospital. The findings from the meta-analysis conducted here demonstrate that a PRA may be more efficacious than systemic analgesia, with a more pronounced effect observed in open surgery. The potential impact of catheterisation on prolonging the effect merits further investigation through clinical studies.

Research question

In view of the substandard quality and considerable heterogeneity of the studies, there is ample scope for enhancement. The effect is only short-lasting, therefore studies incorporating catheter procedures would be beneficial. It is imperative that further studies are conducted to elucidate whether specific recommendations must be formulated for particular visceral surgical procedures.

7.4 Prevention and treatment of postoperative gastrointestinal motility disorders

7.4.1 Pharmacological prevention and therapy

7.4.1.1 Drug treatment options

Given the multifactorial pathogenesis of postoperative gastrointestinal motility disorders, a range of pharmacological interventions are available. However, the study situation is heterogeneous due to inconsistent core outcome sets with regard to their quality and endpoints as well as the drugs used [270], [271]. The following section will present the evidence base for approved drug options for the prevention or treatment of postoperative gastrointestinal motility disorders or postoperative (paralytic) ileus (POI) in Germany.

7.14	Evidence-based Recommendation	2023
GoR **A**	The immediate postoperative s.c. administration of methylnaltrexone for the prophylaxis of postoperative (paralytic) ileus after oncological colorectal resections **shall not** be carried out with systemic opioid-based pain therapy.	
LoE ⊕⊕⊕⊖ ⊕⊕⊕⊕ ⊕⊕⊕⊖ ⊕⊕⊖⊖ ⊕⊕⊖⊖ ⊕⊖⊖⊖ ⊕⊕⊖⊖	[272], [273] ⊕⊕⊕⊖: Overall complications: no effect (RR 1.00; 95% CI 0.9 to 1.10) ⊕⊕⊕⊕: Cardiac complications: no effect (RR 1.25; 95% CI 0.90 to 1.73) ⊕⊕⊕⊖: Pulmonary complications: no effect (RR 0.79; 95% CI 0.21 to 2.96) ⊕⊕⊖⊖: Duration until GI-2: no effect (MD -0.79 days; 95% CI -2.02 to 0.45) ⊕⊕⊖⊖: Duration until first defecation: no effect (MD -0.44 days; 95% CI -1.26 to 0.39) ⊕⊖⊖⊖: Tolerance of solid food: methylnaltrexone may shorten the time to complete food build-up (MD -26.50 hours; 95% CI -33.63 to -19.37) ⊕⊕⊖⊖: Length of hospital stay: no effect (MD -0.28 days; 95% CI -1.99 to 1.42)	
	Consensus	

Methylnaltrexone is the only selective μ-opioid receptor antagonist approved in Germany that has been tested in three RCTs against placebo at different doses for the prevention of postoperative gastrointestinal motility disorders in patients with (among others oncological) colorectal resections with primary anastomosis. However, there is no approval for the prophylaxis or treatment of POI in Germany. While the significantly smaller study by Viscusi et al. showed benefits of the intervention on gastrointestinal motility [272], these could not be reproduced in the significantly larger patient cohorts at a similar dosage by Sik Yu et al. [273]. It is crucial to emphasise that the findings of the second study, as outlined by Sik Yu et al., could not be transferred to the meta-analysis. However, given the lack of effect of methylnaltrexone on postoperative gastrointestinal motility and postoperative bowel movements, as described in this study, it cannot be concluded that a change in recommendation is necessary. No recommendation can be made for other visceral oncology operations due to the paucity of data.

In contrast, a selective μ-receptor antagonist, alvimopan, has demonstrated a positive effect in terms of a shorter time to complete food intake, the time to first defecation, the time to GI-2, and a reduction in the length of hospital stay [270]. However, it is important to note that this substance is not approved in Germany.

7.15	Evidence-based Recommendation	2023
GoR **0**	The preoperatively initiated and postoperatively continued administration of NSAIDs **can** be used to prevent postoperative (paralytic) ileus after oncological colorectal resections.	
LoE ⊕⊕⊖⊖ ⊕⊕⊕⊕ ⊕⊕⊖⊖ ⊕⊕⊖⊖	[274], [275] ⊕⊕⊖⊖: Cardiac complications: no effect (RR 0.49; 95% CI 0.05 to 5.23) ⊕⊕⊕⊕: Time to first defecation: NSAIDs shorten the time to first defecation (MD -18.00 hours; 95% CI -31.07 to -4.93) ⊕⊕⊖⊖: Tolerance of solid food: no effect ⊕⊕⊖⊖: Length of hospital stay: no effect	
	Strong Consensus	

A number of smaller randomised controlled trials (RCTs) have examined the effect of non-steroidal anti-inflammatory drugs (NSAIDs) and selective cyclooxygenase inhibitors on postoperative gastrointestinal motility disorders for analgesic reasons, and thus an opioid-sparing effect, as well as due to their anti-inflammatory properties. In two independent systematic reviews, five and six RCTs, respectively, were identified, and in their meta-analyses, an effect was calculated for the drug group with regard to the duration until the first postoperative bowel movement and the dietary build-up after colorectal resections [276], [277]. owever, it should be noted that several RCTs were included here whose interventions were carried out with drugs that are currently not approved in Germany, such as ketorolac in the approved dosage form and coxibe. As Milne et al. have previously discussed, it remains unclear which drugs from the group of NSAIDs and/or more selective COX inhibitors are particularly effective with regard to the prophylaxis of POI [276].

The systematic literature search identified two RCTs in which NSAIDs were administered perioperatively. In summary, the addition of NSAIDs to perioperative pain therapy is the clinical standard. The administration of NSAIDs prior to surgery, for instance 50 mg diclophenac, has been shown to reduce the time to first postoperative bowel movement following colorectal resection[274], [275]. However, the analysis of these two studies did not demonstrate any additional effects on diet build-up or length of hospital stay, although confidence in the evidence is low [275]. It is important to note that the perioperative administration of NSAIDs has been associated with an increased incidence of anastomotic insufficiency [278], [279], [280], [281], [282]. Consequently, when formulating recommendations, it is essential to consider the potential connection between NSAID administration and anastomotic insufficiency.

In addition, the intra-abdominal or intravenous application of local anaesthetics, bupivacaine and lidocaine was investigated as a further opioid-sparing mechanism, with regard to their effect on the development of postoperative gastrointestinal

motility disorders and the occurrence of POI in the context of abdominal surgery [221], [283]. A single study was identified in which patients who had undergone oncologic colorectal resections were included [221]. In this study, the effects of perioperative administration of lidocaine, either via a thoracic epidural catheter or intravenously, were compared with those of a placebo in a three-arm randomised controlled trial. The time to first bowel movement was not measured in the study, but lidocaine therapy, especially administered via the thoracic epidural catheter, showed an effect on the time to first flatus and benefits in terms of postoperative pain, but not on the length of hospital stay [221]. A further investigation by a Cochrane Review in 2018 examined the analgesic impact and prophylaxis of POI in various abdominal surgical procedures, comparing intravenous lidocaine administration with EA, placebo, or a no control group. The overall confidence in the evidence is low to very low, and the effect of lidocaine remains unclear or there is no demonstrable effect [284]. Due to the paucity of data, no recommendation can be made for the intravenous or intra-abdominal application of local anaesthetics in the context of visceral oncological surgery (parallel to the very weak recommendation of the AWMF S3 guideline on treatment of acute perioperative and post-traumatic pain for lidocaine i.v. as a "may" recommendation with a recommendation grade GoR 0).

Reduction of perioperative sympathetic hyperaction

The treatment of choice for postoperative gastrointestinal paralysis is the administration of B-adrenoreceptor blockers and A2 receptor agonists, which have been shown to downregulate postoperative sympathetic hyperactivity and break through the involvement of the enteric nervous system in the pathophysiology of the condition [285], [286].

7.16	**Evidence-based Recommendation**	**2023**
GoR **A**	Propranolol **shall not** be used for the prophylaxis of postoperative (paralytic) ileus after oncologic colorectal resections.	
LoE ⊕⊖⊖⊖ ⊕⊖⊖⊖	[285] ⊕⊖⊖⊖: Pulmonary complications: no effect (RR not determinable) ⊕⊖⊖⊖: Time to first defecation: propranolol may shorten the time to first defecation (MD -29.00 hours; 95% CI -49.94 to -8.06)	
	Strong Consensus	

The influence of the non-selective beta-blocker propranolol versus placebo was examined in the Cochrane analysis by Traut et al. 2008. However, the study by Ferraz et al. from 2001 did not include any patients who had undergone gastrointestinal tumour resection, so that only the results of the study by Hallerbäck et al. from 1987 are considered in isolation below [285], [270], [287]. The perioperative use of B-adrenoreceptor blockers in the prophylaxis of postoperative ileus was tested in the placebo-controlled study by Hallerbäck on patients undergoing colorectal resection for oncological reasons, among others [285], [270]. The study revealed that both doses of propranolol demonstrated a reduced duration of ileus, with statistical significance ($p<0.01$). This effect was particularly evident in older patients (>60 years) and in patients who had undergone left-sided colon resection [285]. However, it

should be noted that this is an old study with a mixed patient population and unclear blinding, so the reliability and confidence in the evidence is very low. Furthermore, Hallerbäck et al. exclusively utilised the time to first defecation as a surrogate marker for gastrointestinal function following colorectal resection. Consequently, no definitive conclusions can be drawn regarding the treatment of future patients, and the use of propranolol for the prophylaxis of POI after oncologic colorectal resections is not recommended. No recommendation can be made for other visceral oncological operations due to the paucity of data.

Dexmedetomidine

Dexmedetomidine, an alpha2 receptor agonist, has a central sedative and analgesic effect and therefore has an opioid-sparing effect, particularly when administered intraoperatively [286]. In the meta-analysis by Behera et al., the authors came to the conclusion that the perioperative application of dexmedetomidine leads to a faster regulation of gastrointestinal functions postoperatively [288].

