Rectum

Jens Wannenmacher and Stefan Willis

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F. Billmann, T. Keck (eds.), *Essentials of Visceral Surgery*,
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4.1 Anatomy and Physiology

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4.1.1 Definition, Location and Structure

Definition

- Part of the large intestine between sigmoid colon and anus

Location

- In the pelvis with close relationship to neighbouring organs—therefore special features in diagnosis and therapy

Limits

- Boundary between colon and rectum defined differently: in Germany at 16 cm and in the USA at 12 cm (from anocutaneous line (a.a.) measured with rigid rectoscope (caution literature comparison)
- According to the Union for International Cancer Control (UICC) division into 3 parts:
  - Upper third 12–16 cm a.a. (= intraperitoneal portion)
  - Middle third 6–12 cm a.a.
  - Lower third <6 cm a.a.

4.1.2 Anatomy and Embryology

Topographic Anatomy

- Curved course along the sacrum and the coccygeal bone to the levator funnel
- Dorsal retroperitoneal position up to the promontory, ventral variable peritoneal envelope (excavatio rectouterina in females or rectovesicalis in males)
- Extraperitoneal envelopment of the rectum by the mesorectum with the lymphovascular pathways
- Circumferential boundary of the mesorectum by the visceral pelvic fascia, which turns into the parietal pelvic fascia at the level of the pelvic floor, in between avascular separating layer
- Denonvillier's fascia = ventral part of the parietal pelvic fascia (covering of vagina or seminal vesicle and prostate together with associated vessels and nerves)
- Waldeyer's fascia = dorsal part of the parietal pelvic fascia (covering the presacral venous plexus and the vegetative hypogastric and pelvic nerves)
- Inferior part of the rectum without mesorectal and fascial envelope

Blood Supply and Drainage

- Arterial Supply:
  - From cranial = superior rectal artery (end section of the inferior mesenteric artery, course: dorsal in the mesorectum)
  - From caudal: inferior rectal artery (from A. iliaca interna), occasionally inconstant middle rectal artery
- Venous drainage:
  - 2/3 oral: drainage in superior rectal vein to inferior mesenteric vein and portal vein
  - 1/3 aboral: drainage in middle rectal veins + inferior rectal veins to internal iliac vein and inferior vena cava
- Lymphatic drainage: bidirectional
  - Cranial along the superior rectal artery to paraaortal nodes and vessels
  - Distally along the internal iliac artery
  - No lymphatic vessel arcades near the intestinal wall

Caution

Caudal portion = intramural lymphatic drainage (due to missing mesorectum)

Innervation

- Through autonomic nerves:
  - Sympathetic innervation:
    - inferior mesenteric trunc ventral to the aorta at the level of the outlet of the inferior mesenteric artery, becomes the superior hypogastric

plexus presacral at the level of the promontory, than divides into right and left hypogastric nerves, which course dorsal to the mesorectum

Damage of the sympathetic portion leads to retrograde ejaculation.

- Parasympathetic innervation:
  - pelvic splanchnic nerves unite with the sympathetic hypogastric nerves at the level of the seminal vesicles and form the inferior hypogastric plexus (= pelvic plexus).
  - Further course along the lateral border of the prostate gland

Damage of the parasympathetic part leads to erectile dysfunction or disturbance of lubrication and bladder emptying disorder.

4.1.3 Physiology

- Direct continuity with sigmoid colon, but different function

Special Functions of the Rectum

- Defecation: action of defecation
- Continence: ability to retain stool; controlled voiding
- anorectal continence apparatus

4.2 Benign Diseases

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4.2.1 Benign Neoplasms/ Malformations

Polyps/Adenomas (Chap. 3)

- Mostly asymptomatic
- Symptoms:
  - Mostly incidental findings during screening endoscopy
  - Bleeding
  - Mucus production
  - Passage obstruction
  - Histology obligatory

