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Editorial board member of *World Journal of Gastroenterology*, Yong-Song Guan, MD, PhD, Professor, Department of Oncology, West China Hospital of Sichuan University, Chengdu 610041, Sichuan Province, China

AIMS AND SCOPE

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Retrospective Study

Aspiration therapy for acute embolic occlusion of the superior mesenteric artery

Yi-Ren Liu, Zhu Tong, Cheng-Bei Hou, Shi-Jun Cui, Lian-Rui Guo, Yi-Xia Qi, Li-Xing Qi, Jian-Ming Guo, Yong-Quan Gu

ORCID number: Yi-Ren Liu (0000-0002-5004-1690); Zhu Tong (0000-0001-5266-8721); Cheng-Bei Hou (0000-0002-2146-1899); Shi-Jun Cui (0000-0003-3696-5931); Lian-Rui Guo (0000-0001-8437-2845); Yi-Xia Qi (0000-0002-5761-309X); Li-Xing Qi (0000-0002-0039-579X); Jian-Ming Guo (0000-0001-9390-660X); Yong-Quan Gu (0000-0002-6177-5198).

Author contributions: Gu YQ designed the research and wrote the paper; Liu YR performed the research and wrote the paper; Hou CB contributed to analytic tools and analyzed the data; Tong Z and Cui SJ edited the manuscript; Guo LR, Qi LX, Qi YX, and Guo JM collected the human samples.

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Patients were not required to give informed consent to the study because the analysis used anonymous clinical data that were

Yi-Ren Liu, Zhu Tong, Shi-Jun Cui, Lian-Rui Guo, Yi-Xia Qi, Li-Xing Qi, Jian-Ming Guo, Yong-Quan Gu, Department of Vascular Surgery, Xuanwu Hospital, Capital Medical University, Beijing 100053, China

Cheng-Bei Hou, Center of Evidence-Based Medicine, Xuanwu Hospital, Capital Medical University, Beijing 100053, China

Corresponding author: Yong-Quan Gu, MD, Chief Doctor, Professor, Department of Vascular Surgery, Xuanwu Hospital, Capital Medical University, No. 45, Changchun Street, Beijing 100053, China. 15901598209@163.com

Telephone: +86-15901598209

Fax: +86-10-83125113

Abstract

BACKGROUND

Embolic superior mesenteric artery (SMA) occlusion is associated with high mortality rates. Delayed treatment often leads to serious consequences, including intestinal necrosis, resection, and even patient death. Endovascular repair is being introduced, which can improve clinical symptoms and prognosis and decrease the incidence of exploratory laparotomy. Many reports have described successful endovascular revascularization of embolic SMA occlusion. However, most of those reports are case reports, and there are few reports on Chinese patients. In this paper, we describe the technical and clinical outcomes of aspiration therapy using a guiding catheter and long sheath technique which facilitates the endovascular repair procedure.

AIM

To evaluate the complications, feasibility, effectiveness, and safety of endovascular treatment for the acute embolic occlusion of the SMA.

METHODS

This retrospective study reviewed eight patients (six males and two females) from August 2013 to October 2018 at Xuanwu Hospital, Capital Medical University. The patients presented with acute embolic occlusion of the SMA on admission and were initially diagnosed by computed tomography angiography (CTA). The patients who underwent endovascular treatment with a guiding catheter had no obvious evidence of bowel infarct. No intestinal necrosis was identified by gastrointestinal surgeons through peritoneal puncture or CTA. The complications, feasibility, effectiveness, safety, and mortality were assessed.

obtained after each patient agreed to treatment by written consent.

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RESULTS

Six (75%) patients were male, and the mean patient age was 70.00 ± 8.43 years (range, 60-84 years). The acute embolic occlusion of the SMA was initially diagnosed by CTA. All patients had undertaken anticoagulation primarily, and percutaneous aspiration using a guiding catheter was then undertaken because the emboli had large amounts of thrombus residue. No death occurred among the patients. Complete patency of the suffering artery trunk was achieved in six patients, and defect filling was accomplished in two patients. The in-hospital mortality was 0%. The overall 12-mo survival rate was 100%. All patients survived, and two of the eight patients had complications (the clot broke off during aspiration).

CONCLUSION

Aspiration therapy is feasible, safe, and beneficial for acute embolic SMA occlusion. Aspiration therapy has many benefits for reducing patients' death, resolving thrombi, and improving symptoms.

