Subacute Superior Mesenteric Artery Embolization with Bowel Infarction – A Rare Complication of Catheterized Angiography

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Cholesterol embolization syndrome (CES) is an atheroembolization caused by cholesterol crystals from aortic atheromatous plaques. The reported incidence of CES as a complication of catheterized angiography, which usually presents as acute renal failure and blue toe syndrome, is low in clinical studies. Only a small number of CES cases presenting as acute mesentery artery occlusion after invasive catheterization have been reported. We report a case of a 73-year-old man with CES-caused subacute mesenteric artery occlusion followed by life-threatening bowel infarction; 24 hours after catheterized carotid angiography, he was successfully treated by emergent operation.

Key Words: Catheterized angiography • Cholesterol embolization syndrome • Complication • Ischemic bowel disease

INTRODUCTION

The rates of life-threatening complications such as catheter-related cardiac arrhythmia and vessel perforation have been low in non-interventional angiography. Cholesterol embolization syndrome (CES) is an atheroembolization caused by cholesterol crystals from aortic atheromatous plaques. It was first reported in 1945 by Flory and may involve eyes, kidneys, and extremities.1, 2 Complications from angiography such as blue toe syndrome or acute renal failure have been reported.3-5 CES often occurs after a vascular procedure in patients with systemic inflammation. Even though it is not a rare occurrence, only a minority of patients can be clinically recognized; the clinical characteristics of CES and actual incidence of this syndrome remain uncertain. Estimates of the incidence of CES after vascular procedures have ranged from 0.15% in clinical studies4 to 25% to 30% in pathologic series.3 Only a few cases6, 7 presented with acute superior mesenteric artery embolization as a complication of invasive catheterizations; the incidence is unknown, and there is an extremely high mortality rate, which may be up to 93%.6 Here, we present a case of CES-caused subacute superior mesenteric artery occlusion followed by bowel infarction after a catheterized carotid angiography, which was quickly diagnosed and successfully treated with emergent operation.

CASE REPORT

A 73-year-old man presented with right leg claudication and dizziness for a period of 2 weeks. He had a long history of hypertension, type 2 diabetes mellitus and dementia for more than ten years with regular medical control. The initial heart rhythm in ECG showed...
normal sinus rhythm, and the coagulation profile was normal in prothrombin time, activated partial thromboplastin time, and platelet count. There was neither sign nor clinical history of hypercoagulation state. Therefore, we did not check fibrinogen and fibrin degradation products. On closer examination, the patient’s right femoral pulsation could not be detected, and Doppler exam revealed total occlusion of the left internal carotid artery. He was then admitted for diagnostic angiography.

Catheterized angiography was arranged via a left transfemoral approach. Total occlusion of the left internal carotid artery and diffuse atherosclerosis with 95% stenosis over the right external iliac artery were detected, which were compatible with both the carotid Doppler examination and clinical manifestations. An immediate percutaneous transluminal angioplasty (PTA) of the right iliac artery was indicated to prevent critical right leg ischemia. The right iliac artery lesion was crossed by a 0.035 cm \texttimes 150 cm guide-wire (Terumo), and then PTA was performed by deployment of a 10 \times 49-mm Wall-stent (Boston Scientific) followed by an 8 \times 40-mm Smash balloon (Boston Scientific) for secondary dilatation at maximal 8 atm. The final angiography revealed 5% residual stenosis with optimal distal blood flow. At the time we finished this procedure, the patient did not feel abdominal pain, and there were no significant complications.

However, about 18 hours after the procedure, the patient started to complain of abdominal distension and poor appetite. On physical examination, mild abdominal tenderness without muscle guarding or rebounding pain was detected. In the following 2 hours, tachycardia (heart rate: 120 beats per minute), shock (a gradual systolic blood pressure decrease from 160 to 120 mmHg) and fever (body temperature: 37.8 °C) were detected. The patient developed a disoriented consciousness, and livedo reticularis was found bilaterally over the lower extremities. A complete blood cell count revealed leukocytosis (white blood cell count: 10,640/mm³) with an extremely left-shifting and young cell presentation (segments: 36% and bands: 57%). Additionally, serology analysis showed a high C-reactive protein (CRP) concentration (17.7 mg/dl) and acute renal failure. Arterial blood gas revealed metabolic acidosis. Given the impression of septic shock, the patient was transferred to intensive care unit 20 hours after procedure.