Caution
Adenoma = facultative precancerous lesion

- Therapy:
  - Endoscopic ablation with snare, EMR (endoscopic mucosal resection) or submucosal dissection
  - Surgical therapy by means of transanal resection or TEM (transanal endoscopic microsurgery) possible
  - Avoid peacemeal resections (histology, topographic assignment for R1 resection)

Schwannomas, Leiomyomas, Angiomyomas

- Very rare
- Diagnosis occasionally by CT- or EUS (endoscopic ultrasound)-guided puncture
- Therapy: Enucleation in healthy tissue is sufficient

Hirschsprung's Disease

- Congenital intestinal aganglionosis
- Pathophysiology:
  - Aganglionic segment starting from linea dentata, reaching to different degrees proximally, dilated intestine above it
  - Mostly disease of childhood
- Diagnosis: by deep rectal biopsy
- Therapy: Resection of the aganglionic segment and the adjacent dysfunctional dilated section

Infiltrating Endometriosis

- Unclear pathogenesis, mostly young women
- Symptoms:
  - Unspecific, cyclically occurring complaints
  - Pelvic pain, rectal bleeding, constipation, diarrhoea

- Therapy:
  - Primarily conservative/symptomatic therapy
  - Recurrence rate: up to 60%
  - Resection required in individual cases
  - Interdisciplinary approach at specialised centres

4.2.2 Rectal Prolapse

Key Points

- Etiology unclear
- Mainly older, female patients affected
- Diagnosis by inspection
- Often simultaneous constipation + incontinence
- Choice of procedure dependent on: size of the prolapse + comorbidity of the patient
- Perineal procedures: Lower morbidity but worse long-term outcomes
- Abdominal procedures: Better results, but higher risk

Definition, Classification, Differential Diagnosis, Epidemiology

Definition

- Protrusion of the entire rectal wall outwards through the anal sphincter apparatus

Classification

- Grade 1: Internal, partial prolapse (intussusception)
- Grade 2: Internal prolapse extending to the anocutaneous line
- Grade 3: External solid wall prolapse

First-degree prolapse can also be detected in a high percentage of healthy individuals; findings requiring treatment only when symptoms occur.

Differential Diagnoses

- Anal prolapse (► Sect. 5.2.1 Haemorrhoids)
- Mucosal prolapse alone

Epidemiology

- Age peak: children around 3 years and older women
- Incidence = 1% in the over-65s
- Combination with bladder, vagina and/or uterus prolapse = frequent

Etiology and Pathogenesis

- Variable expression of morphological/functional changes:
  - Abnormally deep rectovesicale/rectovaginale space ("Cul de sac")
  - Atone pelvic floor and sphincter muscles
  - Diastasis of the pelvic diaphragm (levator ani muscle)
  - Mobile mesorectum with lack of lateral + dorsal fixation
  - Pudendal nerve neuralgia
- Causal pathogenesis vs. secondary phenomenon = unclear
- Often associated with:
  - Functional disorders (e.g. excessive pressing during defecation)
  - Structural changes (e.g. hysterectomy, post anal atresia in children)

Symptoms and Diagnosis

Symptoms

- Common concomitant symptomatology:
  - Symptoms of constipation (up to 65%)
  - Symptoms of incontinence (up to 90%)
- Rectal prolapse = clinical diagnosis

Diagnosis

- Inspection
- Rectal digital examination = crucial!
  - Spontaneously reducible in the initial stage
  - If more severe: Manual reduction required
- Dynamic pelvic floor MRI: Helpful for evaluation of the ventral compartments and detection of an enterocele
- Rectoscopy/colonoscopy: to exclude endoluminal concomitant diseases
- Anal manometry not required

Therapy

- Therapy goals
  - Permanent removal of the prolapse
  - Restoration of adequate function
- Strategy: Choice of procedure depends on:
  - Prolapse size
  - Comorbidity of patients

Non-surgical Therapy

- Preoperative exhaustion of conservative options (stool regulation, pelvic floor exercises, biofeedback if necessary)
- Possible combination of all procedures with:
  - Sacral nerve neuromodulation/stimulation (SNS, stable good continence improvement)
  - Sphincteroplasty/levatoroplasty (poor long-term results)

Surgical Therapy

- Therapy principles
  - Resection, fixation or plication of the redundant bowel
  - Abdominal or perineal/transanal procedure
- Strategy
  - No significant risks = laparoscopic resection rectopexy (= best functional long-term result)
  - In moderate prolapse without constipation: Current preference for laparoscopic ventral rectopexy
  - In case of high risk for abdominal surgery: perineal procedures

No clear recommendations based on evidence-based randomized trials.

