American Journal of Gastroenterology
© 2005 by Am. Coll. of Gastroenterology
Published by Blackwell Publishing

ISSN 0002-9270
doi: 10.1111/j.1572-0241.2005.00306.x

Urgent Colonoscopy for Evaluation and Management of Acute Lower Gastrointestinal Hemorrhage: A Randomized Controlled Trial

Bryan T. Green, M.D., Don C. Rockey, M.D., G. Portwood, M.D., Paul R. Tarnasky, M.D., Steve Guarisco, M.D., Malcolm S. Branch, M.D., Joseph Leung, M.D., and Paul Jowell, M.D.
Division of Gastroenterology, Department of Medicine, Duke University Medical Center, Durham, North Carolina

OBJECTIVES: We hypothesized that early intervention in patients with lower gastrointestinal bleeding (LGIB) would improve outcomes and therefore conducted a prospective randomized study comparing urgent colonoscopy to standard care.

METHODS: Consecutive patients presenting with LGIB without upper or anorectal bleeding sources were randomized to urgent purge preparation followed immediately by colonoscopy or a standard care algorithm based on angiographic intervention and expectant colonoscopy.

RESULTS: A total of 50 patients were randomized to each group. A definite source of bleeding was found more often in urgent colonoscopy patients (diverticula, 13; angioectasia, 4; colitis, 4) than in the standard care group (diverticula, 8; colitis, 3) (the odds ratio for the difference among the groups was 2.6; 95% CI 1.1–6.2). In the urgent colonoscopy group, 17 patients received endoscopic therapy; in the standard care group, 10 patients had angiographic hemostasis. There was no difference in outcomes among the two groups—including: mortality 2% *versus* 4%, hospital stay 5.8 *versus* 6.6 days, ICU stay 1.8 *versus* 2.4 days, transfusion requirements 4.2 *versus* 5 units, early rebleeding 22% *versus* 30%, surgery 14% *versus* 12%, or late rebleeding 16% *versus* 14% (mean follow-up of 62 and 58 months).

CONCLUSION: Although urgent colonoscopy identified a definite source of LGIB more often than a standard care algorithm based on angiography and expectant colonoscopy, the approaches are not significantly different with regard to important outcomes. Thus, decisions concerning care for patients with acute LGIB should be based on individual experience and local expertise.

(Am J Gastroenterol 2005;100:2395–2402)

INTRODUCTION

Acute lower gastrointestinal bleeding (LGIB) is a common disorder, requiring hospitalization in 21 adults per 100,000/yr (1). Diverticula are the most common cause of acute LGIB and account for 42–56% of episodes (1–3). Other lesions (colonic vascular ectasis, or angiodysplasias, rectal or colonic ulcers, colonic varices, vasculitis, neoplasia, colitis, intussusception, or small intestinal lesions) account for the remaining identifiable causes of LGIB. A major problem in LGIB is that approximately 10–40% of patients will have recurrent hemorrhage, usually within the first 48 h of the index bleed (1, 4). This is often treated by surgical resection. Since the major causes of acute LGIB (diverticulosis and vascular ectasis) are most prevalent in the elderly, surgery often entails a high morbidity and mortality.

Although early endoscopy for the diagnosis and, in particular, treatment of upper gastrointestinal bleeding is widely accepted, early endoscopy has not been similarly applied to LGIB. Colonoscopy is often performed after the bleeding has stopped and the patient adequately prepared, generally several days after presentation (3). However, a major problem with colonoscopy in this setting has been the low detection rate of bleeding lesions, thus not allowing endoscopic hemostasis. It has been widely reported that urgent colonoscopy is safe and yields a specific diagnosis in a high proportion of cases (5–7). Further, a number of case series have demonstrated that endoscopic therapy during urgent colonoscopy allows initial hemostasis, especially in diverticular bleeding, although follow up has been lacking (8–13). Endoscopic therapy of vascular ectasis has also been shown to be safe and effective (14, 15). A recent nonrandomized study demonstrated a dramatic reduction in rebleeding and the need for surgery with urgent endoscopic therapy in diverticular hemorrhage (7). However, other nonrandomized studies have failed to demonstrate improvement in outcomes after urgent colonoscopy (16, 17).

Despite the lack of data from randomized controlled studies, urgent colonoscopy is widely recommended and employed by some experts (7). At our institution, the standard care for LGIB, after excluding an upper or anorectal source, is to perform a technetium labeled red cell scan if active bleeding is suspected, followed by visceral angiography for positive scans. Expectant colonoscopy is performed if bleeding is felt to be inactive.

We hypothesized that urgent colonoscopy would improve early rebleeding and also the secondary outcomes measures of length of stay and transfusion requirements. We present the results of a prospective, randomized, controlled trial of urgent colonoscopy compared to a standard protocol commonly implemented at this institution in patients with acute LGIB.