The majority of included studies administered dexmedetomidine perioperatively in the context of visceral surgical tumour resections, utilising loading doses ranging from 0.5 µg/kg to 1 µg/kg shortly before induction of anaesthesia, with continuous intraoperative administration at a rate ranging from 0.2 µg/kg/h to 0.4 µg/kg/h [286], [289], [290]. In contrast, the study by Xin explored the administration of dexmedetomidine via PCA, in conjunction with opioid-based pain therapy [291]. In the latter, the target parameters relevant to this study were not recorded. The meta-analysis of the studies included in this analysis demonstrated a reduction in the duration of the first defecation, the complete build-up of food, and the hospital stay following dexmedetomide administration. However, the absence of data pertaining to the perioperative use of spinal anaesthesia constitutes a notable limitation. It is notable that peridural anaesthesia has sympathicolytic properties that may also enhance postoperative gastrointestinal motility. Further studies must show whether the effect of dexmedetomidine is comparable to the sympatholytic reaction under epidural anaesthesia.

The studies included in the meta-analysis demonstrated that treatment with dexmedetomidine resulted in reduced heart rates and blood pressure values, as well as diminished variability. However, it did not lead to critical bradycardia, hypotension, or an elevated incidence of clinically apparent hemodynamic instability. In contrast to the cardiac safety profile of dexmedetomidine described by Cho et al., Chen et al., and Lu et al.[286], [289], the study on balanced opioid-free anaesthesia by Beloeil et al. had to be discontinued for safety reasons due to severe intraoperative bradycardia up to asystole in the dexmedetomidine group [292]. The bradycardic complications were attributed to the significantly higher doses of dexmedetomidine [292].

Nevertheless, when using dexmedetomidine, the opioid-sparing and additional sedative effect of the drug, as well as the contraindications described, in particular bradycardia and cardiac excitation/conduction disorders, must be urgently observed. In addition, the current Red Hand Letter (German Federal Institute for Drugs and Medical Devices - Risk information - Red Hand Letter on dexmedetomidine: Risk of increased mortality in intensive care patients ≤ 65 years, 15.06.2022), which questions the general safety profile of dexmedetomidine, must also be observed. The risk information is based on the secondary data analysis of the SPICE III study ([293], [294]). Although a general conversion of these results to the intended indication of dexmedetomidine and the question of this guideline is not possible, as the patient

population, indication for use, duration of application and dosage differ significantly, the secondary data analysis of the SPICE III study showed an increased 90-day mortality in critically ill, younger patients (≤ 65 years) under dexmedetomidine as the sole sedative in intensive care units [294]. Dexmedetomidine was sometimes administered over a long period of time (up to 28 days) and at a higher dose (up to 1.5µg/kg/h in SPICE III to achieve sufficient sedation) [294]. In addition, the increased 90-day mortality in a non-surgical setting was [294]. The situation is therefore only comparable to a limited extent with the much more limited and cumulatively lower-dose peri- or intraoperative use of dexmedetomidine as an adjuvant in the context of general anesthesia for the prophylaxis of postoperative (paralytic) ileus. After extensive discussion in response to the above-mentioned Red Hand Letter, the guideline commission refrained for the time being from recommending the peri- or intraoperative adjuvant use of dexmedetomidine in the context of general anesthesia for the prophylaxis of postoperative (paralytic) ileus, but identified a considerable need for research. Further studies are needed to further prove the effectiveness in the prophylaxis of postoperative (paralytic) ileus on the one hand and the safety of dexmedetomidine administered peri- or intraoperatively on the other.

Research question - Dexmedetomidine for the prophylaxis of POI

In view of the current study situation, the evidence for the drug-based prevention of postoperative gastrointestinal motility disorders or the treatment of clinically manifest postoperative (paralytic) ileus following gastrointestinal tumour resections is low, particularly with regard to drugs approved or available in Germany.

The paucity of drug prevention options has been demonstrated to result in increased morbidity, prolonged hospitalisation and elevated healthcare system costs.

However, the available evidence suggests that dexmedetomidine, administered perioperatively as an adjuvant to general anaesthesia, has the potential to serve as a prophylactic agent against gastrointestinal motility disorders. A meta-analysis of the effects of dexmedetomidine on postoperative paralytic ileus has yielded encouraging results. However, the included studies were conducted on heterogeneous, Asian patient collectives, meaning that conclusions about a Western European patient collective are not entirely possible. The studies included in the meta-analysis did not demonstrate any safety concerns in the above-mentioned doses with regard to the temporary peri- and intraoperative use of dexmedetomidine for general anaesthesia in the context of gastrointestinal tumour resections. This finding is in contrast with the results of the SPICE III study, which is notable for its unique patient population, indication, duration of use, and dosage of dexmedetomidine. Consequently, the necessity for further prospective, randomised controlled trials is indisputable, with the objective of fully confirming the efficacy and, in particular, the safety of dexmedetomidine in the perioperative setting.

Moreover, the literature does not provide a clear indication of which patients would benefit from the perioperative administration of dexmedetomidine with regard to the type of gastrointestinal tumour resection. Additionally, the question of whether drug therapy with dexmedetomidine is equivalent or more effective compared to the widespread use of epidural anaesthesia in abdominal surgery remains unanswered. Furthermore, the extent to which the effect can be potentiated by analgesic procedures close to the spinal cord is unclear.

Consequently, the efficacy of dexmedetomidine in diverse patient populations and across various perioperative treatment regimens must be systematically compared and further investigated in subsequent studies.

Parasympathomimetics

Parasympathomimetics have a tonic effect on smooth muscle cells in the intestine.

7.17	Evidence-based Recommendation	2023
GoR **0**	Neostigmine **can** be used as a last resort for the treatment of clinically manifest postoperative (paralytic) ileus.	
LoE ⊕⊖⊖⊖	[295], [296] ⊕⊖⊖⊖: Time to first defecation: neostigmine may shorten the time to first defecation (MD -42.90 hours; 95% CI -47.54 to -38.25)	
	Strong Consensus	

Despite the fact that neostigmine is widely utilised in routine clinical practice for the treatment of postoperative paralytic ileus, the evidence for the acetylcholinesterase inhibitor neostigmine for the prevention or treatment of postoperative gastrointestinal motility disorder following gastrointestinal tumour resection is limited in the current literature. A review of the literature was conducted by Traut et al. in the context of a Cochrane analysis, which included two studies in which neostigmine therapy was initiated immediately after surgery. Although a reduction in the duration until the first postoperative flatus and bowel movement was observed, the number of cases was small and the patient population heterogeneous [270]. The patient population included only those who underwent cholecystectomy and emergency laparotomy [270].

In 1988, neostigmine was evaluated by Myrhoj et al. for the treatment of postoperative gastrointestinal paralysis after oncologic abdominal resections, among others. Paralysis was defined as the absence of flatus or bowel movements on the second postoperative day, with patients receiving either a placebo or 0.5 mg of neostigmine intramuscularly every three hours [295]. However, no effect of neostigmine therapy on the duration of gastrointestinal paralysis was observed [295]. Similar inclusion criteria (absence of flatus or defecation on postoperative day 3-6) were used by You et al. 2018 in their four-arm placebo-controlled study in patients undergoing oncological gastrectomy [296]. In particular, the bilateral injection of 0.5mg neostigmine at each ST36 acupuncture point was particularly effective and reduced the duration until the first flatus and bowel movement [296]. Furthermore, the intramuscular injection of 1 mg neostigmine alone was found to be more efficacious than acupuncture alone and standard therapy [296].

7.18	Evidence-based Recommendation	2023
GoR **B**	Prucalopride **shouldnot** be used for the prophylaxis of postoperative (paralytic) ileus following gastrointestinal tumour resection.	
LoE ⊕⊕⊕⊕ ⊕⊕⊕⊕ ⊕⊕⊕⊕ ⊕⊕⊕⊖ ⊕⊕⊕⊕ ⊕⊖⊖⊖ ⊕⊕⊖⊖ ⊕⊖⊖⊖ ⊕⊖⊖⊖	[297], [298], [299] ⊕⊕⊕⊕: Overall complications: no effect (RR 1.15; 95% CI 0.77 to 1.70) ⊕⊕⊕⊕: Gastric tube reinsertion rate: no effect (RR 0.75; 95% CI 0.40 to 1.39) ⊕⊕⊕⊕: Surgical complications > CD II: no effect (RR 1.05; 95% CI 0.56 to 1.95) ⊕⊕⊕⊖: Cardiac complications: no effect (RR 0.95; 95% CI 0.33 to 2.76) ⊕⊕⊕⊕: Pulmonary complications: no effect (RR 2.00; 95% CI 0.19 to 21.58) ⊕⊖⊖⊖: Duration until GI-2: the duration until the composite criterion GI-2 is reached: no effect (MD -1.80 days; 95% CI -5.39 to 1.78) ⊕⊕⊖⊖: Duration until first defecation: no effect (MD -0.39 days; 95% CI -1.15 to 0.37) ⊕⊖⊖⊖: Tolerance of solid food: no effect (MD -3.08 days; 95% CI -9.60 to 3.43) ⊕⊖⊖⊖: Length of hospital stay: no effect (MD -3.06 days; 95% CI -7.21 to 1.09)	
	Strong Consensus	

Serotonin-5-hydroxytryptamine-4 (5-HT4) receptor agonists have been demonstrated to exert a prokinetic effect through the release of neuronal acetylcholine in the myenteric plexus via parasympathomimetic mechanisms. In addition to this, these agents have been shown to possess a local anti-inflammatory effect, which in turn counteracts gastrointestinal motility disorders, particularly in the aftermath of abdominal surgery [297], [299], [300].

The effect of the 5-HT4 receptor agonist cisapride on gastrointestinal motility after abdominal surgery was examined in the meta-analysis by Traut et al. This showed a shorter duration until the first postoperative defecation, but no effect on postoperative diet build-up or length of hospital stay [270]. However, due to its cardiac side effect profile, cisapride is not approved in Germany. Conversely, the RCTs conducted by Narita et al. and Toyomasu et al. identified the 5-HT4 receptor agonist mosapride as having a beneficial effect on the time to first defecation. However, the results concerning dietary requirements and length of hospital stay are divergent [301], [302].