Perineal and Transanal Procedures

- Wrapping procedure of the anus
  - Techniques: Thiersch ring, subcutaneous placement of foreign material.
  - Results: unsatisfactory + partly considerable complication rates = obsolete
- Rehn-Delorme operation/procedure
  - Principle:
    - Transanal mucosal resection + suprasphincteric plication of the prolapsed rectum
    - Possible in analgosedation
  - Results:
    - Low morbidity and mortality, mean recurrence rate approx. 20% after 2 years
    - In many cases improvement of continence
- Altemeier Rectal resection
  - Principle:
    - Perineal rectum resection with reanastomosis ± pouching at the level of the dentate line
    - Circular resection of the prolapse possible using staple suture devices Transtar®
  - Results:
    - Recurrence rate lower than after Rehn-Delorme (5–15%), immanent risk of anastomotic insufficiency with pelvic sepsis (4%)
    - Significant improvement in constipation, frequent worsening of continence (urge incontinence, stool smearing)

Surgical Procedure
Rehn-Delorme Procedure

- preoperative colonic irrigation
- General anaesthesia, spinal anaesthesia
- Lithotomy position (Lloyd-Davis position), single-shot antibiotics with metronidazole i.v.
- Sphincter dilation, maximum eventration of the prolapse with 2 clamps
- Injection of the submucosa with diluted adrenaline saline solution (better separation of the layers)
- Incision of the mucosa 1 cm orally of the dentate line and circular dissection and resection of the mucosa cylinder of the entire prolapse.
- Accordion-like folding and reduction of the intestinal tube by 4–5 mattress sutures
- Reanastomosis of the mucosa

Abdominal Procedures

- Rectopexy without resection
  - Principle:
    - Dorsal suture rectopexy

  - Laparoscopic ventral mesh rectopexy (d'Hoore), posterior mesh fixation (Ripstein / Wells) largely abandoned
  - Avoidance of lateral mobilization leads to improved postoperative function
  - Use of foreign materials (alloplastic meshes) with risk of erosion, fistula and stenosis formation
- Results:
  - Recurrence rates around 10%
  - Significant variation in functional outcomes
  - Loop formation and kinking of the redundant sigmoid: marked increase in constipation
  - Resection rectopexy
- Principle:
  - Stable stretching and fixation of the rectum + removal of the redundant sigmoid + usually suture rectopexy at the promontory
  - Due to anastomosis, alloplastic material is usually not used
- Results:
  - Recurrence rate = 2–8%
  - Improvement of constipation in more than 50% of patients
  - Improvement of continence in 60–90% of patients

Today's standard = laparoscopic procedure (additional advantages)

Surgical Procedure

Laparoscopic (Resection) Rectopexy

- General anesthesia, lithotomy position (Lloyd-Davis), perioperative antibiosis
- Trocar placement (see laparoscopic sigmoid resection)
- Lateral mobilization of the sigmoid, visualization of the left ureter
- Entering the vessel-free dorsal layer at the level of the promontory, preparation down to the pelvic floor
- Incision of the peritoneum at the anterior fold, anterior dissection up to the upper third of the vagina or up to the seminal vesicles
- **Caution:** Do not cut the lateral ligaments!
- If resection: Tubular transection of the mesosigmoid with preservation of the superior rectal artery, transection of the rectum above the promontory with a stapler, Pfannenstiel incision, resection of the bowel at the descendosigmoid junction, double-stapling anastomosis
- Fixation of the rectum to the presacral fascia at the level of the promontory by non-absorbable simple interrupted sutures close to the midline (**caution:** injury to the presacral venous plexus or pelvic nerves)
- reconstruction of the anterior rectovaginal peritoneum by continuous suture