METHODS

This study was approved by the Duke University Medical Center and Durham Veterans Affairs Medical Center Institutional Review Boards, and fulfilled all criteria for clinical research as set forth in the Declaration of Helsinki (18). All patients gave written informed consent.

Patients presenting with hematochezia who were admitted to our hospitals were eligible for the study. Prior to randomization all patients had upper gastrointestinal sources of bleeding excluded by nasogastric lavage and/or esophagogastroduodenoscopy. An upper endoscopy was performed if there was no bile present in the gastric lavage fluid, there was a high suspicion of upper gastrointestinal hemorrhage, there was a history of peptic ulcer disease, or a history of previous upper gastrointestinal bleed. Anorectal sources of bleeding were excluded by anoscopy and/or proctoscopy, one or both of which was performed in all participants. Patients were randomized to a standard care algorithm or to purge preparation colonoscopy (Fig. 1). Inclusion criteria were as follows: (1) the last bloody bowel movement was within 24 h of presentation; (2) there was clinical or laboratory evidence of significant blood loss, manifested by any one of the following: (a) >3 bloody bowel movements in <8 h; (b) admission to the intensive care unit; (c) decrease of more than 5% hematocrit points in <12 h; (d) transfusion of >3 units of packed red blood cells; (e) hemodynamic instability in previous 6 h defined by: angina, syncope, presyncope, orthostatic vital signs, mean arterial blood pressure <80 mmHg, or resting pulse >110. Patients meeting the following criteria were excluded: (1) age <18 yr; (2) known or suspected inflammatory bowel disease; (3) abdominal surgery within previous 10 days; (4) endoscopic polypectomy within the previous 10 days; (5) known or suspected ischemic bowel, perforation, or peritonitis; (6) refractory angina or suspected myocardial infarction; (7) hemodynamic instability refractory to resuscitation; (8) coagulopathy refractory to correction; (9) acquired immune deficiency syndrome or neutropenia; (10) documented pregnancy; (11) inability to provide informed consent. The number of comorbidities were recorded and scored to determine the Charlson comorbidity index (19). The Charlson index is a measure of the number of associated comorbid medical conditions that predicts mortality risk at 1 yr. Higher scores represent an increased risk of mortality. Patients were randomized from July 1993 through June 1995. Eligible patients were randomized to either purge prep colonoscopy or the standard care algorithm (defined later) by a computer-generated randomization list. All patients were admitted to either the intensive care unit or to telemetry units and managed by a team of internists, intensivists, and general surgeons in consultation with gastroenterologists. Investigators were not primarily involved in the care or decision making for the patients; in some instances, investigators served as consultants to the primary care team. Patients were transferred out of the intensive care unit after hemodynamical stability had been achieved and maintained. Anticoagulants and nonsteroidal anti-inflammatory drugs (NSAIDs), including aspirin, were discontinued during hospitalization in all patients. Packed red blood cells were transfused to correct severe anemia (transfusion threshold—hemoglobin <8 g/dL) or to help achieve hemodynamic stability in massive bleeding. Coagulopathy was corrected with platelet and/or fresh frozen plasma transfusion.

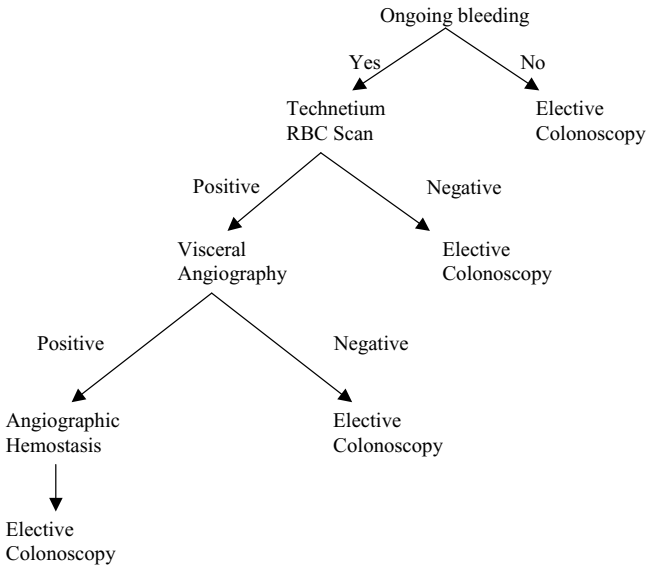

Figure 1. *Standard care algorithm.* Technetium RBC scanning was performed on patients with suspected active bleeding while those without active bleeding had an elective colonoscopy. Patients with a positive technetium scan went to visceral angiography while those with a negative scan had an elective colonoscopy. Active bleeding on angiography was treated. All patients receiving angiography (whether positive or negative) had an elective colonoscopy.