Three further RCTs evaluate the oral 5-HT4 receptor agonist prucalopride, which is approved in Germany for the reserve treatment of chronic constipation due to its more favorable cardiovascular risk profile, for the prevention of gastrointestinal motility disorders and POI after visceral oncological surgery, among other things. Here, 2 mg prucalopride was administered orally perioperatively up to a maximum of the 7th postoperative day [297], [298], [299]. However, the meta-analysis of the study data demonstrated an absence of effect on postoperative gastrointestinal motility. A notable limitation is the unavailability of continuous study data from Gong et al. for meta-analysis, which hinders the reliability of the findings. In a collective of 45 patients in the intervention group, no effect of prucalopride on diet build-up was observed, but an advantage for prucalopride with regard to the time to first

defecation and the length of hospital stay after gastrointestinal resections was demonstrated [297].

Prokinetics

7.19	Evidence-based Recommendation	2023
GoR **A**	Metoclopramide **shall not** be used for the prophylaxis of postoperative (paralytic) ileus after gastrointestinal tumour resections.	
LoE ⊕⊕⊕⊖ ⊕⊕⊕⊖	[303], [304] ⊕⊕⊕⊖: Gastric tube reinsertion rate: no effect (RR 0.88; 95% CI 0.27 to 2.92) ⊕⊕⊕⊖: Tolerance of solid food: no effect (MD -0.20 days; 95% CI -1.04 to 0.64)	
	Strong Consensus	

In the meta-analysis by Traut et al. of several older studies on i.v. or i.m. medication with dopamine antagonists started immediately postoperatively, no advantage of the intervention could be described with regard to the duration until the first bowel movement or with regard to diet build-up after abdominal surgery. medication with dopamine antagonists, no advantage of the intervention could be described with regard to the duration until the first bowel movement or with regard to the dietary build-up after abdominal surgery [270]. However, heterogeneous patient collectives with, among other things, exclusively cholecystectomies [305] or aortic interventions were included here [306], as well as a study with bromopride, which is not approved in Germany [270]. Two studies were identified to evaluate the effect of metoclopramide on the prevention of postoperative gastrointestinal motility disorders after oncologic small and large bowel resections [303], [304]. The findings of both studies, when considered collectively as well as in isolation, failed to demonstrate any significant impact of metoclopramide (10 mg, administered repeatedly three times per day parenterally, initiated immediately postoperatively) on either the time to first defecation or the rate of gastric tube reinsertion.

7.20	Evidence-based Recommendation	2023
GoR **A**	Erythromycin **shall not** be used for the prophylaxis of postoperative (paralytic) ileus after gastrointestinal tumour resections.	
LoE ⊕⊕⊕⊖ ⊕⊕⊕⊖ ⊕⊕⊕⊖	[270] ⊕⊕⊕⊖: Duration until first defecation: no effect (MD 0.99 days; 95% CI 0.90 to 1.08) ⊕⊕⊕⊖: Tolerance of solid food: no effect (MD 1.04 days; 95% CI 0.93 to 1.15) ⊕⊕⊕⊖: Length of hospital stay: no effect (MD 1.00 days; 95% CI 0.90 to 1.11)	
	Strong Consensus	

The macrolide antibiotic erythromycin has a prokinetic and emptying-promoting effect on the stomach, primarily via motilin receptors. In 1993, Yeo et al. were able to show a reduced incidence of delayed gastric emptying after pancreatic head resections and total pancreatectomies in their prospective randomized, placebo-controlled study with postoperative infusion of 200 mg every 6 hours in the postoperative course [307]. With regard to postoperative gastrointestinal dysfunction, Traut et al. were unable to show in their meta-analysis any effect of i.v. erythromycin therapy started immediately postoperatively on the postoperative diet build-up, the duration until the first bowel movement or the length of hospital stay after primarily trans-abdominal tumour resections [270].

7.21	Evidence-based Recommendation	2023
GoR **B**	Laxatives **should** be implemented early in a multimodal prophylaxis and/or therapy of postoperative (paralytic) ileus after oncologic colorectal resections.	
LoE ⊕⊕⊖⊖ ⊕⊕⊖⊖ ⊕⊕⊖⊖ ⊕⊕⊖⊖ ⊕⊕⊖⊖ ⊕⊕⊖⊖ ⊕⊕⊖⊖ ⊕⊕⊖⊖ ⊕⊕⊖⊖	[308], [309], [310] ⊕⊕⊖⊖: Overall complications: no effect (RR 0.86; 95% CI 0.41 to 1.79) ⊕⊕⊖⊖: Gastric tube reinsertion rate: no effect (RR 0.94; 95% CI 0.65 to 1.36) ⊕⊕⊖⊖: Surgical complications > CD II: no effect (RR 1.65; 95% CI 0.92 to 2.97) ⊕⊕⊖⊖: Cardiac complications: no effect (RR 1.26; 95% CI 0.35 to 4.60) ⊕⊕⊖⊖: Pulmonary complications: no effect (RR 2.39; 95% CI 0.85 to 6.77) ⊕⊕⊖⊖: Duration until GI-2: the duration until the composite criterion GI-2 is reached (narrative: advantage for laxatives) ⊕⊕⊖⊖: Time to first defecation: laxatives shorten the time to first defecation (MD -1.12 days; 95% CI -1.42 to -0.82) ⊕⊕⊖⊖: Tolerance of solid food: no effect (MD -0.07 days; 95% CI -0.38 to 0.25) ⊕⊕⊖⊖: Length of hospital stay: no effect (MD -1.08 days; 95% CI -3.01 to 0.84)	
	Strong Consensus	

Certain laxatives have been observed to exert an osmotic effect, thereby increasing motility within the colon. Two studies were identified that evaluated the use of laxatives (bisacodyl [309] or coloxyl® with senna + movicol® + fleet® [310]) administered orally perioperatively for the prevention of gastrointestinal motility disorders, and one that evaluated bisacodyl in the treatment of clinically manifest POI, administered rectally [308]. The laxatives were administered repetitively, especially until the respective study endpoint (defecation or GI-2) was reached.

Our meta-analysis showed an advantage for the administration of laxatives both in the prevention of gastrointestinal motility disorders and in the treatment of clinically manifest POI after colorectal resection with regard to the time to defecation. In addition, Dudi-Venkata et al. have seen an advantage with regard to the GI-2 composite criteria for prophylactic postoperative laxative administration versus standard perioperative treatment [310]. However, laxatives do not have an isolated effect on diet build-up or the length of hospital stay. Since the complication rates did not differ in the groups studied, it can be recommended that laxatives should be implemented early on in both the prophylaxis and treatment of gastrointestinal motility disorders and POI after oncological colorectal resections in the sense of a

multimodal stepwise concept. However, given the paucity of data, no recommendation can be made for other visceral oncologic operations.

In contrast to the use of laxatives, simethicone (160 mg orally, 4x/d) has been shown to have no effect on the prophylaxis of gastrointestinal motility disorders following colorectal resections [311] Similarly, osmotically active X-ray contrast agents, such as Gastrografin® (100 ml orally), have been demonstrated to offer no therapeutic benefit in the treatment of clinically manifest POI [312].

7.22	Evidence-based Recommendation	2023
GoR **A**	Simethicone **shall not** be used for the prophylaxis of postoperative (paralytic) ileus after gastrointestinal tumour resections.	
LoE ⊕⊕⊕⊕ ⊕⊕⊕⊕ ⊕⊕⊕⊕ ⊕⊕⊕⊕	[311] ⊕⊕⊕⊕: Overall complications: no effect (RR 1.10; 95% CI 0.63 to 1.91) ⊕⊕⊕⊕: Surgical complications > CD II: no effect (RR 0.52; 95% CI 0.05 to 5.55) ⊕⊕⊕⊕: Duration until first defecation: no effect (MD -1.80 days; 95% CI -11.02 to 7.42) ⊕⊕⊕⊕: Length of hospital stay (narrative: no effect)	
	Strong Consensus	

7.23	Evidence-based Recommendation	2023
GoR **A**	Osmotically active X-ray contrast media (e.g. gastrografin®) **shall not** be used to treat postoperative (paralytic) ileus following gastrointestinal tumour resection.	
LoE ⊕⊕⊕⊕ ⊕⊕⊕⊕ ⊕⊕⊕⊕ ⊕⊕⊕⊕ ⊕⊕⊕⊕	[312] ⊕⊕⊕⊕: Overall complications: no effect (RR 1.21; 95% CI 0.72 to 2.03) ⊕⊕⊕⊕: Pulmonary complications: no effect (RR 0.56; 95% CI 0.05 to 5.82) ⊕⊕⊕⊕: Duration until first defecation: no effect (MD -1.18 days; 95% CI -4.03 to 1.67) ⊕⊕⊕⊕: Tolerance of solid food: no effect (MD -2.22 days; 95% CI -5.42 to 0.98) ⊕⊕⊕⊕: Length of hospital stay: no effect (MD -4.50 days; 95% CI -11.17 to 2.17)	
	Strong Consensus	

7.4.1.2 Traditional Japanese medicine: Daikenchuto

7.24	Evidence-based Recommendation	2023
GoR **B**	Daikenchuto **should not** be used for the prophylaxis of postoperative (paralytic) ileus after gastrointestinal tumour resection.	
LoE ⊕⊕⊖⊖ ⊕⊕⊖⊖ ⊕⊖⊖⊖ ⊕⊕⊖⊖ ⊕⊖⊖⊖ ⊕⊖⊖⊖ ⊕⊖⊖⊖ ⊕⊖⊖⊖	[313], [314], [315], [316], [317], [318], [319], [320], [321], [322], [323] ⊕⊕⊖⊖: Overall complications: no effect (RR 0.93; 95% CI 0.69 to 1.24) ⊕⊕⊖⊖: Gastric tube reinsertion rate: no effect (RR 0.99; 95% CI 0.06 to 15.62) ⊕⊖⊖⊖: Surgical complications > CD II: no effect (RR 0.60; 95% CI 0.31 to 1.16) ⊕⊕⊖⊖: Pulmonary complications: no effect (RR 0.37; 95% CI 0.10 to 1.47) ⊕⊖⊖⊖: Time to first defecation: no effect (MD -9.41 hours; 95% CI -25.27 to 6.44) ⊕⊖⊖⊖: Tolerance of solid food: no effect (MD -36.73 hours; 95% CI -95.11 to 21.66) ⊕⊖⊖⊖: Patient satisfaction: no effect ⊕⊖⊖⊖: Length of hospital stay: no effect (MD -2.41 days; 95% CI -5.56 to 0.74)	
	Strong Consensus	

Daikenchuto (DKC) is a phytotherapeutic formula from traditional Japanese medicine and consists of the herbal ingredients Japanese pepper, dried ginger, ginseng root, and maltose powder [313]. DKC is said to have stool-regulating and anti-inflammatory properties [317], [315], [324]. A large number of RCTs, particularly from the Asian-Japanese region, are concerned with the effect of perioperatively orally administered DKC on postoperative gastrointestinal motility disorders and POI following abdominal surgery. In the systematic literature search conducted de novo here, 11 RCTs were identified in which the perioperative oral administration of DKC on postoperative gastrointestinal motility in the context of visceral surgical tumour resections was tested against placebo or standard therapy [313], [314], [315], [316], [317], [318], [324], [320], [321], [322], [323]. As can be seen from the meta-analysis of these RCTs, no effect of DKC on the time to first defecation, diet build-up or length of hospital stay could be determined. A limitation to be mentioned here is that 3/7 studies had to be excluded with regard to the time to first defecation. However, two of the excluded RCTs with a high number of subjects were able to show a positive effect of DKC on the time to first defecation [313], [314]. The third study could not prove this [315]. With regard to the length of hospital stay, the data from one RCT could not be included in the meta-analysis [316]. However, in line with the results of the meta-analysis, no effect of DKC on the length of hospital stay was described [316]. In the narrative analysis of postoperative quality of life, as an expression of patient satisfaction with treatment, which was surveyed in 4/11 studies in various dimensions, there were also no differences between the intervention and placebo or standard treatment groups.

