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Case Report Open Access

A novel approach for lower extremity malperfusion in type A aortic dissection: A case report

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ABSTRACT

Lower extremity malperfusion (LEM) is a severe complication of type A aortic dissection, often leading to ischemia and increased mortality. Optimal management remains debated, with limb-first and aortic dissection-first approaches under consideration. A 53-year-old male presented with syncope and signs of type A aortic dissection extending from the ascending aorta to the iliac bifurcation, causing dynamic LEM. To manage LEM while addressing the dissection, temporary distal perfusion was achieved using a 10F catheter connected to the femoral artery cannulation line during surgery. A Bentall procedure with hemiarch replacement was carried out (cardiopulmonary bypass time: 229 min). Postoperatively, the right lower extremity pulses were restored, and ischemia resolved without sequelae. Temporary perfusion via a central catheter from the cardiopulmonary bypass line offers a simple and effective solution to manage LEM during aortic dissection repair, potentially reducing ischemic complications. This approach may serve as a bridge to definitive repair, particularly in time-sensitive scenarios.

Keywords: Cardiopulmonary bypass, lower extremity ischemia, type A aortic dissection, vascular surgical procedures.

Aortic dissection is a life-threatening condition often complicated by branch vessel malperfusion, causing ischemia in the central nervous system, visceral organs, or extremities, posing significant therapeutic challenges.[1] Malperfusion occurs in up to 40% of cases, increasing risks of amputation, mortality, and poor outcomes. Malperfusion is classified as static, dynamic, or both. Dynamic malperfusion results from hemodynamic forces where the dissection flap obstructs a branch vessel's orifice, while static malperfusion arises from false lumen thrombosis compressing the true lumen. Blood pressure control may restore circulation in dynamic malperfusion, but intervention is required if ineffective; static malperfusion always necessitates intervention. Rapid correction of malperfusion is critical, and choosing between a limb-first or aortic dissection-first approach impacts outcomes. Acute end-organ ischemia requires urgent reperfusion to maximize survival.[1] However, the optimal strategy for lower extremity malperfusion (LEM) in dissection remains unclear, and amputation rates may be underreported.[1] Traditional interventions include extra-anatomic bypasses (e.g., femoro-femoral, axillo-femoral) or surgical fenestration, while less invasive techniques such as stent grafting and endovascular fenestration have been used since the 1990s.

This case report described a novel strategy for managing LEM in type A aortic dissection by providing temporary perfusion during dissection repair, minimizing ischemic complications.

CASE REPORT

A 53-year-old male presented to the emergency department with syncope and limb pain. Physical examination revealed left-sided ptosis and absent pulses in the right lower extremity, which was cold and pale. Echocardiography showed severe aortic

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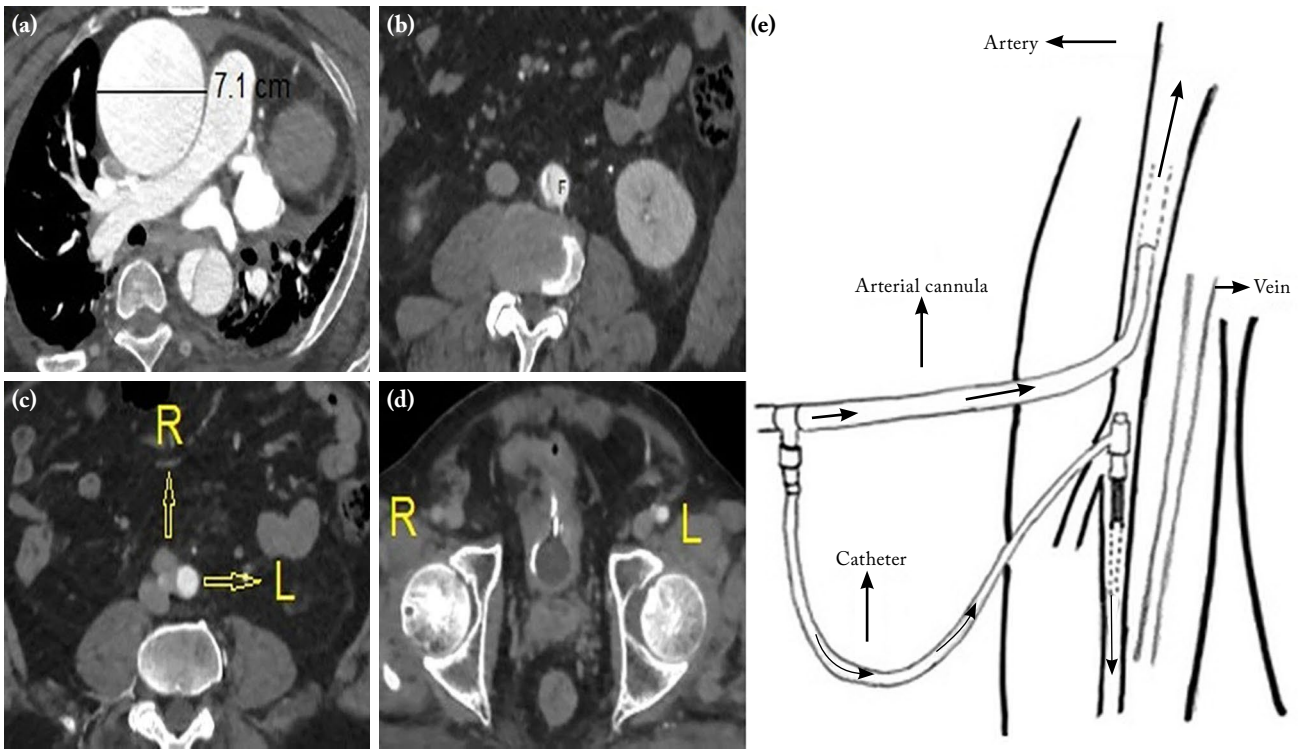