Urgent Purge Preparation Colonoscopy

Patients randomized to urgent colonoscopy underwent colonic preparation with a polyethelyne glycol based purgative (Golytely, Braintree Laboratories, Braintree, MA) administered either orally (25 patients) (one cup every 15 min)

or by nasogastric tube (25 patients) (250 mL every 15 min). Oral administration was the preferred route and only when patients were unable to comply was the preparation administered via nasogastric tube. Four to six liters of purge and 3–4 h were required to clean the colon. Colonoscopy was performed within 2 h after the clearance of stool and large clots and within 8 h of hospitalization or the diagnosis of hematochezia. Patients received conscious sedation with meperidine and diazepam while monitoring heart rate, blood pressure, and oxygen saturation. A standard video colonoscope (Olympus, Tokyo, Japan) was used for all procedures. The colonoscope was advanced to the cecum in all cases. The terminal ileum was intubated when possible. The quality of the preparation was graded as "excellent" if there was no stool, blood, or clots covering the mucosa, "fair" if less than 25% of the mucosa was obscured by stool, blood, or clots, and "poor" if there was formed stool or if greater than 25% of the mucosa was obscured by stool or blood. The colon was carefully examined on withdrawal with careful attention to washing any obscured mucosa.

Diverticula or angioectasia with active bleeding or with stigmata of recent hemorrhage (see below for definitions) were treated endoscopically. In patients with active bleeding, 1 or 2 mL aliquots of epinephrine (dilution, 1:10,000) was injected into each of four quadrants around the lesion to control bleeding. Lesions were then treated with bipolar electrocautery with 10 to 15 W of power, moderate appositional pressure, and one-second pulses until coagulation and/or flattening of the vessel was achieved. Patients with stigmata of bleeding were treated with bipolar electrocautery alone. Endoscopic therapy was considered "successful" if bleeding ceased at the end of the procedure or for non-bleeding lesions if the underlying stigmata were obliterated. After recovery from sedation, patients were managed by their primary team as their clinical status dictated.

Definition of Endoscopic Lesions and of a Definite Bleeding Source

Active bleeding was defined as visualization of blood emanating from a specific, distinct, readily identifiable lesion, and in which bleeding continued after vigorous irrigation. A visible vessel was defined as a protuberant, purple or red, punctate, lesion. Stigmata of recent hemorrhage was defined as present in the setting of non-bleeding visible vessel or as a densely adherent clot that remained present after vigorous washing. A definite source of bleeding was defined as a lesion visualized by either endoscopy or angiography that was either actively bleeding or had clear stigmata of recent bleeding (as described previously). Lesions were classified as a presumptive source of bleeding if they did not have active bleeding or stigmata of bleeding but after colonoscopy, upper endoscopy, and small bowel enteroscopy with a 210-cm video enteroscope (Olympus), no other potential bleeding sites were identified. The source of bleeding was considered unknown only after colonoscopy with an adequate preparation (fair or excellent as assessed by the aforementioned scale), upper endoscopy, and small bowel enteroscopy all failed to reveal a potential source of bleeding. Small bowel follow through radiographs were obtained at later time points in patients with an unknown source of bleeding.

Standard Algorithm

The standard care algorithm is shown in Figure 1. Patients with suspected ongoing bleeding underwent technetium labeled red cell scanning. The presence of "ongoing bleeding" was based on clinical judgment made by the primary team in consultation with the gastroenterology team, and was defined as the continued passage of bloody stools during medical evaluation or as persistently unstable vital signs despite resuscitation (the presence of unstable vitals signs was judged as above). Patients with positive scans proceeded to angiography while those with negative scans underwent elective colonoscopy. Elective colonoscopy was defined as that performed after routine preparation (4–6 L of polyethelyne glycol based purgative, administered orally beginning the night prior to the procedure) within four days of admission. Active bleeding found on visceral angiography was treated with intra-arterial infusion of vasopressin. Super-selective embolization was not performed. Angiographic therapy was considered successful if extravasation of contrast ceased at the conclusion of the procedure. Patients without active bleeding on angiography underwent elective colonoscopy.

Follow-Up

Patients and their outcomes were prospectively assessed during the index hospitalization. Outpatient follow-up was with either an attending gastroenterologist or the patient's primary physician. These records as well as hospital records were retrospectively reviewed and abstracted to obtain late rebleeding and mortality data. Patients with definitive or presumed bleeding from diverticula were advised to avoid prescription or over the counter nonsteroidal anti-inflammatory agents (including aspirin) as well as anticoagulants. The mean duration of follow-up was 62 and 58 months for the urgent colonoscopy and standard therapy groups, respectively.

End Points

The primary end point was rebleeding. This was classified as either early rebleeding (prior to hospital discharge) or late rebleeding (after hospital discharge). Secondary end points were duration of hospital and intensive care unit stay, blood transfusion requirements, need for surgery, and mortality. Rebleeding was defined as hematochezia developing after index colonoscopy or angiography was defined as that occurring after clinical cessation of the index bleeding event (using criteria for bleeding as above).