In summary, the effect of perioperatively orally administered DKC on the time to first defecation remains unclear. However, as DKC has no effect on dietary build-up, length of hospital stay or gastric tube reinsertion rate and is difficult to obtain in

Germany, perioperative administration in the context of gastrointestinal tumour resections should be avoided.

7.4.2 Adjuvant interventions

7.4.2.1 Coffee

7.25	Consensus-based Recommendation	2023
EC	Caffeinated coffee (up to 3x150 ml) **can** be offered to patients after abdominal surgery. Coffee consumption **can** be started in the recovery room.	
	Consensus	

The recommendation is based on a current meta-analysis of four RCTs and 312 patients following colorectal surgery [325]. The study population was characterised by heterogeneity with regard to the indication for surgery (benign and malignant operations), the surgical approach (open and minimally invasive), and the section of bowel resected (right/left hemicolectomy, rectal resection, colectomy). The meta-analysis demonstrated that coffee consumption can reduce the time to first bowel movement by 10.36 hours (95% CI -14.61 to -6.11 hours). However, the time to first flatus or complete bowel movement did not differ between the control and intervention groups. Furthermore, coffee consumption was found to reduce the length of hospital stay by 0.95 days (95% CI -1.57 to -0.34 d).

However, the current literature does not permit the stratification of operations into the hepatopancreatobiliary area and operations in the upper gastrointestinal tract. However, a separate meta-analysis encompassing a range of surgical interventions has yielded noteworthy findings: A meta-analysis on postoperative coffee use and POI from 2020 with a total of 563 patients included concludes that coffee use after abdominal surgery effectively reduces the incidence of postoperative ileus [326]. The mean time to first flatus was reduced by 7 hours (95% CI -9.5 to -4.4), the mean time to first solid food intake was reduced by 10 hours (95% CI -18.2 to -0.9), and the mean time to defecation was reduced by 9 hours (95% CI -17.6 to -1.2). However, the length of hospital stay was not reduced in this meta-analysis [326].

The level of evidence in the studies was found to be limited by a performance bias due to the lack of blinding of the patient and the investigator (detection bias). Notwithstanding the potential for bias, a recommendation is made for the postoperative consumption of caffeinated coffee, owing to the favourable side effect profile and demonstrable effect.

7.4.2.2 Chewing gum

7.26	Consensus-based Recommendation	2023
EC	After colorectal resections, patients **should** chew gum 3-4 times for 10-15 minutes in the first five postoperative days.	
	Strong Consensus	

Gum chewing has been shown to mimic food intake, which in turn results in the release of peristaltic-promoting hormones and activation of the anti-inflammatory and prokinetic cephalovagal reflex.

Two recent meta-analyses, which were methodologically sound, have led to similar conclusions; namely, that chewing gum increases motility and reduces the incidence of postoperative ileus [327], [328].

A meta-analysis from 2020 included RCTs with colorectal resections performed both open and laparoscopically for malignant and benign bowel diseases. Initially, 16 RCTs were included in the meta-analysis, but 6 studies were excluded due to a high risk of bias, leaving 10 studies with a low risk of bias. The analysis encompassed a total of 970 patients, revealing a reduction in postoperative ileus with a risk ratio of 0.55 (95% CI 0.30 to 0.79). The median time to first defecation was observed to be 2.7-4.5 days in the control group and 2.0-3.9 days in the chewing gum group. Furthermore, the first postoperative flatus was detectable about 8 hours earlier in the chewing gum group, and the first defecation about 12 hours earlier in the control group compared to the placebo group. Subsequent investigations into the length of hospital stay and mortality revealed no significant differences between the two groups under study. A stratification with regard to minimally invasive or open surgery was not carried out in Roslan's meta-analysis [327].

A 2017 meta-analysis encompassed 17 studies comprising 1,845 patients with colorectal cancer who underwent both open and laparoscopic surgery. The analysis included smaller and lower-quality studies. Despite this, the results of the two meta-analyses are comparable. In both analyses, the times to first flatus (approximately 12 hours) and first bowel sounds (approximately 14 hours) were found to be significantly reduced. In two studies involving a total of 80 patients, the tolerance of the first food intake was shortened by 1.3 days. (Mei 2017).

The control group was defined as "standard treatment" in most of the studies. The extent to which mPOM protocols, epidural catheters and opioid-sparing analgesia have already had an impact in this group was not reported in most cases.

7.27	Consensus-based Recommendation	2023
EC	After open liver resections, patients **can** be offered chewing gum.	
	Strong Consensus	

In a randomized controlled trial, the effect of chewing gum on intestinal function was investigated in open liver surgery without further specification [329]. In 107 patients with HCC, chewing gum improved intestinal motility ($p<0.05$). The first defecation occurred earlier (3.3 vs 4.7 days), peristalsis started earlier (25 vs 30 hours) and the first flatus started earlier (56 vs 71 hours). However, the shortening of the POI did not lead to a reduced length of hospital stay.

An RCT was conducted on pancreatic resections, in which only seven patients were included in the intervention group and ten patients in the control group. Ultimately, there was no demonstrable effect in terms of an improvement in intestinal motility [330].

There is a paucity of data from randomised controlled trials on postoperative gum chewing in minimally invasive liver or pancreas resections.

In conclusion, the scientific evidence for the use of chewing gum in liver and pancreatic surgery is low. However, given the absence of adverse effects and the observed reduction in postoperative complications in liver resections (Clavien-Dindo Classification 0: 34% with chewing gum vs. 4% without chewing gum) [329], the use of chewing gum in these surgical indications can be considered.

7.4.2.3 Acupuncture

7.28	Consensus-based Recommendation	2023
EC	Acupuncture **can** be used after abdominal surgery. The Zusanli and Shangjuxu acupuncture points **should** be used for this as a minimally invasive option with few side effects.	
	Consensus	

A systematic review conducted in 2016 demonstrated the efficacy and safety of acupuncture in promoting recovery following colorectal surgery, including the management of postoperative ileus (POI) [331].
A recent meta-analysis from 2018 builds on these findings and synthesises the results of 21 studies involving 1,546 patients [332]. The analysis revealed that acupuncture, when administered post-surgery, notably reduced the time until the first bowel sounds (MD -11.41; 95% CI -20.96 to -1.85), the first flatus (MD -15.79; 95% CI -26.10 to -5.49), and the first defecation (MD -22.42; 95% CI -39.14 to -5.70) in four blinded, high-quality, randomised studies involving 281 participants and 17 lower-quality, non-blinded, randomised studies with 1,265 participants.

A further meta-analysis of 15 high-quality randomised trials in 965 patients examined the impact of electroacupuncture and transcutaneous electroacupuncture on the duration of POI in various abdominal surgical procedures, with 12 studies on conventional surgery and 3 studies on laparoscopic surgery [333]. The pooled results of the 15 studies that investigated the primary endpoint "time to first flatus" demonstrated a positive effect of the intervention (MD -11.60; 95% CI -16.19 to -7.02). Furthermore, a positive effect of acupuncture compared to patients in the control group was demonstrated for the endpoint "time to first bowel movement" in 13 studies (MD -12.94; 95% CI -12.94 to -7.06). Furthermore, a reduction in the

length of hospital stay was demonstrated both in the overall population (MD -1.19; 95% CI -1.78 to -0.60) and in a subgroup analysis for minimally invasive surgery after electroacupuncture and transcutaneous electroacupuncture (MD -1.30; 95% CI -2.10 to -0.51).

In the context of abdominal surgery, meridian-related point selection may encompass Zusanli and Shangjuxu ("Stomach 36" and "Stomach 37") in isolation or conjunction with other acupuncture points, with the objective of expediting the emergence of the first bowel sounds, flatus, and defecation.

The meta-analyses by Bik, Liu, and Kim analyze different forms of acupuncture, whereby the spectrum includes both needle techniques and special applications such as electroacupuncture or moxibustion, mostly as body acupuncture, more rarely as ear acupuncture or other topical TCM techniques such as acupressure ([331], [332], [333]).

This apparent heterogeneity contrasts with the predominantly homogeneous selection of specific acupuncture points such as Zusanli and Shangjuxu ("Stomach 36" and "Stomach 37"), which were used in the various techniques according to the meridian theory of TCM. According to Chen [333], 93.3% of Zusanli was the target site of an acupuncture technique with evidence of a shortened time to first postoperative defecation compared to control groups without acupuncture application. Despite the methodological problems with the inclusion of studies of heterogeneous design, the meta-analysis by Kim [331] showed a slight superiority of the selection of the Zusanli and Shangjuxu acupoints over Sham acupuncture. The majority of the studies included in the above-mentioned meta-analyses combined the treatment of the Zusanli or Shangjuxu acupoints with other TCM techniques such as the use of special traditional Chinese herbal preparations. In addition, in a large number of the studies included, the acupoints mentioned are used with others in different combination patterns: These include Xiajuxu ("Stomach 39"), Yanglingquan ("Gallbladder 34"), Hegu ("Large Intestine 4"), Xiajuxu (Stomach 39), Zhongwan ("Conception Vessel 12"), Tianshu (Stomach 25), Guanyuan ("Conception Vessel 4"), Qihai ("Conception Vessel 6"), Zhigou ("Triple Warmer 6"), Yinlingquan ("Spleen 9") and Pishu ("Bladder 20").