4.3 Malignant Diseases

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Key Points: Rectal Cancer

- Most common malignancy of the rectum
- Locoregional risk of recurrence: Higher than for colon cancer (due to lymphatic spread pathways, narrowness of the pelvis)
- Operative standard = en bloc resection of the tumor with regional vascularization. Systematic pathoanatomical examination on perirectal tumor spread
- Continence-preserving surgery (approx. 85% of rectal carcinomas): Through better understanding of continence mechanisms + optimized surgical technique.
- Current Standards:
  - Tumors of the upper third of the rectum: Proximal partial mesorectal excision + reconstruction by end-to-end descendorectostomy

- Tumors of the middle and distal third of the rectum: Total mesorectal excision obligatory + side-to-end anastomosis/colonic pouch-anal anastomosis
- Local excision (transanal or by TEM): for limited to small and histologically favorable uT1 tumors
- For extraperitoneally located T3/4 tumors: Neoadjuvant therapy approaches > postoperative radiochemotherapy

4.3.1 Histological Tumour Entities

- Rectal carcinoma = most frequent malignancy of the rectum
- GIST (Chap. 14)
  - Mesenchymal submucosal tumor
  - High malignancy potential at >5 cm and/or >5 mitoses per 50 HPF (high power field = microscopy field)
  - Aim for complete surgical removal
  - if necessary, follow-up treatment with Imatinib
- Neuroendocrine carcinoma/carcinoid
  - Rectum = most frequent localization in the intestine
  - Increasing incidence
  - Malignancy potential: depending on the degree of differentiation (G1–G3)
  - Tumours <2 cm mostly benign: local resection sufficient
  - Oncological radical resection for tumours >2 cm + proven malignancy
  - Simultaneous cholecystectomy if planned therapy with somatostatin analogues
- Lymphomas, sarcomas = rarities

4.3.2 Rectal Cancer

Definition

- All epithelial malignancies from the linea dentata to 16 cm ab ano measured with the rigid rectoscope

Forms/Classification

- By growth:
  - Exophytic polypous
  - Endophytic ulcerative
  - Diffusely infiltrating
- By histological cell type:
  - Mostly adenocarcinomas
  - Rare adenosquamous carcinomas
- By differentiation:
  - Low grade
  - High grade

Epidemiology and Etiology

- s. Colon cancer
- More than 50% involve the rectum

Tumor Spread

- Continuous
  - Intramural
  - Direct organ infiltration
- Discontinuous
  - Tumor satellites in the mesorectum outside lymph nodes
  - At a distance of up to 4 cm from the tumor
- Lymphogenous
  - Mesorectal and para-aortic lymph nodes
  - Rarely iliac lymph nodes
- Hematogenous
  - Into the liver via portal vein
  - Into the lungs (rare) in distal tumors via the vena cava

Classification

Classification According to Mason (Clinical Staging)

- After palpation
  - CS I Mucosa displaceable
  - CS II Intestinal wall displaceable
  - CS III Intestinal wall partially fixed
  - CS IV Intestinal wall fixed
  - CS V Disseminated disease

TNM Classification (2017)

- T (tumor)
  - T0 No infiltration
  - T1 Infiltration of the submucosal layer

  - T2 Infiltration of the muscularis propria
  - T3 Infiltration of the subserosa
  - T4a Infiltration of the visceral peritoneum
  - T4b Infiltration of other organs/structures
- N (lymph nodes)
  - N0 No metastases in the lymph nodes
  - N1 Metastases in 1–3 regional lymph nodes
  - N2a Metastases in 4–6 regional lymph nodes
  - N2b Metastases in >6 regional lymph nodes
- M (metastases)
  - M0 No distant metastases
  - M1 distant metastases

