Perioperative Medicine

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Contents

F. Billmann, T. Keck (eds.), *Essentials of Visceral Surgery*,
https://doi.org/10.1007/978-3-662-66735-4_15

15.1 Preoperative Phase

Key Points

- Risk stratification (patient-related, surgery-related risk factors, medication, laboratory chemistry).
- Determination of perioperative anticoagulation and medication management.

15.1.1 Risk Stratification

- Patient-related surgical risk depending on the patient's state of health and the invasiveness of the operation.

Identification of Patient-Related Risks

- Careful anamnesis, thorough examination.
- Presentation in the anaesthesia department (ideally max. 6 weeks before surgery).
- Initiate further diagnosis.
- General condition of the patient according to ASA classification:
  - Description of preoperative health status, 1 (healthy patient) to 6 (brain-dead patient at organ removal ◘ Table 15.1).

Systemic Diseases with High Postoperative Risk

- Cardiovascular System:
  - Various scores: RCR (Revised Cardiac Risk) index according to Lee (Lee et al. 1999), NYHA (*New York Heart Association)* classification, MET (metabolic equivalent).
  - Risk factors for cardiovascular complications: Coronary artery disease (CAD), heart failure, fresh myocardial infarction, chronic venous insufficiency (CVI), insulin-dependent diabetes mellitus (IDDM), chronic renal failure, cardiac arrhythmia (CAr), fresh insult.
  - Diagnosis: 12-lead ECG, echocardiography, exercise ECG, coronary angiography, carotid Doppler, chest X-ray.

◘ **Table 15.1** ASA (American Society of Anesthesiologists) classification

Class	Criteria
ASA 1	Normal, healthy patient
ASA 2	Patient with mild general illness
ASA 3	Patient with severe general illness
ASA 4	Patient with a severe general illness that is a constant threat to life
ASA 5	Moribund patient unlikely to survive without surgery
ASA 6	Brain-dead patient whose organs are removed for organ donation

- Pulmonary disease:
  - Different scores for the prediction of postoperative ventilation risk and re-intubation.
  - Increased risk in chronic obstructive pulmonary disease (COPD), asthma, obesity, obstructive sleep apnoea syndrome (OSAS) and smokers.
  - Diagnosis: chest X-ray, blood gas analysis BGA, lung function test.
- Diabetes mellitus:
  - Perioperative normoglycemic setting: blood glucose (BG) = 140–180 mg/dl and close-meshed BG controls.

Perioperative Risk (◘ Table 15.2)

- Depending on invasiveness, duration and possible blood loss.
  - Mild: minor endoscopic and outpatient procedures, breast surgery.
  - Moderate: intraperitoneal, intrathoracic surgery, orthopedics.
  - High: Aortic surgery, vascular surgery.

Intubation Conditions

- To estimate a possible difficult airway.
- Mallampati score (relation of tongue size to pharynx).
- Head reclination.
- Mouth opening.
- 3-3-2 rule (mouth opening >3 fingers, os hyoideum chin distance ≥3 fingers, thyromental distance >2 fingers).
- Aspiration risk.

Table 15.2 Risk of perioperative myocardial infarction or death within 30 days after surgery

Low <1%	Mean 1–5%	High >5%
Chest Tooth Eye Gynecology Minor orthopedic surgery (knee) Urology	Visceral surgery Carotid Angioplasty Endovascular aneurysms Head and neck Major orthopedic surgery Transplant Major urological surgery	Aorta Major vascular surgery PAOD Esophagectomy Cystectomy Pneumonectomy

PAOD peripheral arterial occlusive disease

15.1.2 Laboratory and Blood Products

Blood Management

- Preoperative anemia prevalence: approx. 30%.
- Risk factor for perioperative morbidity and mortality.
- Preoperative improvement through "patient blood management" by increasing erythropoiesis (erythropoietin, iron substitution).
- Preoperative blood transfusion.
- Preparation of packed red blood cells (PRBCs) depending on the planned procedure.
- **Caution:** PRBCs administration: increased morbidity, mortality and risk of complications.

Laboratory Diagnosis

- Blood tests dependent on:
  - Age.
  - ASA classification (see above).
  - Operation.
  - Risk profile of the patient.
- Small blood count, electrolytes, coagulation, BG, creatinine, transaminases.
- No routine screening.

