Intra-arterial Fibrinolytic Therapy Using Modified Sullivan Technique in SMA Thromboembolism: a case report

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Our aim is to present the role of contrast-enhanced CT in the early diagnosis of superior mesenteric artery (SMA) thromboembolism and to report our experience in the fibrinolytic therapy of this disorder using modified Sullivan technique. Contrast-enhanced helical CT clearly demonstrated the various findings of SMA thromboembolism in all 3 cases. In the first 2 patients, the modified Sullivan method of transthrombus high dose bolus technique followed by pump infusion of recombinant tissue plasminogen activator (r-TPA) was used. In the third case, only pump infusion of r-TPA was done. Fibrinolytic therapy was successful in the first 2 patients but failed in the third. In our limited experience, contrast-enhanced CT was helpful in the early diagnosis of SMA thromboembolism and the intrathrombus high dose bolus technique using r-TPA appeared to accelerate clot lysis.

Key words: Fibrinolysis; Thromboembolism; Superior mesenteric artery

Acute mesenteric ischemia is considered a lethal disease with a reported mortality rate of 60-90% [1, 2, 3, 4, 5]. To improve survival in this catastrophic disease, an aggressive approach towards early diagnosis with extensive use of computed tomography (CT) and angiography is deemed necessary. Fibrinolytic therapy is considered a remedy when effectively administered before bowel infarction sets in. The successful use of fibrinolytic agents in the treatment of vascular occlusion may replace surgery as the treatment of choice for SMA thromboembolism. We report our own experience in 3 patients with the use of recombinant tissue plasminogen activator in treating superior mesenteric artery thromboembolism.

CASE REPORT

Case 1

A 77-year-old woman was awakened in her sleep by severe abdominal pain. Two hours later, she was sent to our hospital emergency room for persistent pain. Demerol 50 mg. IM was given, but it did not relieved the pain. The WBC was 12,500/ml and LDH was 516 IU/L. ECG demonstrated atrial fibrillation. Whole abdomen helical contrast-enhanced CT study showed a filling defect at the main trunk of superior mesenteric artery (Fig. 1 a). The initial impression of SMA thromboembolism was made. Three hours after the onset of abdominal pain, SMA angiography was done using conventional angiography with 4F cobra catheter (Terumo), which confirmed the initial impression of SMA thromboembolism (Fig. 1 b). Since there was absence of peritoneal sign, and no contraindication to fibrinolytic therapy, we opted to perform fibrinolytic therapy by first inserting an angled 0.035 inch Terumo guidewire into the clot, followed by a 4-F cobra catheter and intrathrombus bolus instillation of 25 mg r-TPA (Actilyse, Boeringer Engelheim, Germany) while slowly withdrawing the catheter. The catheter tip...
was then placed proximal to the clot and the remaining diluted 25 mg r-TPA given by pump infusion at the rate of 12 cc per hour (Life care pump, Abbott Laboratories, Chicago). Two hours after fibrinolytic therapy, patient’s abdominal pain was relieved. Repeat SMA angiography revealed recanalization of the SMA main trunk and complete contrast filling of distal branches (Fig. 2). Fibrinolytic therapy was discontinued and was replaced with systemic heparin at a dose of 500 units per hour for 48 hours. Patient had persistent equivocal peritoneal sign, and subsequent diagnostic laparoscopy was done. At laparoscopy, viable bowels were seen without evidence of bowel infarction. Patient was discharged on the 4th day of hospitalization with oral Warfarin.

Case 2

A 53-year-old man presented with intermittent bloody stool associated with abdominal pain and vomiting for 1 day. CT study revealed intimal flap at proximal SMA and distal filling defect associated with segmental edematous small bowel wall (Fig. 3 a,b). Digital subtraction angiography was immediately performed and demonstrated intimal tear of the proximal SMA with contrast filling of the middle colic artery and the first branch of jejunal artery. Collateral supply to the right, colic and ileocolic arteries from middle colic artery was also visualized (Fig. 4 a). In the absence of peritoneal sign and no contraindication to fibrinolysis, fibrinolytic therapy was done. Two hours after intrathrombus fibrinolysis, abdominal pain subsided, and repeat angiography revealed patent SMA main branch with serriform stenosis and minimal residual insignificant thrombus (fig. 4 b).

Since peritoneal sign was elicited after fibrinolysis, diagnostic laparoscopy was done to exclude bowel infarction. During laparoscopic examination, edematous viable small bowel wall were visualized. Patient refused further endotherapy for SMA stenosis. He was systemically anticoagulated using heparin followed by oral Warfarin 5mg daily. At one year follow-up, the patient remained well without recurrence of abdominal pain or bloody stool.
Case 3

A 36-year-old man presented with acute onset of left hemiparesis and aphasia. Patient had cardiomyopathy and his cardiac echo revealed thrombus formation in left ventricle. Six days after admission, patient developed severe abdominal pain, right flank pain and hematuria. Contrast-enhanced CT study demonstrated complete occlusion of the distal SMA main trunk and perfusion defects in multiple segmental parenchyma of right kidney indicating renal infarction (Fig. 5a). SMA angiography demonstrated complete occlusion of the distal main trunk of SMA with contrast filling in the proximal jejunal branches which were displaced to the right, suggestive of partial torsion (Fig. 5b). Right renal angiography revealed segmental arterial occlusion and renal parenchymal perfusion defects (Fig. 5c). The patient was diagnosed to have SMA, right renal thromboembolism and possible SMA torsion. Since no peritoneal sign was elicited, and there was no contraindication to fibrinolysis, an angled Terumo guidewire was maneuvered across the clot but failed. The tip of 4F cobra catheter (Terumo) was then placed proximal to the clot and bolus of 25 mg r-TPA was instilled followed by pump infusion of the remaining 25 mg r-TPA. Two hours after fibrinolysis, symptoms did not subside and peritoneal sign developed. Repeated angiography still showed occlusion of the SMA main trunk. Patient was then referred for imme-

**Figure 3.** a. Contrast-enhanced CT scan shows intimal flap in proximal trunk of SMA (arrow). b. CT scan in more caudal level shows a SMA branch with filling defect and adjacent focal edematous and thickened jejunal wall (arrows).