Statistical Analysis

A power calculation was performed using available estimates of the diagnostic yield for the two strategies examined here. It was estimated that urgent, purge prepped colonoscopy would identify a source of bleeding at 0.75 (P1) while the alternative

algorithm would lead to a detection rate of 0.50. Based on these estimates, to have 80% power $(\beta + 0.2)/\alpha$ set at 0.05 (2-tailed), 58 subjects would be required for each group. Enrollment for the study terminated early because of the difficulty in recruiting and because several of the key investigators left Duke. The data were analyzed by the first two authors (BTG and DCR). Statistical analysis was performed with the Student's *t*-test and the Mann-Whitney test for continuous variables and Fisher's exact test for categorical variables. A p value of <0.05 was considered to be statistically significant. Odds ratios were calculated using the approximation of Woolf.

RESULTS

A total of 112 patients were screened by the investigators for potential participation in the study. Seven were excluded prior to randomization for the following reasons: Four had upper gastrointestinal sources of bleeding identified on upper endoscopy and three had anorectal sources identified when anoscopy was performed during their initial examination. One hundred and five patients were randomized, however 5 dropped out prior to completing their initial diagnostic evaluation (all patients dropped out because they decided that they did not wish to participate and before any diagnostic testing was performed). Of these 5 participants, 3 were randomized to the urgent colonoscopy group and 2 to the standard care group. All patients in the study underwent anoscopy at the time of initial evaluation. Two patients were found to have hemorrhoids, and 1 patient had proctitis, and thus were excluded from possible randomization. Eight patients underwent upper endoscopies, of whom 4 had lesions detected (and were not enrolled) and another 4 had negative studies (and were enrolled).

Thus, 50 patients were randomized to each of the urgent colonoscopy and standard care groups. The number of patients undergoing specific procedures is highlighted in Figure 2. The demographic and clinical characteristics are shown in Table 1. Overall, 16% of patients had a history of previous LGIB and 55% were using NSAIDs or aspirin. On presentation 59% of all patients had ongoing bleeding and 64% had unstable hemodynamics.

Among patients randomized to urgent colonoscopy, the mean time from presentation to the procedure was 7.2 h (4.2–7.6 h) compared to 38.1 h (27.2–74 h) in patients randomized to standard care. The endoscopic view during urgent and elective colonoscopy was rated (by the previously stated scale) as "excellent" in 36% and 38%, "fair" in 56% and 52%, and "poor" in 8% and 10% of patients (respectively). There was fresh blood present during colonoscopy in 44% of urgent colonoscopy patients and 12% of standard care patients.

Ongoing bleeding was suspected in 27 (57%) of patients randomized to urgent colonoscopy. Diverticula or angioectasia with either active bleeding or stigmata of recent bleeding were found in 17 patients in the urgent colonoscopy group.

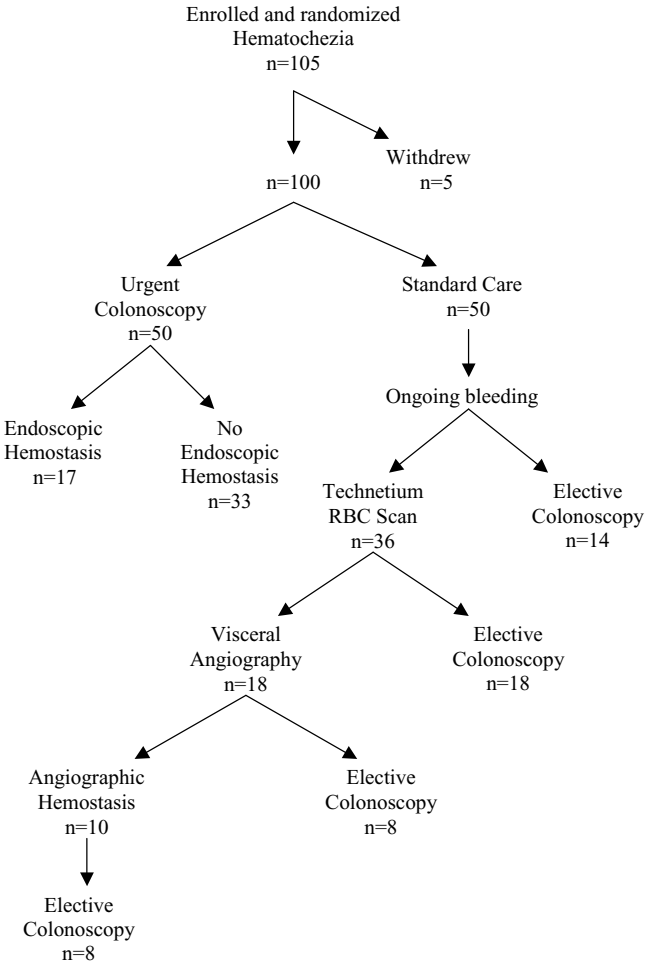

Figure 2. *Study flow.* The number of patients having specific diagnostic and therapeutic interventions is shown.