Derivation of UICC Stages from TNM Classification

Stage I	T1, T2	N0	M0
Stage II	T3, T4	N0	M0
Stage III	Each T	N1, N2	M0
Stage IV	Each T	Each N	M1

Symptoms

- Section 3.3 Colon cancer

Diagnosis

Rectal Digital Examination

- Assessment of the tumor location
- Infiltration depth and sphincter function

Rigid Rectoscopy

- Biopsy
- Exact localization (distance from anocutaneous line)

Colonoscopy

- Exclusion of second tumor

Endorectal Ultrasound

- Infiltration depth
- Crucial for the evaluation of T1 tumors
- Limited for the assessment of lymph node involvement

MRI Pelvis

- Distance to circumferential resection margin (CRM)
- Infiltration depth
- Crucial for local staging of T2 to T4 tumors
- Limited for evaluation Lymph node involvement

Thoracic CT, Abdominal CT

- Exclusion of distant metastases; sonography abdomen and Chest X-ray alternatively possible, but less sensitive

PET-CT

- Not required for primary diagnosis
- Helpful in recurrence diagnosis

Therapy

Indication

- Therapeutic procedure according to guidelines depending on preoperative staging (◘ Table 4.1)
- Increasing trend towards neoadjuvant therapy depending on the distance of the tumor from the mesorectal fascia, currently evaluation in trials: distance to CRM <1 mm: neoadjuvant therapy; distance to CRM ≥1 mm: primary resection.
- Optimal procedure for cancer in the upper third of the rectum = unclear = neoadjuvant therapy and surgery vs. treatment as in sigmoid cancer (primary surgery ± adjuvant chemotherapy)
- Increased morbidity in emergency surgery for ileus:
  - In case of ileus: relief by insertion of a double-barrel transverse colostomy or endoscopic insertion of a fully covered metal stent, followed by definitive therapy according to the guidelines

Table 4.1 Therapy strategy depending on preoperative staging

Tumor stage	Therapy
T1 "low risk"	Local excision
T1 "high risk", T2 N0 M0	Primary resection
T3/4 N0 M0 Tx N+ M0	Neoadjuvant therapy, followed by resection + adjuvant chemotherapy
Tx Nx M1	Radical resection of tumor and metastases ± adjuvant chemotherapy Primary tumor resection followed by additive chemotherapy and metastasectomy or vice versa Palliative therapy

Neoadjuvant Therapy

- Neoadjuvant radiotherapy: Significant reduction of local recurrence rate in locally advanced tumor stages from 27 to 11%.
- Adjuvant radiotherapy: positive effect after optimal surgery smallerwhen compared with neoadjuvant, but still present

Long-Term Radiochemotherapy (Preferred in Germany and USA)

- Target:
  - Downstaging + Downsizing
  - Increase in the rate of sphincter-preserving surgery
- Implementation:
  - Conventional fractionated radiotherapy with 45–50 Gy (28 single doses of 1.8 Gy each) + concomitant chemotherapy with 5-FU and folinic acid (5-fluorouracil) or capecitabine over a period of 6 weeks
  - Operation 6–8 weeks later
  - In recent meta-analyses, higher remission rates after 10–12 weeks (but contradictory RCT from France)
  - Postoperative: Adjuvant chemotherapy

Short-Term Therapy (Preferred in the Netherlands, Poland and Scandinavia)

- No tumor reduction
- In the lower third of the rectum: less effective than long-term radiochemotherapy
- Implementation:
  - Exclusively radiotherapy with 25 Gy distributed over 5 individual doses
  - Operation in the immediate aftermath
  - Comparable results with regard to the oncological outcome—in recent studies, delayed surgery with subsequent tumor reduction is also possible
- **Problems of Neoadjuvant Therapy as a Whole:**
  - Preoperative overstaging in 18% of UICC-II/-III classified patients, especially correct detection of lymph node status (see above)
  - Long-term side effects possible: sphincter weakness, potency disorders, secondary cancers
  - No significant effect on survival rate, therefore generally not indicated in the metastatic stage
  - Neoadjuvant chemotherapy without radiotherapy or intensified neoadjuvant chemotherapy with prior or subsequent radiotherapy (= "total neoadjuvant therapy"): Currently the subject of trials (RAPIDO)
  - Complete remission after neoadjuvant therapy: radical surgery generally indicated due to remaining vital tumor cells, "watch and wait" = individually possible, preferably only in studies

