Diagn Interv Radiol 2018; 24: 23–27

INTERVENTIONAL RADIOLOGY

ORIGINAL ARTICLE

Acute lower gastrointestinal bleeding: predictive factors and clinical outcome for the patients who needed first-time mesenteric conventional angiography

Onur Sıldıroğlu
Jamil Muasher
Tara A. Bloom
İrem Kapucu
Bülent Arslan
John F. Angle
Alan H. Matsumoto
Ülkü Cenk Turba

PURPOSE
We aimed to investigate patients with lower gastrointestinal bleeding who presented to the emergency department requiring initial conventional angiography. We report risk-stratified and mesenteric conventional angiography outcomes.

METHODS
We retrospectively reviewed patients with lower gastrointestinal bleeding between 2001 and 2012. We included all consecutive patients with clinical lower gastrointestinal bleeding with a requirement of further angiography and possible embolization. Patients who had prior interventions or surgery were excluded.

RESULTS
A total of 88 patients (35 women, 53 men) with a median age of 71 years (range, 23–99 years) were included in the analysis. Conventional angiography was positive and endovascular treatment was intended in 35 patients. Once the source of bleeding was found angiographically, endovascular treatment had a technical success rate of 90.3% and clinical success rate of 71.4%. Overall early rebleeding rate (<30 days) was 14.8% and late rebleeding rate (>30 days) was 13.6%.

CONCLUSION
Identifying the source of lower gastrointestinal bleeding remains to be a clinical and angiographic challenge. Although we did not observe an association between mortality and clinical success, increased early rebleeding rates were associated with higher mortality rates.

Most acute lower gastrointestinal (GI) bleeding stop spontaneously; therefore, no intervention or invasive diagnostic test such as conventional angiography is necessary (1). Prior to mesenteric arteriogram, colonoscopy, flexible sigmoidoscopy, and radionuclide imaging are usually performed. Recently computed tomography (CT) angiography has demonstrated promising results (1, 2). If the diagnostic tests locate the bleeding, or if intractable bleeding occurs, more invasive test warrants arteriogram and possible intervention. While other authors have performed similar analyses of patients with lower GI bleeding who required conventional angiography, they differed from our study in that some analyzed upper and lower GI bleeds together (3, 4), or patients with negative angiograms were not factored into the analysis (5), or more importantly, the patients were not separated in terms of first-time versus multiple bleeders (3–8). We aimed to analyze patients with acute lower GI bleeding who presented to the emergency department for the first time and required conventional angiography for localization of the bleed and potential endovascular treatment. We also wanted to identify a subgroup of procedural factors, comorbidities associated with rebleeding, technical success, clinical success and mortality in association with lower gastrointestinal bleeds.

Methods

Patients

Institutional review board approved this retrospective study. Consecutive cases of acute lower GI bleeding between 2001 and 2012 were reviewed retrospectively. We included all

This project was an oral presentation in ARRS annual meeting in 2012.

From the Department of Radiology (O.S., J.M., J.F.A., A.H.M. Ü.C.T. ✉ *ulku_c_turba@rush.edu*) University of Virginia, Charlottesville, VA, USA; Department of Radiology (O.S.), Gülhane Medical School, Istanbul, Turkey; and Department of Interventional Radiology (T.A.B., İ.K., B.A., Ü.C.T.) Rush University Medical Center, Chicago, IL, USA.

ORCID iDs of the authors: O.S. 0000-0001-7261-2397; J.M. 0000-0003-0401-6694; T.A.B. 0000-0002-3906-0102; İ.K. 0000-0001-9828-1223; Ü.C.T. 0000-0002-9449-9572.

Received 5 October 2015; revision requested 9 November 2015; last revision received 17 August 2017; accepted 10 September 2017.

DOI 10.5152/dir.2018.15427.

You may cite this article as: Sıldıroğlu O, Muasher J, Bloom TA, et al. Acute lower gastrointestinal bleeding: predictive factors and clinical outcome for the patients who needed first-time mesenteric conventional angiography. Diagn Interv Radiol 2018; 24: 23–27.

patients who presented to the emergency department with acute lower GI bleeding with a clinical need for further conventional angiography and possible endovascular intervention if the source was found. Exclusion criteria were prior interventional procedures, iatrogenic, surgical or traumatic causes of lower GI bleeding, as well as successful treatment with colonoscopy or medical management without need for conventional angiography.

