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Lower gastrointestinal bleeding: therapeutic strategies, surgical techniques and results

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Abstract Lower gastrointestinal bleeding (LGIB) is normally treated conservatively or by noninvasive techniques. Emergency operations are only necessary when patients with severe hemorrhage cannot be stabilized by emergency endoscopy or angiography. To improve the postoperative outcome it is of importance to operate on the patients without any unnecessary time delay. If the preoperative localization of the bleeding source failed, a total or subtotal colectomy should be regarded as a safe procedure. A blind segmental resection should not be done. Alternatively, several ileotomies or colotomies might be performed in order to localize and treat the bleeding site.

Elective surgery is indicated with chronic or recurrent bleeding that cannot be treated conservatively. A meticulous preoperative localization of the bleeding site, including anorectoscopy, endoscopy, angiography and nuclear scan is required. With reliable knowledge of the cause and localization of the suspected hemorrhage, a directed segmental bowel resection should be performed.

Keywords Lower gastrointestinal bleeding · Therapeutic strategies · Surgical techniques

General aspects of lower intestinal bleeding

Lower gastrointestinal bleeding (LGIB) is thought to originate distal to the ligament of Treitz. The estimated incidence rate is 20.5 patients/100.000/year [1], with a male to female ratio of 1.4:1. Compared to upper gastrointestinal bleeding, bleeding in the lower gastrointestinal tract only accounts for 24% of the cases [2]. It has been reported that there is more than a 200-fold rise in bleeding events from the third to the ninth decade of life [3]. The mortality rate of LGIB is about 10% [4]. The LGIB in the elderly is associated with greater morbidity due to the natural aging process, higher comorbidity and medication use. In this aspect, Longstreth et al. have shown an all-cause post-hospital mortality rate during a follow-up of 34 months of 19%, although no patient died from gastrointestinal hemorrhage [1].

Clinical symptoms

The most common clinical symptom in patients with acute LGIB is hematochezia. By definition, acute LGIB lasts up to 3 days, most frequently resulting in instability of vital signs. However, in more than 70% of cases, LGIB is chronic and self-limiting [5]. Chronic bleeding can be occult and therefore only detectable by chemical tests, or it can be visible as intermittent melena or scant hematochezia [6].

Etiology

Regarding therapeutic strategies and surgical techniques, the etiology of the underlying disease is also of relevant importance, and the directed intervention and cure is mainly determined by the primary disease. Therefore, a

short summary and overview of the most frequent disorders seems necessary. LGIB is generally a disease of the elderly patient, peaking in incidence in the sixth decade of life [5]. In younger patients, LGIB is rare but, when it occurs, it typically is caused by a Meckel's diverticula. The diverticula shows gastric mucosa in 30–50% of the cases that demonstrate acid secretion and ulceration [7]. It is a complex clinical problem that requires disciplined management and accurate diagnosis. Precise identification of the bleeding source is crucial for a successful outcome. Using colonoscopy, a bleeding source in the small bowel is identified in only 1–9% of cases, whereas angiography detects 30% of the bleeding sites in the small bowel [1, 8, 9]. A review of the literature shows the etiology of bleeding sites (Table 1).