We surveyed possible sources of infection and detected no significant evidence of pneumonia, pyuria, or subcutaneous wound infection. Gastric fluid drained from the nasogastric tube revealed positive for occult-blood. Abdominal distension was found, and abdominal sonography showed dilated bowel lumen without either ascites or intra-abdominal abscess formation. Emergent abdominal computed tomography (CT) scan for further infection surveillance showed multiple mixed non-calci- fied and calcified plaques along the wall of the abdominal aorta and loss of contrast enhancement in some of the superior mesenteric artery and vein branches. In addition, diffuse segmental and distended small bowel loops were also found (Figures 1A, B). The CT scan suggested the possibility of ischemic bowel disease. Approximately 24 hours after the procedure, operation was performed and a large part of the ischemic and congestive intestine (from the jejunum to the descending colon) was resected (Figure 2A). The pathology report of the resected small intestine and colon also revealed a diffuse ischemic infarct with focal hemorrhage, which confirmed the diagnosis (Figure 2B).

Both hemodynamic status and toxic signs improved significantly after the operation. The patient was observed as having returned to alert consciousness 8 hours after the operation, and he was successfully weaned from mechanical ventilation. He was transferred to general ward on the 4th post-operation day, and an oral diet was started on the 6th post-operation day. Although anorexia and bilateral gangrenous toes were noted, there were no more clinical septic signs seen as of 120 days after the operation.

**DISCUSSION**

Atheromatous material may dislodge either from atherosclerotic debris within the thoracic aorta spontaneously or from manipulation of the aorta during cardiac surgery or angiography. However, the actual mechanism of how inflammation leads to CES is unknown. Most commonly, embolism is thought to result from dislodgement of atheromatous material as the catheter is manipulated across areas of severe atherosclerosis within the aorta. The abdominal aorta is one of the most heavily involved areas containing atherosclerotic plaques; there-
fore, procedures involving catheter-related mechanical injury to these regions could potentially disrupt plaque material and induce CES. Therefore, the frequency of CES should be decreased if procedures are performed via the brachial artery approach. In our patient, PTA of the right external iliac artery was performed in the downstream site of the mesenteric artery. Thus, we believed the CES and bowel infarction was caused by the
Among 1,786 consecutive patients in one prospective study, 25 patients were diagnosed as having CES (1.4%); 12 patients were diagnosed with definite CES, and 13 patients were diagnosed with possible CES. The in-hospital mortality rate was 16.0% (4 patients) among patients with CES, which was significantly higher than in those without CES (0.5%, p < 0.01). Although the incidence of catheter-related embolism has been low in clinical studies, the incidence of embolism after cardiac catheterization in necropsy studies has been reported to be as high as 30%. Acute coronary syndromes and multivessel coronary artery disease are univariate predictors of CES. Hypertension, smoking, cerebrovascular disease, and aortic aneurysm are also associated with an increased post-procedure CES risk. No significant differences in atrial fibrillation, hypercholesterolemia, and diabetes mellitus were found between patients with and without CES. The elevated baseline CRP level was an independent predictor of CES (> 1.0 mg/dl).

In another study, an embolic event temporally related to femoral catheterization occurred in 10 (17%) of 59 patients with atherosclerotic aortic debris compared to 2 (3%) of 71 control patients without atherosclerotic aortic debris (p = 0.01). This may also imply the existence of debris as a risk factor of CES: interestingly, no patients with atherosclerotic aortic debris who underwent brachial catheterization had an embolic event. The strongest correlation of aortic debris in the clinical literature has been between advanced age and peripheral vascular disease, which is similar to our case. Our patient received carotid angiography by a femoral approach, and severe atherosclerotic aortic debris was confirmed by abdominal CT, which is compatible with previous reported risk factors for catheter-related CES.

