

Mesenteric angiography of patients with gastrointestinal tract hemorrhages: a single center study

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PURPOSE

This retrospective study was designed to investigate the transcatheter mesenteric angiography of patients with gastrointestinal (GI) bleeding and to determine the most important variables that should be monitored in patients with GI bleeding prior to transcatheter arteriography.

MATERIALS AND METHODS

In this study, we evaluated the transcatheter mesenteric angiography results of patients with massive GI bleeding (defined as hypotension, tachycardia, and a greater than 4-unit blood transfusion requirement in 24 h) seen between 2005 and 2009. Detailed clinical follow-up and accessible hospital data from 45 procedures were examined from 42 patients (two procedures were performed in three patients) between 24 and 85 years old (mean age, 57.6 years). The present study included 33 males and 9 females. Angiography was performed for lower GI bleeding in 22 patients, upper GI bleeding in 15 patients, and upper/lower (multiple origins) GI bleeding in five patients. Imaging work-ups, including endoscopic interventions, and follow-ups with patients after the procedure were evaluated in detail. Several variables recorded prior to the procedure, including the clinical status, etiological cause of the bleeding, bleeding parameters (e.g., international normalized ratio, platelets), imaging work-up, gender, season, and angiography time, were examined.

RESULTS

Embolization was performed in 24 (53%) of the 45 procedures. Overall, the technical success rate of the diagnostic arteriograms was 100%, and no major complications occurred. For the embolizations, coils were used in 17 patients (70%), polyvinyl alcohol particles were used in six patients (25%), and n-butyl cyano-acrylate was used in one patient (4%). The detection rate of mesenteric arteriographies to examine GI bleeding performed outside of normal working hours was significantly greater than the detection rate of the arteriographies performed during normal working hours ($P = 0.050$). Low platelet levels or a prolonged prothrombin time were not associated with the mesenteric arteriography results ($P = 1.00$). Interestingly, the intermittent nature of GI bleeding was the most challenging part of detection, which made management of the bleeding difficult. Blind embolization of the left gastric artery was only helpful in preventing massive bleeding in three out of eight patients with upper GI bleeding.

CONCLUSION

Endoscopy for upper gastrointestinal bleeding and scintigraphy for lower gastrointestinal bleeding are important steps in the management and outcome of transcatheter angiography. Computerized tomography angiography is a promising tool for the treatment of both upper and lower GI bleeding, and this procedure has become part of the imaging toolset. In addition, angiography performed outside of working hours had a higher rate of clinical success than the angiographies performed in working hours, most likely secondary to much appropriate timing of arteriogram in terms of critical bleeding intervals.

Key words: • mesenteric angiography • gastrointestinal bleeding • transcatheter embolization

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Gastrointestinal (GI) bleeding is one of the major causes of morbidity and mortality, and the incidence of hospital admittance for GI bleeding is 120 per 100 000 cases. Gastrointestinal bleeding primarily occurs in the upper GI tract above the Treitz ligament; however, 15% of GI bleedings occur in the lower GI tract. Although bleeding spontaneously stops in 80% of patients, it progresses or relapses in the other 20% (1). Although endoscopy is the primary diagnostic method to detect upper GI bleeding, scintigraphy is widely used for lower GI bleeding. Sulfur colloid scintigraphy can detect a bleeding in the range of 0.05–0.1 mL/min, and scintigraphic imaging with tagged red blood cells can detect a bleeding in the range of 0.2–0.4 mL/min (2). Consistent with recent technological advances, mesenteric computed tomography angiography (CTA) is a promising diagnostic approach for the detection of GI bleeding. CTA is less invasive than catheter angiography, but it is less sensitive than scintigraphy (0.1 mL/min for scintigraphy compared to 0.35 mL/min for CTA). However, there are several important advantages to CTA, namely that it can be performed 24 h a day in a matter of seconds (using multidetector CT equipment) and it can easily localize the bleeding. In addition, CTA can detect important findings that accompany the bleeding, such as bowel wall thickness, mass, and perforation, through its cross-sectional scanning ability (3).

