Atlas of Colonoscopy

Techniques • Diagnosis • Interventional Procedures

Helmut Messmann

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Atlas of Colonoscopy

Techniques · Diagnosis · Interventional Procedures

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Preface

Flexible colonoscopy is now nearly fifty years old. In 1957, the first attempts at constructing a flexible colonoscope were made in Japan by Matsunaga and Hirosaki.

Now, almost half a century later, colonoscopy has become a vital part of gastroenterology. Advancements in recent years—especially in chip technology—have led to previously unseen standards in image quality, which continues to gain in importance, especially in combination with new staining techniques. In addition to the enormous significance of diagnostic colonoscopy, interventional colonoscopy also plays a major role in gastroenterological endoscopy. New techniques have enabled the removal of increasingly larger polyps by means of mucosectomy, without the need for surgical intervention. Measures for achieving hemostasis, managing anastomotic leakages, and placing decompression tubes are also part of a more conservative approach using minimally invasive endoscopy, and increasingly avoiding surgical intervention.

The endoscopy team at the Augsburg Clinic in Augsburg, Germany performs more than 13 000 endoscopies per year, including a large number of interventions, providing us with a wealth of experience to draw on and the source of inspiration for writing this book. Additionally, we used only the latest equipment in creating this book—including zoom endoscopy—in order to produce pictures of superior image quality.

This book is aimed at health-care professionals who are interested in learning more about colonoscopy. However, it also of interest for the experienced gastroenterologist who is already familiar with colonoscopy, providing useful tips and tricks organized by experienced physicians in an informative and instructive manner. It is my hope that we can provide our readers with a good atlas, filled with numerous interesting findings and pictures, to support learning and further education in the area of colonoscopy.

We hope you enjoy reading this volume and look forward to receiving any comments or suggestions that may assist us in continuing to offer our colleagues a top-quality book.

Helmut Messmann

The Augsburg endoscopy team (from left to right):
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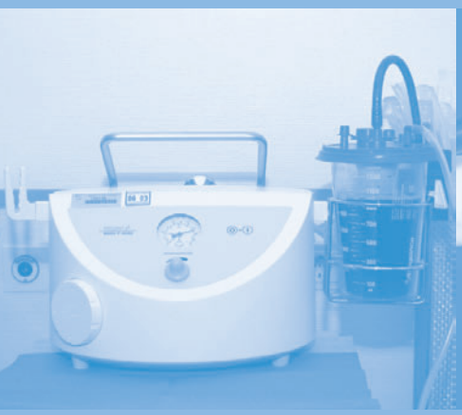


I General Information




1 General Information Regarding Examination

G. Jechart

Introduction

In the thirty years since 1971 when total colonoscopy was first described (16), significant technical advancements have been made in terms of instrument handling and imaging capability. Nevertheless, colonoscopy remains a procedure requiring manual dexterity and concentration. The experienced examiner can now successfully reach the cecum in 98% of patients and in most cases can also reach the terminal ileum. Difficulties can be posed by a mobile and elongated sigmoid colon or transverse colon as well as by postoperative intestinal fixations and other adhesions. The entire examination generally takes around 30 minutes. Rapid advancement and inspection up to the cecum is desirable, considering the discomfort to the patient, though a careful examination of all colon segments when withdrawing the instrument is essential for a thorough examination.

Proper training and experience are necessary for correct diagnosis. The diagnostic spectrum of colonoscopy encompasses not only macroscopic assessment of the condition of the mucosa, but also the possibility of collecting a targeted biopsy sample and, more recently, the use of dye spraying techniques and magnification (see Chapter 3). The instrument channel of the flexible endoscope allows for therapeutic treatment during the examination to an extent not possible with any other imaging technique. Polyps, for example, can be removed at first diagnosis and bleeding can be stopped immediately.

Thus, colonoscopy is a technically demanding examination procedure with a high clinical yield combined with the capability of therapeutic intervention.

Indications and Contraindications

Indications. An assessment of the condition of the colonic mucosa is important where there are clinical indications of colitis, i. e., abdominal pain, diarrhea, malabsorption, perianal bleeding as a result of possible intestinal ischemia, inflammation, erosions and ulcers of various geneses, polyps and tumors, diverticula, or vascular malformations. Changes in bowel habits and an increasing tendency toward constipation are cause for performing an endoscopic search for a stricture in the intestinal lumen, e. g., due to neoplasia, diverticular myochosis (thickening of the circular muscle layer), or postinflammation stricture (Tab. 1.**1**).