Clinical manifestations of CES range from mild to catastrophic. In the ACC/AHA guidelines for percutaneous coronary intervention, “definite CES” is defined as a patient who has cutaneous signs including livedo reticularis, blue toe syndrome, and digital gangrene with or without renal impairment. In our patient, livedo reticularis and acute renal failure were noted 18 hours after the procedure, but possibly caused by septic shock. Specifically, the CES presented with subacute mesenteric artery occlusion and bowel infarction. In addition, CES also caused gangrene in the toes that was found 5 days subsequently. Although a pathologic study did not find any definite cholesterol crystals in the mesenteric artery, the diagnosis of CES should be seriously considered. The other possibility, namely thrombus formation caused by routine premedication of heparin 5000 units, was thought to be low; however, we could not exclude this possibility completely. Staphylococcus Lugdunensis endocarditis may cause bowel ischemia which related to possible embolization, but there was no positive blood culture for infective endocarditis or echocardiographic evidence of endocardial involvement in this patient.

Despite the availability of aggressive means to manage acute ischemic events, the prognosis of patients with catheter-related embolisms remains poor. The reported mortality rate among patients with catheter-related embolism has been reported to be between 16% and 81%. The mortality rate was higher in elderly patients and patients with peripheral vascular disease.

In patients without detected aortic cholesterol debris, the risk of CES wasn’t different between transfemoral approach and transradial approach. Invasive aortic procedures are planned in a patient with echocardiographically-detected atherosclerotic aortic debris (especially mobile aortic debris); the risk of embolism can be significantly reduced by substituting brachial for femoral catheterization and by avoiding intra-aortic balloon pump placement. Better understanding and early recognition of CES will reduce patient mortality and morbidity after cardiac catheterization. Transesophageal echocardiography (TEE) images of the aorta can be used to assess the risk of embolism. In our patient, we arranged carotid and right iliac angiography for both definite diagnosis and simultaneous PTA after Doppler exam and physical examination. TEE is an invasive procedure, and not usually performed before angiography. If CT is arranged before angiography, the risk of CES could be predicted by the finding of severe atherosclerotic aortic debris.

Insufficient blood supply caused by mesenteric artery occlusion will result in inflammation or injury of the intestine. Clinical presentations include sepsis, bowel perforation, or intestinal gangrene and require more aggressive interventions such as surgery and intensive care. No observational studies about mesenteric artery occlusion related to CES have been documented, only

carotid angiography procedure.
case reports are available.\textsuperscript{6,7} In 2008, Miklik reported on an acute superior mesenteric artery occlusion that was caused by CES and successfully solved by immediate local thrombolysis with recombinant t-PA (alteplase).\textsuperscript{6} In addition, another author reported successful local thrombolysis treatment and reperfusion of the superior mesenteric artery with streptokinase four hours after injection; however, the patient died four days later due to septic shock with metabolic acidosis.\textsuperscript{7} The major selection criteria for fibrinolysis include pain with less than 12 hours of evolution, partial mesenteric artery occlusion, absence of peritoneal signs, severe acidosis, or organ failure. In our case, the patient had no acute onset of symptoms such as abdominal pain or peritoneal signs after angiography. All the symptoms occurred 18 hours after procedure, presenting as nausea, abdominal distention and gastrointestinal bleeding, the latter being a contraindication for thrombolytic therapy. In this situation, the best treatment choice was starting surgical treatment as soon as possible after the definite diagnosis.

In conclusion, CES should be considered in elderly patients with peripheral arterial disease who are planning to undergo catheterized angiography. Transbrachial or transradial approaches may be better choices to avoid dislodgement of atheromatous material when the catheter is manipulated across areas of detected aortic cholesterol debris within the abdominal aorta. Although the incidence is very rare, subacute CES with mesentery artery occlusion should be kept in mind in elderly patients with multiple risk factors who underwent transfemoral angiography and demonstrate a non-specific clinical presentation. Early diagnosis with emergent operation is the only way to successfully treat such patients.

REFERENCES