Successful Simultaneous Revascularization for Acute Limb Ischemia and Concomitant Acute Myocardial Infarction

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Acute limb ischemia (ALI) is associated with high morbidity and mortality rates, even with the advent of technical advances. Although myocardial infarction is one of the causes of ALI along with intraventricular thrombus formation and subsequent embolism, ALI with concomitant acute myocardial infarction (AMI) is extremely rare. Here, we report a complicated ALI case with concurrent AMI and prolonged limb ischemic duration. The cause may be attributed to thrombosis with atherosclerotic disease of the coronary and peripheral arteries triggered by dehydration. We successfully treated the patient using simultaneous revascularization in a hybrid operating room with the aid of intraoperative hemodialysis for preventing life-threatening reperfusion syndrome.

Keywords: acute limb ischemia, myocardial infarction, hemodialysis

Introduction

Acute limb ischemia (ALI) is associated with high morbidity and mortality rates even after technical improvements have been made. The various causes of ALI include thromboembolism, commonly from a cardiac source (e.g., atrial fibrillation and previous myocardial infarction), thrombosis in situ, trauma, and peripheral aneurysms.1,2 However, ALI with concurrent acute myocardial infarction (AMI) is extremely rare and seldom reported, and an appropriate strategy for revascularization is essential for achieving optimal outcomes. Both ALI and AMI can lead to adverse outcomes if left untreated or if they are treated at an inappropriate time. Herein, we report a complicated ALI case with concurrent asymptomatic AMI that was treated with simultaneous revascularization for both ALI and AMI in a hybrid operating room.

Case Report

A 73-year-old man with a medical history of untreated arteriosclerosis obliterans (ASO) in a previous hospital and with current smoking status presented with right leg cyanosis and rest pain. He was transferred to the emergency department of our hospital 7 h after symptom onset, showing both sensory and motor loss with a dropped foot. The Doppler auscultation of the dorsalis pedis artery was inaudible, and auscultation of the vein was barely audible. The electrocardiogram simultaneously showed a marked ST elevation in leads II, III, and aVF and a complete atrioventricular block pattern (Fig. 1), indicating concomitant AMI even though the patient had no recent chest symptoms. Blood test findings showed an elevated level of creatinine kinase (CK, 5714 U/L); CK-MB (835 U/L); %CK-MB (14.6%); aspartate aminotransferase (AST, 561 U/L); alanine aminotransferase (ALT, 171 U/L); lactate dehydrogenase (LDH, 1165 U/L); creatinine (Cr, 2.8 mg/dL); and urea nitrogen (UN, 34.9 mg/dL). Cardiac ultrasonography showed asynergy on the inferior wall...
of the left ventricle without showing intraventricular thrombus formation. Computed tomography angiography (CTA) findings revealed the presence of an occluded external iliac artery extending to the proximal half of the superficial femoral artery and a patent deep femoral artery, while the tibial vessels were not depicted because of slow blood flow (Fig. 2).

In the context of the prolonged limb ischemic duration involving the considerable risk of reperfusion syndrome and concurrent AMI, immediate and simultaneous revascularization for both AMI and ALI and intraoperative hemodialysis were planned in the hybrid operating room. The angio suite system used was Artis Zeego (Siemens Healthcare, Forcheim, Germany). The door-to-hybrid operating room time was 90 min and the door-to-skin incision time was 120 min. Under local anesthesia, through a longitudinal groin incision, common, superficial, and deep femoral arteries were dissected. Simultaneously, the common femoral vein was dissected. Next, thrombectomy for the external iliac artery to common femoral artery (CFA) occlusion with a 5-Fr balloon (LeMaitre Vascular®, Burlington, MA, USA) via transverse arteriotomy of the CFA was performed, securing straight and direct blood flow from the iliac artery to the deep femoral artery (Fig. 3A). The arteriotomy was closed and hemodialysis was simultaneously initiated via a catheter inserted into the internal jugular vein. Even though residual iliac artery stenosis was detected, this lesion was not treated at that time for minimizing the cardiac ischemic time. Coronary intervention was then initiated by cardiologists. After temporary pacing wire placement in the right ventricle via the exposed femoral vein, coronary angiography (CAG) was performed through the ipsilateral CFA. CAG detected the total occlusion of the right coronary artery (RCA). Cath-
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eter-directed thrombectomy for RCA occlusion showed organic stenosis of the RCA, and balloon angioplasty with subsequent stent placement was performed (Figs. 3B–3D). The door-to-balloon time was 180 min. Balloon angioplasty and subsequent stent deployment for the residual stenosis of the external iliac artery were then performed. A complete angiogram showed a residual superficial femoral artery occlusion but detected sufficient blood flow to the ischemic foot through the collateral arteries (Fig. 3E).