**Figure 4.** a. Selective digital SMA angiogram shows intimal flap in proximal SMA main trunk and complete occlusion of distal main trunk. Also visualized are patent first jejunal branch and middle colic artery with collateral supply to the right colic and ileocolic arteries. b. Repeated SMA angiogram 2 hours after fibrinolytic therapy shows patent SMA main trunk with serriform stenotic narrowing. Residual minimal thrombus in the proximal jejunal branch with good collateral perfusion of the distal ileocolic and jejunal branches are shown.
Diate surgery. During operation, Fogarty catheter embolectomy was done and a short segment of non-viable small bowel was resected. One day after operation, repeated angiography demonstrated patent SMA main trunk and branches without residual thrombus formation or stenosis (Fig. 6).

**DISCUSSION**

The occurrence of SMA thromboembolism is rare and the clinical symptomatology varied and non-specific [6]. Clinical diagnosis of acute SMA thromboembolism is difficult. High index of clinical suspicion and judicious use of CT scan in a patient who has prevailing heart disease experiencing sudden onset of severe abdominal pain should be done to avoid high percentage of delayed diagnosis leading to greater morbidity and mortality. The CT finding of filling defect in the SMA main trunk is specific for diagnosis of SMA thromboembolism. Previous authors reported low sensitivity for diagnosis of SMA occlusion by CT scan [7, 8, 9]. Those reports differ from our cases, which all patients reported had positive CT scan findings for SMA occlusion. This discrepancy may be partially explained by the use of 4th generation CT scanner and helical technique with bolus contrast injection. The CT findings of segmental small bowel wall and mesenteric edema together with SMA occlusion in our second case negate the previous findings of Taourel et al. [6], which they reported that only venous occlusion manifested with bowel wall edema.

The duration of abdominal pain is not a limiting factor to fibrinolytic therapy. There is no clear correlation between the duration of abdominal pain and severity of intestinal ischemia [1, 2]. These differences in the therapeutic window of mesenteric ischemia depend not only on the duration of occlusion but also on other factors such as location, presence of collateral circulation and splanchnic autoregulation [2, 4]. Our second case had a longer duration of abdominal pain compared with the other two cases. The indication for fibrinolytic therapy in our 3 patients depended on the clinical absence of peritoneal irritation which result from residual blood flow to the bowel walls, or absence of frank bowel infarction. As...
in any form of fibrinolytic therapy, all patients were screened for possible risk of cerebral or internal bleeding. Based on the reported experience of many authors with the used of r-TPA that produces rate of fibrinolysis more rapid than urokinase, we choose to use r-TPA in all our cases [10, 11, 12, 13].

From many methods of fibrinolysis we opted to modify the Sullivan technique of transthrombus with high dose bolus infusion to accelerate lysis rate in the first 2 cases but failed in the third case. Clinical and experimental evidence suggests that infiltration of clot with a fibrinolytic agent accelerates clot lysis [14, 15]. The higher the transthrombus dose produces a three-fold decrease in the time required to complete clot lysis, compared with a lower dose [14]. The positive lysis rate of intrathrombus bolus technique can be inferred from the increased surface area of contact between the clot and fibrinolytic agents and the rapid formation of intrathrombus plasmin.

Immediate clinical follow-up is important to confirm clinical improvement and absence of peritoneal sign of bowel infarction. Criteria for successful treatment of SMA thromboembolism were defined by Simo et al., as the following: 1) complete abatement of abdominal pain during fibrinolytic therapy. 2) absence of peritoneal signs of intestinal necrosis. 3) angiographically demonstrated resolution of the occlusion [2]. We observed the clinical improvement in our first 2 patients two hours after the start of fibrinolysis. This was later documented by angiographically patent SMA trunk and branches with insignificant residual thrombus. However, equivocal peritoneal sign can be observed in our patients that led us to use the diagnostic laparoscopy as the most appropriate conservative approach of determining the presence of intestinal infarction. This approach has not been reported in previous literature.

This limited experience demonstrated the important role of contrast enhanced CT in the early diagnosis and suggested accelerated clot lysis with intrathrombus high dose bolus technique using r-TPA in SMA thromboembolism. After successful SMA recanalization, we recommend diagnostic laparoscopy to exclude bowel infarction.

REFERENCES

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修改Sullivan方法之經動脈內上腸系膜動脈血栓溶栓術：病例報告

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本篇提出加顯影劑之腦部斷層影像對於早期診斷上腸系膜動脈血栓栓塞之角色以及報告施行動脈內血栓溶栓術之經驗。在所有三例個案中，加顯影劑之腦部斷層影像皆可清楚顯示血栓栓塞位於上腸系膜動脈主幹上。於前二例個案，施行栓塞內高劑量血栓溶栓劑（recombinant tissue plasminogen activator, r-TPA）直接注射，接著經順管注射血栓溶栓劑；而第三個案只施行經順管注射血栓溶栓劑。血栓溶栓治療於前二例個案結果完全成功，而第三個案治療失敗。因此在我們有限的經驗中，加顯影劑之腦部斷層影像能夠幫助早期診斷上腸系膜動脈血栓栓塞以及施行栓塞內高劑量血栓溶栓劑（r-TPA）直接注射能夠加速血栓之溶解。

關鍵詞：血栓溶栓術；血栓栓塞；上腸系膜動脈