Adjuvant Therapy

Modalities

- As adjuvant chemotherapy after long-term neoadjuvant therapy (see above)
- As combined radiochemotherapy after R0 resection and not-performed neoadjuvant therapy in stages II and III
- After R1 resection, tumor perforation or intraoperative tumor rupture also indicated in stage I

Results

- Lower local recurrence rate and higher morbidity than after neoadjuvant therapy
- Benefit of adjuvant chemotherapy in the context of long-term neoadjuvant therapy = controversial
- No benefit from intensification of chemotherapy

Additive/Palliative Therapy

Principles

- Individual approach depending on tumor location, extent of metastasis and general condition of the patient
- Distant metastasis = prognostic in non-stenosing/non-bleeding tumor with extensive metastasis
- Benefit of primary tumor resection before chemotherapy = unclear

Strategy

- In stenosing cancer and multimorbid patients:
  - Use of a double-barrel stoma or insertion of a flexible metal stent
  - With or without subsequent chemotherapy
- In patients in good general condition and potentially resectable metastases = curative approach:
  - Primary resection of the primary tumor, if necessary additive chemotherapy and subsequent resection of the metastases
  - Alternatively primary resection of the metastases with subsequent resection of the primary tumor
  - Depending on the localization, thermoablation instead of or in combination with resection of metastases
  - Additive chemotherapy not longer than max. 5 cycles; also in case of complete radiological response: Metastasectomy obligatory (in 30% still vital tumor cells detectable).
  - Up to 30% long-term survival after R0 resection of primary tumor and metastases
  - Benefit of additional "pseudoadjuvant" chemotherapy after R0 resection of primary tumor and metastases = not proven
  - Benefit of "pseudoneoadjuvant" chemotherapy before resection of primary resectable metastases = controversial
- Palliative chemotherapy with as few side effects as possible (e.g. 5-FU, capecitabine), additive chemotherapy with as good a response as possible (e.g. FOLFOX/FOLFIRI ± EGFR/VEGF antibodies)

Operative Therapy Principles

Local Limited Procedures

- Indication:
  - For malignant, non-invasive polyps
  - For carcinomas with early infiltration of the submucosa, maximum T1 sm 1–2, maximum size 3 cm without other negative predictors (G1–2, R0, L0, V0, Pn0).
- Disadvantages:
  - No assessment of lymph node status possible, but under these conditions low risk of metastasis (approx. 2%)
  - Increased risk of local recurrence compared to anterior resection (approx. 10%)
- Principle:
  - Surgical rectal full wall excision
  - Endoscopic resection (endoscopic mucosal resection, submucosal dissection)
  - Avoid peacemeal resection
- Surgical procedure:
  - Transanal full wall excision (lower third of the rectum)
  - Transanal endoscopic microsurgery: TEM/TEO = transanal endoscopic surgery, TAMIS ("transanal minimally invasive surgery"); middle and upper third of the rectum

In multimorbid patients, locally limited rectal resection is permissible as an individual therapy after appropriate patient information, even in the case of locally advanced tumours (exception).