Table 1 Etiology of lower gastrointestinal bleeding

Etiology	Frequency (%)	Reference
Diverticula	23	Schilling MK et al. (1998) [5]
	56	Eaton AC (1981) [25]
	55	Colacchio TA et al. (1982) [47]
	23–55	Berry AR et al. (1988) [24][a]
	29	Gordon RL et al. (1997) [35]
	19	Mäkelä JT et al. (1993) [23]
	55	Farner R et al. (1999) [26]
Mean	40	
Arteriovenous malformations	17.5	Schilling MK et al. (1998) [5]
	6.5	Eaton AC (1981) [25]
	7	Colacchio TA et al. (1982) [47]
	1–20	Berry AR et al. (1988) [24][a]
	6	Mäkelä JT et al. (1993) [23]
	18	Farner R et al. (1999) [26]
Mean	11	
Inflammatory bowel disease	7.5	Schilling MK et al. (1998) [5]
	5	Eaton AC (1981) [25]
	3	Colacchio TA et al. (1982) [47]
	3–8	Berry AR et al. (1988) [24][a]
	8	Mäkelä JT et al. (1993) [23]
	3	Farner R et al. (1999) [26]
Mean	5	
Neoplasia	6	Colacchio TA et al. (1982) [47]
	1–6	Berry AR et al. (1988) [24][a]
	7	Gordon RL et al. (1997) [35]
	10	Mäkelä JT et al. (1993) [23]
	17	Farner R et al. (1999) [26]
Mean	9	
Colitis	2	Eaton AC (1981) [25]
	1–3	Berry AR et al. (1988) [24][a]
	4	Mäkelä JT et al. (1993) [23]
	3	Farner R et al. (1999) [26]
Mean	2	
Anorectal diseases	2.5	Eaton AC (1981) [25]
	1	Berry AR et al. (1988) [24][a]
	28	Mäkelä JT et al. (1993) [23]
Mean	10	
Unclear	26	Eaton AC (1981) [25]
	18	Colacchio TA et al. (1982) [47]
	7	Gordon RL et al. (1997) [35]
	5	Mäkelä JT et al. (1993) [23]
	8	Farner R et al. (1999) [26]
Mean	13	

[a] Review article

Diverticula

Diverticular bleeding is responsible for 40% of LGIB. Three to five percent of all patients with diverticulosis will develop hemorrhage. The clinical presentation is painless but with an abrupt onset. About 90% of patients report spontaneous cessation of bleeding, with a recurrence rate of 22–38% [1, 10]. The left colon is the primary site of diverticulosis in about 90% of patients from the Western world; however, bleeding occurs in 50–90% in the ascending colon [11]. The use of nonsteroidal antiinflammatory drugs is associated with a threefold higher risk of diverticular bleeding [12].

Arteriovenous malformations

Arteriovenous malformations are frequent, accounting for 11% of all LGIB episodes. Bleeding can be chronic, slow, intermittent, or recurrent. Massive bleeding has only been described in 2% of the cases, with a high rebleeding rate of up to 85% [8]. Angiodysplasia, a condition leading to arteriovenous malformations, is a progressive venular dilatation found in association with cardiovascular and peripheral vascular disease, and aortic stenosis [13]. Another arteriovenous malformation, colonic varicele, rarely causes bleeding and is most commonly due to portal hypertension [14]. The prevalence of colonic angiodysplasia among healthy asymptomatic people is unknown. Based on screening colonoscopies for the detection of neoplasia in 964 asymptomatic adult men and women, Fouch et al. reported an estimated prevalence of 0.83%, with synchronous angiodysplasias in 20% [15]. This group did not show any bleeding episodes during a 3-year follow-up period.

Inflammatory bowel disease

Acute LGIB is an unusual complication of Crohn's disease, with a prevalence of about 1% [16]. Recent studies cite an equal frequency of severe gastrointestinal hemorrhage in both Crohn's disease and ulcerative colitis [17, 18, 19]. The Mayo group retrospectively described the clinical features and the course of patients with acute LGIB from inflammatory bowel disease [20]. The study concluded that acute major gastrointestinal bleeding is uncommon in inflammatory bowel disease. Most gastrointestinal bleeding cases were due to Crohn's disease, without a predilection for site of involvement. Surgery was required in less than half of the cases during the ini-

tial hospitalization. Recurrent hemorrhage did occur in an appreciable number of cases, and, for these cases, surgery was the chosen treatment.

Neoplasia

LGIB of colon cancer or polyps has been described in 1–17% of cases. Most frequently, chronic bleeding originates from the ulcerated or eroded surface of the benign or malignant lesion. Apparent bleeding may also occur after endoscopic removal of polyps, and occasionally from rupture of a polyp stalk. The overall probability of bleeding is 11% for adenomas and about 60% for colon cancer [1].