Although the limit of detection of the GI bleeding rate using transcatheter mesenteric angiography and the conventional film cassette technique is 0.5 mL/min, *in vivo* studies have shown that the limit of detection using digital subtraction angiography (DSA) is 5–9 times greater than conventional systems (2). However, both radiation exposure and the side effects of the contrast media used in nuclear medicine and radiological diagnostic methods must be considered when examining patients with GI bleeding. Although transcatheter mesenteric angiography is an invasive procedure, it is used in patients with massive GI bleeding because it not only detects the bleeding, but the underlying cause can be treated in the same endovascular session. The combination of mesenteric CT angiography and catheter angiography demonstrates that radiology plays a key role in the diagnosis and treatment of GI bleeding, which is a clinical problem requiring a multidisciplinary approach. Even after taking into account the different detection limits and the advantages and disadvantages of imaging, there is currently no defined, standard approach to treat GI bleeding (2).

Medical or endoscopic coagulation, transcatheter embolization and surgical resection are the treatment options for GI bleeding. Although surgical resection is the definitive treatment, its mortality and morbidity rates are between 10%–15% (4). Colonoscopy is widely used for the diagnosis of lower GI bleeding, but very few patients benefit from endoscopic treatment (5). Transcatheter embolization is widely used throughout

the world, and this procedure is an effective method in the treatment of GI bleeding. After the localization of the hemorrhage using angiography, doctors are able to obstruct the bleeding artery within minutes using various embolizing agents. The choice of embolization material can change depending on the bleeding focus and the experience of the interventionalist.

Various clinical features have been shown to predict the outcome of patients admitted with GI bleeding. Studies have shown that the bleeding prognosis can be affected by several clinical features, including ongoing bleeding, hypotension, prolonged prothrombin time, mental status, and comorbid factors (6). In the present study, we retrospectively investigated patients with massive GI bleeding who underwent transcatheter mesenteric angiography and examined several factors that may have affected the success of the angiography, including the presence of bleeding disorders, anticoagulant treatment, the initial imaging work-up, and angiography timing.

Materials and methods

We retrospectively evaluated the results of patients with massive GI bleeding who had endoscopy, scintigraphy, and/or CTA before being referred to our department between 2005 and 2009. We reviewed the algorithms that were used in our tertiary care center by comparing the modalities used for the diagnosis and treatment of GI bleeding with the clinical results. Transcatheter mesenteric angiography was performed in patients with massive GI bleeding who were referred to the vascular interventional radiology department from the emergency room, intensive care units, and various other departments. Massive bleeding was defined as bleeding that required transfusion of at least 4 units of blood in 24 h and hypotension (systolic blood pressure <90 mmHg) (7). Patients who underwent angiography during the study period were excluded from the study if detailed procedure information and follow-up data could not be obtained. For statistical analysis, chi-square test and *t*-test were used.

Detailed clinical follow-up data from 45 transcatheter mesenteric angiography procedures performed on 42 patients between 24 and 85 years old (mean, 57.6 years) were examined. The

present study included 33 males and 9 females. Abdominal aortograms and visceral arteriograms were obtained via a right main femoral artery approach in 40 transcatheter mesenteric angiography procedures and a left main femoral artery approach in five procedures. Despite negative findings in the first mesenteric angiography, three patients underwent a second mesenteric angiography because of the progression of the GI bleeding and severe hemoglobin decreases. All patient assessments before the procedures and the diagnostic and therapeutic catheter angiographies were performed by the same two interventional radiologists.

The variables evaluated in relation to the transcatheter angiography results were the possible underlying causes of the bleeding, bleeding parameters (e.g., international normalized ratio [INR] and platelet level), the diagnostic work-up (scintigraphy, endoscopy, or CTA) performed, sex, season, and angiography time.