Key words: Superior mesenteric artery; Acute embolic occlusion; Aspiration embolectomy; Transcatheter thrombolysis; Endovascular repair

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Core tip: Percutaneous aspiration embolectomy was recently used to treat embolic superior mesenteric artery (SMA) occlusion. The aim of this study was to assess the utility of endovascular revascularization. Eight patients with acute embolic SMA occlusion underwent aspiration therapy using a guiding catheter. The rate of technical success, clinical success, and adverse events was 100%, 100%, and 25%, respectively. Recurrence was not observed. The median follow-up period after aspiration was 328 d. Aspiration using a guiding catheter achieved immediate revascularization of emboli of the SMA trunk and is a useful tool in the recanalization of embolic occlusion of the SMA in select patients.

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INTRODUCTION

Acute abdominal emergencies are critical, and the pathogenesis is complicated, partly due to acute mesenteric ischaemia (AMI), which comprises 1%-2% of acute abdominal emergencies^[1-3]. Embolic superior mesenteric artery (SMA) occlusion is the most common cause of AMI and is associated with high mortality rates^[4]. Delayed treatment of SMA occlusion often leads to serious consequences, including intestinal necrosis, resection, and even patient death. Exploratory laparotomy and surgical removal of the thrombus has been the major surgical technique in the past; however, endovascular repair is being introduced, as its efficacy has been proven in clinical trials^[5-10]. Intervention improves clinical symptoms and prognosis and decreases the incidence of exploratory laparotomy.

Many reports have described successful endovascular revascularization of embolic SMA occlusion by several endovascular techniques, such as catheter thrombolysis and percutaneous aspiration embolectomy^[1,11-17]. However, most of those reports are case reports, and there are few reports on Chinese patients. In this paper, we describe the technical and clinical outcomes of endovascular repair, namely, aspiration therapy using a guiding catheter, in eight Chinese patients with embolic SMA occlusion.

MATERIALS AND METHODS

Patients

This study was a retrospective analysis in our institution. From August 2013 to October 2018, eight patients with SMA embolism, including six males and two females and ranging in age from 60 to 84 years (mean age, 70.00 ± 8.43 years), were treated by transcatheter aspiration therapy at Xuanwu Hospital. All patients were initially diagnosed by computed tomography angiography (CTA, [Figure 1](#)). The patients who underwent endovascular treatment had no obvious evidence of bowel infarct ([Figure 2](#)). No intestinal necrosis was identified by gastrointestinal surgeons through peritoneal puncture or CTA.

Aspiration technique

All operations were performed by an experienced vascular surgeon. Under local anaesthesia, the right common femoral artery was punctured according to the Seldinger technique and an 8-Fr short sheath (Introducer II; Terumo) was implanted. Then, heparin was administered (50 IU/kg, North China Pharmaceutical Company Ltd, China) *via* a short sheath. An additional 1000 IU was administered every hour. Selective catheterization of the SMA with the 5-Fr Cobra catheter (C1, Cook, Bloomington, IN, United States) or the SIMON 5-Fr catheter (SIM1, Selecon; Terumo, Tokyo, Japan) was performed. Through the catheter, angiography was performed to confirm the SMA embolism ([Figure 3](#)). A hydrophilic guidewire (Radifocus, Terumo, Tokyo, Japan) was navigated into the distal segment of the SMA. The short sheath replaced the 8-Fr long sheath of 65 cm (Super Arrow Flex PSI set, Arrow International, Reading, PA, United States), and the long sheath was inserted into the orifice of the SMA. The 8-Fr long sheath was left in the proximal section of the SMA. The 5-Fr catheter of 110 cm in length (DAV, Cook) was inserted into the 6F guiding sheath of 90 cm in length (BRITE TIP; Cordis, Miami Lakes, Florida), and the 6-Fr guiding catheter and the 5F catheter were advanced coaxially to the SMA over the guidewire. The 5-Fr catheter was removed and the 6-Fr guiding catheter reserved for aspiration of the emboli. A 50-mL syringe was connected to the 6-Fr guiding catheter. When the guiding catheter became occluded with the emboli, it was withdrawn slightly with pumping until blood was aspirated. The 6F guiding sheath was flushed thoroughly with saline solution into gauze so that the thrombus could be found ([Figure 4](#)). The guiding catheter was reinserted and the procedure repeated. The emboli of the branches were treated using a 5-F catheter. Urokinase (250000 IU, Tianjin Biochemical Pharmaceutical Co., Ltd.) was infused into the SMA through the catheter to resolve residual emboli. Papaverine (30 mg, North China Pharmaceutical Company, Ltd, China) was infused into the SMA through the catheter to resolve vasospasm.