Colitis

LGIB from colitis can be due to infectious enterocolitis or ischemic lesions. Bacterial- or viral-induced enterocolitis may trigger bloody diarrhea. Severe hemorrhage is uncommon and neither operative nor other interventional treatment is required. Therefore, these diseases should be treated symptomatically.

Colitis after radiation therapy of pelvic, intra- or retroperitoneal tumors may cause acute or chronic bleeding. Acute radiation-induced colitis occurs a few days after radiation, but hemorrhage is uncommon at this time. More often (2–4% of cases), late complications, such as LGIB caused by progressive intramural vasculitis, occur 1–2 years after chronic radiation damage. The clinical presentation varies from mild disease to debilitating rectal bleeding, diarrhea, obstruction and fistula. Surgery should be reserved for severe refractory bleeding. Due to the recurrent character of the disease and the high complication rate, surgery should be viewed as a last resort treatment [21].

Anorectal disease

LGIB due to anorectal diseases is mainly caused by hemorrhoids, rectal varices, or anal fissures. During outpatient examination for hematochezia, the prevalence rate of internal hemorrhoids reaches 75.7% [22]. About 10% of LGIB cases are caused by hemorrhoids. Bleeding is sometimes profuse but painless. Hemorrhoids are more often the cause of bleeding among patients less than 50 years of age [23]. Constipation occasionally causes solitary stercoral ulcers or anal fissures. Anal fissures are usually painful but cause only scant hematochezia.

Our own patient data are summarized in Fig. 1. From 1992 to 2000, we treated 42 patients with severe rectal bleeding: 37 patients had surgical intervention and 5 patients were treated symptomatically. Most LGIB cases were caused by inflammatory bowel diseases (n=11), followed by diverticulas (n=7), arteriovenous malformations (n=5), and hemorrhoids (n=4).

Management of LGIB

The management of LGIB depends on the amount of bleeding and the recurrence rate. Occult bleeding requires chemical tests; however, scant or intermittent he-

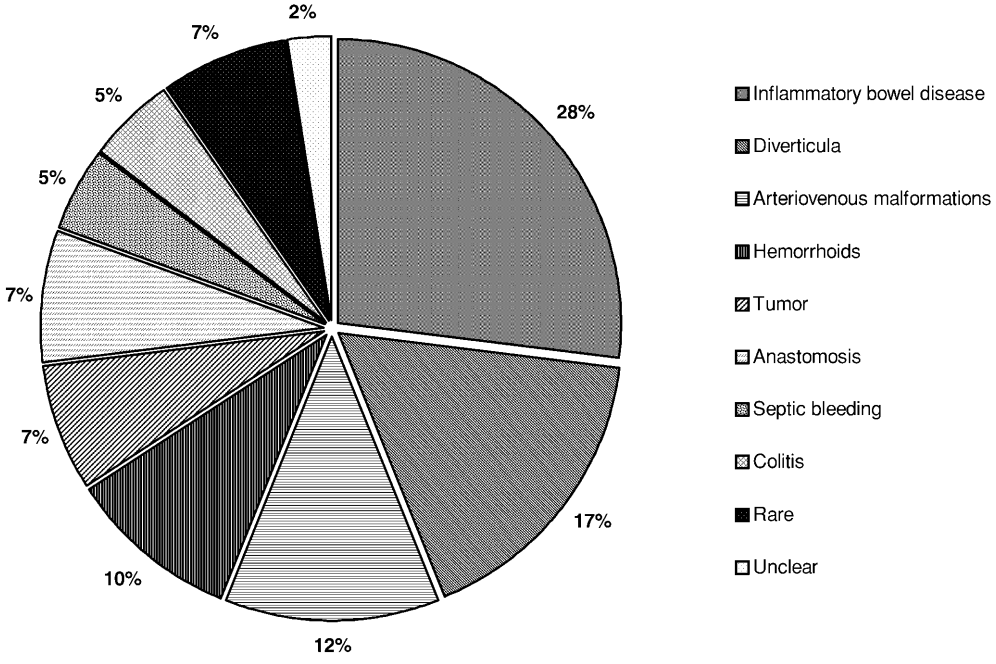

Fig. 1 Etiology of different bleeding sites in our own patients with severe lower gastrointestinal bleeding (n=42)