The duration of acupuncture application has been demonstrated to be consistent across a substantial number of studies. In the four meta-analyses, the duration of application ranged from 20 to 30 minutes, and the frequency of application per day remained relatively constant, with the majority of studies reporting a single application. However, the duration of application varied between two and six postoperative days in the studies.

Despite the existence of a robust evidence base supporting the utilisation of acupuncture for the management and prevention of postoperative ileus, it necessitates specialist knowledge. Given the absence of such expertise on a universal scale, the recommendation level was consequently downgraded to an "optional recommendation".

Appendix:

Zusanli is located approximately 1.5 centimetres laterally ventral to the tibial crest, approximately 4.5 centimetres below the patella at the level of the tibial tuberosity.

The location of Shangjuxu is approximately 4.5 centimetres distal to Zusanli, and 1.5 centimetres lateral to the anterior edge of the tibia.

It is acknowledged that commercially available acupuncture needle products can be utilised for this procedure; however, it is imperative that the procedure is carried out under sterile conditions.

7.5 Postoperative mobilization

7.29	Consensus-based Recommendation	2023
EC	Patients **shall** be mobilized early postoperatively.	
	Consensus	

Early postoperative mobilisation has now become part of the clinical routine of postoperative care in many places as part of mPOM programmes. The selected relevant studies defined early mobilization as occurring on the first postoperative day. However, a single study delineated early mobilization as the period immediately subsequent to extubation or admission to the intensive care unit, encompassing passive exercise utilising a bed bike. The nature of mobilization is heterogeneous, encompassing a wide range of interventions, from basic sitting on the edge of the bed to guided physiotherapy sessions multiple times a day, or the utilisation of a bed bike. The term "intensified" mobilization therefore remains undefined. The observation periods are usually limited to the inpatient stay.

In the systematic review by Castelino et al. (2016) [334], 3 RCTs and a prospective observational study with mixed abdominal procedures (n=225) were summarized in addition to 4 thoracic surgery studies. With regard to postoperative complications, 2 of the 4 studies could be analyzed and no difference in the postoperative complication rate was found in any of the studies [335], [336]. Of the 3 studies in the review that analyzed the length of hospital stay, only one reported a reduction in the length of stay in the early mobilized intervention group [336]. In addition, 2 of the 4 studies reported a positive impact of early mobilization on PROs (patient reported outcomes) [335], [337]. The other two studies did not investigate PROs.

In addition, 4 further relevant studies have been published since then.

Almeida et al. [338] included 108 patients after complex visceral, gynecological and urological surgery. The patients received either early mobilization on the first postoperative day or standard mobilization as a control. The primary endpoint was independent mobilization in the patient's room on the 5th postoperative day. The intervention group was independently mobilized more quickly; there was no difference in the secondary endpoints of health-related quality of life, length of hospital stay and perioperative morbidity.

Balvardi et al. [339] randomized 99 patients with colorectal surgery and focused on postoperative lung function as the primary endpoint; intensified early mobilization did not improve postoperative lung function or convalescence.

The RCT by Fiore et al. [340] examined the proportion of patients who achieved the same walking ability 4 weeks after the operation as before the operation (6-minute walk test) as the primary endpoint. The aim was to analyse the effect of early and intensified mobilization. There were no differences between the groups with regard to walking distance after 4 weeks (primary endpoint), bowel motility and mobilization in hospital (secondary endpoints). However, the risk of bias of this study was classified as "questionable" as there was no study protocol with predefined methodology.

Svensson-Raskh et al. [341] randomized patients after complex abdominal surgery (>2h). The primary endpoint was the change in oxygen saturation (SpO2) between the groups and over time. A total of 214 people in three comparison groups (early sitting in a chair including breathing exercises, early sitting in a chair only and control group without intervention) showed that the group with breathing exercises had better measured values (oxygen saturation and oxygen partial pressure) than the comparison groups. If only general postoperative complications are considered, there are no differences between the intervention and control groups.

A single RCT on 56 patients after pancreatic resection with follow-up over 12 months showed significant advantages of intensified physiotherapy initiated early and continued beyond the inpatient stay in the long-term outcome with regard to certain aspects of quality of life [342]. The authors concluded that supervised physiotherapy or prescribed home exercise after pancreatic cancer resection is safe and feasible and should be started as soon as possible after surgery.

n summary, the extant literature demonstrates an absence of confirmed benefits in terms of morbidity, mortality, intestinal motility, and postoperative length of stay following early postoperative and intensive mobilisation as a solitary intervention. However, there appears to be a tendency for early mobilisation to be more beneficial. Furthermore, none of the studies demonstrate evidence of an increased risk of complications due to early mobilisation. It is noteworthy that several of the interventions previously assessed can be readily implemented in clinical practice with minimal effort. However, as an integral component of all mPOM programmes recommended for all visceral surgical entities in this guideline (see Chapter 8 of this guideline), an evidence-based recommendation for this individual measure in isolation is not possible, especially since interventions, patient collectives, controls, outcomes, and follow-up periods are so heterogeneous that confidence in the sparse evidence is very low.

7.6 Postoperative respiratory therapy

7.30	Evidence-based Recommendation	2023
GoR **0**	After abdominal and thoracic surgery, respiratory therapy in the form of incentive spirometry **can** be dispensed with as the sole measure to prevent postoperative pulmonary complications.	
LoE ⊕⊕⊕⊖ ⊕⊕⊖⊖ ⊕⊕⊖⊖	[343] ⊕⊕⊕⊖: Postoperative pulmonary complications (26 RCTs): no effect (RR 1.00; 95% CI 0.88 to 1.33) ⊕⊕⊖⊖: Postoperative mortality (9 RCTs): no effect (RR 0.73; 95% CI 0.42 to 1.25) ⊕⊕⊖⊖: Length of hospital stay (15 RCTs): no effect (MD -0.17 days; 95% CI -0.65 to 0.3)	
	Strong Consensus	

Abdominal and thoracic surgical procedures, both open and minimally invasive, result in a multifactorial impairment of postoperative lung function, which can be objectively measured using spirometry to assess reduced vital capacity (VC) and one-second capacity (FEV1). Impaired lung function has been proven to be a risk factor for postoperative pulmonary complications (PPC), particularly atelectasis and pneumonia. A range of physiotherapeutic rehabilitation programmes have been developed with the aim of improving postoperative pulmonary function. Postoperative incentive spirometry is a widely used method that aims to maximize inspiratory lung volume through the use of breathing trainers (e.g. TRIFLO®) [344].

The evaluation of the benefits of incentive spirometry after thoracic and abdominal surgery is based on a meta-analysis from 2021, which included a total of 31 RCTs with a total of 3,776 patients [343]. In this meta-analysis, incentive spirometry is compared with the absence of any use of a breathing trainer or other rehabilitation strategies (e.g. diaphragmatic breathing exercises or CPAP breathing exercises using positive pressure ventilation). The individual studies were published between 1974 and 2019. The analysis encompasses both open and minimally invasive procedures. Studies that were part of an mPOM or prehabilitation programme were excluded, as it was deemed that possible effects cannot be attributed to incentive spirometry in the analysis. The meta-analysis is of high methodological quality, as it is based on the Cochrane Handbook for Systematic Reviews of Interventions; accordingly, a summary-of-findings table was generated using GRADE-Pro for the entire collective.

The extant literature suggests that the implementation of postoperative incentive spirometry does not result in a reduction of postoperative pulmonary complications, 30-day mortality, or hospital length of stay for the overall study population. The subgroup analysis further demonstrated that there was no distinction between the intervention and control groups with respect to the primary endpoint of PPC following abdominal (RR 0.93; 95% CI 0.74 to 1.17) and thoracic surgery (RR 0.99; 95% CI 0.79 to 1.25).

Despite the high methodological quality of the meta-analysis, additional factors must be taken into account when making a final recommendation for the use of incentive spirometry. In the majority of the individual studies comprising the meta-analysis, incentive spirometry is not examined as a standalone measure, but rather in

comparison with other potential rehabilitation strategies. This limitation precludes a definitive conclusion regarding the efficacy of incentive spirometry as a standalone modality. Furthermore, although the individual studies examined a homogeneous group of patients, they were not stratified with regard to their preoperative risk of pulmonary postoperative complications. The question of whether patients with preoperatively impaired lung function due to pre-existing lung diseases benefit from postoperative incentive spirometry and thus whether patient selection is a factor in proving possible evidence remains unanswered. The statement on the benefit is further limited by the demonstrably limited compliance of included study patients. A 2016 meta-analysis of 31 RCTs concluded that the evidence regarding patient compliance with incentive spirometry is inconclusive due to a lack of data [345]. Consequently, the authors of the meta-analysis recommended the standardisation of methodology to enhance the comparability of incentive spirometry data. From the patient's perspective, the use of a breathing trainer is linked to effective pain management.

Despite the exclusion of studies on mPOM and prehabilitation programmes from this meta-analysis, the potential benefits of postoperative incentive spirometry remain to be elucidated in the context of additional measures. Individual RCTs suggest a benefit in the context of multiple pre- and postoperative measures [346]. A meta-analysis published in 2020, incorporating a total of 95 RCTs and 18,062 patients, examined a large number of variables with the potential to reduce the incidence of PPC [347]. Seven of the interventions examined showed low to moderate evidence of achieving this goal. In addition to mPOM, these included prophylactic administration of mucolytics, postoperative CPAP ventilation, intraoperative protective lung ventilation, prophylactic physiotherapy, pain therapy using an epidural catheter, and targeted hemodynamic therapy.

A salient issue that merits attention is the financial implications of these interventions, particularly in contexts where postoperative respiratory trainers are routinely administered to all patients.