Bleeding diverticula (8 with active bleeding and 5 with stigmata of bleeding) were located as follows: 5 in the left colon, 1 in the transverse colon, and 7 in the right colon. All 4 of the identified vascular ectasias (3 with active bleeding and 1 with stigmata) were located in the right colon. All underwent endoscopic treatment according to the protocol outlined in "Methods" section.

The flow of patients through the standard care algorithm is shown in Figure 1.

Ongoing bleeding was suspected in 36 patients (72%) randomized to standard care; all underwent technetium labeled RBC scans. These scans were positive in 18 patients (50%). Visceral angiography was performed in all of these patients and revealed putative sites of bleeding in 10 (56%). In 8 of these patients, diverticula were presumed to be the cause of bleeding. However, the source could not be identified with certainty in the other 2 patients. The bleeding diverticula were located as follows: 3 in the left colon, 1 in the transverse colon, and 4 in the right colon. Vasopressin was administered to all 10 patients and successfully caused bleeding to stop in 8 (80%). Both patients in whom it was unsuccessful went

Table 1. Baseline Patient Characteristics

	Urgent Colonoscopy (n = 50)	Standard Care (n = 50)
Men/women	27/23	32/18
Age (yr)	68 + 3	71 + 4
Race		
White	24	21
Black	26	26
Other	1	3
History of LGIB	6	10
Comorbidities	1.8 + 0.3	2 + 0.4
NSAID	29	26
Duration of bleeding prior to presentation (h)	13.6 + 1.9	14 + 2.1
Ongoing bleeding	27 (54%)	36 (72%)
Initially unstable		
Hemodynamics	30 (60%)	34 (68%)
Initial hematocrit (%)	31	32
Transfusion—resuscitation only (units of PRBC)	1.5 + 0.3	1.5 + 0.2

There was no significant difference between values.
Data are expressed as mean + standard deviation.
LGIB = lower gastrointestinal bleeding; NSAIDs = nonsteroidal anti-inflammatory drugs; PRBC = packed red blood cells; ns = not significant.

to emergent surgery (1 subtotal colectomy and 1 segmented resection). Colonoscopy was performed in 15 patients in this group. No lesions with stigmata of bleeding were identified.

The sources of bleeding in each group are shown in Table 2. The likelihood of identifying a definite source of bleeding was greater in the urgent colonoscopy group (21 patients (42%)) than in the standard care group (11 patients (22%)) (odds ratio 2.6; 95% CI 1.1–6.2). Diverticula were considered to be a definite source of bleeding in 8 patients in the standard care group (all diagnosed by angiography). Ischemic colitis was considered the definite source of bleeding in 3 standard care patients due to stigmata of recent bleeding (not amendable to endoscopic hemostasis) identified on routine colonoscopy. All definite and presumptive diagnoses in the urgent colonoscopy group were made during the initial colonoscopy. Small bowel enteroscopy was performed in all patients with either a presumptive or unknown source of bleeding. A large angioectasia in the jejunum was considered the presumptive source of bleeding in 1 patient in the urgent colonoscopy group. Two patients in the urgent colonoscopy group and 5 patients in the standard care group with either a presumed or unknown source of bleeding had a poor preparation and all underwent repeat colonoscopy during the index hospitalization; a definite bleeding source could not be identified in any of these patients. In 9 patients with an unknown source of bleeding, small bowel follow-through radiographs were obtained as outpatients were unrevealing in all cases. None of the 14 patients with an unknown source of bleeding experienced either early or late rebleeding.

Table 2. Identified Bleeding Sources

	Urgent Colonoscopy (n = 50)	Standard Care (n = 50)	OR; 95% CI
Definite			
Diverticula	13	8	
Angioectasia	4	0	
Ischemic colitis	4	3	
Total	21 (42%)	11 (22%)	2.6; 1.1–6.2
Presumptive			
Diverticula	26	20	1.6; 0.7–3.6
Angioectasia (colon)	0	1	
Angioectasia (jejunum)	1	0	
Colitis	0	3	
Polyp	0	2	
Ulcer (colon)	0	1	
Total	27 (54%)	27 (54%)	1.0; 0.4–2.2
Unknown	2	12	

Table 3. Outcomes

	Urgent Colonoscopy (n = 50)	Standard Care (n = 50)
Early rebleed	11 (22%)	15 (30%)
Late rebleed	8 (16%)	7 (14%)
Mortality		
LGIB	1 (2%)	2 (4%)
Other	0	2
Hospital stay (days)		
Total	5.8	6.6
ICU	1.8	2.4
Total PRBC (u)	4.2 + 0.4	5.0 + 0.5
Surgery	7 (14%)	6 (12%)
Subtotal colectomy	0	3
Hemicolectomy	5	2
Segmental	2	1
Complications	1	0

Data are expressed as mean + standard deviation.
LGIB = lower gastrointestinal bleeding; ICU = intensive care unit; PRBC = packed red blood cells; u = units; ns = not significant.