One patient underwent catheter-directed thrombolysis (CDT). Thrombolysis was performed using a multiple-sidehole infusion catheter (Multi-Sideport, Cook) *via* the SMA with urokinase at a rate of 50000 IU/h to downsize the emboli. Thrombolysis was monitored by fibrinogen (fibrinogen value was larger than 1 g/L). Catheter-directed local anticoagulation with heparin sodium was continuously administered into the SMA as well. Dosage should be adapted to patients individually on the basis of tests of activated partial thromboplastin time (APTT 1.5-2.0 times normal value). An angiograph of thrombolysis efficiency was performed 48 h after the intervention.

Follow-up after aspiration

All patients had clinical and imaging follow-up, which was performed every 3 mo one year after operation and then every 6 mo until death or October 31, 2018. During the follow-up, all patients were evaluated by clinical symptoms and signs, laboratory tests of blood routine examination, and CTA or ultrasonography of the SMA.

Assessment of outcomes

We reviewed the case file records. The clinical outcomes included feasibility, effectiveness, complications, clinical symptoms and signs, laparotomy, bowel resection, hospital stay, mortality and recurrence, SMA perfusion observed by CTA, and digital subtraction angiography (DSA).

Definitions

Absence or presence of peritonitis was determined by clinical abdominal examination. Embolism was considered according to atrial fibrillation and a history of embolism. Degree of thrombus removal was divided into complete and partial. Complete thrombus removal referred to complete patency of the SMA and sufficient perfusion of the entire bowel, and partial thrombus removal referred to residual emboli or sluggish flow of the SMA.

Statistical analysis

The statistical methods of this study were reviewed by Cheng-Bei Hou from Center of

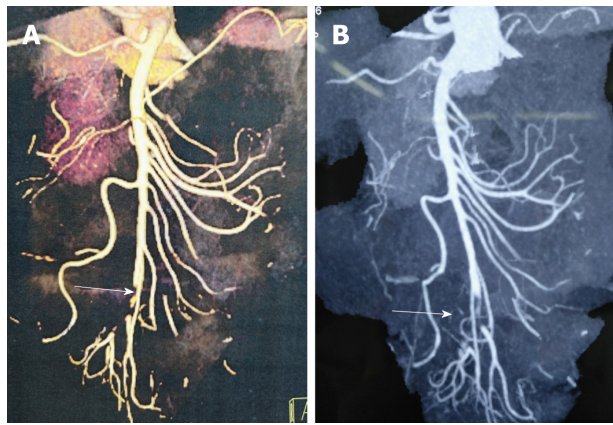


Figure 1 Computed tomography angiography images. A and B: Acute embolic occlusion of the superior mesenteric artery indicated by the white arrows.

Evidence-Based Medicine, Xuanwu Hospital, Capital Medical University. Data management and statistical analyses were performed using SPSS 19.0 software (SPSS Inc, Chicago, IL, United States). Continuous variables were tested for normal distribution. Normally distributed variables are expressed as the mean \pm standard deviation (SD), whereas non-normally distributed variables are reported as median. Categorical variables are reported as counts with proportions.

RESULTS

The patients included six men and two women, with an age range from 60 to 84 years (mean age, 70.00 ± 8.43 years). SMA embolism was initially diagnosed by a vascular surgeon considering clinical manifestation and CTA findings. All patients were seen in consultation with a gastrointestinal surgeon and vascular surgeon. No intestinal necrosis was identified by doctors considering clinical symptoms, signs, peritoneal puncture, and CTA findings. After admission, all patients received low molecular weight heparin (LMWH) (100 IU/kg Sanofi Winthrop Industrie, France) anticoagulant therapy. Routine blood examination was performed, including white blood cell (WBC), neutrophilic granulocyte, red blood cell (RBC), and platelet (PLT) counts and hepatic and renal function analyses. The clinical characteristics of patients are shown in Table 1.

The median white cell blood count was $17.25 \times 10^9/L$ (range from 15.3 to $24.0 \times 10^9/L$), C-reactive protein (CRP) was 27.60 mg/L (range from 5 to 52 mg/L), platelet concentration was $264.35 \times 10^9/L$ (range from 128 to $385 \times 10^9/L$), and the glomerular filtration rate (GFR) was 81.24 mL/min (range from 75 to 96 mL/min). No renal insufficiency was observed.