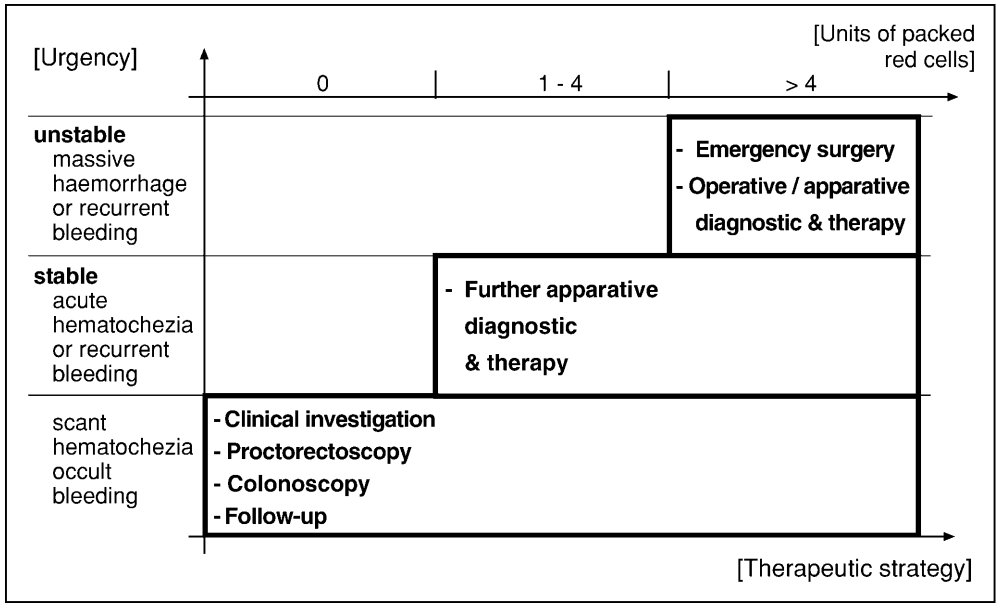

Fig. 2 Management of lower gastrointestinal bleeding relating to the bleeding rate

Table 2 Recurrent bleeding data after total versus limited directed colonic resection. Limited colonic resection was performed in case of positive preoperative localization; limited blind resection was performed if preoperative localization failed

Colonic resection	No. of patients	Rebleeding (%)	Mortality (%)	Reference
Limited-directed	23	4	13	Leitman IM et al. (1989) [45]
Total	7	0	40	
Limited-directed	14	7	14	Brit LG et al. (1983) [46]
Total	10	0	20	
Limited-directed	46	11	22	Colacchio TA et al. (1982) [47]
Total	12	8	33	
Limited-directed	42	10	2	Welch CE et al. (1978) [49]
Total	10	0	10	
Limited-blind	24	75	50	Eaton AC (1981) [25]
Total	4	0	0	
Limited-blind	23	35	30	Drapanas T et al. (1973) [50]
Total	35	0	11	
Limited-directed	14	14	7	Parkes BM et al. (1993) [41]
Limited-blind	7	42	57	
Total	10	0	30	
Limited-directed	50	18	7	Farner R et al. (1999) [26]
Total	27	4	2	

matochezia should be clinically investigated by means of a digital rectal examination, anoproctorectoscopy, and colonoscopy. Acute or recurrent bleeding must be investigated to find and treat the source of bleeding. In case of massive hemorrhage and hemodynamic instability, an emergency operation may be warranted. Surgical management of LGIB is the ultima ratio. Emergency surgery is necessary in 10–25% of those patients with severe hemorrhage (Fig. 2, Table 2).