Thickening of the intestinal wall can be viewed using imaging techniques such as sonography (Fig. 1.**1**), computed tomography, and magnetic resonance imaging. A resulting pathological finding is an indication for colonoscopy that often can provide greater accuracy and allows taking a biopsy.

Early detection and cancer prevention. Colonoscopy is becoming increasingly important for early detection and the prevention of colorectal carcinoma in the asymptomatic general population. According to the guidelines established by the German Federal Committee of Doctors and Health Insurers (*Bundesausschuss der Ärzte und Krankenkassen*) on 5 October 2002 and based on recommendations from the German Society of Digestive and Metabolic Diseases (*Deutsche Gesellschaft für Verdauungs- und Stoffwechselkrankheiten, DGVS*), colonoscopy should be performed as a part of cancer prevention every 10 years among those aged 55 and over in the general population (14). Given the polyp–carcinoma relationship according to Vogelstein and the results of large cohort studies in the USA and Europe, there is no doubt about the effectiveness of endoscopic polyp removal in carcinoma prevention (17). With regard to these indications as well, total colonoscopy has proved itself over sigmoidoscopy and Hemoccult testing (11) (Tab. 1.**2**). Considering the current capacity for colonoscopy it would take 10 years to screen the US population following these guidelines (15).

Table 1.**1** Indications for colonoscopy

- Constipation
- Diarrhea
- Abdominal pain
- Bleeding per rectum, unexplained anemia, weight loss
- Postpolypectomy surveillance
- Prevention/aftercare colorectal carcinoma
- Pathological thickening of the colon wall detected by other imaging procedures
- Primary tumor search with metastasizing malignancy, if resulting therapeutic measures

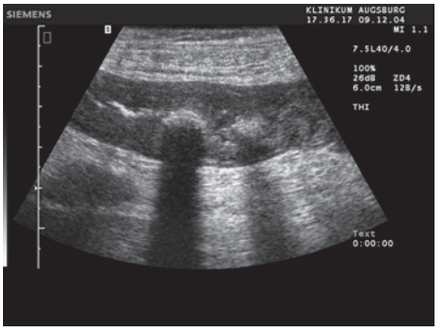

Figure 1.**1** **Thickened intestinal wall in the sigmoid colon.** Ultrasound examination of the left lower abdomen.

Contraindications. Only in a limited number of situations do the risks of colonoscopy outweigh the benefits of its diagnostic value. Contraindications include suspected intestinal perforation, imminent risk of perforation accompanying acute diverticulitis, deep ulcerous lesions, or vascular necroses (Tab. 1.**3**).

The overall condition of the patient should always be assessed to determine whether he could tolerate the physical strain of preparing for colonoscopy and endoscopy, including conscious sedation. Colonoscopy in patients with a recent myocardial infarction is associated with a higher rate of minor cardiovascular complications compared with control patients. (3)

Table 1.**2** Recommendations for cancer prevention

Population	Periodic colonoscopy for cancer prevention
General population	Once every 10 years starting at age 55
Patients with colorectal polyp	Colonoscopy check-up once every three years, if no pathological findings at first examination, then further check-ups every five years
Patients with hamartomatosis polyposis	No general surveillance recommendations
Immediate family member with colorectal carcinoma or polyp at *> 60 years of age*	Ten years earlier than the age of the index patient at which carcinoma/polyp occurred, repeat every 10 years
Immediate family member with colorectal carcinoma or polyp at *< 60 years of age*	First colonoscopy at age 40, repeat every 10 years
Immediate family member with FAP (familial adenomatous polyposis)	*Genetic carriers:* starting at age 10, annual rectosigmoidoscopy, if polyp detection then colonoscopy; after proctocolectomy annual pouchoscopy *Noncarriers:* same as general population
Immediate family member with HNPCC	Starting at age 25, annual colonoscopy
Patients with colitis ulcerosa	For pancolitis > 8 years of age or left-sided colitis > 15 years of age: complete colonoscopy with annual biopsy for two years, then once every two years
Patients with Crohn disease	No general recommendations at this time

Table 1.**3** Contraindications for colonoscopy

- Perforated intestine
- Acute diverticulitis
- Deep ulcerations
- Severe ischemic necroses
- Fulminant colitis
- Cardiopulmonary decompensation

Attention

- The physical stress of preparation for the examination and the colonoscopy itself limits its use in seriously ill patients.