Patients were classified according to underlying cause of bleeding, which was malignancy in 15 patients, anticoagulant and non-steroid anti-inflammatory drug usage in 13 patients, iatrogenic reasons in five patients, angiodysplasia and vasculitis in four patients, a gunshot injury in one patient, sepsis in one patient, bleeding secondary to pancreatitis in one patient, and diverticulitis in two patients.

Patients with massive GI bleeding whose hemodynamic conditions were stabilized quickly were initially assessed using other imaging modalities (e.g., endoscopy, scintigraphy, or CTA) before the transcatheter mesenteric angiography. However, catheter angiography was directly performed on two patients whose clinical status showed very rapid deterioration (i.e., hypovolemia that could not be fixed and the situation could not be stabilized).

Scintigraphy was performed in 18 of 22 patients with lower gastrointestinal bleeding and four of five patients with lower/upper (multiple-origin) gastrointestinal bleeding. Scintigraphy was not used in patients with only upper gastrointestinal bleeding.

Endoscopy was performed in 12 of 15 patients with upper gastrointestinal bleeding. During endoscopy, we detected active bleeding in nine patients, an antral mass in one patient, a bulbar mass in one patient, and erosion

in one patient. Interestingly, none of these patients could be managed using endoscopic approaches.

CTA was performed in three patients with lower GI bleeding and three patients with upper GI bleeding. Pseudoaneurysm or active contrast extravasation was identified in all of the patients with upper GI bleeding and two of the patients with lower GI bleeding, and all of these patients were embolized. The one patient with a negative CTA also underwent transcatheter arteriography during follow-up, and this procedure was also negative.

In two patients (one with lower GI bleeding and one with multiple origin [lower/upper] GI bleeding), transcatheter mesenteric angiography was performed without any prior imaging work-ups because of hemodynamic instability.

An INR over 1.2 and a platelet count below 150 000 per μ L were used to assess bleeding disorders. In addition, the blood urea nitrogen and creatinine values, which were used to assess the renal function of the patients at the time of transcatheter mesenteric angiography, were within normal limits in all patients.

Results

In the present study, there were no complications related to diagnostic transcatheter mesenteric angiography. In addition, embolization was performed in 24 of the 45 diagnostic angiographies with 100% technical success rate, and there were no complications related to embolization.

The primary angiographic signs of GI bleeding (active contrast extravasation or pseudoaneurysm) were detected in 17 of the 45 transcatheter angiographies, and subsequent embolization was performed in 16 of these cases. One patient had to undergo surgical resection because they did not have an embolization and showed multifocal bleeding and pseudoaneurysm consistent with mesenteric vasculitis. Bleeding was stopped in all 16 cases treated with embolization, and none of these patients had any problems with GI bleeding during the follow-up period (five patients died during follow-up due to other co-morbidities). Active contrast material extravasation, which provides the best angiographic evidence of bleeding, was only detected in 11 (46%) of the 24 embolized patients,

and pseudoaneurysm was detected in five (21%) patients. In the remaining eight (33%) cases treated with embolization, the presumed location of the bleeding was identified by other imaging studies. In these cases, the embolization was performed even though there were no signs of active bleeding during the angiography (left gastric artery and jejunal arteries feeding the tumoral mass). Prophylactic embolization was performed in two patients with known tumors (one was jejuna, the other gastric). In the remaining six patients, stomach was the source of the bleeding as documented by other imaging studies caused by single big or multiple ulcers. Only three of the eight patients who underwent blind embolization benefited from the procedure (i.e., bleeding ceased). In the other five patients, bleeding continued intermittently, which led to sepsis, multiorgan failure, and eventual death.

Various embolization materials were used in the patients of the present study: coils were used in 17 patients (71%), polyvinyl alcohol (PVA) particles were used in six patients (25%), and n-butyl cyano-acrylate (n-BCA) was used in one patient (4%).

Scintigraphy was performed in 18 of the 22 patients with lower gastrointestinal bleeding: seven patients had positive scan results for bleeding, and 11 patients had negative scan results for bleeding. Active bleeding was detected in four of seven patients with positive scan results using transcatheter mesenteric angiography, and these patients were subsequently embolized.