Patient history

The diagnostic procedure should start with a detailed patient history. Important points include the duration of bleeding, stool color, stool frequency, and change in bowel habits. Furthermore an anamnesis of the last medication (e.g., nonsteroidal anti-inflammatory drugs), the co-morbidity, abdominal and vascular surgeries, radiation of pelvic and abdominal organs may help to plan further diagnostic steps. Furthermore coagulopathies should be ruled out by history and laboratory investigations.

Physical examination

Physical examination helps to differentiate between acute and chronic bleeding. A blood loss of more than 800 ml induces a heart rate increase of 10 beats/min and

a drop in blood pressure of 10 mmHg; whereas, blood loss of less than 250 ml shows no influence on vital parameters. An extensive blood loss (>1500 ml) usually causes shock symptoms, including tachypnea and depressed mental status. A crucial point is the digital rectal examination, since 40% of rectal carcinomas should be detected using this investigation and 2% of massive rectal hemorrhages are caused by rectal cancer [24].

Diagnostic approach and intervention

The treatment of acute LGIB has been a controversial topic. Preoperative localization of the bleeding site is useful when a clear bleeding source is found. However, detection of the bleeding source is often negative. If one waits to operate only on positive scans, there might be a problematic delay before definitive treatment. Patients with significant LGIB have a better outcome when they are resuscitated and taken to the operating room without delay [25, 26]. From another point of view, a fast positive preoperative localization can diminish the operative trauma, as well as the mortality. It is notable that bleeding episodes stop spontaneously in 75% of cases. Furthermore, since 99% of all patients with LGIB require less than four units of packed red cells, they most likely would not profit from an immediate operative treatment [27]. A possible pathway for the management of LGIB is shown in Fig. 3.

Endoscopy

Anoproctorectoscopy followed by colonoscopy is the diagnostic procedure of choice both for its accuracy in lesion localization and its therapeutic capability. Furthermore, treatment can be done simultaneously. Colonoscopy should be considered early in the evaluation of patients with acute gastrointestinal hemorrhage [28]. Endoscopy successfully identifies the origin in 74–89% of cases in patients with severe hematochezia [29, 30, 8]. Before colonoscopy, an anterograde colon preparation with a purge solution is recommended in stable patients [31]. If a defined source of bleeding is localized (e.g., arteriovenous malformations), argon beam ablation, electrocautery, laser ablation, or injection sclerotherapy may be used to stop the acute hemorrhage [13]. Endoscopic therapy is indicated only when a discrete source of bleeding is identified. Only about 20% of patients with LGIB have a lesion that can be treated via endoscopy [31].

Angiography

If colonoscopy fails, mesenteric angiography can be performed. This approach has a sensitivity of 42–86% [8]. If the ongoing arterial bleeding is at least 0.5 ml/min, selective visceral angiography may show extravasation of contrast dye into the bowel lumen. A massive hemorrhage shows a bleeding of 30 ml/h [32]. Bleeding may be provoked by anticoagulation with heparin in patients with intermittent recurrent bleeding.