Clinical outcomes are shown in Table 3. Early rebleeding did not appear to be different between the urgent colonoscopy and standard care groups (11 (22%) and 15 (30%), respectively; odds ratio 0.7; 95% CI 0.3–1.6). Over a mean follow-up period of 62 and 58 months in the urgent colonoscopy and standard care groups, respectively, late rebleeding was not different (8 (16%) and 7 (14%), respectively). All episodes of late rebleeding in both groups were due to diverticula. Total hospital and intensive care unit stay was also not significantly different between the groups. The mean total blood requirement per patient was lower in the urgent colonoscopy group (4.2 U *vs* 5.0 U, respectively), but it did not reach statistical significance ($p = 0.09$). The need for surgery was not different between the groups. The mean duration of stay in the intensive care unit was shorter in the endoscopic hemostasis group than in the angiographic hemostasis group (1.9 days *vs* 3.9 days, respectively), but this was not statistically significant ($p = 0.62$). The mean total blood requirement per patient appeared to be less in the endoscopic hemostasis group than in the angiographic hemostasis (5.4 U *vs* 9 U, respectively), but the difference did not reach statistical significance ($p = 0.165$).

One patient in the urgent colonoscopy group had a colonic perforation after endoscopic treatment of an angioectasia in the cecum and required surgery. Finally, we compared the outcomes of the 17 patients undergoing endoscopic hemostasis to the 10 patients undergoing angiographic therapy. These groups were nearly identical in terms of baseline characteristics. The initial hemostasis rate, early rebleeding rate, late rebleeding rate, surgical intervention rate, length of hospital stay, transfusion requirement, complication rate, and mortality rate was identical in each group. Comparisons between groups were additionally analyzed based on an intention to treat basis (53 and 52 patients in the urgent colonoscopy and standard care groups, respectively). The primary end point of early rebleeding still did not differ between the urgent colonoscopy and standard care groups (11 (21%) and 15 (29%), respectively). This analysis also revealed identical results for other end points as compared to the primary analysis.

DISCUSSION

This study demonstrated that urgent colonoscopy identified a definite source of lower gastrointestinal hemorrhage more often than a standard care algorithm that utilized elective colonoscopy. Despite this apparent improvement in diagnosis, in this study, urgent colonoscopy did not significantly improve important outcomes such as either early or late rebleeding.

While it is tempting to extrapolate the well documented benefits of urgent endoscopy with hemostatic treatment in acute upper gastrointestinal bleeding (20, 21) to LGIB, it should be emphasized that such an extrapolation may not necessarily be valid. There are several distinctions between the two types of bleeding. For upper gastrointestinal bleeding lesions such as ulcers and varices, these lesions may be readily identified, and thus, endoscopic therapy can be readily applied. However, in lesions that cause LGIH are often difficult to identify, and may be different pathologically (the colon is different than the stomach and duodenum, diverticula are different anatomically than ulcers) so that it remains unproven whether endoscopic therapy is effective. Additionally, unlike gastric or duodenal ulcers in which therapy after control of the acute bleeding leads may lead to elimination of the causal agent (*i.e.*, NSAIDs, acid, or *Helicobacter pylori*), the same is not necessarily true for the lesions that cause LGIB. While it has been suggested that lifestyle modifications such as high fiber diets and avoidance of foods with small seeds may alter the natural history of existing diverticuli, this remains speculative. In addition, the pathophysiology of diverticular and vascular ectasia bleeding is such that treatment of an individual lesion may be effective, however, other lesions may bleed.

Our results differ from a recent nonrandomized study (7) that demonstrated an apparent beneficial effect for urgent colonoscopy in LGIH. In this previous study (7), endoscopic treatment of bleeding diverticula led to a reduction in rebleeding. In the current study, 13 patients received endoscopic treatment to culprit diverticula and yet 5 rebled early and 2 rebled late. This finding could be related to a variety of technical factors, but this was unlikely given standardization of the techniques utilized. The most notable difference in the two studies was that the current study was randomized. The previous study (7) compared therapy in two different time periods, 1986–1992 and 1994–1998. One drawback of such an approach includes the possibility that changes in clinical care such as improvements in intensive care, improved endoscopic techniques, divergent transfusion practices, updated general medical care, and different thresholds for surgical intervention. Further, differences in the acuity of bleeding could have accounted for the differences in study outcome. For example, our study included all patients admitted with hematochezia and hemodynamically significant blood loss. Finally, follow-up for the current study was nearly twice as long (57 months) as that in the previous study (34 months).

The standard care group required angiography and although this is a small number of patients, there were no complications from angiography. The absence of complications in this group was surprising, but could be related to the emphasis on vascular radiology procedures at our institution.

