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Pros and cons of colonoscopy in management of acute lower gastrointestinal bleeding

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in the hospitalization, can decrease hospital length of stay, rebleeding and the need for surgery. However, results from available small trials are conflicting and larger, multicenter studies are needed. Compared to other management options, colonoscopy is a safe procedure with complications reported in less than 2% of patients, including those undergoing urgent examinations. The requirement of bowel preparation (typically 4 or more liters of polyethylene glycol), the logistical complexity of coordinating after-hours colonoscopy, and the low prevalence of stigmata of hemorrhage complicate the use of colonoscopy for LGIB, particularly in urgent situations. This review discusses the above advantages and disadvantages of colonoscopy in the management of acute lower gastrointestinal bleeding in further detail.

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Abstract

Acute lower gastrointestinal bleeding (LGIB) is a frequent gastrointestinal cause of hospitalization, particularly in the elderly, and its incidence appears to be on the rise. Endoscopic and radiographic measures are available for the evaluation and treatment of LGIB including flexible sigmoidoscopy, colonoscopy, angiography, radionuclide scintigraphy and multi-detector row computed tomography. Although no modality has emerged as the gold standard in the management of LGIB, colonoscopy is the current preferred initial test for the majority of the patients presenting with hematochezia felt to be from a colon source. Colonoscopy has the ability to diagnose all sources of bleeding from the colon and, unlike the radiologic modalities, does not require active bleeding at the time of the examination. In addition, therapeutic interventions such as cautery and endoclips can be applied to achieve hemostasis and prevent recurrent bleeding. Studies suggest that colonoscopy, particularly when performed early

Key words: Colonoscopy; Acute lower gastrointestinal bleeding; Management; Diagnostic yield; Therapeutic intervention; Outcomes; Colon preparation; Stigmata of hemorrhage

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INTRODUCTION

Acute lower gastrointestinal bleeding (LGIB) is a disorder frequently encountered by gastroenterologists, surgeons and internists. Hospitalization for LGIB in the 1990s was estimated to occur at an incidence of 20.5 per 100 000 person-years^[1]. The incidence of LGIB may be rising concomitant with the aging of our population and the increasing use of aspirin/non-steroidal anti-inflammatory drugs and anticoagulants^[2]. LGIB is associated with significant mortality, health care costs and increased length of hospitalization, emphasizing the need for effective evaluation and treatment^[2-4].

Currently, physicians managing LGIB have a number of different diagnostic and therapeutic options to choose from, ranging from radiographic interventions such as radionuclide scintigraphy and angiography to colonoscopy and flexible sigmoidoscopy. Although no modality has emerged as the gold standard in the management of LGIB, colonoscopy has several advantages and is generally regarded as the preferred initial test in the majority of cases. The advantages are as follows: (1) ability to identify bleeding source regardless of rate or presence of bleeding; (2) multiple therapeutic possibilities; (3) efficiency given diagnostic and therapeutic potential; (4) irrespective of initial testing, colonoscopy is required for definitive diagnosis; and (5) safety. Disadvantages are as follow: (1) requirement for colon preparation; (2) need for sedation, experienced staff and endoscopy facilities; (3) low prevalence of stigmata of hemorrhage; (4) invasive nature; and (5) rare but serious complications.

This article will explore the advantages and disadvantages of colonoscopy in the management of LGIB.

PROS OF COLONOSCOPY

Potential for diagnosis and therapeutic intervention

A major advantage of colonoscopy over other management options is the potential for diagnosis and therapeutic intervention even in the absence of ongoing bleeding. This is important given the often intermittent nature of LGIB and slow bleeding from diffuse mucosal sources such as colitis. In contrast, the radiographic alternatives including angiography, radionuclide scintigraphy and computed tomography (CT) require active bleeding at the time of the examination in order to identify and treat the source of bleeding, and are useful only in a subset of patients with severe ongoing bleeding. It is therefore not surprising that the diagnostic yield of colonoscopy exceeds that of the radiographic modalities.