All 11 patients with lower gastrointestinal bleeding and negative scan results were eventually examined using transcatheter mesenteric angiography due to the ongoing intermittent massive bleeding that was observed during follow-up. Eight of these patients had negative angiography results, did not undergo embolization, and eventually had a full recovery. Transcatheter embolization was performed in two patients, and their clinical status improved rapidly in follow-up. Embolization was not performed in one of the patients with lower GI bleeding and negative scan results who underwent subsequent surgical exploration and resection.

In the remaining four out of 22 patients with lower GI bleedings, instead of nuclear medicine study, CTA

was obtained prior to transcatheter mesenteric arteriography. In the final patient, transcatheter mesenteric angiography was performed directly and followed by embolization. Among the three patients who underwent CTA for lower GI bleeding, embolization was performed immediately at the site of bleeding identified using CTA. In one patient, however, a subsequent transcatheter arteriogram was also negative for bleeding.

Scintigraphy was positive in four out of five patients who presented with lower/upper (multiple-origin) GI bleeding. Subsequent embolization was performed in three of the four patients with positive scintigraphy results.

Among the patients who underwent scintigraphy prior to transcatheter angiography, the positive predictive value of scintigraphy for GI bleeding was 42.9%, the negative predictive value of scintigraphy for GI bleeding was 72.7%, the sensitivity of scintigraphy in GI bleeding was 50%, and the specificity of scintigraphy in GI bleeding was 66.7%. Scintigraphy was not performed in the patients who only had upper gastrointestinal bleeding.

Endoscopy was performed on 12 of 15 patients with upper gastrointestinal bleeding. During endoscopy, active bleeding was detected in nine of these patients, an antral mass was detected in one patient, a bulbar mass was detected in one patient, and erosion was detected in one patient. Despite several endoscopic management attempts, the subsequent transcatheter arteriograms showed active bleeding, and embolization was performed in five patients. Despite no signs of active bleeding during the transcatheter arteriography, seven patients with an endoscopically detected site of upper GI bleeding underwent blind embolization of the left gastric arteries with PVA particles, and two of these patients clinically benefited from the procedure.

Computed tomography angiography was performed in three patients with upper GI bleeding. Pseudoaneurysm or active contrast extravasation was identified in all patients with upper GI bleeding, who were all embolized (Figs. 1–3).

As a part of the routine initial work-up for an arteriogram, the bleeding parameters of the patients were evaluated prior to the procedure. Because of the underlying co-morbidities or the transfusion of significant amounts of blood

due to bleeding, 24 patients had high INR values, 20 patients had low platelet counts, and 13 patients had a high INR value and a low platelet count during the transcatheter arteriograms. The primary signs of active bleeding were detected in 10 of the 24 patients with high INR values and in seven of the 18 patients with normal INR values. Similarly, active bleeding was detected in eight of the 20 patients with a low platelet count and in nine of the 22 patients with a normal platelet count. The INR value was not an effective parameter of positive angiography results or embolization rates ($P = 1.00$ and $P = 0.261$, respectively). In addition, the platelet count was not an effective parameter of positive angiography results or embolization rates ($P = 1.00$ and $P = 0.196$, respectively). Furthermore, there was no significant difference between the angiography results or embolization rates of patients with normal coagulation parameters and patients with a low platelet count and high INR values ($P = 1.00$). As a result, there was no significant relationship between the bleeding parameters and the results of the diagnostic catheter angiography and the embolization rates.

Another surprising result of this study was that the transcatheter mesenteric angiographies performed outside of the normal working hours (i.e., out of 08:00–18:00 hours) had more positive results and a higher rate of embolization. Active bleeding or pseudoaneurysm was detected in nine of 15 transcatheter mesenteric angiographies performed outside of the normal working hours compared with eight out of 30 angiographies performed within working hours. Similarly, the rate of embolization was higher for arteriographies performed outside of normal working hours. Interestingly, most of the blind embolizations were performed within the working hours (five out of eight blind embolizations). Statistically, more positive results and higher embolization rates were achieved with the angiographies performed outside of normal working hours ($P = 0.050$ and $P = 0.048$, respectively).