All patients requiring angiographic hemostasis had intra-arterial vasopressin infusion, as was standard at the time. Recently, super-selective embolization techniques have been introduced, and may reduce the rebleeding rate (*i.e.*, from approximately 40% to as low as 7% in expert hands) (22–24). Thus, it is possible that super-selective embolization could improve outcomes in the standard care group.

Although urgent colonoscopy did not alter the primary end point of rebleeding, its use could be justified if it improved secondary end points such as hospital stay, transfusion requirements, or the need for surgery. Previous work has demonstrated that urgent colonoscopy may reduce hospital stay (3, 25). Although there was a trend toward lower total blood transfusion requirements in the urgent colonoscopy group (4.2 units *vs* 5 units), this difference did not reach statistical significance ($p = 0.09$). The requirement for surgery and length of hospital stay (total or ICU) were not different in the two groups. It has been suggested that urgent colonoscopy might provide better localization of bleeding sites, thus allowing a more focused surgical resection for lesions that continue to bleed. Indeed, no patients in the urgent colonoscopy group required subtotal colectomy compared to three in the standard care group. Although this comparison is attractive, the number of patients seen in this study are too small to allow us to make firm conclusions.

A definite source of bleeding was identified in 42% of patients in the urgent colonoscopy group, compared to only 22% in the standard care group. Other studies investigating urgent colonoscopy have found this approach to yield a definite bleeding site in 7.7–100% of patients (2, 6, 7, 17, 26–28). The wide discrepancy reported in the literature almost

certainly is reflective of a number of inherent biases. For example, definitions of a "definite" bleeding site are likely to vary. Some required, as we did, active bleeding or stigmata of recent bleeding (6, 16) while others were less stringent (2, 6). Additionally, differences in the ability to assess lesions, as well as differences in equipment, timing and quality of the preparation among studies, likely translate into variability in detection of lesions.

There are several important strengths of this study, including that it is the first randomized study evaluating urgent colonoscopy in acute LGIB, it had long-term follow-up, the patient management was standardized, and that a homogeneous patient population was studied. Nonetheless, there are several important weaknesses of this study. The greatest weakness is that because the sample size is modest, we are unable to exclude differences in outcomes due to a type II statistical error (unfortunately, the study did not reach its planned size because the study was terminated early). Indeed, the possibility of a type II statistical error may be insurmountable without a study employing a multicenter design that allows recruitment of an extremely large sample size. A further weakness of this study was that physicians caring for patients were not blinded to randomization or specific interventions (because withholding the findings of endoscopy or radiology procedures to the responsible physicians was felt to be unethical with regard to delivery of quality patient care). Thus, the unblinded study design could have introduced any of a number of biases, although there is no reason to presuppose *a priori* that patients in one group or the other were handled differently because of their randomization assignment. For example, routine care such as transfusion practices, criteria for intensive care unit, endoscopic techniques, and the like were standardized. Elective colonoscopy in the standard care group was performed at a range of 1–4 days after admission and thus could have potentially caused some variability in the total hospital stay if patients were kept in the hospital awaiting a colonoscopy. It is not however, standard practice at our institution to prolong patient hospitalization for an elective procedure. Finally, initial enrollment in this study was begun approximately 10 yr ago and it is possible that some aspects of care have improved. For example, it is possible that intensive care unit treatment, surgical techniques, transfusion, and early hospital discharge criteria have all improved. In this situation, it is likely that such improvements would affect both intervention groups equally, thus improving the outcomes for all patients but not altering the comparison between groups.

In summary, the data from this study suggest that for patients with substantial lower gastrointestinal hemorrhage, outcomes are similar whether urgent colonoscopy or expectant colonoscopy is performed as part of a standard care algorithm. Except for diagnosis, urgent colonoscopy proved to provide no advantage over radiographic intervention. Thus, we suggest that the choice of these two approaches should be based on local expertise and available resources.

ACKNOWLEDGMENTS

We thank the Nurses, the Housestaff, and the Fellows and Faculty involved in the care of these patients for their assistance. This work was supported by the Burroughs Welcome Fund (DCR is the recipient of a BWF Translational Scientist Award) and in part by a grant from the American College of Gastroenterology.

Reprint requests and correspondence: Don C. Rockey, M.D., Division of Digestive and Liver Diseases, University of Texas Southwestern Medical Center, 5323 Harry Hines Blvd., Dallas, TX 75390-8887.

Received August 27, 2004; accepted May 23, 2005.