In summary, the routine use of incentive spirometry is not currently recommended as the sole measure, irrespective of the surgical procedure and patient-related factors. The rationale for conducting a randomised study design to investigate the value of incentive spirometry as the sole preoperative prehabilitation intervention is compelling, given the available data and explanations. Patients with esophageal cancer and scheduled transthoracic esophagectomy are a particularly suitable high-risk group for PPC due to their pre-existing pulmonary comorbidity and intraoperative single-sided ventilation.

7.7 Abdominal binder after median laparotomy

7.31	Evidence-based Recommendation	2023
GoR **0**	After a median laparotomy, an abdominal binder **can** be applied to reduce pain.	
LoE ⊕⊕⊕⊕ ⊕⊕⊕⊕	[348] ⊕⊕⊕⊕: Abdominal pain on postoperative day 1 (5 RCTs): lower with abdominal binder (SMD -0.38; 95% CI -0.69 to -0.07) ⊕⊕⊕⊕: Abdominal pain on postoperative day 5 (3 RCTs): lower with abdominal binder (SMD -0.55; 95% CI -0.89 to -0.21)	
	Consensus	

The evaluation of the efficacy of an abdominal binder following median laparotomy is informed by a meta-analysis conducted in 2021, which encompassed a total of five RCTs involving 281 patients [348]. he total number of patients examined for this question is low. Notably, no statistical calculations of an effect estimate are available for three of the endpoints investigated (FEV1, VC and 6-minute walk test). The risk of bias is inadequately documented or investigated in the individual studies. Furthermore, the meta-analysis does not provide any information on the type of postoperative pain therapy.

The present meta-analysis allows the conclusion that the routine application of an abdominal binder after median laparotomy reduces abdominal pain in the early postoperative course without impairing postoperative lung function. However, the validity of this assertion is constrained by several factors. Primarily, the meta-analysis is encumbered by the limited number of patients who were included in the analysis. Moreover, the quality of the individual studies is suboptimal, which further undermines the reliability of the findings. Nevertheless, given that the use of an abdominal binder in the postoperative period is associated with minimal costs and no significant adverse outcomes such as impaired wound healing or abdominal compartment syndrome are anticipated, the primary benefit of postoperative pain reduction, as one of the patient-relevant primary goals of postoperative management, is emphasised. The present meta-analysis exclusively encompasses endpoints of the early postoperative course, precluding any conclusion regarding the long-term benefits of the abdominal binder, such as the reduction in the incidence of postoperative incisional hernias. A further limitation is that the individual studies only included patients who had undergone median laparotomy with minimum incision lengths of 14 cm or 17 cm. Therefore, a statement on the effect of abdominal binders in other conventional abdominal approaches (transverse laparotomy) or minimally invasive surgery is not possible. Additionally, there is an absence of a more precise definition of the duration for which the abdominal bandage should be worn and the extent to which the bandage itself is perceived as disturbing or obtrusive.

8 Multimodal perioperative management concept (mPOM) as an overall measure

8.1 Care as part of a multimodal perioperative management concept (mPOM)

8.1.1 Esophageal resections

8.1	Evidence-based Recommendation	2023
GoR **B**	Oncologic esophageal resection **should** be performed in the context of a multimodal perioperative management concept.	
LoE ⊕⊖⊖⊖ ⊕⊕⊖⊖ ⊕⊖⊖⊖ ⊕⊕⊕⊖ ⊕⊕⊕⊕ ⊕⊕⊕⊕ ⊕⊕⊕⊕	[349] ⊕⊖⊖⊖: Mortality: no effect (OR 1.33; 95% CI 0.48 to 3.70) ⊕⊕⊖⊖: Overall morbidity: reduction due to mPOM (OR 0.68; 95% CI 0.49 to 0.96) ⊕⊖⊖⊖: Anastomotic insufficiency: reduction due to mPOM (OR 0.60; 95% CI 0.37 to 0.99) ⊕⊕⊕⊖: Postoperative hospital stay: reduction due to mPOM (SMD -1.92; 95% CI -2.78 to -1.06) ⊕⊕⊕⊕: Costs: reduction through mPOM (SMD -1.62; 95% CI -2.24 to -1.01) ⊕⊕⊕⊕: Time to first bowel movement: shortened by mPOM (SMD -1.36; 95% CI -1.78 to -0.94) ⊕⊕⊕⊕: Pulmonary complications: reduced by mPOM (OR 0.45; 95% CI 0.31 to 0.65)	
	Strong Consensus	

The meta-analysis by Triantafyllou et al. [349] combines data from a total of eight studies involving 1,133 patients. The included studies comprised four Chinese RCTs from the years 2014 to 2017. The remaining four studies were prospective observational studies from Canada, China, the USA, and the Netherlands. The quantitative synthesis yielded a reduction in the following endpoints with mPOM: overall morbidity, anastomotic insufficiency rate, pulmonary complications, costs.

Subsequent to the publication of Triantafyllou's meta-analysis, two Chinese RCTs with a limited number of cases were published in 2020, which investigated the effect of intensified enteral nutritional support in combination with an mPOM concept.

In the study by Liu et al. [73] 50 patients were randomly assigned to either an experimental arm, which received intensified pre- and postoperative enteral nutritional support in combination with mPOM, or a control arm, which received a conventional nutritional regime in combination with mPOM. The experimental arm, which received intensified nutritional support and mPOM, exhibited a reduced loss of weight, BMI and muscle mass (quantified by the ASMI, or appendicular skeletal muscle mass index). Furthermore, the experimental arm demonstrated enhanced scores on the EORTC QoL C30 questionnaire, particularly in the domains of physical

function and fatigue. No significant disparities were observed in terms of morbidity, length of stay, ICU stay, readmission, and mortality.

The RCT by Ding [350], published in part by the same authors, investigated the additional effect of mPOM in combination with an enteral nutrition programme versus an enteral nutrition regimen without mPOM in 100 patients with Ivor-Lewis esophagectomy. The results demonstrated a favourable impact of integrating mPOM with enteral nutritional support, as evidenced by enhanced nutritional status, as indicated by elevated albumin and prealbumin levels. In accordance with extant evidence on mPOM, a reduction in pulmonary infections, a faster resumption of bowel function and a shorter length of stay was also observed.

However, the significance of these findings is constrained by the limited sample size and the exploratory nature of the study, particularly in the case of the RCT conducted by Liu due to its design as a pilot study.

Research question

The extant evidence indicates a paucity of data concerning the impact of mPOM on oncological endpoints. Furthermore, there is an absence of evidence concerning the impact of mPOM on quality of life.

8.1.2 Gastric resections

8.2	Evidence-based Recommendation	2023
GoR **B**	An oncologic gastric resection **should** be embedded in a multimodal perioperative management concept.	
LoE ⊕⊕⊖⊖ ⊕⊕⊖⊖ ⊕⊕⊖⊖ ⊕⊕⊕⊖ ⊕⊕⊖⊖ ⊕⊕⊕⊕ ⊕⊕⊖⊖	[351] ⊕⊕⊖⊖: Wound infection: no effect (RR 0.83; 95% CI 0.42 to 1.62) ⊕⊕⊖⊖: Postoperative ileus: no effect (RR 1.73; 95% CI 0.84 to 3.56) ⊕⊕⊖⊖: Anastomotic insufficiency: no effect (RR 0.87; 95% CI 0.35 to 2.15) ⊕⊕⊕⊖: Pulmonary infections: mPOM shows a reduction (RR 0.51; 95% CI 0.29 to 0.91) ⊕⊕⊖⊖: Urinary tract infections: no effect (RR 1.73; 95% CI 0.84 to 3.56) ⊕⊕⊕⊕: Postoperative hospital stay: mPOM shows a reduction (MD -1.85 days; 95% CI -2.27 to -1.43) ⊕⊕⊖⊖: Costs: reduction with mPOM (MD -$548; 95% CI -761 to -335)	
	Strong Consensus	

The meta-analysis by Changsheng et al. [351] pools the data from 15 RCTs with a total of 1,216 patients that were published before February 2019. The significance of the results of the meta-analysis is limited by the following factors: only 2 of the 15 RCTs were of high quality, all included studies were from the East Asian region (possibly limited transferability to European patient populations) and there was relevant heterogeneity with regard to the results on the resumption of bowel function (Chi2= 55.85, df= 11 (p< 0.00001); I2= 80%) and the costs (Chi2= 60.16, df= 8 (p< 0.00001); I2= 87%). Despite the limitations mentioned, this meta-analysis represents

the best available evidence. The results of the meta-analysis suggest that mPOM achieves a reduction in pulmonary infections, a shorter hospital stay, a faster return to bowel function and lower costs. However, compared to conventional perioperative management, nausea/vomiting and gastric emptying disorders occur more frequently with mPOM. The readmission rate is also higher.

Following the publication of Changsheng's meta-analysis, three further relevant RCTs were published in 2020 and 2021, all of which are concordant with the meta-analysis in terms of their effects:

Cao et al. [352] randomized 171 elderly (65-85 years) patients with laparoscopic oncologic gastrectomy. The postoperative hospital stay was shorter in the mPOM arm (11 (7-11) vs 13 (8-20) days, p<0.001). In addition, there was less major morbidity, a faster recovery and a lower CRP value after mPOM.

Swaminathan et al. [353] included 58 patients with elective open gastrectomy for gastric cancer. Here, too, the postoperative hospital stay (primary endpoint) was shorter in the mPOM group (11 vs 13 days, p=0.003). In addition, there was evidence of better respiratory function in the mPOM arm on the second postoperative day.

The highest quality of the current studies is the multicenter RCT by Tian et al. [354], which recruited 400 patients with gastric carcinoma and planned laparoscopic distal gastrectomy. In the mPOM arm, there was a shorter hospital stay (7.27 vs 8.85 days), shorter time to first flatulence (2.52 vs 3.37 days), to drinking fluids (1.13 vs 3.09 days), to mobilization (1.38 vs 2.85 days) and lower costs ($6328 vs $6826). In addition, mPOM patients started their adjuvant chemotherapy earlier: 29 vs 32 days. No differences were found with regard to complications, readmission rate and mortality. The selection was limited by the exclusion of patients with neoadjuvant therapy and/or relevant comorbidities.