The interval between the onset of symptoms and the acquisition of angiography ranged from 9 to 30 h (median time, 9.50). Eight complete SMA trunk occlusions were detected by angiography *via* the catheter. In one patient (No. 2), emboli were noted in the jejunal artery branches. Six patients (Nos. 1 and 4-8) had good collateral flow. One patient (No. 2) had slow collateral flow, and one patient (No. 3) had no collateral flow (Table 2).

Percutaneous aspiration embolectomy using a guiding catheter was performed in all eight patients. The total procedure time from the initial diagnostic angiography to the final angiography was 53-85 min (mean time, 72.00 ± 13.70). Seven (Nos. 1, 2, 4, 5, and 6-8) patients initially underwent aspiration embolectomy, and thrombolysis was initially performed in one patient (No. 3). Thrombolysis was initially performed in the early study period because of the patient had heart failure, and primary aspiration embolectomy using a guiding catheter was performed in the late period as some thrombolysis was found 3 d after urokinase injection. In one patient (No. 2), primary percutaneous aspiration embolectomy was attempted, but residual emboli were noted in the jejunal artery branches. Intra-artery transcatheter thrombolytic therapy with urokinase was performed for the treatment of residual emboli. Thrombolysis was conducted for 3 d, resulting in complete resolution of the emboli. Follow-up angiography showed reestablishment of arterial flow. In two patients (Nos. 1 and 4), primary percutaneous aspiration embolectomy was applied, and the two patients received primary thrombolysis with urokinase (250000) during the operation because