Preparing for the Examination

Oral preparation. Thorough bowel cleansing is essential for a sufficient endoscopic examination of the colon. The development in 1990 of a nonabsorbable electrolyte solution (polyethylene glycol, PEG) by Fordtran was a significant improvement over earlier laxatives using sodium sulfate and modified forms are still in use today. But, due to the large quantity of liquid that must be consumed (up to 4 L) and the salty taste, these solutions are not tolerated by all patients. Their effectiveness has, however, been verified by numerous studies; data on sodium phosphate solutions (e.g., Fleet) and whether these are an improvement in terms of cleanliness and patient acceptability are less conclusive (8). Though they may appear to be a viable alternative for some patients, caution should be exercised if the patient has kidney insufficiency given the high phosphate content.

Enemas and clysmas. The use of an irrigator is recommended for patients who, due to an obstruction, cannot be prepared for examination using an oral solution. If the patient is admitted for emergency endoscopy, a quick cleansing using a clysma is a feasible option for partial colonoscopy.

Complications and Risks

Perforation, bleeding, and infection. Endoscopy of the colon entails risk of perforation, injury to blood vessels causing bleeding, and infection (Figs. 1.**2**, 1.**3**). The rate of complications can be minimized if the examiner takes precautions such as advancing the instrument only under conditions of high visibility. Sigmoidoscopy involves an average perforation rate of 1.8 per 100 000 examinations; bleeding severe enough to require a blood transfusion and perforations requiring surgical repair occur at the same rate so that the number of patients who experience a serious complication is 6.4 per 100 000 (10).

Comparing diagnostic and therapeutic colonoscopy (1, 4), statistics indicate that, with a total morbidity of 0.4%, more complications arise from therapeutic measures, such as polypectomies (1.2% vs. 0.2%) (Tab. 1.**4**).

Treatment. Not all complications require surgical intervention. Bleeding can be stopped in 92% of patients endoscopically and infections can be controlled with antibiotics. Injury to the serosa related to perforation of the intestine is painful for the patient and in most cases is surgically repaired before peritonitis occurs. In some patients, gaping wound edges can be closed with endoscopically applicable clips and further healed with a liquid diet and antibiotics (5).

Cardiopulmonary complications. The use of analgesics for colonoscopic examination increases the risk of cardiopulmonary complications, even when the utmost caution is exercised in selecting medication and dosage (cf. Chapter 4). Older and comorbid patients are especially at risk for medicamentosus hypotension, tachycardia, and respiratory failure.

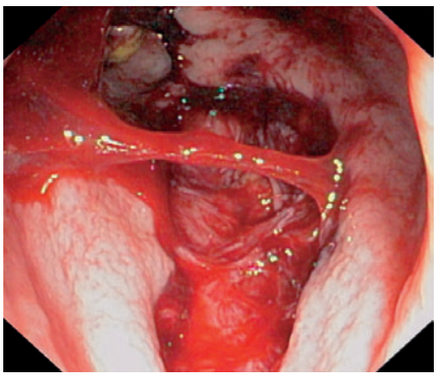

Fig. 1.2 **Intestinal perforation**

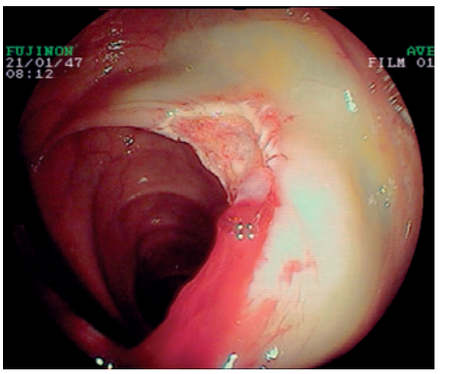

Fig. 1.3 **Intestinal bleeding following an endoscopic polypectomy.**

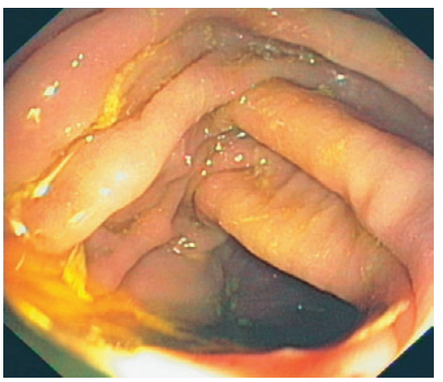

Fig. 1.4 **Intestinal lumen with low air insufflation.**

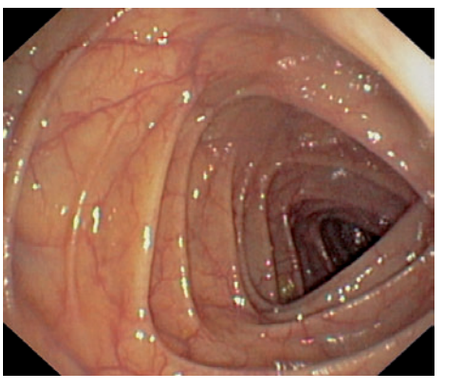

Fig. 1.5 **Intestinal lumen with high air insufflation.**

Table 1.4 Complications arising from colonoscopy (1, 4)