Procedures and techniques

After obtaining the informed consent, angiographic procedures were performed via common femoral artery access in all patients. Typically, using microcatheters and microguidewires, superselective catheterization and embolization of the mesenteric arteries were performed. Typical embolization materials were commercially available microcoils, gelfoam (Pharmacia & Upjohn), polyvinyl alcohol (Unipoint) and combinations. In one patient, colonoscopy demonstrated ischemic findings and bleeding; conventional angiography demonstrated no active bleeding, but colonoscopy showed ischemic, friable mucosa and severe inferior mesenteric artery stenosis, which was subsequently treated with a Palmaz stent (Cordis). No empiric embolization/treatment was performed in any of the patients.

Definitions and criteria

Lower GI bleeding is defined as bleeding into bowel distal to the ligament of Treitz. The cause of lower GI bleeding was diagnosed either with tagged red blood cell scan, contrast-enhanced CT, or conventional arteriography. Data collection included lab results (lactate, serum creatinine, white blood cell count), coagulopathy, transfusion history, comorbid conditions, angiography findings, treatment history such as embolization, provocation (if any), technical success, clinical success, rebleeding, and complications. We evaluated blood pressure at historic baseline and initial presentation per report of the Joint National Committee (9). Since normotension may indicate a false result in patients with hypertension who lost substantial amount of blood due to bleeding, we determined the blood pressure difference (hypotension versus normotension or fall of blood pressure at presentation compared with patient's history). Technical success was described as the immediate termination of GI bleeding following angiography. Clinical success was described as no rebleed within 30 days of treatment. Rebleeding was described as relapse of clinical signs of lower gastrointestinal bleeding necessitating immediate attention. Early rebleeding was described as relapse of bleeding within 30 days of angiography. Hemodynamic instability was defined as transfusion of more than 4 units of blood during a single admission. We used all aforementioned definitions from the standard of practice per American College of Radiology and Society of Interventional Radiology (10, 11). We are reporting the outcomes of not only the patients who underwent endovascular treatment but also patients who had angiography negative for GI bleeding.

Main points

- Positive initial conventional angiography was highly predictive of rebleeding.
- Early rebleed (within the first 30 days) was associated with higher mortality.
- Late rebleed (after 30 days) was associated with multiple angiograms and positive initial angiograms.
- Factors associated with longer hospitalization included older age, hematocrit drop, high creatinine, and comorbid conditions such as cardiomyopathy and cirrhosis.
- Provocative arteriography resulted in visualization of active clinical bleeding in 33% of the patients.

Statistical analysis

SPSS 20 (IBM Corp.) software was used. Kaplan-Meier method was used to demonstrate clinical success, rebleeding, and mortality; log-rank analysis was used to show statistical significance. A P value of <0.05 was considered statistically significant.

Results

We performed 120 consecutive mesenteric angiograms in 88 patients (35 women and 53 men; median age, 71 years; age range, 23–99 years) with "intent-to-treat" using endovascular approach in 11 years. The reasons for GI bleeding included diverticulosis (n=19, 20.5%), unknown (n=14, 15.9%), diverticulitis (n=12, 13.6%), ulcer (n=10, 11.4%), tumor (n=9, 10.2%), arteriovenous malformation (n=6, 6.8%), colitis (n=6, 6.8%), anticoagulation (n=3, 3.4%), ischemia (n=3, 3.4%), inflammatory bowel disease (n=3, 3.4%), vasculitis (n=2, 2.3%), Meckel's diverticulum (n=1, 1.1%), and jejunal Dieulafoy lesion (n=1, 1.1%). Demographics, clinical presentation, laboratory findings, and comorbid conditions were summarized in the Table.

Before conventional angiography, CT angiography was performed in 15 patients (17%) and active bleeding was detected in one patient (6.7%). Colonoscopy was done in 71 patients (80.7%), 12 of whom had active bleeding (16.9%); but endoscopic treatment was unsuccessful. Tagged red blood cell bleeding scan was performed in 45 patients (51.1%), with positive finding in 34 patients (75.6%), questionable in 3 patients (6.7%), and negative in 8 patients (17.8%).