Even though Tian et al. investigated the start of adjuvant chemotherapy, this otherwise high-quality RCT still lacks endpoints that reflect the long-term oncological outcome. Only two retrospective cohort studies from China by Yang et al. [355] and Tian et al. [356] from 2020 are available in this regard. Yang et al. analyzed the long-term data of 1,042 patients who had undergone oncological gastrectomy with D2 lymphadenectomy at their institution between 2007 and 2012. The mPOM cohort had better 5-year overall survival than controls (73 vs 66%). Subgroup analysis by UICC stage showed that this advantage was also true for stages II and III, but not for stage I. Concordant results were also found in the study by Tian et al.

Research question

The extant evidence demonstrates a paucity of data concerning the impact of mPOM on oncological endpoints. The multicenter RCT by Tian et al. [354] only examines the endpoint "start of adjuvant chemotherapy", which can at best be considered a surrogate parameter for the oncological outcome. Consequently, there is an absence of evidence from randomised controlled trials investigating the effect of mPOM on the oncological outcome. Furthermore, there is a paucity of evidence regarding the effect of mPOM on quality of life.

8.1.3 Pancreatic resections

8.3	Evidence-based Recommendation	2023
GoR **B**	Oncologic pancreatic resection **should** be performed as part of a multimodal perioperative management concept.	
LoE ⊕⊖⊖⊖ ⊕⊖⊖⊖ ⊕⊖⊖⊖ ⊕⊖⊖⊖ ⊕⊖⊖⊖ ⊕⊖⊖⊖	[357] ⊕⊖⊖⊖: Overall morbidity reduced by mPOM (RD [risk difference] 0.96; 95% CI 0.92 to 0.99) ⊕⊖⊖⊖: Operative revision: no difference (RD 1.00; 95% CI 0.98 to 1.02) ⊕⊖⊖⊖: Postoperative pancreatic fistula (POPF): no effect (RD 0.99; 95% CI 0.97 to 1.02) ⊕⊖⊖⊖: Postoperative hospital stay: shortened by mPOM (MD -2.33 days; 95% CI -2.98 to -1.69) ⊕⊖⊖⊖: Delayed gastric emptying: less frequent with mPOM (RD 0.89; 95% CI 0.80 to 0.99) ⊕⊖⊖⊖: Mortality: no effect (RD 1.00; 95% CI 0.99 to 1.01)	
	Strong Consensus	

The meta-analysis by Kümmerli et al. [357] comprised 31 studies with a total of 3,108 patients that were published prior to August 2020. Individual patient data (IPD) were available for 17 of the 31 comparative studies. However, it was observed that only five of these studies adhered to the RCT (randomised controlled trial) framework. The remaining studies were observational, which resulted in a significant reduction in confidence in the evidence. Furthermore, the RCTs were predominantly characterised by a low number of cases. With the exception of one RCT, the intervention arms contained an average of only 49 (37-83) patients. Despite the identified weaknesses, this meta-analysis is regarded as the most robust evidence available. The results of the meta-analysis indicate that mPOM leads to a reduction in overall morbidity, a shorter hospital stay and a reduction in the rate of delayed gastric emptying. No statistically significant differences were observed between mPOM and traditional perioperative management with respect to mortality, postoperative bleeding, pulmonary complications and readmission rates.

It is noteworthy that no further relevant RCTs have been published subsequent to the publication of Kümmerli's meta-analysis. The data from the three most recent RCTs by Hwang [358], Takagi [359] and Kapritsou [360] from 2019 and 2020 have already been included in Kümmerli's meta-analysis.

The endpoints of quality of life and costs, which were not analysed by Kümmerli, were only examined by Takagi. The monocentric RCT from Japan, published in 2019, involved 74 patients who underwent pancreatoduodenectomy between 2014 and 2016 for malignant or benign indications. The study found that patients who underwent mPOM had a better quality of life (assessed using the QoR-40 questionnaire). No statistically significant difference was observed in terms of costs (25,445 vs. 28,384 $).

To date, there is a paucity of randomised controlled trials on the effect of mPOM on oncological outcomes. The most robust evidence derives from a US prospective cohort study conducted in 2020: Passeri et al. [361] compared the long-term

oncological outcomes of 86 mPOM patients with 86 controls, finding no difference in 2-year overall survival or 2-year disease-free survival after pancreatoduodenectomy between the cohorts.

Research question

The extant evidence indicates a paucity of high-quality data concerning the impact of mPOM on oncological outcomes, quality of life and costs. The results pertaining to quality of life and costs are only found in the monocentric RCT by Takagi et al. [359], and the confidence in the effect estimate is limited by the small number of cases.

8.1.4 Liver resections

8.4	Evidence-based Recommendation	2023
GoR **B**	An oncologic liver resection **should** be embedded in a multimodal perioperative management concept (mPOM).	
LoE ⊕⊕⊖⊖ ⊕⊕⊖⊖ ⊕⊖⊖⊖	[362] ⊕⊕⊖⊖: Mortality: no effect (RR 0.98; 95% CI 0.06 to 15.17) ⊕⊕⊖⊖: Overall morbidity: mPOM is associated with fewer complications (RR 0.58; 95% CI 0.48 to 0.72) ⊕⊖⊖⊖: Postoperative hospital stay: mPOM leads to a shorter postoperative hospital stay (MD -3.18 days; 95% CI -3.97 to -2.38)	
	Strong Consensus	

The meta-analysis by Noba et al. [362] combines data from six randomised controlled trials (RCTs) involving a total of 803 patients, published between 2008 and March 2019. The significance of the results of the meta-analysis is limited by the following factors: Five of the six included studies originate from East Asia (potentially limiting the transferability to European patient populations), the study included both malignant and benign resections, and there was significant heterogeneity with regard to the results on the complication rate (I2=54%) as well as the postoperative hospital stay (I2=98%). Notwithstanding the limitations mentioned, this meta-analysis represents the best available evidence. The results of the meta-analysis demonstrated that mPOM led to a reduction in the complication rate and a shorter postoperative hospital stay when compared to a conventional perioperative treatment regime. However, the analysis did not demonstrate a significant impact on mortality.

Subsequent to the publication of Noba's meta-analysis, three additional relevant RCTs were published in 2020 and 2021, all of which corroborated the meta-analysis with respect to their outcomes:

Kang et al. [363] randomized 250 patients with partial liver resection or hemihepatectomy. The postoperative hospital stay was shorter in the mPOM arm (8 days [6 to 10] vs. 9 days [7 to 11]; p=0.022). In addition, no complications occurred more frequently in the mPOM arm (72% vs 52%; p=0.001). With regard to Clavien-Dindo complications > I, mortality and readmission rate, no statistical differences were detectable.

Nakanish et al. [364] randomized only 57 patients over a period of just under 3 years. In this small group, there was only an advantage for mPOM with regard to the time of the first flatus and the first defecation. In all other endpoints (time until patients were considered fit for discharge, length of hospital stay, mortality, Clavien-Dindo morbidity ≥ 3, mortality, first ambulation and freedom from infusions), no difference could be identified.

Jones et al. [365] included 91 patients with elective open liver resection. This study only examined endpoints that were not covered in the meta-analysis. Firstly, mPOM resulted in a lower median total cost (£9,538 vs £14,793). However, a statistical analysis of these data is not available. On the other hand, a survival benefit was demonstrated in the mPOM arm after 2 years (91% vs 73%, p=0.03), but this was not detectable after 1 and 5 years.

No data on the oncological outcome are available from randomized controlled trials. Day et al. [366] evaluated 118 patients with liver resections in a prospective cohort study. One of the endpoints was the initiation of necessary adjuvant chemotherapy. In the mPOM arm, 38 patients required adjuvant chemotherapy, in the arm with traditional perioperative therapy 24 patients. Patients in the mPOM arm were able to start adjuvant therapy more frequently (96% vs 87%) and faster (45 vs 60 days). However, long-term survival data is completely lacking in this study.

Research question

The extant evidence indicates a paucity of data concerning the impact of mPOM on oncological endpoints. Furthermore, there is an absence of evidence concerning the impact of mPOM on quality of life.

8.1.5 Colorectal resections

8.5	Evidence-based Recommendation	2023
GoR **A**	A colorectal resection **shall** be embedded in a multimodal perioperative management concept (mPOM).	
LoE ⊕⊕⊖⊖ ⊕⊕⊖⊖ ⊕⊕⊕⊖ ⊕⊕⊕⊖ ⊕⊕⊖⊖ ⊕⊕⊕⊖	[367], [368] ⊕⊕⊖⊖: Mortality: no effect (RR 0.89; 95% CI 0.34 to 2.3 or Greer et al.: OR 1.79; 95% CI 0.81 to 3.95) ⊕⊕⊖⊖: Complications: fewer with mPOM (RR 0.59; 95% CI 0.40 to 0.86 or Greer et al.: RR 0.66; 95% CI 0.54 to 0.80) ⊕⊕⊕⊖: Time to first flatus: shorter with mPOM (MD -12.18 hours; 95% CI -16.69 to -7.67) ⊕⊕⊕⊖: Time to first bowel movement: shortened with mPOM (MD -32.93 hours; 95% CI -45.36 to -20.5) ⊕⊕⊖⊖: Wound infections: no effect (RR 0.75; 95% CI 0.52 to 1.07) ⊕⊕⊕⊖: Postoperative hospital stay: mPOM shortened (MD -2.0 days; 95% CI -2.52 to -1.48 or MD -2.59 days; 95% CI -3.22 to -1.97)	
	Strong Consensus	

The meta-analysis by Ni et al. [367] combines data from 13 RCTs, encompassing a total of 1,298 oncology patients. The significance of the results of the meta-analysis is limited by the following factors: Firstly, three of the included RCTs exclusively evaluated rectal resections, while the remaining ten encompassed a combination of colorectal resections. Furthermore, the analysis was exclusively focused on laparoscopic procedures. Furthermore, substantial heterogeneity was observed in the results concerning the resumption of bowel function (I^2=92% and 96%), the complication rate (I^2=57%), and the postoperative hospital stay (I^2=95%). Notwithstanding the limitations mentioned, this meta-analysis represents the best available evidence. The results of the meta-analysis suggest that mPOM leads to a reduction in complications, a shorter postoperative hospital stay and a faster return to bowel function compared to a conventional perioperative treatment regimen. The mortality rate remains unaltered by mPOM.