Studies have shown a diagnosis is made in 74%-100% of patients with LGIB undergoing colonoscopy (Table 1)^[5-11]. A pooled analysis by Strate *et al*^[12] of six recent studies of colonoscopies following bowel preparation for LGIB found a composite diagnostic yield of 91% for colonoscopy. In comparison, in radionuclide scanning, a commonly used radiological diagnostic modality in LGIB, scans were positive in 40%-70% of patients with accuracy ranging from 35%-100%^[13-17]. In small case series, multidetector

row CT scanning (MDCT) has shown promising results with localization of bleeding in 50%-100% of select cases^[16,18,19]. Angiography is less sensitive than radionuclide or MDCT scan and therefore is infrequently utilized as a front line test. In a collected series of 247 patients reported by Browder *et al*^[20], angiography demonstrated a bleeding site in 72% of patients whereas a retrospective chart review study by Cohn *et al*^[21] yielded only 35% positive angiographic findings. In addition, it is important to note that colonoscopy is generally required following radiographic tests, whether positive or negative, to confirm the source of bleeding and to exclude colorectal malignancy or other serious diagnoses. Therefore, colonoscopy is the most efficient initial test for the majority of patients with LGIB who can be stabilized and can undergo colon preparation.

Few studies have directly compared colonoscopy to radiographic interventions. In a study by Jensen *et al*^[22], emergency colonoscopy and upper endoscopy as well as emergency angiography were performed in 22 patients with severe bleeding. In the 17 patients with lower intestinal sources of bleeding, the diagnostic yield of colonoscopy was 82% *vs* 12% for angiography^[22]. Similarly, in a retrospective study by Strate *et al*^[23], initial colonoscopy within 24 h of admission offered a diagnostic yield of 85% *vs* 45% for initial scintigraphy and angiography.

The timing of colonoscopy also may have an effect on diagnostic and therapeutic outcomes. Several studies indicate that urgent colonoscopy, or colonoscopy within 12-24 h of presentation, may improve the diagnostic and therapeutic yield of colonoscopy in LGIB. In a prospective study, Jensen *et al*^[6] identified stigmata of hemorrhage in approximately 20% of patients with diverticular bleeding undergoing urgent colonoscopy. Subsequent endoscopic treatment significantly reduced the rate of rebleeding and surgery compared to historical controls. In a trial by Green *et al*^[7] of colonoscopy following bowel preparation within 12 h *vs* elective colonoscopy (within 74 h), a definitive bleeding source was identified in 42% of patients undergoing urgent colonoscopy *vs* 22% in those undergoing elective colonoscopy. Most recently, in a trial of colonoscopy within 12 h *vs* colonoscopy in 36-60 h, Laine *et al*^[24] found no differences in outcomes including the number of diagnoses. However, 78% of colonoscopies were diagnostic in the urgent group compared to 67% in the elective group, and the only 2 stigmata of hemorrhage were both identified in patients with diverticulosis undergoing urgent colonoscopy^[24].

For patients undergoing colonoscopy, once a diagnosis is made, endoscopic hemostasis can be carried out depending on the source. Epinephrine or saline injection, thermal contact, argon plasma coagulation, clipping and band ligation are available therapeutic modalities. A review of published series by Strate *et al*^[12] showed that endoscopic therapy was applied to 10% to 40% of patients undergoing colonoscopy for LGIB and the most common intervention was thermal contact plus injection. Their review of 71 cases of diverticular bleeding treated with endoscopically placed hemoclips showed

Table 1 Comparison of management options for lower gastrointestinal bleeding (%)

Procedure	Diagnosis	Therapy	Early rebleeding	Major complications	Colon preparation	Requires active bleed
Colonoscopy ^[5-8]	74-100	8-37	0-24 ¹	0-2	Yes	No
Sigmoidoscopy ^[9-11]	About 10	0-20	0	Rare	Minimal	No
Angiography ^{[20,21,26-29]2}	23-72	14-100	1-57	0-60	No	Yes
Radionuclide scan ^[13-15]	40-73	N/A	N/A	Rare	No	Yes
Multi-detector CT scan ^[16,18,19]	24-94	N/A	N/A	0%-11%	No	Yes

N/A: Not available; CT: Computed tomography. ¹Early rebleeding in patients who had undergone endoscopic therapy for diverticular bleeding; ²Therapy, rebleeding and complications refer to superselective embolization only. It is difficult to determine the frequency of superselective embolization use because most series only report patients who receive therapy.

particular promise with a homeostasis success rate of 100% and with no complications.