Total morbidity	0.4 %
for diagnostic colonoscopies	0.2 %
for therapeutic colonoscopies	1.2 %
Bleeding	0.2 % of all colonoscopies 0.3–6.1 % of therapeutic colonoscopies
Perforations	0.1 % of diagnostic colonoscopies 0.1–0.3 % of therapeutic colonoscopies
Mortality	0–0.006 % of all colonoscopies

Attention

- Cardiopulmonary complications are the leading cause of death related to colonoscopy.

General Principles

The success of the procedure is determined by the cooperation of the physician, assistant, and patient, all of whom must adjust to varying patient conditions in terms of anatomy and pain threshold, to the different equipment positions and functions, and to varying levels of training and expertise on the part of the examiner and assistants.

Insufflation of air. In order to inspect a 1.20-m-long, stool-filled hollow organ, it must be cleansed prior to the procedure and then distended using air during the examination. The distention of the intestinal lumen is vital for advancing the colonoscope under constant visualization, but it is also the source of much of the discomfort experienced by the patient through the mechanoreceptors and pain receptors. Using CO_2 instead of air may be advantageous due to its quicker absorption. Nevertheless, a good rule of thumb for all colonoscopies: use as little air as possible and as much air as necessary (Figs. 1.**4**, 1.**5**).

Mesenteric discomfort. The patient may also experience discomfort from the mechanical strain on the mesentery. This occurs when the advancement of the colonoscope is prevented, for example, by looping in the sigmoid colon. An experienced examiner can determine the position of the instrument by the movement of the endoscope in the intestine and can attempt to avoid looping or to pull back (cf. Chapter 5) before the patient experiences noticeable discomfort.

Patient care. The examiner should continue to pay close attention to the patient while concentrating on the advancement of the colonoscope on the monitor screen. The effort to produce a thorough and accurate diagnosis is almost equally important to the patient as the subjective experience of colonoscopy, which includes all aspects of the examination, including the experience of discomfort, receiving sufficient information and the maintenance of dignity.

Five basic rules of colonoscopy
1. Do not advance the endoscope without a clear view of the lumen.
2. Do not advance the endoscope if there is any resistance.
3. When in doubt, pull back.
4. Use as little air as possible and as much air as necessary.
5. Pay attention to patient's pain reaction.

Anatomy of the Colon

The endoscopist views the colon from a perspective unlike that of any other visualizing technique, viewing the inner relief of the "intestinal skeleton," which is made up of three straplike bands of longitudinal muscles (tenia coli) and numerous half-moon-shaped cross-folds (semilunar folds) which give rise to the pouchlike haustra between them (Fig. 1.**6**).

Structure of the intestinal wall. The intestinal wall can be divided microscopically into four layers, the structure of which does not vary significantly from the six macroscopic segments of the colon (rectum, sigmoid colon, descending colon, transverse colon, ascending colon, and cecum) (Figs. 1.**7**, 1.**8**). The endoscopic forceps biopsy usually takes samples limited to the mucosa. In order to collect deeper proportions of the intestinal wall (e.g., submucosa) it is practical to use a snare.

Colon segments. The division of the colon into segments is based primarily on anatomical rather than functional aspects. Only the rectum and cecum are unlike the other segments in that they function as reservoirs.

Cecum. Passage from the ileum to the cecum is restricted by the Bauhin valve that prevents the backward flow of the contents of the intestine out of the colon into the small intestine. The Bauhin valve is made up of two lips with a reinforced circular muscle layer that permit the opening of a narrow slit, the ileocecal valve, and that merge into two membrane folds at the front and back (Fig. 1.**9**).

The cecum is normally located intraperitoneally in the iliac fossa of the lower right abdomen. In the final months of pregnancy, the beginning of the large intestine grows up the inside of the right side of the abdomen. A "displaced" cecum can result if it remains at the level of the liver.

The three tenia of the cecum converge in a star shape at the end of the (vermiform) appendix that is not intubated during colonoscopy.

