

Application of Transcatheter Arterial Embolization in the Diagnosis and Treatment of Acute Small Bowel Bleeding

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Gastrointestinal bleeding; Small bowel bleeding; Colonic bleeding; Transcatheter arterial embolization

1. Abstract

1.1. Aim: Acute small bowel bleeding is a life-threatening condition that can result in death. Embolization is considered to be the first line for treating lower gastrointestinal (GI) bleeding when surgery cannot be carried out. This study aims to evaluate the effectiveness and safety of this technique retrospectively in a group of patients who underwent embolization for acute lower GI bleeding. In addition, a new method for identification of the bleeding site was discovered when extravasation of contrast media is not apparent.

1.2. Methods: Twenty patients diagnosed with small intestinal or colonic bleeding by angiography were retrospectively reviewed. The diagnostic methods, success rates, and complication rates of super-selective embolization were recorded.

1.3. Results: Sufficiently selective catheterization embolization failed in two out of the 20 patients (10.0%). Initial control of bleeding was achieved in 18 patients (100%), and only one of these patients developed a rebleeding within seven days of the operation. Eight patients were diagnosed by the presence of contrast spotting within the intestinal tube, and the remaining ten were diagnosed by observation of contrast agent extravasation. Three patients had an apparent bowel infarction after undergoing embolization. One patient with stage 5 chronic kidney disease passed away seven days after the embolization was conducted.

1.4. Conclusion: Super-selective embolization for acute lower GI bleeding is safe and effective. Importantly, the diagnostic value of the new method of contrast spotting within the intestinal tube was equal to the gold standard of extravasation of contrast medium in the diagnosis of small bowel bleeding by angiography.

2. Introduction

Small bowel bleeding accounts for approximately 5–10% of all patients presenting with gastrointestinal (GI) bleeding [12]. Acute small intestinal bleeding can be life-threatening due to its nonspecific clinical symptoms and signs in the early stage. The etiology of small bowel bleeding may vary according to age. For instance, while small bowel bleeding may be a result of Dieulafoy's lesions and Neoplasia in patients of all ages, it can also be caused by inflammatory bowel disease, Meckel's diverticulum, and Polyposis syndromes in those under age 40. In contrast, for patients over age 40, small bowel bleeding can also be caused by angioectasia and NSAID ulcers [15]. Furthermore, small bowel varices and/or portal hypertensive enteropathy can also result in small bowel bleeding, although only in rare cases [2]. Due to advances in small bowel imaging with video capsule endoscopy (VCE), double-balloon enteroscopy and radiographic imaging, the diagnosis, cause, and location of small bowel bleeding can be identified accurately in most patients [4]. Capsule endoscopy and magnetically controlled capsule endoscopy

are the most commonly used medical procedures for identifying suspected small bowel bleeding as they are noninvasive and have a high completion rate [13,18]. However, due to their noninvasive characteristics, these two techniques are used only for identification rather than treatment of the small bowel lesion. In addition, in an emergency where the patient's life signs are not stable, capsule endoscopy cannot be used.

In such emergency cases where interventions need to occur immediately, conventional angiography is the best choice due to its ability to both detect the location of the bleeding site and perform transarterial embolization. Throughout the years, the success rate of angiography has improved through the use of super-selective transarterial embolization, which reduced related complications. However, for the majority of such cases where angiography was used, bleeding occurred outside of the small bowel. Thus, we aimed to evaluate angiography treatment for cases of bleeding within the small bowel itself.

3. Materials & Methods

3.1. Patient Characteristics

From January 2018 to December 2020, 20 patients with acute or subacute small bowel bleeding as their main clinical manifestation were admitted to Department of Interventional Diagnosis and Treatment for an emergency angiography examination to determine whether signs of active bleeding requiring further treatment were present. These 20 patients consisted of 17 men and three women, with ages ranging from 22 to 91 years, the average age is 55 years. All patients suffered from life-threatening acute GI bleeding. There were a further three patients who suffered from frank cardiogenic shock, with systolic blood pressure levels below 80 mmHg. For those patients, transfusions of 2-4 units of packed red blood cell were conducted to compensate for the massive blood loss. This medical record review was carried out with approval from the ethics committee of our hospital.