Different techniques have been used to control LGIB with selective catheterization, including vasopressin infusion, autologous clots, metal coils, gel-foam coils, and tissue glues [33]. Microcoil embolization seems to be a safe and efficient procedure for controlling acute LGIB, if performed in a superselective catheter position [34]. Gordon et al. reported that bleeding was stopped in 93% of cases if selective arterial embolization was possible, and in 76% of cases when there was an intention to treat

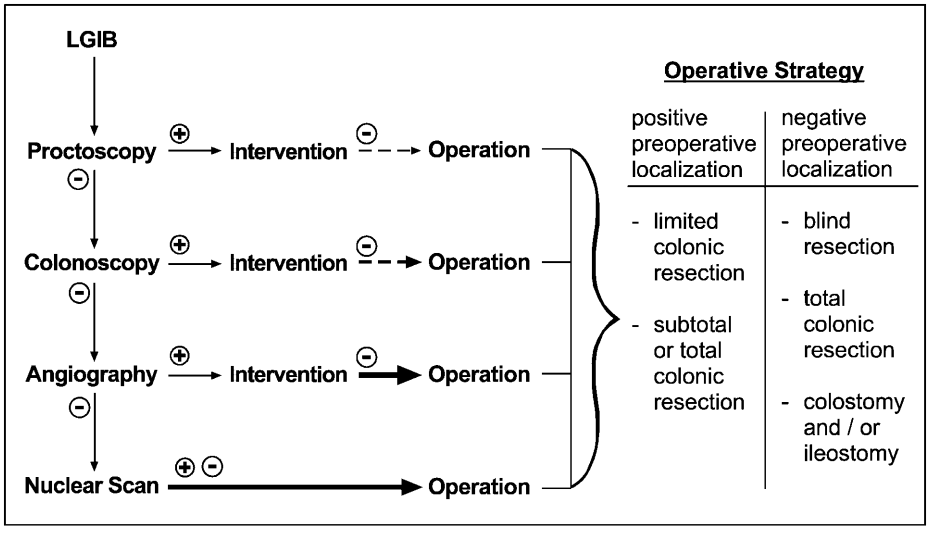

Fig. 3 Algorithm for evaluation and management of lower gastrointestinal bleeding

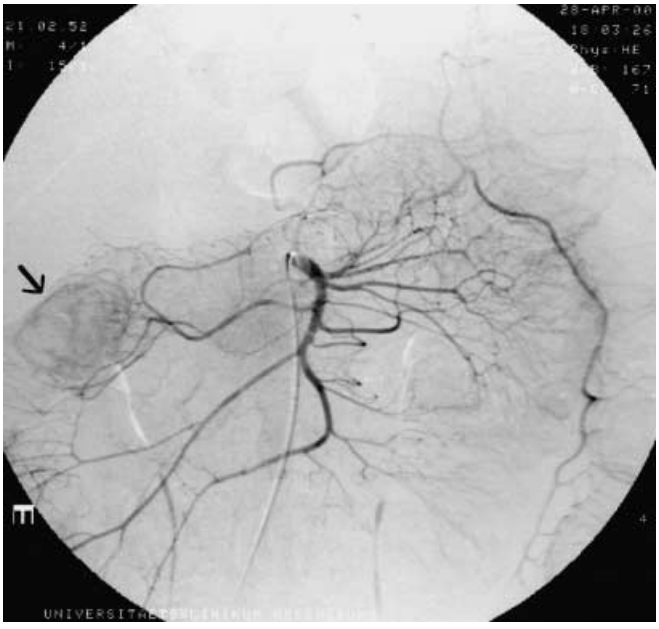

Fig. 4 Extravasation (→) of contrast dye in a patient with lower gastrointestinal bleeding caused by arteriovenous malformation. Hemodynamic stabilization resulted in a right hemicolectomy. There was no rebleeding episode during the follow-up period of 1 year

[35]. However, it has been described that selective angiography carries a relatively high complication risk, including bowel necrosis [36]. This procedure should be reserved for those patients where colonoscopy is not practical (Fig. 4).

Nuclear scan

In case of negative angiography results, an improved demonstration of gastrointestinal hemorrhage can be achieved by nuclear scan with ^{99m}Tc- or sulfur-labeled autologous erythrocytes. The threshold rate of LGIB for localization with this method is about 0.1 ml/min [33]. Delayed red blood cell scans at 12 h or 24 h are able to detect even small or intermittent blood loss.