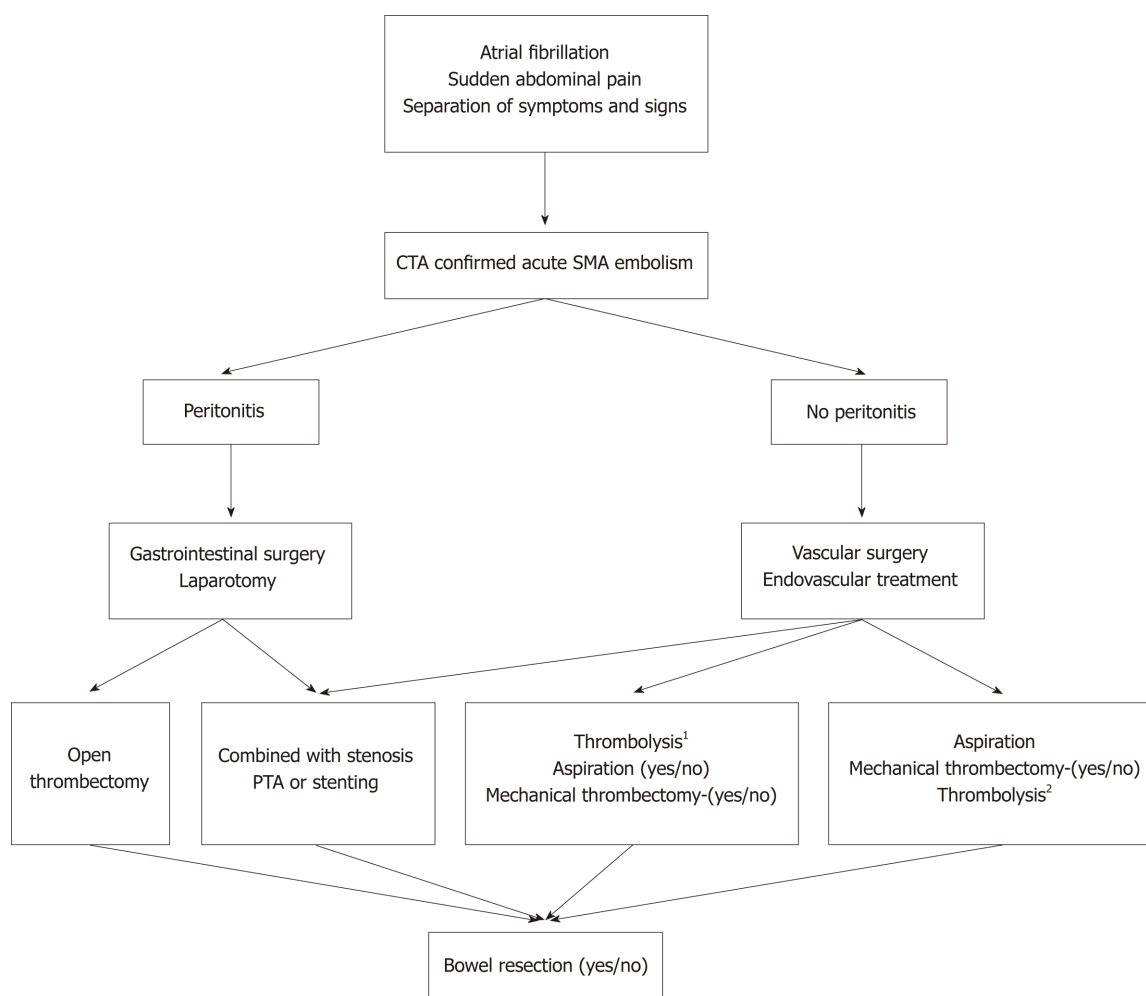


Figure 2 The processing flow of acute embolic occlusion of the superior mesenteric artery.¹Patients with poor general condition first underwent thrombolysis; ²Residual thrombus was treated by thrombolysis during the operation or catheter-directed thrombolysis after aspiration. PTA: Percutaneous transluminal angioplasty; CTA: Computed tomography angiography; SMA: Superior mesenteric artery.

of the clot breaking off. PTA was performed in one patient (No. 4) because of SMA stenosis. Aspirated emboli consisted of white and red clots. At completion of the SMA aspiration, significantly improved filling of the SMA was seen in all eight patients. Aspiration thrombectomy of the SMA resulted in complete (Nos. 1, 2, and 4-7) or partial (Nos. 3 and 8) restoration of blood flow in the main SMA, which was documented on immediate direct SMA angiography. Primary percutaneous aspiration embolectomy was applied for two patients (Nos. 1 and 4), and the two patients received primary thrombolysis with urokinase (250000) during the operation because of the clot breaking off. The detached clots did not result in intestinal ischaemia, as collateral flow to the jejunal/ileal branches was good (Table 3).

Substantial improvement in abdominal pain was observed within 1-2 d after the operation in all patients. Sufficient clinical improvement, characterized by a progressive decrease in abdominal pain and distention, was observed in all patients. Oral nutrition intake was started at 2-17 (7.75 ± 5.65) d. The eight patients were discharged 9-17 (12.25 ± 3.11) d after admission. The in-hospital mortality was 0%. Abdominal pain, nausea, distention, haematochezia, and diarrhoea were completely resolved when the patients were discharged. CTA images obtained before discharge demonstrated nearly complete recanalization of SMA thrombosis in all patients, with improvement in oedema of the intestine in all patients. Heart failure of one patient (No. 3) was improved. One patient (No. 4) suffered from left cerebral infarction because of an embolism aroused by atrial fibrillation, and symptoms improved after discharge (Table 4).

The median length of time of follow-up was 328 (range, 90-390) months. One patient (No. 4) developed mild abdominal pain 3 mo after surgery because of SMA stenosis, and other patients persisted asymptotically. Routine blood tests were normal. No patients required extensive bowel resection. No thrombus recurrence was found under regular anticoagulation. Warfarin or rivaroxaban was applied orally in

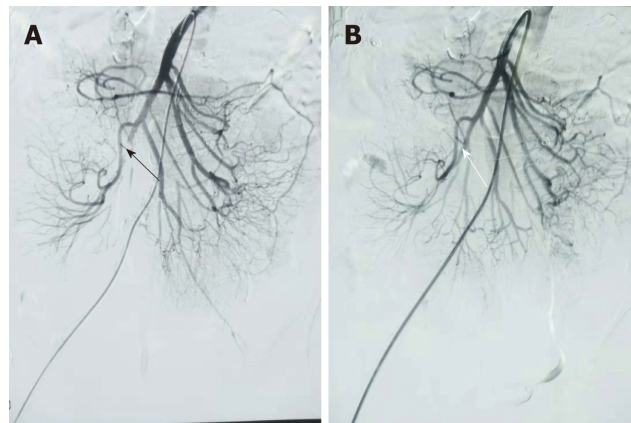


Figure 3 Digital subtraction angiography images. A: Filling defect of the superior mesenteric artery (SMA) indicated by the black arrow; B: Complete patency of the SMA indicated by the white arrow.

all patients at least 6 mo after discharge if there were no risk factors for recurrence. During the follow-up, ultrasonography confirmed the blood flow perfusion of the SMA.