3.2. Interventional Dsa Examination and Bleeding Management

Embolization therapy was performed on all patients in a specialized angiographic suite with advanced diagnostic and interventional therapeutic capabilities. Standard 5 Fr catheters were inserted into the right femoral artery for selective diagnostic arteriography purposes. The presence of extravasation of contrast medium or contrast spotting within the intestinal tube indicative of an active hemorrhage was detected in 18 patients and the conduction of angiograph were failed in 2 patients. Specifically, the angiography showed extravasation of contrast medium and contrast spotting within the intestinal tube were seen in ten and eight patients, respectively. When the active hemorrhage site was detected, the latest generation of co-axial catheters was used to perform super-selective catheterization. Embolization was performed on 18 patients, but a lack of sufficient space for safe embolization meant that it was not performed for the remaining two patients. Out of these 18 patients, 15 underwent superior mesenteric artery branch embolization, and

three patients underwent inferior mesenteric artery embolization. In these embolization procedures, the tip of the catheter should be located as near to the site of active bleeding as possible. Ten patients were treated with 560-710 μm gelfoam (Alicon, China) fragments as the embolic agent. A mixture of biogum and lipiodol with diameters ranging from 40 μm to 60 μm was used in six patients, and a few embolization microcoils (MWCE-18S-4, USA) were administered to the remaining two patients to achieve complete hemostasis. Repeated angiography showed that the extravasation and occlusion in the pseudoaneurysm was treated, indicating that bleeding was stopped.

4. Results

A total of 20 patients with acute lower GI bleeding participated in this experiment (17 males and 3 females), and the average age was 55 (age range: 22 to 91 years). Transcatheter embolization was performed in 18 of the patients. Diagnosis of small intestinal hemorrhages can be determined during angiography in two ways. The gold standard for determining a small intestinal hemorrhage during angiography is the extravasation of the contrast medium (Figure 1a), and ten patients were diagnosed via this method. Alternatively, the presence of contrast spotting within the intestinal tube is another diagnostic standard for determining small bowel bleeding when patients have systolic blood pressure levels below 80 mmHg or suffer from a chronic small bowel bleeding (Figure 1b). This method confirmed a further eight cases of small bowel bleeding among the 20 patients (Table 1). Three types of embolization were applied to control the small bowel bleeding (Table 2). Eighteen (90.0%) patients who were willing to undergo embolization achieved initial technical success. Embolization could not be conducted on the remaining two patients due to a lack of sufficiently selective catheterization. Most of the bleeding occurred in the proximal colon and the right colon (Table 3). All 18 patients who accepted embolization therapy achieved successful hemostasis. However, rebleeding occurred in one (5.55%) of the patients seven days after embolization. Three of the 18 patients also suffered mild abdominal pain during the embolization. Furthermore, one patient died during the embolization procedure due to advanced stage chronic kidney disease (stage 5). No ischemic complications occurred during the post-procedure period.

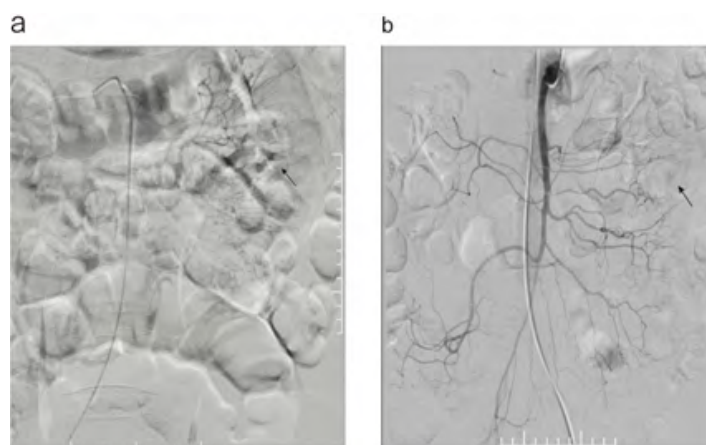


Figure 1: Different diagnostic methods. (a) Extravasation of the contrast medium. (b) Contrast spotting within the intestinal tube.