All angiograms were performed during the course of a single admission. During the same hospitalization, only one angiogram was needed in 61 patients (69.3%) while two angiograms were needed in 22 patients (25%), and three angiograms were needed in 5 patients (5.7%). As a result, 34 patients (38.6%) demonstrated active lower GI bleeding, and endovascular embolization was attempted. One patient (1.1%) had mild celiac artery, mild superior mesenteric artery, and severe inferior mesenteric artery stenoses, and colonoscopy showed ischemic findings in inferior mesenteric artery territory and without the angiographic bleeding site. No angiographic culprit lesion was identified in 53 patients (60.2%). In order to find a culprit lesion, pharmacologic provocation (Protocol: 4–8 mg of tissue plasminogen activator followed by angiography at 5, 10, 15, and 30 min) was performed in 6 patients (6.8%). Following pharmacologic provocation, two patients (33.3%) developed active GI bleeding and were successfully treated with angioembolization, while 4 patients (66.7%) did not have active GI bleeding. Following conventional angiography, active bleeding arteries were detected as right colic artery (n=8), jejunal artery (n=6), ileocolic artery (n=4), superior rectal artery (n=4), middle colic artery (n=3), sigmoidal artery (n=3), left colic artery (n=2), ileal artery (n=2), ileal and ileocolic artery (n=1), and left colic and sigmoidal artery (n=1). Thus, of 34 patients, 21 (61.8%) had active large bowel bleeding, 8 (23.5%) had active small bowel bleeding, and 5 (14.7%) had active bleeding in both small and large bowels. Four patients with angiographic active bleeding (11.8%) were considered to be at high risk for bowel infarction by the interventional radiologist

Table. Risk stratified outcomes; mortality vs. factors related to overall mortality and 30-day mortality

Risk factors	n (%)	30-day mortality *P*	Overall mortality *P*
Demographics			
Age <49 years	10 (11.4)	0.585	0.772
50-59 years	12 (13.6)	0.937	0.951
60-69 years	18 (20.5)	0.932	0.362
70-79 years	26 (29.5)	0.581	0.345
>80 years	22 (25)	0.748	0.920
Men/women	53 (60.2)/35 (39.8)	0.397	0.302
Symptoms at presentation			
Fainting	2 (2.3)	0.179	0.285
Weakness	10 (11.4)	0.715	0.458
Dizziness	16 (18.2)	0.243	0.027[a]
Abdominal pain	11 (12.5)	0.507	0.303
Melena	14 (15.9)	0.340	0.215
Hematochezia	66 (75)	0.725	0.998
Bloody diarrhea	3 (3.4)	0.447	0.218
Vomiting	9 (10.2)	0.127	0.944
Nausea	9 (10.2)	0.133	0.980
Tachycardia	6 (6.8)	0.017[a]	0.011[a]
Coagulopathy	15 (17)	0.635	0.949
Laboratory			
Lactic acid (increased)	7/27 (25.9)	0.117	0.323
WBC (increased)	31 (35.2)	0.510	0.327
Creatinine (increased)	22 (25)	0.019[a]	0.0001[a]
Blood pressure drop	58 (65.9)	0.642	0.698
Hemodynamic instability	49 (55.7)	0.488	0.479
Comorbid conditions			
Hyperlipidemia	31 (35.2)	0.576	0.551
Renal failure	Acute; 9 (10.2), Chronic; 19 (21.6)	0.390	0.035[a]
Hypertension	59 (67)	0.818	0.767
Hemorrhoids	8 (9)	0.206	0.800
Diabetes mellitus	23 (26.1)	0.818	0.490
COPD	14 (15.9)	0.157	0.041[a]
MI history	7 (7.95)	0.322	0.468
CAD	23 (26.1)	0.679	0.808
Atrial fibrillation	16 (24.2)	0.058	0.316
CHF	13 (14.77)	0.947	0.030[a]
Cardiomyopathy	3 (3.4)	0.403	0.003[a]
Cirrhosis	3 (3.4)	0.381	0.012[a]
Procedural parameters			
Multiple diagnostic angiograms	27 (30.7)	0.656	0.170
Positive angiogram	34 (39.77)	0.155	0.675
Small versus large bowel[b]	8 (23.5) vs. 21 (61.8)	0.116	0.065
Technical success	28/31 (90.3)	0.151	0.558
Clinical success (early)	20/28 (71.4)	0.494	0.118
Clinical success (long-term)	14/28 (50)	1.0	0.689
Rebleed (early)	13 (14.8)	0.115	0.004[a]
Rebleed (late)	12 (26.1)	N/A	0.331