DISCUSSION

Percutaneous aspiration using a guiding catheter for acute embolic occlusion of the SMA may lead to dissection of the SMA. The dissection restricting blood flow requires emergency treatment. Dissection of the SMA may be caused by the gap between the guidewire and the guiding catheter. The gap between the guidewire and the guiding catheter should be reduced. Since there were no dilators that fit the guiding catheter, a smaller catheter was used as a dilator. There is no gap between the 6-Fr guiding catheter and the 5-Fr catheter; thus, the 6-Fr guiding catheter was used to remove the SMA emboli, and the 5-Fr catheter was used to remove the emboli in the branches of the SMA. From two studies performed by Acosta *et al*^[11] and Kawasaki *et al*^[14], we conclude that larger catheters lead to increased intima dissection. SMA dissection was not found in any patients in our study. With a careful operation and coaxial advancing of the guiding catheter and a seamless dilator, the incidence of SMA dissection can be reduced. It is crucial to select the appropriate guiding catheter according to the SMA diameter. As for difficult transcatheter cases, it is a good choice using a hybrid approach. SMA puncture was practiced under genuine direct vision can avoid dissection of the SMA. Furthermore, the intestine can be detected through laparotomy.

All four patients successfully underwent aspiration. Raupach *et al*^[18] analysed 37 patients with acute mesenteric embolism who underwent primary endovascular therapy, and achieved complete recanalization of the SMA trunk in 91.9% of cases. Our technique used a long sheath compared with other reports on the treatment of trunk lesions. The long sheath was inserted into the orifice of the SMA, and the long sheath was left in the proximal section of the SMA. The guiding catheter was inserted into the SMA repeatedly and immediately through the long sheath. Using a long sheath both saves time and avoids SMA dissection.

A distal embolism may develop during advancement of the catheter. As for the SMA trunk, the therapeutic effects of thrombolysis are uncertain. Björnsson *et al*^[9] reported a feature that successful thrombolysis was achieved in 30 patients; 13 explorative laparotomies, 10 repeat laparotomies, and 8 bowel resections were performed; and the in-hospital mortality rate was 26%. Boo-Gyoung *et al*^[19] initially tried endovascular thrombolytic therapy, but it did not achieve complete revascularization. Therefore, they performed a percutaneous aspiration thrombectomy, which led to complete revascularization without any additional procedures. However, for branch arteries, the thrombolysis was useful^[20].

Heiss *et al*^[13] reported that SMA aspiration showed a 30-d mortality rate of 33%. In another paper, 1 patient died at 12 h, and another patient died of short bowel syndrome at 8 mo^[11]. Kawasaki *et al*^[14] reported a 30-d mortality rate of 14% (1 of 7 patients). The patients in our study recovered quickly. No patients needed bowel resection. We think that the low morbidity of our study might be explained by the following: (1) patients were diagnosed early by CT; and (2) patients had relatively

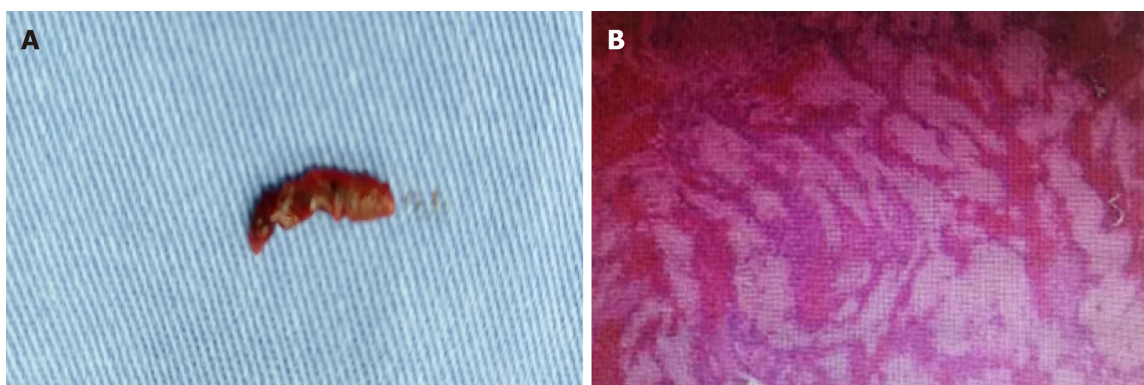


Figure 4 Embolus images. A: Aspirated embolus; B: Pathology consisting of white and red clots.

mild symptoms and signs, because severe patients were admitted to undergo gastrointestinal surgery. The initial treatment modality should be decided by consensus between gastrointestinal and vascular surgeons considering the patient's symptoms and signs, CT findings, laboratory results, and clinical experiences^[21]. We first tried endovascular treatment if the CT scan had no obvious evidence of bowel infarct^[22]. Rebound tenderness may suggest bowel necrosis and may lead to exploratory laparotomy. However, endovascular treatment may make surgical laparotomy unnecessary or may reduce surgical procedure and time. Thus, we adopted endovascular treatment first in seven patients (7/8). Choi *et al*^[23] reported that nine patients with embolic occlusion of the SMA were treated by percutaneous aspiration embolectomy, and no patients had obvious evidence of bowel infarction on CT scans. One patient died of whole bowel necrosis and sepsis, and eight patients survived without complications.