Table 1: Different diagnostic methods

Diagnostic Methods	No. of Patients, N = 20
Extravasation of the contrast medium	10
Contrast spotting within the intestinal tube	8
Failed to detect the bleeding site	2

Table 2: Embolization agents

Embolization Agents	No. of Patients, N = 18
Gelfoam	10
biogum and lipiodol	6
embolization microcoils	2

Table 3: Sites of embolization

Sties of Embolization	No. of Patients, N = 18
Right colon	8
Middle colon	4
Left colon	4
Others	2

5. Discussion

Super-selective arterial embolization is an effective method for the rapid and safe control of upper GI bleeding [6,11]. Unlike upper GI bleeding, the treatment of bleeding sites occurring below the ligament of Treitz have always been considered more conservative due to the bowels, especially the large bowels. As the collateral blood supply is relatively deficient, bowel ischemia may occur during transcatheter embolization procedures [5,7]. The use of transcatheter arterial embolization for the lower GI bleeding was first reported in 1975 [10]. Consequently, a few cases documented excellent results of transcatheter arterial embolization for the treatment of lower GI bleeding. Furthermore, clinicians were already aware of the complications of a bowel infarction in the early 1980s. Beverage et al. reported on a 2-year-old boy who suffered a complicated Meckel diverticulum and received transcatheter embolization [1]. Kwak et al. reported that 17 of 36 patients who suffered from active lower GI bleeding in the small bowel were successfully treated with a transcatheter microcoil embolization, as shown by the results of an angiography [8]. Nykänen et al. suggested that transcatheter arterial embolization should be the first-line approach over surgery in patients with both profuse lower GI bleeding and hemodynamic instability, when a colonoscopy has failed or is unavailable, or when small intestinal bleeding is detected by computerized tomography angiography, and despite the occurrence of major post-embolization complications [16]. The latest guidelines by the American College of Gastroenterology strongly recommend angiography in unstable patients as the first-line procedure in those presenting with massive small bowel bleeding [4,19]. Furthermore, small bowel endoscopy cannot be performed on patients who have intestinal adhesions or those who have undergone prior surgeries [4].

In the present study, 20 patients with lower GI bleeding were treated

with embolization. Embolization was successfully performed in 18 patients, and hemostasis was achieved in all patients. Rebleeding occurred in one of these patients, who was consequently treated again with embolization. Embolization failed to be accomplished in the remaining two patients because the catheter tip could not be directed to the active bleeding site. One patient with stage 5 chronic kidney disease died during the embolization procedure. Safe and effective embolization is based on super-selective catheterization.

The main concern when performing transcatheter arterial embolization for small bowel bleeding is the potential occurrence of ischemic complications due to poor collateral circulation [3]. In the literature, the rate of bowel ischemia after embolization ranges from 0% to 22% [14]. In our study, three patients developed ischemic complications after transcatheter arterial embolization. Especially when a suitable catheter position cannot be achieved, a careful technique and preparation for turning down the embolization is required to avoid bowel ischemia after embolization is carried out [9].

Data from multiple studies showed that the rate of detection of bleeding within the GI tract through the use of angiography ranged between 20–77%, with a mean of approximately 50% [4,17]. The diagnosis of small bowel bleeding requires higher rates of bleeding (0.5–1.0 ml/min) to be detected in conventional angiography. However, we found that higher rates of bleeding were not necessary for the diagnosis of small bowel bleeding. Instead, the presence of contrast spotting within the intestinal tube can also be used for the diagnosis of small bowel bleeding, apart from the current gold standard, which is the observation of contrast medium extravasation during an angiography. Once the bleeding rate slows down, contrast agent extravasation is less apparent, and the presence of contrast spotting in the intestinal tube assists in pinpointing the bleeding site. Furthermore, when intestinal inflammation occurs, the presence of contrast spotting within the intestinal tube is seen during angiography, instead of contrast agent extravasation.

In summary, our results suggest that small bowel bleeding can be diagnosed in two ways. The first method is the gold standard for detecting small bowel bleeding, which is observation of contrast medium extravasation, while the presence of contrast spotting within the intestinal tube can also be used to indicate small bowel bleeding. Our study also demonstrated that the use of super-selective arterial embolization for treatment of acute lower GI hemorrhage is effective and safe. Transcatheter arterial embolization should be the first line of treatment in patients suffering from severe bleeding that requires an angiography. With the use of super-selective embolization, the risk of symptomatic bowel ischemia can be minimized.

6. Acknowledgements

All authors have approved the manuscript.

7. Contributions

Study design and the surgery conduction: Suiliang Zhang; data collection and follow up: Yanli Zhang; figure preparation: Hui Liu;

writing and correcting the manuscript: Yanli Zhang and Hui Liu.

8. Ethics Declarations

The study was approved by the ethics committee.

9. Conflict of Interest

The authors declare no competing interests.

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