Although a specificity of up to 94%, with a sensitivity of 95%, has been reported [37], other authors cite a significant rate of incorrect localization [38, 33, 39]. We suggest caution in recommending limited colonic resection on the basis of a positive red blood cell scan only.

Surgical treatment

Surgical management of LGIB is ideally undertaken with reliable knowledge of the cause and localization of the suspected hemorrhage. The patient should be in a stable hemodynamic situation, and bowel resection should be performed after preoperative localization. In recent years, intraoperative endoscopy has been used more extensively, but mainly in the elective setting [40]. In our personal experience using intraoperative ileoscopy and diaphanoscopy, we were able to identify a small-bowel hemangioma of 2 mm in diameter in a 14-year-old boy, with recurrent massive hemorrhage.

Emergency surgery

An emergency operation is necessary in those patients with severe hemorrhage, which occurs in 10–25% of LGIB cases. Criteria for emergency surgery include a blood loss of more than four to six units of packed red blood cells within 24 h and no stabilization by emergency endoscopy or angiography. Other criteria are significant persistent bleeding after diagnosis with failed intervention made by colonoscopy or angiography, as well as significant rebleeding within 1 week of initial cessation [33]. Blind segmental resection carries a high mortality rate of up to 57% and is associated with significantly higher rebleeding rates than limited directed or total colectomies [41]. In principle, this operative strategy should not be performed [41, 42, 43].

If emergency surgery is needed, the first step after laparotomy is the meticulous inspection and palpation of the whole intestinum. In case there are no evident macroscopic alterations, colotomy and ileotomy may be done. After bowel cleansing by suction of the intraluminal clots over the colotomies, the whole colon should be investigated by segmental clamping and tamponage or endoscopy to detect the responsible bleeding site. Whenever the bleeding site is clearly localized, a directed segmental colectomy should be performed, according to the rules for the treatment of the suspected disease.

If there is no evidence of a colonic bleeding source, and the bleeding is suspected to be in the small bowel, several ileotomies are mandatory to investigate the small bowel (in the previously described manner). A blind segmental small-bowel resection is not a proper procedure and should only be performed as an ultima ratio. In case of an unclear bleeding source in the small bowel, several ileostomies might be performed, followed by repetitive interventional endoscopies in order to localize and treat the responsible bleeding source.

In our personal experience, we could identify the bleeding site using this strategy in two patients. One patient had massive recurrent bleeding with Crohn's disease and the other had bowel involvement with ulceration in previously unknown Wegener's disease. Although this method has been reported to show a high morbidity and mortality as an ultima ratio for continued massive hemorrhage, it can be useful to localize the bleeding site and to avoid blind undirected bowel resection without success [44].

If a colonic bleeding exists but bleeding has not been located, we recommend a total or subtotal colectomy. Because of the high rebleeding rate and the morbidity, a blind segmental colectomy should not be performed. Emergency surgery has a higher mortality and morbidity than elective surgery. It has been reported that the mortality varies with transfusion requirement [44]. Bender et al. reported that during a 6-year period, 49 total abdominal colectomies were performed for LGIB. The overall mortality was 13 of 49 (27%). In the elective/urgent group, mortality was 1 of 14 (7%); in the emergency ileostomy group it was 2 of 2 (100%); and in the emergency anastomosis group it was 10 of 33 (30%). Morbidity and mortality in this latter group were affected by age and the number of units of blood needed preoperatively and intraoperatively. The surgical mortality increased from 8% to 45% for those patients transfused with ten or more units of packed red blood cells. There was no effect on outcome due to type of anastomosis (stapled vs hand-sewn), choice of antibiotics, degree of underlying illness, or day of operation following admission. This emphasizes the conclusion that, in an emergency situation, it is a crucial point, to avoid any unnecessary delay of time, attempting to localize the lesion. Furthermore, it is of importance to operate on the patients before giving them more than ten units of packed red blood cells.