The aspiration method that uses the long sheath technique might therefore be more feasible than thrombolysis^[1]; it may also be more feasible than surgical embolectomy^[10]. Several other devices can be used to remove blood clots in the SMA, for example, a Rotarex systema mechanical rotational thrombectomy device^[24]. These devices are also effective in the removal of blood clots, but they may lead to complications and increase medical costs. Bruno Freitas *et al* reported complications represented by self-limited small perforations with a 6F Rotarex Debulking Device (Straub Medical, Wangs, Switzerland)^[25]. Percutaneous mechanical thrombectomy seems to be a rapid and effective treatment for acute SMA embolism in the median portion of its trunk^[26]. Aspiration using a guiding catheter is inexpensive and effective according to several studies, including the current study^[11,27].

Follow-up of patients for 1 year detected no cases of recurrence. One patient (No. 4) developed mild abdominal pain 3 mo after surgery because of SMA stenosis. The long-term consequences were good because of early revascularization. Echocardiography was performed in all patients, but thrombus was not detected in the left atrium. Anticoagulation drugs were prescribed to all patients to prevent re-embolism regardless of the echocardiography findings.

The main limitation of our study is the analysis of a small number of enrolled patients. Moreover, the peritonitis patients were admitted for gastrointestinal surgery; thus, a comparative study between open surgery treatment and endovascular treatment was not conducted. Third, thrombolysis and aspiration require further study.

Emboli resulting in embolic occlusion of the SMA often come from the atrium. Aspiration using a guiding catheter can remove most of the clots, and aspiration can achieve immediate revascularization of emboli of the SMA trunk. Thrombolysis can deal with residual fresh blood clots. However, with regard to old thrombi, which cannot be cleared by aspiration, further studies are needed.

Table 1 Characteristics of the patients

Patient No.	Sex	Age (yr)	Basal disease	Symptoms	Signs (tenderness)	Signs (re-bound tenderness)	WBC count ($\times 10^3/\mu\text{L}$)	Echocardiography (LA thrombus)
1	M	60	HBP	Abdominal pain, vomiting, dark stool	Present	Present	15.3	Absent
2	M	68	Af, DM	Abdominal pain, diarrhea	Present	Present	17.4	Absent
3	F	71	Af, CAD, HF	Abdominal pain, hematochezia	Present	Present	24.0	Absent
4	M	84	DM	Abdominal pain	Present	Absent	17.8	Absent
5	M	61	Af	Abdominal pain	Present	Absent	15.1	Absent
6	M	66	Af, DM	Abdominal pain, diarrhea	Present	Present	16.9	Absent
7	F	70	HBP	Abdominal pain, dark stool	Present	Present	23.5	Absent
8	M	80	HBP, DM	Abdominal pain, vomiting	Present	Absent	17.1	Absent

Normal range: WBC count = $4.0\text{--}10.0 (\times 10^9/\text{L})$. M: Male; F: Female; WBC: White blood cell; Af: Atrial fibrillation; CAD: Coronary artery disease; HF: Heart failure; HBP: High blood pressure; DM: Diabetes mellitus; LA: Left atrium.

Table 2 Digital subtraction angiography results

Patient No.	CTA	Time from onset to treatment (h)	Occlusion of main SMA trunk	Branch lesion location(s)	Collateral flow to jejunal/ileal branches
1	Filling defect, mild bowel oedema, mild ileus	9	Complete occlusion	None	Good
2	Filling defect, mild bowel oedema, mild ileus	10	Complete occlusion	Jejunal arteries	Slow
3	Filling defect, mild bowel oedema, scanty ascites, mild ileus	30	Complete occlusion	None	Absent
4	Filling defect, mild bowel oedema, mild ileus	7	Complete occlusion; SMA stenosis	None	Good
5	Filling defect, mild bowel oedema, mild ileus	8	Complete occlusion	None	Good
6	Filling defect, mild bowel oedema, mild ileus	11	Complete occlusion	None	Good
7	Filling defect, mild bowel oedema, mild ileus	6	Complete occlusion	None	Good
8	Filling defect, mild bowel oedema, mild ileus	28	Complete occlusion	None	Good

CTA: Computed tomography angiography; SMA: Superior mesenteric artery.