Surgical Procedure
Local Limited Rectal Resection

- Bowel preparation helpful
- General or locoregional anaesthesia
- Positioning with tumor at floor level
- Safety distance 1 cm
- Transanal resection: exposition of tumor using anal spreader, placement of holding sutures, pulling the tumor caudally, excision with electrocautery, transverse suture closure
- Transanal microsurgery/endoscopy: insertion of the instrumentation, marking of the resection line with electrocautery, dissection of the rectal wall with electric knife, transverse suture closure
- Rapid opening of the suture in case of suspicion of pararectal infection

Rectal Resection

- Principles of resection:
  - Removal of the rectum + en bloc removal of the locoregional lymphatic drainage area
  - Preparation along the anatomical enveloping fasciae (see above)
  - For tumors in the upper third: Anterior rectal resection with partial mesorectal excision (PME)
  - For tumors in the middle and lower third: low anterior rectal resection with total mesorectal excision (TME)
  - Radicular ligation of the inferior mesenteric artery and vein, no prognostic difference between truncal ligation and preservation of the left colic artery
  - Protection of the autonomic nerves (see above) essential
  - Maintain sufficient distal clearance margin:
    - Anterior resection with PME: 5 cm
    - Low anterior resection with TME for high-grade tumors: 2–3 cm
    - Low anterior resection with TME for low-grade tumors: 1 cm
    - After neoadjuvant therapy and negative frozen section: At least 0.5 cm
  - En bloc resection of tumor-adherent organs (multivisceral resection)
  - Laparoscopic surgery is oncologically equivalent in suitable patients (less favourable results possibly in low-located rectal carcinoma (ALACART, ACOSOC Trial)—value of robot-assisted procedures in lower conversion rate in men with narrow pelvis (ROLARR Trial))
- Principles of Reconstruction:
  - Reconstruction depending on the extent of resection:
    - PME: End-to-end anastomosis (residual rectal pouch available)
    - TME: colon-J-pouch-anal anastomosis, alternatively in case of narrow pelvis or voluminous mesentery coloplasty-pouch-anal anastomosis or side-to-end anastomosis (= reduction of stool frequency and imperative urge to defecate)
  - Anastomosis:
    - Double-stapling technology
    - For very distally located tumors: intersphincteric resection with coloanal hand suture
    - Ta TME (transanal TME) developed as a transanal adjunct to TME in obese men with low-seated tumors—possible advantages in clarity but higher incidence in urethral lesions.
    - Protective stoma after low anterior resection
  - Background:
    - Insufficiency rate increases distally (up to 30%), therefore optional after PME
    - Does not prevent the insufficiency, but significantly reduced inflammatory reaction in the pelvis
    - Double-barrel ileostomy with less prolapse and lower complication rate than reverse transversostomy
    - Double-barrel transversostoma with less postoperative fluid loss (preferred in elderly patients with renal insufficiency)

Preoperative bowel irrigation and marking of the stoma position (lying, standing and sitting) are important.

Surgical Procedure
Open Low Anterior Rectal Resection

- General anesthesia, lithotomy (Lloyd-Davis) positioning, peridural catheter
- Median laparotomy, exploration of the abdomen
- Lateral mobilization of the descending colon, exposure of the left ureter
- Mobilization of the left colonic flexure from lateral to medial
- transection of the inferior mesenteric artery approx. 1 cm preaortic, transection of the inferior mesenteric vein at the lower edge of the pancreas
- Radicular transection of the mesentery, transection of the colon at the descendosigmoidal junction
- Start of TME dorsally, sharp dissection between mesorectum and Waldeyer's fascia, sparing the hypogastric nerves down to the pelvic floor
- Anterior dissection along the Denonvillier's fascia, protection of seminal vesicles and prostate or vagina
- Transection of lateral bridges along the hypogastric nerves, circular preparation of the rectum at the pelvic floor
- "Rectal washout", transection of rectum with a linear stapler
- Colon J-pouch: limb length 5–6 cm, coloplasty pouch: 6–8 cm incision ventrally between the taeniae coli with transverse closure, side-to-end anastomosis: stump with 2–3 cm length
- Transanal double stapling anastomosis, protective stomy
- Eventually placement of a suprapubic bladder catheter in men