Figure 1. **(a)** Axial contrast-enhanced CT scan of the ascending aorta showing type A dissection. **(b)** Coronal CT showing reduced true lumen area in the descending aorta. **(c)** Axial CT at the iliac bifurcation showing false lumen dominance. **(d)** Contrast in left femoral artery (absent in the right). **(e)** Schematic diagram of femoral and subclavian cannulation with 10F catheter.
CT: Computed tomography.

insufficiency. Computed tomography (CT) confirmed a DeBakey type A dissection (Figures 1a-d). At the celiac artery origin, the false lumen dominated the aortic cross-sectional area, with increasing dominance distal to the renal arteries. At the iliac bifurcation, the false lumen occupied the entire area (Figure 1c). The left iliac artery (false lumen-originating) showed contrast filling, but the right common iliac, external iliac, and proximal femoral arteries (true lumen-originating) exhibited no contrast, indicating dynamic malperfusion (Figure 1d). Written informed consent was obtained from the patient.

Surgical procedure

Arterial cannulation was established in the right subclavian artery for cerebral perfusion and in the right femoral artery for retrograde true lumen perfusion. A 10F catheter was connected to the femoral artery cannulation line, with catheterization distal to the cannulation site to provide distal perfusion to the right lower extremity (Figure 1e). This enabled simultaneous retrograde flow from femoral cannulation and antegrade flow via the 10F catheter. After restoring extremity perfusion, a Bentall procedure with a no. 21 mechanical valved conduit and hemiarch replacement were performed after median sternotomy. Cardiopulmonary bypass (CPB) time was 229 min, cross-clamp time was 146 min, and total circulatory arrest time was 20 min. Postoperatively, pulses returned in the right lower extremity, with complete resolution of ischemia and no sequelae. No ischemia-reperfusion complications, such as severe metabolic acidosis, occurred. The patient stayed in the intensive care unit for eight days due to respiratory issues and was discharged after 15 days with no residual deficits. Follow-up CT showed contrast filling in both femoral arteries (Figure 2).

DISCUSSION

Lower extremity malperfusion in acute type A aortic dissection remains a complex clinical entity with

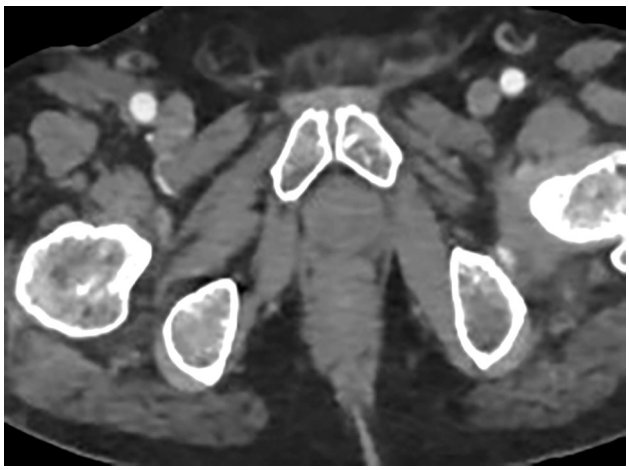

Figure 2. Postoperative computed tomography showing restored bilateral femoral perfusion.

significant prognostic implications. The therapeutic dilemma centers around whether to prioritize limb revascularization or central aortic repair, as delayed perfusion can exacerbate ischemic injury, yet postponing dissection repair may lead to fatal complications. Plotkin et al.[1] reported increased early failure rates in patients undergoing limb-first interventions compared to those receiving immediate aortic repair, while Charlton-Ouw et al.[2] noted that one-third of LEM cases required additional interventions after aortic surgery.

In the present case, the patient exhibited dynamic malperfusion of the right lower extremity due to collapse of the true lumen at the iliac bifurcation. Arterial cannulation was achieved via the right femoral artery to access the true lumen. To preserve perfusion to the distal limb during Bentall procedure, a 10F catheter was introduced distal to the femoral cannulation site and connected to the CPB line. This allowed for simultaneous antegrade and retrograde flow during systemic circulation support, maintaining limb perfusion throughout the surgical period.

This approach is conceptually related to distal perfusion techniques commonly used in extracorporeal membrane oxygenation patients to prevent limb ischemia[3] but has been adapted here to the context of acute aortic dissection surgery. The advantage of this technique lies in its simplicity, timeliness, and compatibility with emergent operative settings without the need for additional surgical exposure or delayed reperfusion.

Postoperatively, the patient did not require any further intervention for the lower extremity. Ischemia resolved completely without evidence of neurologic or muscular sequelae. Although metabolic acidosis occurred transiently following reperfusion, it responded to standard medical management. These outcomes suggest that intraoperative maintenance of distal perfusion may contribute to mitigation of ischemia-reperfusion injury, an effect previously highlighted in the context of malperfusion management.[4,5]

The strategy employed aligns with evolving perspectives on individualized cannulation techniques in aortic dissection. Xia et al.[6] emphasized the utility of double arterial cannulation in providing both cerebral and distal organ perfusion, particularly in complex cases with compromised true lumen flow. While our approach does not involve formal double arterial cannulation in the classic sense, the use of a temporary distal perfusion line achieves a similar goal, ensuring effective systemic and peripheral circulation during the critical phases of aortic repair.

In conclusion, LEM in aortic dissection increases mortality and morbidity, and its optimal management remains unresolved. Our novel approach of temporary perfusion via a 10F catheter from the CPB line during dissection repair offers a simple, effective method to address LEM while enabling prompt dissection repair. This strategy may reduce ischemic complications in time-sensitive settings, warranting further investigation.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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