Table 3 Summary of interventions and clinical outcomes

Patient No.	Total procedure time (min)	Trunk lesion	Branch lesion location(s)	Additional treatment	Complications
1	85	Successful	The clot breaking off and ileal arterial embolism, good flow	Thrombolysis with urokinase during the operation	The clot breaking off
2	85	Successful	Multiple residual emboli in jejunal arteries, slow flow	Intra-artery transcatheter thrombolytic therapy with urokinase successful	-
3	50	Partial rec-analization	-	thrombolysis was initially performed before aspiration embolectomy	-
4	75	Successful (PTA)	The clot breaking off and ileocolic artery emboli.	primary thrombolysis with urokinase during the operation	The clot breaking off
5	79	Successful	-	-	-
6	80	Successful	-	-	-
7	53	Successful	-	-	-
8	69	Partial recanalization	-	-	-

PTA: Percutaneous transluminal angioplasty.

Table 4 Postoperative situations

Patient No.	The time of feed (d)	Hospital stay (d)	In-hospital mortality	Symptoms	Signs (tenderness)	Signs (rebound tenderness)
1	2	9	None	Abdominal symptom resolved in 1 d	Present	Present
2	6	12	None	Diarrhoea developed after aspiration but subsided spontaneously; Abdominal symptom resolved in 1 d	Present	Present
3	6	12	None	Haematochezia developed after aspiration but subsided spontaneously; Abdominal symptom resolved in 1 d	Present	Present
4	17	17	None	Abdominal symptom resolved in 1 d	Present	Absent
5	5	8	None	Abdominal symptom resolved in 1 d	Present	Absent
6	16	11	None	Diarrhoea lasted 2 d	Present	Present
7	7	13	None	Abdominal symptom resolved in 2 d; Dark stool lasted 3 d	Present	Present
8	3	16	None	Abdominal symptom resolved in 2 d	Present	Absent

ARTICLE HIGHLIGHTS

Research background

Embolic superior mesenteric artery (SMA) occlusion is associated with high mortality rates. Delayed treatment often leads to serious consequences, including intestinal necrosis, resection, and even patient death. Endovascular repair is being introduced, which can improve clinical symptoms and prognosis and decrease the incidence of exploratory laparotomy. Many reports have described successful endovascular revascularization of embolic SMA occlusion. However, most of those reports are case reports, and there are few reports on Chinese patients. In this paper, we describe the technical and clinical outcomes of aspiration therapy using a guiding catheter and long sheath technique which facilitates the endovascular repair procedure.

Research motivation

To evaluate the complications, feasibility, effectiveness, and safety of endovascular treatment using a guiding catheter for the acute embolic occlusion of the SMA.

Research objectives

Many reports have described successful endovascular revascularization of embolic SMA occlusion by several endovascular techniques. However, most of those reports are case reports. There are few reports on Chinese patients. In this paper, we describe the technical and clinical outcomes of aspiration therapy using a guiding catheter and long sheath technique which facilitates the endovascular repair procedure.

Research methods

This retrospective study reviewed patients with acute embolic occlusion of the SMA. All patients were treated by aspiration therapy with a guiding catheter. The complications, feasibility, effectiveness, safety, and mortality were assessed.

Research results

All patients had successfully undertaken percutaneous aspiration using a guiding catheter. No death occurred among the patients. Most of the clots were removed and patency of the suffering artery trunk was achieved. Although the complication of the clot breaking off was detected in partial patients, blood perfusion was not affected.

We need a large number of enrolled patients and conduct a comparative study between open surgery treatment and endovascular treatment. Furthermore, thrombolysis can deal with fresh blood clots. However, with regard to old thrombi, which cannot be cleared by aspiration, further studies are needed.

Research conclusions

Aspiration therapy is feasible, safe, and beneficial for acute embolic SMA occlusion. Aspiration therapy using a guiding catheter and long sheath technique facilitates the endovascular repair procedure. Aspiration therapy has many benefits for reducing patients' death, resolving thrombi, and improving symptoms.

Research perspectives

Aspiration therapy using a guiding catheter and long sheath technique is feasible, safe and beneficial for acute SMA embolic occlusion, which should be applied and popularized. Especially, auxiliary applications of a long sheath technique facilitate operation procedure. Tender operation is needed to avoid the clot breaking off. However, with regard to old thrombi, which cannot be cleared by aspiration, further studies are needed. A randomized controlled trial comparing open surgery treatment and endovascular treatment is needed to be conducted in the future.

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