We also evaluated the perennial cycle of GI bleeding in this study, and 19 out of 45 transcatheter angiographies were performed between January and March ($P = 0.032$). Active bleeding or pseudoaneurysm was detected in nine



Figure 1. Computerized tomography angiography imaging revealed a pseudoaneurysm (*arrow*) at the gastroduodenal artery as the source of bleeding.

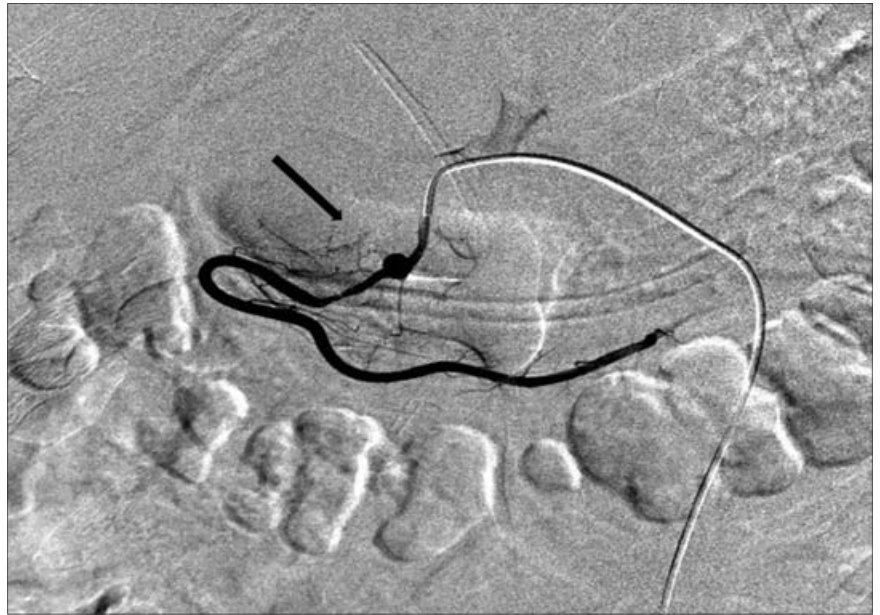


Figure 2. Subsequent transcatheeter mesenteric arteriography confirmed the lesion at the gastroduodenal artery (*arrow*).



Figure 3. Successful coil embolization immediately ceased the bleeding.

of the 19 angiographies in this three-month period, and embolization was performed accordingly.

Discussion

Gastrointestinal bleeding can be caused by various factors in the digestive system. In addition, the intermit-

tent nature of the bleeding, which can be catastrophic, makes diagnosis and treatment extremely difficult. Currently, there is no standard approach for diagnosing and treating GI bleeding. Generally, endoscopy has been used as the initial imaging technique for upper GI bleeding cases, and

scintigraphy has been used in lower GI bleeding cases (8, 9). All of the patients in the present study underwent a transcatheeter mesenteric arteriogram: 57% of patients had a positive scintigraphy scan for lower GI bleeding, and 77% of patients had a positive endoscopy result for upper GI bleeding. Tc99 and Tc99m sulfur colloid scintigraphy, which are used as non-invasive imaging methods, can detect less than 0.04 mL/min bleeding with 93% sensitivity and 95% specificity. Although endoscopy can be safely used for the characterization, localization, and assessment of upper GI bleeding, it cannot provide sufficient information for bleeding below the distal duodenum (8). Scintigraphy plays a major role in the determination of lower GI bleeding, and it can also be used for upper GI bleeding in cases that cannot be reached with endoscopic techniques. Although some centers have used endoscopy for lower GI bleeding, this technique is not successful for lower GI bleeding, especially for cases involving massive bleeding.