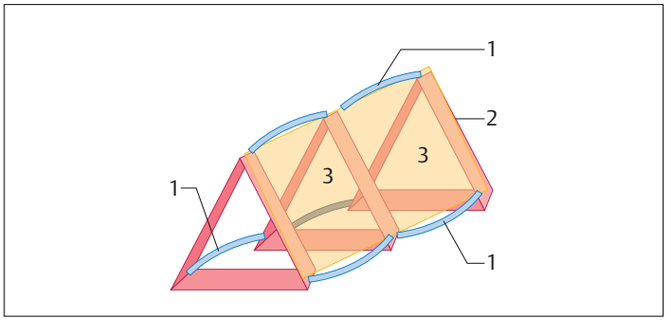

Fig. 1.**6** **Schematic structure of the colon wall.** Tenia (1), pliquae semilunares (2), and haustra (3).

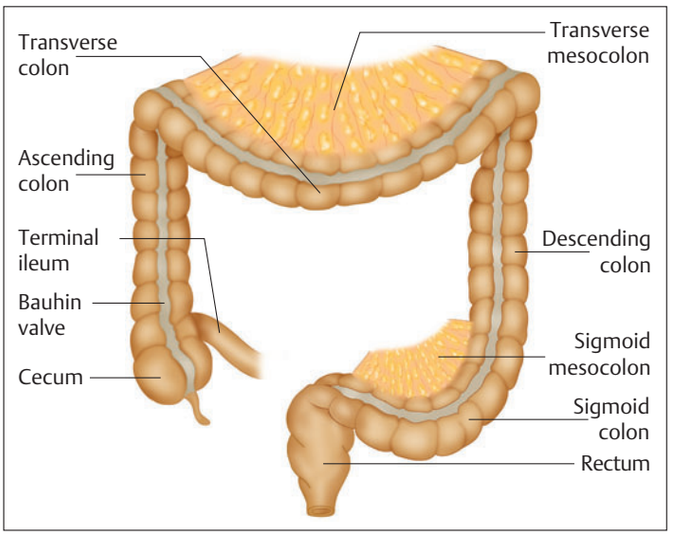

Fig. 1.**7** **Anatomy of the colon.**

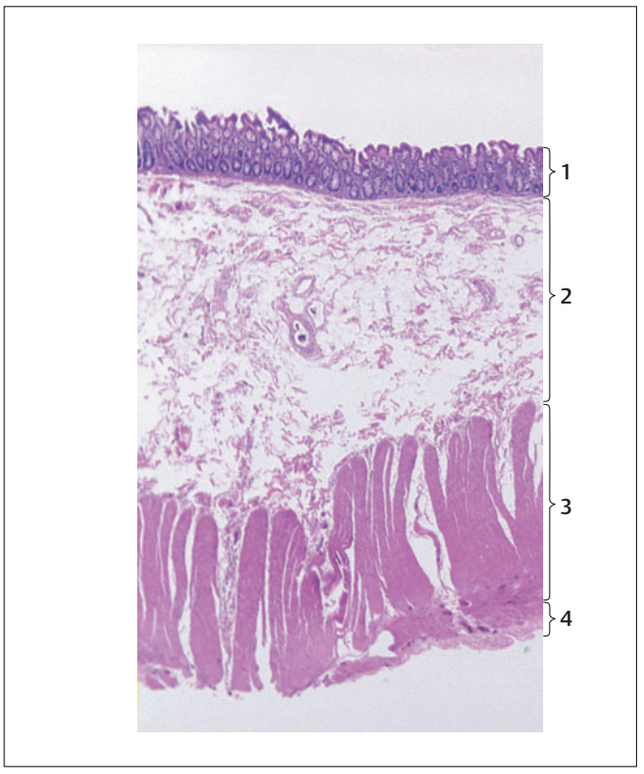

Fig. 1.**8** **Microscopic structure of the intestinal wall** (with the kind ▷ permission of Prof. Dr. H. Arnholdt, Pathological Institute, Klinikum Augsburg).
(1) Mucosa: deep, close together crypts with numerous goblet cells and enterocytes, high brush border;
(2) Submucosa: loose connective tissue layer, latticelike formation of collagen fibers, blood, and lymph vessels, vegetative plexus submucosus;
(3) Muscularis propria: strong inner circular muscle layer, outer longitudinal layer, reinforced tenia, plexus myentericus;
(4) Serosa: peritoneal covering.