Improved outcomes

It is important to note that in most cases, diagnosis needs to be followed by therapeutic maneuvers in order to alter outcomes in patients with LGIB. Early colonoscopy has shown particular promise in this regard in patients with diverticular bleeding. In a study by Jensen *et al*^[6], patients undergoing endoscopic hemostasis for diverticular stigmata with epinephrine plus/minus thermocautery had significantly lower rates of rebleeding and surgery when compared to historical controls who did not receive endoscopic treatment. Indeed, none of the endoscopically treated patients experienced re-bleeding. In addition, length of hospital stay was significantly shorter in the colonoscopy treatment group ($P < 0.001$).

Subsequent randomized trials for all sources of severe LGIB have yielded less positive results. However, these trials were small and the lack of significant findings may have been the result of inadequate power or other methodological issues. In the Green *et al*^[7] trial, patients were randomized to urgent colonoscopy within 8 h or standard of care which was elective colonoscopy within 4 d of admission. As noted above, the diagnostic yield was superior in the urgent colonoscopy group. Other outcomes such as rebleeding, surgery and number of blood transfusions showed a trend in the favor of urgent colonoscopy but did not reach statistical significance. Also of note, only 36% of colon preparations were noted to be “excellent”, which may also have affected the efficacy of urgent colonoscopy. Laine *et al*^[24] also did not find that urgent colonoscopy improved major outcomes compared to delayed colonoscopy. In addition to the small number of patients in their study (the study was stopped early with only 36 patients in each arm *vs* the planned 134 patients), patients in the urgent colonoscopy arm also appeared to have more severe bleeding which may have made it more difficult to detect a favorable difference.

A number of observational studies indicate that urgent colonoscopy reduces hospital length of stay. In a retrospective study of patients admitted with LGIB, Strate *et al*^[25] looked at the impact of time to colonoscopy on hospital length of stay in patients presenting with LGIB. They found that earlier performance of colonos-

copy was associated with a shorter length of stay [hazard ratio (HR) 2.02, 95% CI: 1.5-2.6, $P < 0.0001$] even when adjusted for other factors. Similarly, Schmulowitz *et al*^[30] also showed that having a colonoscopy was associated with reduced hospital length of stay (HR 1.54, 95% CI: of 1.2-1.8), and mean length of hospital stay was significantly shorter in patients undergoing colonoscopy within 24 h compared to more than 24 h (5.4 d *vs* 7.2 d, $P < 0.008$). Since hospital days are a major source of charges in LGIB this could have a significant economic impact. In a cost analysis study, Jensen *et al*^[31] estimated that urgent colonoscopy was associated with an average savings of \$10 065 per patient compared with medical, angiography and surgical management; although this number likely overestimates the degree of cost savings due to other trends in care such as shorter hospital stay, and a recent randomized trial found no difference in hospital charges in patients undergoing urgent *vs* elective colonoscopy^[24]. Overall, colonoscopy, particularly when performed early in the hospital course, has the potential to improve outcomes such as rebleeding, surgery and length of stay, but larger randomized trials are needed to better define its efficacy.

Safety

Colonoscopy with or without intervention for LGIB is considered a safe procedure. In a review of 4 studies with 664 patients, there were 2 perforations for an overall complication rate of 0.3% for colonoscopy and 0.6% for colonoscopy performed urgently^[12]. Other potential risks in addition to bowel perforation include congestive heart failure secondary to volume overload, electrolyte abnormalities and aspiration pneumonia. Also of note, in a review of 137 cases of endoscopic treatment for diverticular hemorrhage using a variety of modalities, there were no reported complications^[12]. Complications are noted more frequently in patients undergoing angiography. The risks of bowel ischemia and cardiac arrhythmia seen with vasopressin infusions have been ameliorated with newer superselective embolization techniques. However, in a review of 20 studies utilizing superselective embolization for control of LGIB, minor complications were seen in 26% of patients and major complications requiring surgery or resulting in death were seen in 17%^[12]. Another significant concern for both angiography and MDCT is renal compromise

secondary to contrast dye load. In the small amount of literature on MDCT there have been 2 reports of renal failure in patients with diabetes who also underwent angiography^[19].