15.1.3 Additional Investigations

ECG

- Preoperative ECG not necessary in asymptomatic and anamnestically unremarkable patients.
- ECG recommended for
  - Patients with cardiac symptoms and/or
  - Abnormal cardiac history.

Chest X-Ray

- Indicated for new onset or acutely symptomatic respiratory symptoms.

Pulmonary Function Diagnosis

- Indicated for severity assessment in new-onset or acutely symptomatic pulmonary disease, lung surgery.

15.1.4 Perioperative Anticoagulation

Coronary Artery Disease and Stent Implantation

- Metal stents: dual platelet aggregation inhibition up to 3 months.
- DES (Drug Eluting Stent): Time interval up to 12 months.
- If possible, no elective operations during this period.
- Commonly used: Acetylsalicylic acid (ASA), dipyridamole, clopidogrel, prasugrel, ticagrelor.
- Perioperative discontinuation: Increased rate of cardiovascular events due to rebound phenomenon = continue ASA.
- Bleeding risk:
  - ASA only moderate bleeding risk, exceptions: NCH (neurosurgery), prostate resection…
  - Dual platelet aggregation = high risk of bleeding: discontinue 7–10 days prior to major procedures, procedures in closed body cavities, and spinal anesthesia close to the spinal cord.

Perioperative Thrombosis Prophylaxis

- Venous thromboembolism = still clinically relevant complication.
- The more morbid the patient, the higher the risk of thrombosis.
- Incidence can be reduced by 50% through prophylaxis.
- Parenteral: Unfractionated heparin (UFH), low-molecular-weight heparin (LMWH), Fondaparinux.

Caution
Heparin-induced thrombocytopenia type II (HIT II) in UFH and LMWH.

- Alternative anticoagulants:
  - Argatroban (Agarta): for HIT II.
  - Bivalirudin (Angiox): Alternative to UFH for coronary intervention.
  - Phenprocoumon.

New Oral Anticoagulants (NOACs/DOACs)

- Pradaxa (dagibatran etexilate) and Xarelto (rivaroxaban) for:
  - Knee and hip joint replacement.
  - Stroke prophylaxis in atrial fibrillation.
  - Therapy for venous thromboembolism.
- Eliquis (apixaban) approved for knee and hip replacements.

15.1.5 Medication Management

Continue

- Antianginal, antihypertensive and antiarrhythmic medication:
  - Beta-blockers: otherwise increase in mortality due to rebound phenomenon; preoperative new medication can be considered with sufficient distance to surgery and high-risk patients.
  - Calcium antagonists: Otherwise possible preoperative blood pressure increase.
  - Nitrates: risk of myocardial ischemia.
  - Antiarrhythmic drugs: risk of arrhythmias.
- Corticosteroids:
  - Continue substitution for longer than 5 days if substitution is already in place.
  - In addition, 50–200 mg hydrocortisone perioperatively over 48 h in patients with long-term medication above the Cushing's threshold, depending on the severity of the procedure.
- Statins:
  - Continue perioperatively.
  - New prescription after vascular surgery.
  - Reduce perioperative risk of infarction.
- Anticonvulsants: triggering seizures.
- Parkinson's drugs: enhancement of extrapyramidal symptoms.
- Thyroid hormones.
- Psychotropic drugs:
  - Tricyclic antidepressants.
  - Neuroleptics.
  - Selective serotonin reuptake inhibitors.
  - Third generation MAO (monoamine oxidase) inhibitors.

Caution
Perioperative drug interaction.

Convert

- Phenprocoumon: convert to heparin 3–5 days before surgery.
- MAO inhibitors: Switch to reversible and selective third generation MAO inhibitors 2 weeks prior to surgery.

Discontinue

- Diuretics
  - Otherwise risk of hypovolaemia with hypotension.
  - Immediate restart after surgery in stable patients.
- ACE (angiotensin converting enzyme) inhibitors and AT II (angiotensin II) blockers
  - Danger of perioperative hypotension in operations with high volume shifts, otherwise due not discontinue.
- Digitalis
  - Controversially discussed.
  - Long half-life, short-term discontinuation associated with little benefit.
  - Continue in patients with normofrequency absolute arrhythmia.

- OAD (oral antidiabetic drugs)
  - Risk of hypoglycaemia: Regular perioperative BG measurements.
  - Metformin: Risk of lactic acidosis, discontinue 48 h before surgery.