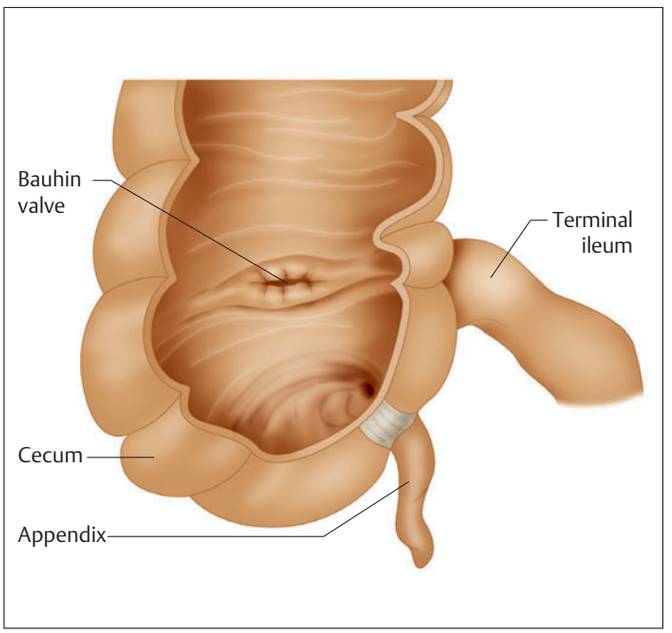

Fig. 1.**9** **Detailed view of the cecum and Bauhin valve.**

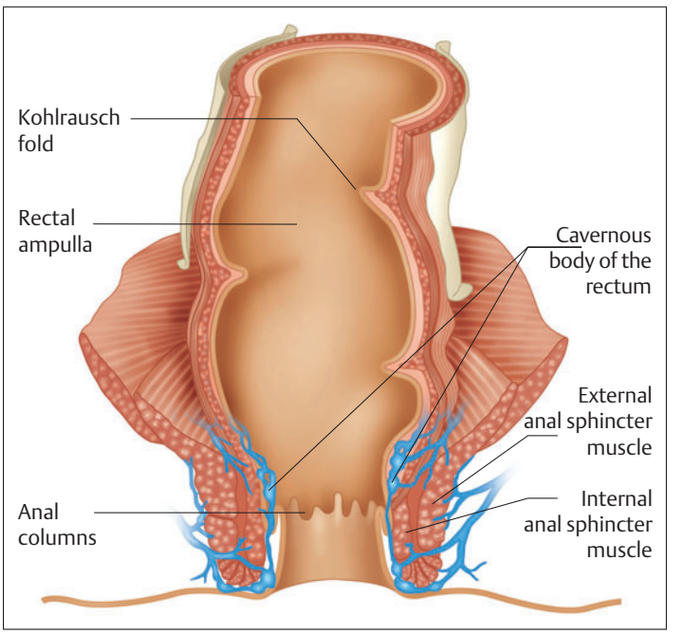

Fig. 1.**10** **Rectum and anal canal.**

Table 1.**5** Mesenterial fixation of the colon

Intestinal segment	Mesentery	Meaning for endoscopy
Sigmoid colon Transverse colon	Persistent, mobile mesentery	Makes endoscope passage difficult due to mobility in abdominal cavity
Descending colon Ascending colon Cecum	Retroperitoneal fixation of the mesentery	Endoscopic passage easier
Rectum	Primarily retroperitoneal	Good maneuverability of the endoscope

Mesentery. The mesentery is a double layer of peritoneum, which, during the embryonic phase, attaches the ascending colon and the descending colon to the back wall of the abdomen, creating a retroperitoneal fixation; the mesentery persists as a free attachment for the transverse colon and sigmoid colon so that they remain mobile (Tab. 1.**5**). Because of this, the passage of the endoscope can result in colon movements and even looping in the abdominal cavity (see Chapter 5).

Rectum and anal canal. The 15–20-cm-long rectum is closed off to the outside by the hemorrhoidal zone, where the anal columns containing arterial and vascular bundles are located. Together with the reinforced muscle layers of the internal and external anal sphincter muscles, the hemorrhoidal zone supports bowel continence. The epidermis extends 2–3 cm into the anal canal. Cranially limited by a transverse fold (the Kohlrausch fold), the rectal ampulla is a highly expandable area that functions as a reservoir (Fig. 1.**10**).

Attention

- Precise knowledge of anatomy is essential for the management of colonoscopy, correct description of pathological findings, and understanding the clinical features of intestinal diseases.

References

See Chapter 2.