WBC, white blood cells; COPD, chronic obstructive pulmonary disease; MI, myocardial infarction; CAD, coronary artery disease; CHF, congestive heart failure; N/A, not applicable.
[a]$P < 0.05$ (Kaplan-Meier, Log-rank test); [b]Patients with both small and large bowel sources excluded.

because of the location of the bleeding and mesenteric arterial anatomy, and no endovascular treatment was attempted. Therefore, embolization was attempted in only 30 of 34 patients with active bleeding (88.2%). Successful embolization was performed with coils in 15 of 27 patients (55.6%), gelfoam slurry and 700–900 µm PVA only in one patient (3.7%), 300 U of thrombin in one patient (3.7%), and coils plus gelfoam slurry in 10 patients (37%). Of 27 patients, 25 (92.6%) had microcoils with a mean of 6.28±4.6 coils per patient. Overall mean fluoroscopy time was 22.7±14.8 min including both diagnostic and/or interventional portions of the procedure. There were no major complications. There were 3 minor complications: groin hematoma, which resolved without the need for further treatment; dissection of the left colic artery, which was not flow limiting; and coil misplacement to the parent jejunal artery, which was successfully retrieved during the same procedure. The median inpatient stay was 8 days (range, 1–90 days).

Endovascular treatment was technically successful in 28 of 31 patients (90.3%). The patient, who had colonoscopy proven ischemia and received balloon angioplasty and stenting, was also among the technically successful cases. Among the 28 technical successes, 11 patients had a single angiogram and 17 patients had multiple angiograms. None of the 3 technical failures had multiple angiograms.

The early clinical success rate was 71.4% (20/28), while long-term clinical success rate was 50% (14/28). Among the 20 clinical successes, 10 had a single angiogram and 10 had multiple angiograms. Of the 8 clinical failures, 7 had multiple angiograms. There was no statistically significant association between clinical success and survival (Log-rank Mantel-Cox, $P = 0.118$, $\chi^2 = 2.437$) (Fig. 1).

In all patients, early rebleeding rate was 14.8% (13/88) at a median of 4 days (range, 1–29 days), while late rebleeding rate was 13.6% (12/88) at a median of 14 months (range, 2–61 months). Two patients had both early and late rebleed, making the total rebleeding rate 26.1% (23/88). Early rebleeding was found to be a strong predictor of overall survival (Fig. 2). Of 13 patients with early rebleed, 8 died within the study period, while 18 of 75 patients without early rebleed died. Early rebleeding showed no significant association with laboratory values, transfusion requirements, or co-

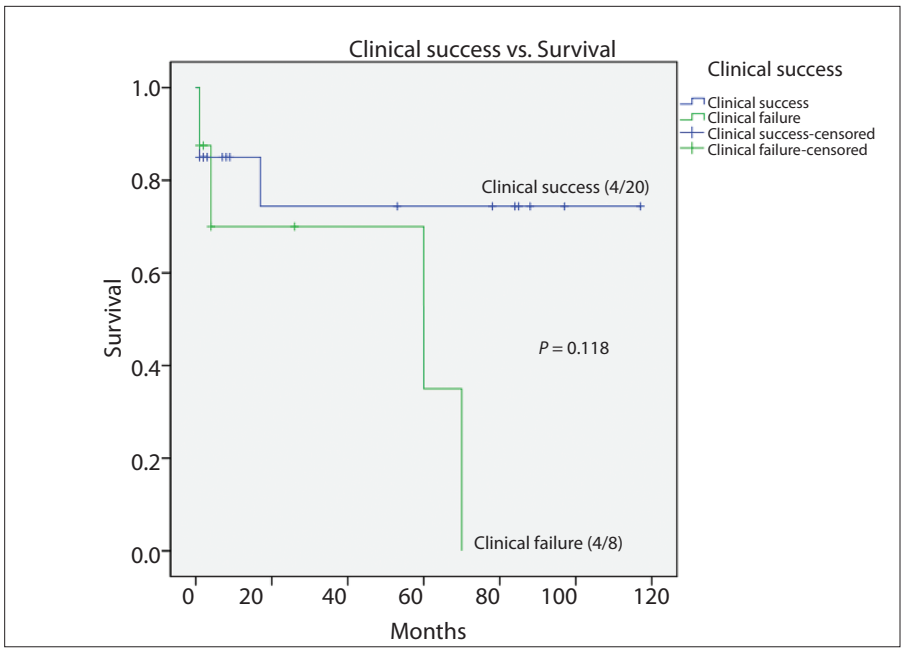

Figure 1. Clinical success vs. survival. Clinical success was not statistically significant in predicting survival ($P = 0.118$).