The literature contains various reported series of scintigraphic detection of GI bleeding with different results. A study by Howarth of 86 patients with positive Tc99m-labeled red blood cell scintigraphy suggested that this test can be used to predict which patients will have detectable bleeding on angiography based on the presence or ab-

sence of a scintigraphic “blush” seen within the first 2 min of the study (10). He reported positive and negative predictive values of 75% and 93%, respectively, which allows greater selection of patients who should undergo angiography. The overall predictive values and clinical utility, however, are likely to be considerably lower in practice because of the inclusion of patients who are negative on Tc99m-labeled red blood cell scintigraphy (10).

Up to 85% of massive rectal bleeding cases and 90% of upper GI bleeding cases can be diagnosed using mesenteric catheter angiography. If massive bleeding continues in the patients who cannot be diagnosed with catheter angiography, angiography can be repeated within the next day (11). The presence of intermittent lower GI bleeding is one of the primary factors affecting the success of angiography. Angiography may be negative because of factors such as short-term decreased bleeding, technical failure, vascular lesions, nutritive artery spasms, and the recovery of intussusception in bleeding, which is caused by intermittent intussusception. Therefore, the timing of catheter angiography is extremely vital for the treatment and control of bleeding (2). To define the correct timing, many variables have to be considered. True “massive” bleeding, which is a life-threatening condition, must first be sought clinically and only then by means of imaging techniques to determine the actual source of bleeding.

Bandi et al. (12) reviewed the literature from the past two decades to determine the incidence of infarction after transcatheter embolization. Studies in the 1980s showed a 10%–20% incidence of post-embolization infarction, whereas later studies in the 1990s demonstrated few, if any, post-embolization infarction cases (12–14). The reduction in postembolization infarction has been attributed to the development of finer coaxial systems and microcoils and the increased experience of the interventionalists. Some patients develop mild mucosal ischemia, which in most cases is asymptomatic. Complete clinical success, which is defined as the termination of bleeding following embolotherapy, has been reported to be between 65% and 86%, which was very similar to our series of patients (12–14). In patients with active bleeding (0.5–1.0 mL/min), mesenteric angiography

can localize the site of small bowel bleeding in 50%–72% of patients, but the diagnostic yield drops if active bleeding has slowed or stopped (13).

The importance of mesenteric CT angiography in the diagnosis of GI bleeding has rapidly increased with the routine use of multidetector CT systems with faster scanning and multiplanar reformation (MPR) images (9). Although it was not routinely used in our patient series, the results were encouraging and definitely need attention (7, 8). In addition, cross-sectional imaging has advantages in the diagnosis of potential intra-luminal pathologies, such as GI bleeding. Additionally, intestinal wall thickening, masses, potential surgical complications, arterial anatomical variations, all of which may affect the arteriography, aneurysms/pseudoaneurysms, and rare causes of GI bleeding, such as hemobilia or hemosuccus pancreaticus, can be recognized using CT imaging.

Transcatheter embolization, which, in GI bleeding, was used 30 years ago, is a well-known treatment method. The initial studies defined the mesenteric ischemia rate after embolization to be as high as 20%–33%, which was believed to be related to thick catheters (5–7 French) and a limited number of embolizing agents (autologous blood clot, gelatin sponge, etc.) (4). With the invention of microcatheters and technical developments in the late 1980s that allowed distal catheterization, transcatheter embolization became a very effective and safe method (15). Interestingly, ischemia has been reported to be more common in cases of lower GI bleeding because of less collaterals and arterial anastomoses compared with the upper GI (4). Therefore, embolization should be performed as close to the site of bleeding as possible to avoid proximal embolization, especially in the treatment of the mesenteric artery for lower GI bleeding.