CONS OF COLONOSCOPY

Colon preparation

Cleansing the colon of stool and blood prior to colonoscopy for management of LGIB is imperative, difficult to accomplish, and unique to endoscopic interventions for LGIB. Colonoscopy preparation is necessary for complete examination to the cecum. Studies of unprepped colonoscopy in LGIB report examinations to the cecum in only 55%-70% of cases^[32-34]. Unprepped colonoscopy may increase the risk of perforation due to poor visualization. The identification of subtle bleeding sites, which are often among multiple lesions as is the case in diverticular hemorrhage, the most common source of LGIB, is contingent on removal of excess debris. In a prospective study by Jensen *et al*^[6] on urgent colonoscopy in severe diverticular bleeding, active bleeding was detected in 21% of cases in the urgent colonoscopy arm and endoscopic hemostasis was achieved in 100% of the cases. The excellent results may have been due, in part, to their aggressive bowel preparation regimen. This regimen required 5-6 liters of sulfate purge over 3-4 h with 33% receiving the purge through a nasogastric tube. However, achieving consistently excellent bowel preparations, particularly in the urgent setting for LGIB, is difficult. The 4 or more hour time frame required for preparation may delay colonoscopy examinations until after-hours when nursing support and endoscopic facilities are not available. Thus, colon preparation makes urgent colonoscopy logistically complicated. Even under highly regulated study situations, colon preparations have been suboptimal in a high percentage of patients. In Green *et al*^[7]'s study, endoscopic view was rated poor to fair in 62%-64% of patients (62% in elective arm and 64% in urgent arm). Laine *et al*^[24] did not comment on the quality of the colon prep in their study but did report that 7% of their patients required a second colonoscopy due to poor bowel prep (2 in the urgent arm and 3 in the elective arm). In these two studies poor colon preparation has been cited as a reason for the lack of significant findings in favor of the colonoscopy arm^[35,36].

As mentioned above, aggressive bowel preparation requires a large volume of bowel preparation, often up to 6-8 liters. Rarely, this can lead to volume overload and electrolyte abnormalities such as hyponatremia^[37]. There is also the risk for aspiration, especially when the prep is rapid or the patient is at risk for aspiration. The need for colon preparation makes colonoscopy for LGIB more complicated than esophagogastroduodenoscopy (EGD) for upper gastrointestinal bleeding, and is likely one of the main reasons it has not been equally embraced. Also, the need for colon prep clearly sets colonoscopy for management of LGIB apart from radiological interven-

tions for LGIB.

Sedation, experienced staff and procedure facilities

Colonoscopy generally requires sedation given by trained professionals in a monitored location such as an intensive care unit or an endoscopy suite. Specialized support staff is also helpful to aid the gastroenterologist with the colonoscopy. These factors add to the complexity of coordinating the procedure, particularly on nights and weekends. However, angiography also requires sedation, an interventional radiologist, support staff and a specialized procedure suite. Indeed, in their study of utilization of early colonoscopy *vs* radiography in severe lower intestinal bleeding, Strate and Syngal found that the median times from admission to colonoscopy or angiography were similar (median of 17 h for colonoscopy *vs* 14 h for angiography)^[23].