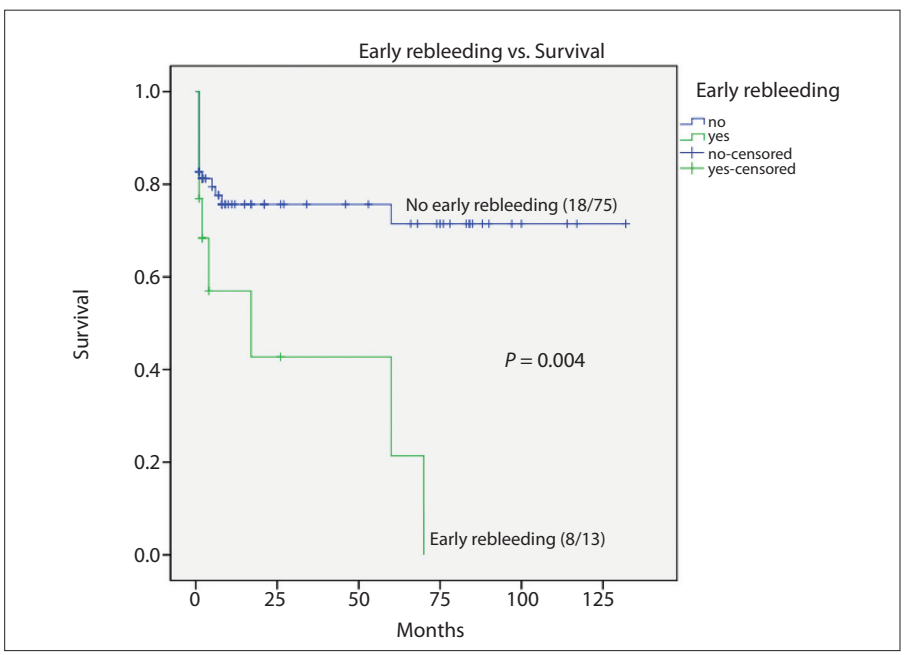

Figure 2. Early rebleeding vs. survival. Early rebleeding was associated with poor survival ($P = 0.004$).

morbidities. Positive initial angiogram was found in 11 of 13 patients with early rebleed versus 23 of 75 patients without rebleed. Late rebleeding was not associated with survival (Table and Fig. 3).

The median follow-up was 7.5 months (range, 1–132 months). Of 88 patients, 32 (36.4%) were alive and under current clinical follow-up at the conclusion of the data review period which was a median of 19 months (range, 1–132 months). Patients were lost to follow-up at a median of 8 months (range, 1–85 months), and 26 patients (29.5%) expired after a median of 1 month (range, 1–70 months). During follow-up, 11 patients had tumors, including colon cancer (n=7), bowel metastasis (n=2), intestinal lymphoma (n=1), or pancreatic cancer (n=1), which may or may not have been related to lower GI bleeding.

On follow-up, 67 patients (76.1%) required no further treatment after diagnostic angiography with or without endovascular intervention, 13 patients (14.8%) had surgical treatment, 5 patients (5.7%) had endoscopic treatment and 3 patients (3.4%) had another angioembolization. Of 28 patients who had technically successful endovascular treatment, 23 (82.1%) did not need supplementary treatment, 3 (10.7%) had another angioembolization, 2 (7.1%) needed further surgical treatment; no patients needed further colonoscopic treatment.

The 30-day mortality rate was 15.9% (14/88). Cause of death within 30 days was gastrointestinal bleeding (n=10), end-stage renal disease (n=1), respiratory failure (n=1), cardiac causes after surgery (n=1), and unknown (n=1). The overall mortality rate was 29.5% (26/88). Cause of death was gastrointestinal bleeding (n=11), end-stage renal disease (n=4), unknown (n=4), tumor (n=2), congestive heart failure (n=2), sepsis (n=1), respiratory failure (n=1), and cardiac causes after surgery (n=1).