Endocarditis Prophylaxis

- Depends on operation and patient-related risk
  - Patients with valve replacements (mechanical and biological prostheses), patients with reconstructed valves using grafts for 6 months after surgery.
  - Patients after endocarditis.
  - Patients with congenital heart defects (cyanotic, postoperative).
  - Patients after heart transplant, with cardiac valvulopathy.
- For interventions in the gastrointestinal tract or urinary tract
  - Prophylaxis only in cases of an infection of these organs.
  - Amoxicillin: 2 g single dose 60 min before surgery.
  - In case of penicillin or ampicillin allergy: Clindamycin 600 mg.

15.1.6 Information from the Anaesthetist's Point of View

Legal Situation (Germany)

- Any medical interference with bodily integrity: criminal offence of bodily harm.
- Consent of the patient only legal after detailed explanation and documentation.
- If possible, 24 h before planned surgical intervention.

Prerequisite

- The patient has to understand and decide, voluntariness.
- Patients who have reached the age of majority and have the capacity to consent and make decisions.
- In the case of minors and persons incapable of giving consent: Parents, legal guardians.

Requirement

- Explanation of the relevant information.
- Procedure with risks typical of procedures and anaesthesia.
- Various therapy options with risk-reward consideration.
- Understanding the patient.
- 3 phases of enlightenment according to hick:
  - Comprehensive information.
  - Summary.
  - Decision of the patient.

Elements of Consent

- Decision for a course of action (alternatives).
- Placement of the treatment order.
- **Caution:** Documentation is obligatory (in writing).

Outpatient Interventions

- For minor surgery: Consent is possible directly prior to surgery (without premedication).

Living Will or Health Care Proxy

- For major procedures or anticipated intensive care stays, inquire about.

15.2 Intraoperative Phase

Key Points

- Essential intraoperative monitoring.
- Central importance of volume management, thermal homeostasis and hemodynamics.

15.2.1 Intraoperative Monitoring According to AAGBI and BDA Guidelines

- WHO checklist, team time-out before start of surgery.
- Essential Equipment:
  - Ventilation system with CO_2 –, O_2 – and ventilation pressure measurement.
  - Pulse oximetry.

  - NIBD (non-invasive blood pressure measurement).
  - ECG.
  - Relaxometry.
  - Temperature measurement.
  - Defibrillator and cardiopulmonary resuscitation equipment.
  - Infusion pumps.
- In addition, according to the severity of the intervention and the morbidity of the patient:
  - Invasive blood pressure measurement and haemodynamic monitoring.
  - Transesophageal Doppler.
  - Cerebral measurement of oxygen saturation.
  - Blood glucose meter.
  - BIS (Bispectral Index) Monitor.

15.2.2 Volume Management

- Avoid preoperative exsiccosis and malnutrition.
- Hemostasis and coagulation management.
- Surgical technique and careful haemostasis decisive.
- Implementation of an evidence-based perioperative transfusion regime.
- Measures to save foreign blood.
- Normothermia and avoidance of acidosis.
- if necessary, use of hemostatic drugs (tranexamic acid, Minirin).

15.2.3 Hemodynamics

Pathophysiology

- MAP (mean arterial pressure) <60 mmHg: decrease in cerebral and renal blood flow.
- Critical perfusion pressure of the coronaries dependent on cardiac output (CO).

Risk Factors for Hypotension

- Age.
- ASA classification.
- Duration of the operation.
- Combined regional and general anaesthesia.
- Premedication.
- Storage.
- Intraoperative hypotension associated with increased 1-year mortality.

Principles/Goals

- MAP >60 mmHg, in hypertensive patients >80 mmHg.
- Early initiation of volume and catecholamine therapy, if necessary with hemodynamic monitoring.

15.2.4 Heat Retention

- Perioperative hypothermia = risk factor for
  - Worsened outcome.
  - Wound healing disorder.
  - Extended length of stay in hospital.

15.2.5 Perioperative Antibiotic Therapy

Incidence of SSI ("Surgical Site Infection")

- Wound healing disorders in approx. 10% of all operations.
- 16% of all nosocomial infections.
- Up to 24.5% after gastrointestinal surgery.
- Lead to longer hospital stays.
- Additional costs.

Risk Factors

- Patient-Related:
  - Diabetes mellitus.
  - Obesity.
  - Clotting disorder.
  - Age.
  - Malnutrition.
  - Medication.
- Patient-independent:
  - Hygiene standards.
  - Operating time.
  - Inadequate perioperative antibiotic therapy.