Clinical picture including the blood volume loss and associated comorbid factors, such as active infections and organ failures, affect the progress of patients with GI bleeding. Until the daily amount of blood loss exceeds 100 mL, the patients remain largely asymptomatic. When the acute blood loss exceeds 500 mL, tachycardia and hypotension can be detected. In addition, a blood loss of greater than 15% of the total blood volume results in

systemic shock (8). In the case of systemic shock, catheter angiography is usually negative because of systemic vasospasm, deep hypovolemia, and late detection, which limits the success of the procedure. Thus, catheter angiography should be performed based on clinical findings that indicate active bleeding in patients with massive bleeding. In patients with severe hypovolemia, the need for catheter angiography should be decided after performing the necessary blood replacements. Interestingly, studies have shown that the tendency to treat the bleeding patient as soon as possible and make the catheter angiography easily accessible during normal working hours seems to decrease the success of transcatheter angiography. Angiography performed outside of normal working hours was more successful in detecting bleeding, which was thought to result from angiographies being performed on patients with more severe bleeding. In the present study, positive results after transcatheter arteriography were as high as 69% when performed outside of normal working hours compared with only 22% when performed within normal working hours. The hemoglobin, blood pressure, and heart rate of each patient should be controlled, and the patients should be monitored at frequent intervals in the clinical wards. Sudden changes in these parameters can indicate the possibility of new bleeding or an increase in the severity of bleeding. In our hospital, hemoglobin levels are routinely checked every 2–4 hours (before and after the procedure) depending on the rate of bleeding and the vital signs of the patient. A sudden decrease in hemoglobin, hypotension, or tachycardia is a significant indicator of excessive bleeding, and nasogastric tube drainage, monitoring, and melena-hematochezia follow-up are extremely important. Good cooperation with clinical physicians and direct dialogue contributes to the success of catheter angiography.

Embolization materials with different properties are used for endovascular treatment. Although PVA particles can be safely used in various arterial regions, they are not recommended as the primary method (especially in the mesenteric system) because the small PVAs (<100 μm) can obliterate the submucosal plexus and cause bowel ischemia by entering the intramural

circulation. Coils provide a safe embolization and are the preferred agents for the mesenteric arterial system because of their ability to be seen in fluoroscopy and the low risk of unwanted non-target embolization. However, microcoil embolization should be performed as close to the bleeding site as possible to prevent bowel ischemia and infarction.

In the present study, coils or microcoils were used in 17 patients, PVA was used in six patients, and nBCA was used in one patient. Although, nBCA, which is a tissue adhesive, is commonly used for various endovascular therapeutic procedures, it is not preferred in the mesenteric arterial system because of the high rate of non-target embolization and the need to replace the catheter/microcatheter used for glue injection, which results in a loss of catheter access to the bleeding site and causes problems in cases of inadequate embolization. In one of our patients, we preferred nBCA for the treatment of a pseudoaneurysm in a growing mass that was fed by the internal iliac artery. Despite the relatively low number of patients in the present study, we believe that scintigraphy, which is a more sensitive tool for the detection of lower GI bleeding, seemed to be a good prognostic factor for negative scans, even in cases of massive, intermittent bleeding. A total of eight patients with massive lower GI bleeding had negative scintigraphy scans with subsequent negative transcatheter mesenteric arteriographies. All eight cases recovered without requiring any intervention. However, it is important to emphasize that it was critical that the patients were scanned at the time of massive bleeding.

In conclusion, GI bleeding is a catastrophic complication for both patients and physicians. Angiographic approaches are minimally invasive and can be very successful in experienced hands and centers. However, correct timing is the key to achieving clinical success in patients with GI bleeding, which requires close contact between interventionalists and primary care physicians and an appropriate work-up for catheter angiography. Prior to arteriography, scintigraphy is generally used to detect lower GI bleeding, and endoscopy is commonly used to detect upper GI bleeding. Because a CT scan may provide additional insight in to the underlying cause, such as extra-luminal pathologies, CTA should considered an alternative method for patients with GI bleeding in emergency settings. CTA can also detect pseudoaneurysms when there is not any bleeding at the time of evaluation, which cannot be observed with a scintigraphic scan. In the treatment of GI bleeding, selective embolization is a safe and effective method of treatment with a high clinical and technical success rate.

Conflict of interest disclosure

The authors declared no conflicts of interest.

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