Independent risk factors for overall mortality included early rebleeding, dizziness or tachycardia at presentation, increased creatinine, and certain comorbidities such as renal failure, chronic obstructive pulmonary disease, chronic heart failure, cardiomyopathy, and cirrhosis. Independent risk factors for 30-day mortality were limited to increased creatinine and tachycardia. The location of the bleeding source was not related to increased mortality (Table).

Discussion

Technical and clinical success rates in our study were 90.3% and 71.4%, respectively. The early rebleeding rate was 14.7%, and early rebleeding was a strong predictor of overall mortality. A positive initial angiogram was strongly associated with early rebleeding. Tachycardia and high creatinine at first presentation were predictors of higher 30-day and overall mortality. Our findings also suggest that patients with negative arteriography may require more aggressive follow-up within 30 days. Although it seemed that patients with positive angiograms were benefiting from the endovascular treatment, risk of mortality was not significantly different in patient groups with and without angiographic localization. In our study, renal insufficiency was one of the most ominous risk factors for both mortality and longer hospitalization, although preexisting chronic renal failure was not associated with increased 30-day mortality. It can, therefore, be surmised that

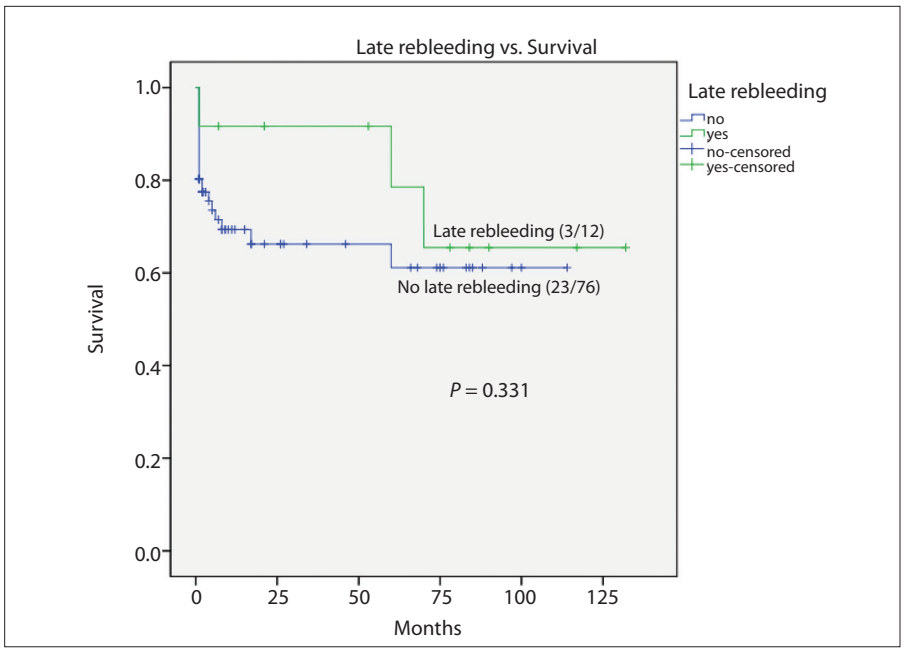

Figure 3. Late rebleeding vs. survival. Late rebleeding was not statistically significant in predicting survival ($P = 0.331$).

acute renal failure is a stronger predictor of poor outcome than chronic renal failure.

Patients with renal failure, chronic obstructive pulmonary disease, chronic heart failure, cardiomyopathy, and cirrhosis showed increased mortality rates, although 30-day mortality was not associated. Other authors found that presence of more than one comorbid condition was associated with increased overall mortality (12, 13). Our technical success, clinical success, and rebleeding rates in patients with positive angiograms are similar to those published in other studies (3, 6–8). Tachycardia at first presentation was a predictor of both 30-day and overall mortality. This finding is in line with other studies that determined the most important component of the physical exam in a patient with bleeding to be the vital signs, which can be used to assess the severity of the hemorrhage. A pulse greater than 100/min was shown to be a clinical factor predictive of severe colonic bleed in another study of 252 patients, as was a systolic blood pressure of <115 mmHg and syncope (12).

It is a clinical challenge when patients have active clinical GI bleeding, but there is no active bleeding on subsequent conventional angiography. A provocative angiogram is controversial secondary to fear of causing uncontrollable bleeding which may overshadow the benefit of an angiographic location of the bleed. In our study, we used provocative arteriography on only 6 patients, which demonstrated the visualization of active clinical bleeding in 2 of 6 patients (33%). Some studies show safety and success rates similar to ours, with active bleeding achieved in 33% of patients (14).