Surgical Procedure
Laparoscopic Low Anterior Rectal Resection

- Lithotomy (Lloyd-Davis) positioning, vacuum mattress, shoulder supports
- Pneumoperitoneum, insertion of the trocars
- Preliminary transection of the vessels, mobilization of the descending colon and the left flexure from medial to lateral (**caution:** vegetative nerves and pancreatic tail)
- TME as for open resection
- Distal transection with angled stacker, several magazines may be required
- Retrieval of the specimen through widening of the incision in the left lower abdomen or suprasymphyseal Pfannenstiel incision
- Reconstruction and anastomosis as for open resection

Abdominoperineal Rectal Extirpation

- Indication:
  - For tumors infiltrating the sphincter/anal canal
  - If the distal clearance margin is not sufficient (see above)
- Principles:
  - For deep-seated T1/2 tumors: classical abdominoperineal extirpation leaving the lateral levator muscles intact
  - In advanced tumor stages: Cylindrical rectal extirpation including the levator musculature, coverage by pedicled myocutaneous flap (VRAM, bilateral gluteal shift flap)
- Results:
  - Higher local recurrence rate than after sphincter-preserving surgery
  - Conventional and laparoscopic procedure = oncologically equivalent

Surgical Procedure
Abdominoperineal Rectal Extirpation

- Insertion of a transurethral bladder catheter
- Abdominal part:
  - Mobilization of the left colonic flexure not required

  - TME as in anterior resection with sphincter preservation in classical extirpation, preparation only up to the levator attachment in cylindrical extirpation
  - Creation of a terminal descendostoma, prevention of a parastomal hernia by mesh augmentation or extraperitoneal drainage
  - Insertion of an omental patch into the sacral cavity
- Perineal part:
  - Preparation for classical extirpation in lithotomy (Lloyd-Davis) position, for cylindrical extirpation: knee-chest position if necessary (better overview for large tumors)
  - Suture (closure) and circular dissection of anus
  - Transection of the ischiorectal fat
  - Transection of the anococcygeal ligament or coccygeal resection
  - Transection or resection of the levator ani muscle
  - Ventral release of the specimen (**caution**: urethral injury)
  - Layered wound closure or flap plastic reconstruction

Prognosis

Prognostic Factors

- Depth of infiltration into the intestinal wall
- Presence of lymph node and distant metastases
- Tumor cell differentiation

5-Year Survival Rates

- 5-year survival rate = on average 40–60% (most frequent finding = stage III)
- 5-year survival rates by UICC stage:
  - Stage I = approx. 80–100%
  - Stage II = approx. 60–80
  - Stage III = approx. 30–60
  - Stage IV = approx. 0–57%
- 5-year survival rate in stage IV dependent on:
  - Lymph node status
  - Number and size of metastases
  - CEA level (tumor marker >200 µg/L unfavorable)
  - Disease-free interval (<12 months unfavorable)

Follow-up

Targets

- Early detection of potentially curable local recurrences (up to 25%)
- Early detection of distant metastases (up to 25%)
- Early detection of metachronous second tumors (up to 10%)

Time Intervals

- Every 6 months:
  - Anamnesis
  - Physical examination
  - CEA determination
  - Abdominal Ultrasound
- After 1 and 5 years:
  - Colonoscopy
  - Exception: If no preoperative complete colonoscopy due to e.g. stenosis: colonoscopy within the first 6 months postoperatively
- On a yearly basis:
  - Thoracic X-ray = optional

Special Features

- Stage I after radical resection (very low risk): Colonoscopy only recommended
- After local resection (due to increased risk of local recurrence): Endoscopic controls after 6, 24 and 60 months recommended
- CT, MRI and PET-CT = suitable for detecting recurrences; not recommended in routine follow-up due to insufficient evidence
- No age limit for follow-up
- No follow-up after palliative therapy

4.3.3 Guidelines

Guideline program oncology (German Cancer Society, German Cancer Aid, AWMF): S3 guideline colorectal carcinoma, long version 2.1, 2019, AWMF registration number: 021-007OL, ► https://www.leitlinienprogramm-onkologie.de/fileadmin/user_upload/Downloads/Leitlinien/Kolorektales_Karzinom/Version_2/LL_KRK_Langversion_2.1.pdf

Further Reading

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