Pathogen Spectrum

- According to the type and location of the intervention
  - Frequently mixed infections with enterobacteria, approx. 2/3 of all infections by: E. coli, Enterococcus spp., Bacteroides spp., Pseudomonas aeruginosa.
- Multi-resistant germs:
  - MRSA (methicillin-resistant Staphylococcus aureus).
  - MRSE (coagulase-negative staphylococci with methicillin/oxacillin resistance).
  - VRE (vancomycin-resistant enterococci).
  - ESBL (extended spectrum beta-lactamases).

Prevention

- Avoid preoperative medications: NSAIDs (non-steroidal anti-inflammatory drugs), chemotherapy, phenprocoumon.
- Optimize concomitant diseases.
- Perioperative antibiotic administration.
- Hygiene measures: Hand disinfection, area clothing, asepsis.
- Wound closure without impairment of local blood circulation.
- Drains as short as possible in situ.

Caution
No recommendation for irrigation of the abdominal cavity before wound closure.

Perioperative Antibiotic Prophylaxis (PAP)

- Requirement: bactericidal, i.v. application, tolerable
- Two goals:
  - Reduction of bacteria introduced into the surgical area.
  - Prevention of systemic germ introduction.
- Antibiotic of choice: aminopenicillins plus beta-lactam inhibitor or first or second generation cephalosporins.
- Second choice antibiotic: third or fourth generation cephalosporins in combination with metronidazole or carbapenem.
- Time of application: 1 h before to 2 h after skin incision.

Caution
Vancomycin or fluoroquinolones have a longer infusion duration (60 min).

- In case of bacteriological sample collection (e.g. blood culture), administration after sample collection.
- 1–2 doses only for 24 h after surgery, if necessary only single dose.
- For long operations second dose intraoperatively.

15.3 Postoperative Phase

Key Points

- Determination of a strategy for postoperative analgesia.
- Prevention/treatment of PONV, delirium, POCD.
- Principles of fast-track surgery.

15.3.1 Analgesia

Pathophysiology

- Prevention:
  - Delirium.
  - Chronification.
  - Cardiorespiratory problems.
  - Delayed mobilization.

Evidence-Based Analgesia

- Evidence-based analgesia positive for:
  - Earlier hospital discharge.
  - Reduce morbidity.

Pain Measurement

- Measurement of pain by:
  - VAS (visual analogue scale).
  - NRS (numerical rating scale).
  - If possible 2-hourly in the first 24 h.

Caution
Increase in pain or new onset of increased analgesic consumption: indication of complications.

Principles

- Individual adaptation to patient, comorbidity.
- Stepwise therapy according to WHO analgesic ladder.
- Administration of opioids as sparingly as possible.
- Use coanalgesics such as clonidine, spasmolytics.
- Prefer perioperative epidural anesthesia.

15.3.2 Postoperative Nausea and Vomiting (PONV)

Forecasting Systems

- For the assessment of postoperative nausea and vomiting.
- E.g. Apfel Score:
  - Female.
  - History of PONV/kinetosis.
  - Non-smoker.
  - Opiate administration.

Prophylaxis

- Regional anaesthesia, no volatile anaesthetics, avoid opiates.
  - Medications:
    - Corticosteroids (dexamethasone).
    - 5-HT_3 antagonists: administration at the end of surgery.
    - No butyrophenones or benzamines because of possible extrapyramidal motor effects.
- Adjuvants: Acupuncture/acupressure on the wrist, aromatherapy, ginger.

Therapy

- Quick action.
- 5-HT_3 antagonists as first-choice drugs.
- Dexamethasone only slow onset of action, only in combination.
- Alternative: haloperidol, dimenhydrinate, promethazine.

15.3.3 Delirium/Postoperative Cognitive Deficit (POCD)

Epidemiology

- Prevalence 15–50%, ventilated patients up to 80%.
- Longer hospital stay, increased mortality, and cognitive late effects on long-term follow-up.

Division

- Three types:
  - Hyperactive.
  - Hypoactive.
  - Mixed type.
- Three forms of postoperative cognitive deficit:
  - Emergence Delirium: at discharge.
  - Postoperative delirium.
  - Transient cognitive impairment.

Preoperative Evaluation of Risk Factors

- Age.
- Morbidity.
- Cognitive skills.
- Severity of the surgical procedure.
- Hypoxia.
- Infection.