Surgery for lower GI bleeding is usually reserved for patients with uncontrollable bleeding and failed angiographic embolization, or postembolization ischemic bowel complications (6, 15). We did not encounter major complications in the 120 procedures in our study. There were 3 minor complications, which resolved without the need for further treatment.

The main limitation of our study, similar to other studies that have analyzed lower GI bleeding, is its retrospective nature. The technical aspects of the procedure varied between interventional radiologists and over the study period. Not all patients could be followed for the same period of time and some patients were lost to follow-up.

In conclusion, identifying the source of lower GI bleeding continues to be a clinical and angiographic challenge as reported in the literature. Interestingly, clinical success of endovascular treatment did not influence the mortality rate, whereas higher early rebleeding rates were associated with higher mortality rates.

Conflict of interest disclosure

The authors declared no conflicts of interest.

References

1. Ghassemi KA, Jensen DM. Lower GI bleeding: epidemiology and management. Curr Gastroenterol Rep 2013; 15:333. [CrossRef]
2. Marti M, Artigas JM, Garzon G, Alvarez-Sala R, Soto JA. Acute lower intestinal bleeding: feasibility and diagnostic performance of CT angiography. Radiology 2012; 262:109–116. [CrossRef]
3. Kim JH, Shin JH, Yoon HK, et al. Angiographically negative acute arterial upper and lower gastrointestinal bleeding: incidence, predictive factors, and clinical outcomes. Korean J Radiol 2009; 10:384–390. [CrossRef]
4. Ali M, Ul Haq T, Salam B, Beg M, Sayani R, Azeemuddin M. Treatment of nonvariceal gastrointestinal hemorrhage by transcatheter embolization. Radiol Res Pract 2013; 2013:604328. [CrossRef]
5. Kickuth R, Rattunde H, Gschossmann J, Inderbitzin D, Ludwig K, Triller J. Acute lower gastrointestinal hemorrhage: minimally invasive management with microcatheter embolization. J Vasc Interv Radiol 2008; 19:1289–1296. [CrossRef]
6. Maleux G, Roeflaer F, Heye S, et al. Long-term outcome of transcatheter embolotherapy for acute lower gastrointestinal hemorrhage. Am J Gastroenterol 2009; 104:2042–2046. [CrossRef]
7. Chang WC, Liu CH, Hsu HH, et al. Intra-arterial treatment in patients with acute massive gastrointestinal bleeding after endoscopic failure: comparisons between positive versus negative contrast extravasation groups. Korean J Radiol 2011; 12:568–578. [CrossRef]
8. Kwak HS, Han YM, Lee ST. The clinical outcomes of transcatheter microcoil embolization in patients with active lower gastrointestinal bleeding in the small bowel. Korean J Radiol 2009; 10:391–397. [CrossRef]
9. Chobanian AV, Bakris GL, Black HR, et al. Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. Hypertension 2003; 42:1206–1252. [CrossRef]
10. Millward SF. ACR Appropriateness criteria on treatment of acute nonvariceal gastrointestinal tract bleeding. J Am Coll Radiol 2008; 5:550–554. [CrossRef]
11. Drooz AT, Lewis CA, Allen TE, et al. Quality improvement guidelines for percutaneous transcatheter embolization. J Vasc Interv Radiol 2003; 14:S237–242.
12. Strate LL, Orav EJ, Syngal S. Early predictors of severity in acute lower intestinal tract bleeding. Arch Intern Med 2003; 163:838–843. [CrossRef]
13. Longstreth GF. Epidemiology and outcome of patients hospitalized with acute lower gastrointestinal hemorrhage: a population-based study. Am J Gastroenterol 1997; 92:419–424.
14. Kim CY, Suhocki PV, Miller MJ, Jr., Khan M, Janus G, Smith TP. Provocative mesenteric angiography for lower gastrointestinal hemorrhage: results from a single-institution study. J Vasc Interv Radiol 2010; 21:477–483. [CrossRef]
15. Czymek R, Kempf A, Roblick UJ, et al. Surgical treatment concepts for acute lower gastrointestinal bleeding. J Gastrointest Surg 2008; 12:2212–2220. [CrossRef]