REFERENCES

1. Longstreth GF. Epidemiology and outcome of patients hospitalized with acute lower gastrointestinal hemorrhage: A population based study. Am J Gastroenterol 1997;92(3):419–24.
2. Wilcox CM, Clark S. Causes and outcome of upper and lower gastrointestinal bleeding: The Grady Hospital experience. South Med J 1999;92(1):44–50.
3. Schmulewitz N, Fisher DA, Rockey DC. Early colonoscopy for acute lower GI bleeding predicts shorter hospital stay: A retrospective study of experience in a single center. Gastrointest Endosc 2003;58:841–6.
4. McGuire HH. Bleeding colonic diverticuli. A reappraisal of natural history and management. Ann Surg 1994;220:653–6.
5. Kok KY, Kum CK, Goh PM. Colonoscopic evaluation of severe hematochezia in an Oriental population. Endoscopy 1998;30:675–80.
6. Chaudry V, Hyser MJ, Gracias VH, et al. Colonoscopy: The initial test for acute lower gastrointestinal bleeding. Am Surg 1998;64:723–8.
7. Jenson DM, Machicado GA, Jutabha R, et al. Urgent colonoscopy for the diagnosis and treatment of severe diverticular hemorrhage [see comments]. N Engl J Med 2000;342:78–82.
8. Johnson JJ, Sones J. Endoscopic heater probe coagulation of the bleeding colonic diverticulum. Gastrointest Endosc 1986;32:168A.
9. Pardole PM, Neubrand S. Injection control of colonic hemorrhage with hypertonic saline-epinephrine solution. Am J Gastroenterol 1989;84:1193A.
10. Kim YI, Marcon NE. Injection therapy for colonic diverticular bleeding. A case study. J Clin Gastroenterol 1993;17(1):46–8.
11. Savides TJ, Jensen DM. Colonoscopic hemostasis for recurrent diverticular hemorrhage associated with a visible vessel: A report of three cases. Gastrointest Endosc 1994;40(1):70–3.
12. Foutch PG, Zimmerman K. Diverticular bleeding and the pigmented protuberance (sentinel clot): Clinical implications, histopathological correlation, and results of endoscopic intervention. Am J Gastroenterol 1996;91(12):2589–93.
13. Pakash C, Chokshi H, Walden DT, et al. Endoscopic hemostasis in acute diverticular bleeding. Endoscopy 1999;31(6):460–3.

14. Gupta N, Longo WE, Vernava AM. Angiodysplasia of the lower gastrointestinal tract: An entity readily diagnosed by colonoscopy and primarily managed nonoperatively. Dis Colon Rectum 1995;38:979–82.
15. Bemvenuti GA, Julich MM. Ethanolamine injection for sclerotherapy of angiodysplasia of the colon. Endoscopy 1998;30:564–9.
16. Bloomfeld R, Shetzline M, Rockey DC. Urgent colonoscopy for the diagnosis and treatment of severe diverticular hemorrhage. N Engl J Med 2000;342:1608–9.
17. Angtuaco TL, Reddy SK, Drapkin S, et al. The utility of urgent colonoscopy in the evaluation of acute lower gastrointestinal tract bleeding: A 2-year experience from a single center. Am J Gastroenterol 2001;96:1782–5.
18. World Medical Association Declaration of Helsinki. Recommendations guiding physicians in biomedical research involving human subjects. JAMA 1997;277:925–6.
19. Charlson ME, Pompei P, Ales KL, et al. A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. J Chronic Dis 1987;40:373–83.
20. Laine L. Multipolar electrocoagulation in the treatment of active upper gastrointestinal tract hemorrhage. A prospective controlled trial. N Engl J Med 1987;316:613–7.
21. Cook DJ, Guyatt GH, Salena BJ, et al. Endoscopic therapy for acute nonvariceal upper gastrointestinal hemorrhage: A meta-analysis. Gastroenterology 1992;102:39–48.
22. DeBarros J, Rosas L, Cohen J, et al. The changing paradigm for the treatment of colonic hemorrhage: Super-selective angiographic embolization. Dis Colon Rectum 2002;45:802–8.
23. Ledermann HP, Schoch E, Jost R, et al. Superselctive coil embolization in acute gastrointestinal hemorrhage: Personal experience in 10 patients and review of the literature [see comments]. J Vasc Interv Radiol 1998;9:753–60.
24. Peck DJ, McLoughlin RF, Hughson MN, et al. Percutaneous embolotherapy of lower gastrointestinal hemorrhage [see comments]. J Vasc Interv Radiol 1998;9:747–51.
25. Strate LL, Syngal S. Timing of colonoscopy: Impact on length of hospital stay in patients with acute lower intestinal bleeding. Am J Gastroenterol 2003;98:317–22.
26. Zuckerman GR, Prakash C. Acute lower intestinal bleeding. Part II: Etiology, therapy, and outcomes. Gastrointest Endosc 1999;49:228–38.
27. Jensen DM, Machicado GA. Colonoscopy for diagnosis and treatment of severe lower gastrointestinal bleeding. Routine outcomes and cost analysis. Gastrointest Endosc Clin N Am 1997;7:477–98.
28. Jensen DM, Machicado G. Diagnosis and treatment of severe hematochezia: The role of urgent colonoscopy after purge. Gastroenterology 1988;95:1569–74.