Elective surgery

To evaluate what has been the most effective surgical treatment for acute LGIB, Parkes et al. reviewed the records of 31 patients who underwent colon resection for massive LGIB. Thirty-one patients underwent either segmental colectomy (21 patients) or subtotal colectomy (10 patients). The rebleeding rate for subtotal colectomy was 0%, while segmental resection with positive and negative angiography showed 14% and 42% rebleeding rates, respectively. Other authors reported even lower rebleeding rates (4–11%) after positive angiography [45, 46, 47]. The complication and mortality rate was highest (83% and 57%) in those patients receiving segmental resection with a negative angiogram. They concluded that segmental resection should be performed when the bleeding site is identified angiographically. The subtotal colectomy should be reserved for massive bleeding with negative angiography [41].

Finally, Farner et al. recommended total or subtotal colonic resection without a positive preoperative bleeding localization [26]. Regarding limited versus total colonic resection, Farner et al. reported of a 10-year period, during which 77 patients with acute LGIB underwent either a limited colon (LCR) or subtotal/total colonic (TCR) resection. Fifty LCR and 27 TCR were performed. Localizing tests were performed in 71 patients, in whom the source of bleeding could be localized in 37%, followed by LCR. Compared with TCR patients (209 min; $P<0.05$), the LCR group (149 min) showed a significantly shorter surgery time. However, recurrent bleeding was significantly more common in the LCR group than in the TCR group (18% versus 4%, respectively). Morbidity and mortality were not significantly different [26]. From these studies, they concluded that preoperative localization is a vital part of delineating what needs to be done to help a patient. However, as previously described, with an acute bleeding episode, too much time can be taken attempting to localize the lesion. In their experience, these patients do get to the operating room faster with similar morbidity, mortality, postoperative bowel function, and less concern for recurrent bleeding after total colectomy.

Table 3 Limited versus total colonic resection. Patient data (Farner R et al. 1999) [26]

Data	Colonic resection		*P* value
	Limited (*n*=50)	Total (*n*=27)	
Preoperative positive localization			
Colonoscopy	86%	16%	0.04
Angiography	71%	7%	0.001
Nuclear scan	42%	20%	n.s.
First rebleed	18%	4%	0.05
Time to operation room	115 h	69 h	0.05
Surgery length	149 min	209 min	0.04
Total blood transfusion	9.6 units	8.1 units	n.s.
Morbidity	12%	14%	n.s.
Mortality	7%	2%	n.s.

Conclusions

In an emergency situation with LGIB, the preoperative localization of the bleeding source by colonoscopy or angiography is desirable but not mandatory. In case of positive preoperative localization of bleeding, the surgeon's operation of choice should be a limited colonic or limited small-bowel resection (Table 3).

If preoperative localization of LGIB fails, we recommend a total or subtotal colectomy before the blood requirement exceeds ten units of packed red cells. Any unnecessary delays should be avoided in the emergency situation and every effort should be made to speed the diagnostic work-up and the operative intervention before excessive blood loss and massive transfusion occurs. In case of an unclear massive small-bowel hemorrhage, one or several ileostomas should be performed in order to identify the bleeding site for directed resection.

The elective LGIB requires meticulous preoperative localization diagnostic to detect the bleeding source, including anorectoscopy, endoscopy, angiography, and nuclear scan. More recently interventional treatment by co-

lonoscopy, as well as selective catheterization and embolization, shows good results with low rebleeding rates. If an interventional therapy is not possible, a directed limited colonic or small-bowel resection should be considered.

Finally, the total or subtotal colectomy must be regarded as a safe procedure, even in an emergency situation if no preoperative localization of the bleeding site was possible. This conclusion does not deviate from the first report of a successful abdominal colectomy described by Cate in 1953 [48]. He performed a subtotal colectomy in a 40-year-old woman with multiple bleeding episodes. After the operative intervention, she had no further bleeding episodes during a follow-up of 30 years.

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