The patient’s postoperative course was uneventful. Although he required temporary pacing for bradycardia because of a first-degree atrioventricular block and temporary hemodialysis, they were terminated on postoperative day 2 after the patient regained normal sinus node function and adequate renal function. His electrolyte level was consistently within normal limits, while his serum CK level rapidly decreased and was normalized by postoperative day 5. He also regained his leg motor function without dropped foot, and he was discharged with ambulatory status on postoperative day 10. Postoperative blood tests showed markedly decreased Cr and UN levels, 1.25 mg/dL and 14.5 mg/dL, respectively, indicating underlying dehydration. Patient consent was obtained for publishing this report.

Discussion

ALI remains a significant cause of morbidity and mortality, with a 30-day amputation rate of 5%–12% and a 30-day mortality rate of 10%–38%.[1-4] The etiology of ALI is often an embolism from a cardiac source; for example, thrombus formation in the left atrium due to atrial fibrillation or in the left ventricle after a previous myocardial infarction is common.[1,2] The other mechanism is in situ thrombosis, which is commonly observed in patients with underlying ASO, as is noted in the present case.

Regarding thrombosis formation, the mechanisms in ALI and AMI are similar; namely, acute thrombotic occlusion of an artery causes ischemia and, unless promptly relieved, tissue death. Just as the onset of chest pain occurs with AMI, ALI manifests as the acute onset of limb pain, often with paresthesia, weakness, or paralysis.[3,5] Theoretically, ALI and AMI may be caused by the same reason; however, simultaneous occurrence is extremely rare. In this case, preoperative blood tests showed no signs of coagulopathy but did reveal the patient’s relatively dehydrated status, and this relatively higher viscosity caused by dehydration may simultaneously predispose a patient to thrombosis in diseased iliac and coronary arteries.

In this case, both the ALI and AMI required immediate revascularization because they are associated with high morbidity and mortality rates. For achieving an optimal outcome, a hybrid operating room is the ideal setting where both vascular surgeons and cardiologists can simultaneously collaborate. Regarding the ALI, because of the prolonged ischemic time, the possibility of limb salvage was marginal; the ALI grade was between category IIb and III in the Rutherford Society for Vascular Surgery ALI classification, and revascularization could lead to life-threatening myonephropathic metabolic syndrome (MNMS).[6] The mortality rate of MNMS reportedly ranges from 30% to 80% because of the reentry of reperfusate with its various metabolites into the systemic circulation and subsequent multiple organ failure.[7,8] Various methods have been studied for preventing MNMS, including controlled reperfusion and intraoperative continuous hemodialysis.[1,8,9] The evidence of the efficacy of intraoperative hemodialysis is not sufficient, but it is reported to be effective in maintaining a normal electrolyte balance,
rapidly reducing and normalizing serum CK levels, and removing various metabolites for preventing MNMS in a limited number of cases.\textsuperscript{8)} In this case, we prevented fatal complications despite the prolonged limb ischemic duration with the help of hemodialysis.

We successfully treated a complicated ALI case with concurrent AMI without severe systemic complications with simultaneous and immediate revascularization in a hybrid operating room and intraoperative hemodialysis.

**Conclusion**

ALI with concurrent AMI is an extremely rare but challenging condition, as both ALI and AMI require immediate and adequate treatment, especially when the ischemic duration of ALI is prolonged. Simultaneous revascularization in a hybrid operating room combined with intraoperative hemodialysis enabled the achievement of the optimal outcome.

**Disclosure Statement**

The authors declare that they have no conflicts of interest to disclose.

**Author Contributions**

Study conception: KM
Data collection: KM
Writing: KM
Critical review and revision: all authors
Final approval of the article: all authors
Accountability for all aspects of the work: all authors

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