Prevention

- Avoid preoperative food restriction and fluid deficit.
- Stress avoidance (isolation, lack of daylight, restraint).
- Communication aids (glasses, hearing aid).
- Early mobilization.
- Avoid prodelirant drugs (e.g. benzodiazepines, opiates, sedative hypnotics).

Early Screening

- CAM-ICU (Confusion Assessment Method/Intensive Care Unit), ICU:

- Acute onset or fluctuating course.
- Attention Deficit Disorder.
- Changes in awareness.
- Disorganized thinking.

- Nu-DESC (Nursing Delirium Screening Scale), PACU.

Therapy

- Most important tool: Recognition of delirium.
- Reduce risk factors.
- Strengthen reorientation.
- Drug therapy:
  - Haloperidol.
  - Atypical neuroleptics.
  - Dexmedetomidine.
- **Caution:** Haloperidol: QT time, extrapyramidal symptoms at more than 4.5 mg/day.

15.3.4 Recovery Room (PACU)

- Regular documentation of vital parameters.
- Surveillance:
  - State of alertness according to AVPU ("alert, voice, pain, unresponsive") scheme, protective reflexes present.
  - Circulatory situation: blood pressure, heart rate, ECG.
  - Airway: pulse oximetry, oxygen supply and if necessary airway protection e.g. by Wendl tube.
- Assessment of dressings and drains.
- Recognize and Treat:
  - PONV.
  - Shivering.
  - Restlessness.
  - Postoperative pain.
- Transfer if:
  - Patient awake, cooperative, preserved protective reflexes.
  - No more risk from anaesthesia and perioperative respiratory or circulatory problems.
  - Discharge criteria met.
  - Responsibility for discharge lies with anaesthetist.
  - Transfer to another ward/home.

15.3.5 Intensive Care Unit (ICU)/ Intermediate Care (IMC)

- In addition to the tasks of the PACU listed above:
  - Ward with monitoring and treatment of patients after extensive operations.
  - Monitoring and treatment of patients with high morbidity/mortality after minor surgery.
  - Circulatory the rapy.
  - Weaning.
  - Pre-operative stabilisation and preparation for surgery.
  - Organ-specific support.

15.4 Fast Track Surgery

Key Points

- Evidence-based multimodal interdisciplinary perioperative treatment concept.
- Goals = Shortening of treatment duration + Reduction of perioperative complications.

15.4.1 Definition

- Multimodal interdisciplinary perioperative treatment concept according to defined clinical treatment algorithms.
- Objectives
  - Shortening the duration of treatment.
  - Reduction of perioperative complications.

15.4.2 Preoperative Management

- Short preoperative food abstinence.
- Premedication with short-acting substances.

15.4.3 Intraoperative Management

- Atraumatic surgical technique.
- Anaesthetic guidance with short-acting substances.
- PONV prophylaxis.
- Peridural analgesia: Improves perioperative mortality and reduces tumor recurrence rate.
- Balanced volume therapy.
- **Caution:** Intestinal edema.
- Avoid hypothermia.
- Periopertiave antibiotic prophylaxis.

15.4.4 Postoperative Management

Analgesia

- Peridual anesthesia instead of systemic opiate administration.
- Analgesia according to WHO stage scheme.

Caution
Gastrointestinal bleeding is possible with NSAIDs.

Early Mobilization

Optimized Diet

- Epidemiology: mortality rate in ICU patients with gastrointestinal failure 43.7% vs. 5.3% without gastrointestinal failure.
- Pathophysiology:
  - Operation = motility disorder.
  - Motility disorder = passage disorder (bacterial density increased) + barrier function impaired.
  - Causes of motility disorder:
    - Drugs (opiates).
    - Immobilization.
    - Electrolyte derailments.
    - Shock.
    - Inflammation of the intestinal wall due to cytokine release also during surgical interventions.
    - Bowel wall edema.
    - Increased sympathetic tone with vasoconstriction in the splanchnic area.
- Fast track therapy.
  - Keep alimentation interruption as short as possible.
  - Start enteral nutrition early.
  - Laxatives (lactulose, macrogol).
  - Prokinetics (metoclopramide, erythromycin, neostigmine).
  - Opiate receptor antagonist (Relistor).

15.4.5 Guidelines

ESC/ESA (2014) Guidelines on non-cardiac surgery: cardiovascular assessment and management. Eur Heart J 35:2383–2243.

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