The second available current meta-analysis of good quality by Greer et al. [368] (available in detail at https://www.hsrd.research.va.gov/publications/esp/eras.cfm), in which 20 RCTs and 4 controlled clinical trials with 3,787 patients were pooled, included studies with both laparoscopic and open colorectal resections. The analysis included both oncological and benign diseases. The meta-analysis revealed that mPOM led to a reduction in overall morbidity and a comparatively shorter postoperative hospital stay when compared to a conventional perioperative treatment regime. Mortality and wound infection rates were comparable.

Following the publication of Ni's meta-analysis, seven additional relevant RCTs were published from 2019 to 2021, all of which were consistent with the findings of the two meta-analyses. The four studies with a cohort size of >100 are presented below:

Li et al. [369] randomised 200 patients with elective laparoscopic colorectal resection due to carcinoma. However, it should be noted that the study population was exclusively composed of patients between the ages of 55 and 65 years. The

postoperative complication rate was found to be lower in the mPOM arm (12% vs. 25%; p=0.028). Furthermore, in this study, mPOM was found to result in a more rapid resumption of bowel function (defined as the first defecation postoperatively; mean 60±17 hours vs. 69±16 hours; p=0.0001). Furthermore, patients in the mPOM arm were extubated more quickly. Furthermore, the laboratory parameters albumin and total protein were higher in the mPOM arm on postoperative day 7.

De Queiroz et al. [370] randomized 161 patients with elective laparoscopic colorectal resection. The length of hospital stay was shorter in the mPOM arm (median 3.0 days vs. 5.0 days, p<0.0001). In addition, bowel function (defined as the ability to flatus) was faster in the mPOM arm (65% vs 35% on the first postoperative day, p=0.002). Tolerance of solid food was also possible earlier in the mPOM arm and pain medication consumption was lower.

Ng et al. [371] randomized 150 patients between 18 and 80 years of age with colon or high rectal cancer. In the mPOM arm, there was a shorter postoperative hospital stay (4 [2-24] days vs 5.5 [4-59] days, p<0.001), less pain, improved quality of life, earlier tolerance of solid food, faster return of bowel function and the ability to walk independently. No significant effect was found with regard to complications (p=0.051), readmission rate, mortality and costs.

Ostermann et al. [372] randomized 150 patients ≥ 70 years with planned open or laparoscopic colorectal resection (malignant and benign). In this cohort, MPOM led to a reduction in overall morbidity (35% vs 65%, p=0.0003), infectious complications, incidence of anastomotic leakage and length of hospital stay (7 vs 12 days, p=0.003).

No randomized controlled trials are available to date on the effect of mPOM on oncological outcomes. In 2014, a prospective cohort study by Lohsiriwat [373] compared colorectal resections performed in an emergency setting (mPOM 20 patients vs. 40 patients with traditional perioperative management). In patients in the mPOM arm, necessary adjuvant therapy could be initiated significantly faster (37 vs 49 days, p=0.009). The same working group also conducted a prospective cohort study in 2021 [374], which investigated long-term oncological survival in 359 patients. The 5-year survival in the mPOM arm was 80.3% versus 65.6% with traditional management. mPOM was associated with better 5-year survival in UICC stage III (73% vs 57%, p=0.041). However, this effect could not be demonstrated in stages I and II. In a subgroup analysis of UICC stage III patients, 5-year survival was improved in the mPOM arm for rectal cancer (68.8% vs. 48.7%; p=0.035), but not for colon cancer. A Swedish cohort study of 911 consecutive patients [17] was associated with better adherence to mPOM measures with 5-year cancer-specific survival (HR 0.58; 95% CI 0.39 to 0.88). A Polish cohort study also showed very similar results [19].

Research question

The extant evidence indicates a paucity of data concerning the impact of mPOM on oncological endpoints. Furthermore, there is an absence of evidence concerning the impact of mPOM on quality of life.

8.2 Perioperative support from specialists in perioperative interventions

8.6	Evidence-based Recommendation	2023
GoR **0**	In the context of a multimodal perioperative management concept (mPOM), patients undergoing colorectal resection can receive perioperative accompaniment from a specialist in perioperative interventions.	
LoE ⊕⊕⊖⊖ ⊕⊕⊕⊖ ⊕⊕⊕⊖	[83] ⊕⊕⊖⊖: Mortality: no effect (0/80 in the arm with specialist vs 2/84 in the control arm, p=0.17) ⊕⊕⊕⊖: Overall morbidity: no effect (29/80 in the arm with specialist vs. 37/84 in the control arm, p=0.31); likewise, no differences in the individual consideration of major (anastomotic insufficiency, ileus/post-operative bleeding with need for reoperation, multi-organ failure) and minor complications (wound infection, pneumonia, intestinal atony, pleural effusion, pulmonary embolism, urinary tract infection, etc.). ⊕⊕⊕⊖: Postoperative hospital stay: reduction through the use of a specialized specialist (5 (2-24) days vs. 7 (2-35) days)	
	Consensus	

8.7	Consensus-based Recommendation	2023
EC	For patients undergoing non-colorectal visceral oncological resection in the context of a multimodal perioperative management concept, care by a specialist in perioperative interventions **may** be considered.	
	Strong Consensus	

To date, only one monocentric RCT by Forsmo et al. [83] from Bergen, Norway, is available on the question of the importance of support for mPOM patients by a specialist.

The study investigated the extent to which the utilisation of a specialist in the context of a multimodal perioperative management concept provides an additional benefit compared to mPOM without a specialist. The primary endpoint of the RCT was the total length of hospital stay (sum of the primary inpatient stay plus any inpatient days after readmission due to complications). Secondary endpoints included postoperative complications, reoperation rate, and mortality. The study population comprised 164 patients who had undergone planned laparoscopic or open elective colorectal surgery for a benign or malignant underlying disease. These patients were randomised within 1.5 years of recruitment (03/2015-12/2016).

The postoperative and total hospital stay were found to be shorter in the arm that was accompanied perioperatively by a specialist. Furthermore, adherence to the core elements of mPOM was higher in the intervention group, including earlier mobilisation, faster initiation of oral nutrition, faster pain control with oral analgesics,

and earlier first bowel movement. However, the two arms did not differ with regard to postoperative complications, reoperation rate, readmission rate and 30-day mortality.

Despite the RCT by Forsmo et al. being of high methodological quality, the evidence base for a recommendation remains very weak due to the lack of further studies, with the exception of the lack of blinding, monocentric setting and rather small number of cases.

The absence of robust evidence precludes the formulation of recommendations for other organ entities, such as the esophagus, stomach, liver, and pancreas.

The current body of evidence does not permit any conclusions to be drawn about the effect of perioperative support provided by a specialist in the mPOM context on oncological endpoints or on quality of life.

9 Quality indicators

Quality indicators are defined as measures that are utilised for the evaluation of the quality of the underlying structures, processes and results. These indicators represent a pivotal instrument within the domain of quality management. The overarching objective of their utilisation is to facilitate continuous improvement in healthcare outcomes by means of the presentation, critical reflection, and, when deemed necessary, enhancement of care results. The selection of quality indicators under discussion was created in accordance with the methodology of the Oncology Guidelines Program [375]. The development process involved the establishment of a "Quality Indicators Working Group" (AG QI). This group was responsible for deriving the final set of quality indicators, which were informed by the strong recommendations ("should") of the new guideline "Perioperative management of gastrointestinal tumours" and the results of a comprehensive search for existing national and international quality indicators. The precise procedure and composition of the WG QI are delineated in the guideline report.

Following two online meetings of this working group, the final set of four quality indicators (QI) was defined.

It is imperative to note that the numerator is invariably a subset of the denominator.

It is important to note that none of the aforementioned quality indicators are to be documented with the oncological basic data set of the cancer registries. (Status: 03/2022).

Tabelle 4: Quality Indicators

Quality Indicator	Reference Recommendation	Evidence Basis / Additional Information
QI 1: No intra-abdominal drainage after elective oncological colorectal resections (new 2023)		
Enumerator Pat. of the denominator with intra-abdominal drainage **Denominator** All patients with colon carcinoma (C18) or rectal carcinoma (C20) and elective resection	Bei elektiven kolorektalen Resektionen **soll keine** intraabdominelle Drainage eingelegt werden.	**Quality objective** As few intra-abdominal drains as possible after elective colorectal resection: Quality target 0%
QI 2: No drainage after uncomplicated oncological liver resections (new 2023)		
Enumerator Pat. of the denominator with insertion of a drainage **Denominator**	Bei unkomplizierten Leberresektionen **soll keine**	**Quality objective:**

Quality Indicator	Reference Recommendation	Evidence Basis / Additional Information
All patients with gastrointestinal tumour and uncomplicated liver resection	prophylaktische Drainage eingelegt werden.	As few drains as possible after uncomplicated oncologic liver resections Remark: • Quality target 0% • Uncomplicated liver resection = liver resection without biliary or vascular reconstruction

QI 3: No feeding tube after extubation (new 2023)

Enumerator Patients of the denominator without feeding tube after extubation **Denominator** All patients with \- gastrectomy or partial gastric resection or \- elective liver resection or \- elective colorectal surgery	Bei elektiven kolorektalen Eingriffen **soll** eine nasogastrale Sonde vor Narkoseausleitung gezogen werden.	**Quality objective:** As many patients as possible without a feeding tube after extubation

QI 4: No permanent transurethral catheter 24h after the end of surgery (new 2023)

Enumerator Patients of the denominator without transurethral indwelling catheter 24h after the end of the surgery of the denominator **Denominator** All patients with oncologic colon resection	Der transurethrale Dauerkatheter **soll** bei kolorektalen Resektionen innerhalb der ersten 24 Stunden entfernt werden. Bei Risikofaktoren für einen Harnverhalt (männliches Geschlecht, tiefe anteriore Rektumresektion, Rektumexstirpation) **kann** eine verlängerte Ableitung bis zum 3. postoperativen Tag erfolgen.	**Quality objective:** As many patients as possible without permanent transurethral catheters 24 hours after the end of surgery

10 List of Tables

Table 1: Participating professional associations and organizations (alphabetical) 9

Table 2: Composition of Guideline Workgroups 12

Table 3: Abbreviations Used 13

Tabelle 4: Quality Indicators 119

11 List of Figures

Figure 1: Surgical procedures lead to perioperative immunosuppression and increase the risk of metastasis 23

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