Urgent vs delayed performance of colonoscopy

The optimal timing of colonoscopy remains an area of controversy. As noted above, some studies suggest that performing colonoscopy within the first 12-24 h of hospital admission aids in the identification and treatment of the bleeding source. However, the two published randomized controlled trials of LGIB showed no difference in important clinical outcomes such as rebleeding and surgery^[7,24]. Unfortunately, none of these studies was adequately powered to detect a statistically significant difference in important clinical outcomes, and the utility of urgent colonoscopy remains uncertain. The conflicting, albeit flawed, evidence paired with the practical issue of colon preparation make it difficult for clinicians to embrace urgent colonoscopy. Based on available literature, there is no specific time threshold for colonoscopy, but rather colonoscopy should be performed after a thorough bowel preparation, and more urgently in patients with signs of significant or ongoing bleeding as stigmata are rarely identified in delayed examinations^[7,24].

Low prevalence of stigmata of hemorrhage

The identification and treatment of the bleeding source is the goal of urgent interventions for GI bleeding particularly when severe. Diagnostic interventions alone are unlikely to alter significant outcomes such as rebleeding and need for surgery. However, stigmata are infrequently identified in the colon. Studies report stigmata of hemorrhage in 7.7% to 43% of cases^[5,30]. The colon has a large and complex surface area, often with multiple potential sources. In addition, bleeding tends to be intermittent in nature and it can be difficult to differentiate fresh blood from old blood and stool. Therefore, the effort entailed in orchestrating an urgent colonoscopy may be perceived as great in relation to the gain. Decision aids and predictive models have the potential to improve the utility of urgent colonoscopy for LGIB by identifying patients who are most likely to have ongoing bleeding and stigmata of hemorrhage and hence benefit from intervention. Three studies to date have aimed at

identifying high risk patients with LGIB with reasonable accuracy^[38-40]. However, the use of these tools in routine practice has not been studied and they have not been widely embraced.

In addition to the low prevalence of stigmata, a substantial subset of patients (up to 20%) presenting with hematochezia and presumed LGIB will ultimately be found to have bleeding from the upper or small bowel^[22,24]. An EGD or nasogastric lavage is necessary in briskly bleeding patients to begin to exclude these possibilities. In small bowel bleeding, colonoscopy and upper endoscopy serve only to exclude these areas of the bowel as bleeding sources, and these patients generally require a number of procedures for diagnosis^[41].

Complications

As mentioned earlier, the complication rate of colonoscopy is low, 0.3% and 1.3% in two comprehensive reviews^[12,42]. Safety is generally thought of as a relative strength of colonoscopy over other modalities. Radionuclide scanning and CT scanning are the only noninvasive option and these modalities do not provide therapeutic opportunities. However, complications of colonoscopy when they occur can be severe. Colon perforation is the most common complication and generally requires urgent surgical intervention. Other complications are mainly due to colon preparation and can be minimized with proper and careful administration of colon purge. For example, rapid preps should be avoided in patients with altered mental status, difficulty swallowing, delayed gastric emptying or bowel obstruction. Fleets Phosphosoda has been associated with renal compromise and is no longer available. Balanced electrolyte solutions are considered safer and less likely to result in fluid and electrolyte shifts^[43]. However, there have been case reports of patients with decreased left ventricular systolic function experiencing exacerbation of their symptoms, thought to be secondary to fluid shifts in the setting of bowel preparation with polyethylene glycol (Golytely)^[44]. These patients should hence be monitored closely while undergoing their prep.

CONCLUSION

Colonoscopy offers many advantages in the management of acute lower gastrointestinal bleeding. All sources and severities of LGIB can be diagnosed with colonoscopy and the overall diagnostic yield of this procedure is high. Endoscopic hemostasis can be utilized to stop or prevent bleeding, and therefore colonoscopy offers the potential to improve important clinical outcomes such as rebleeding, although the data from existing small studies are conflicting. The need for bowel preparation, the logistical difficulty of coordinating the procedure after-hours and the infrequent identification of stigmata of hemorrhage deter the widespread use of urgent colonoscopy in LGIB. However, most of these difficulties also apply to other modalities such as angiography and radio-

nuclide scan. Albeit imperfect, current data indicate that colonoscopy offers more advantages than other management options and should be the initial modality in the majority of patients with LGIB. Further prospective randomized studies are needed to more clearly define the optimal timing of colonoscopy in LGIB and its role relative to other available options including radionuclide scanning, angiography and MDCT scanning.

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