From the Midwestern Vascular Surgical Society

Acetabular and pelvic fracture repair complicated by phlegmasia cerulea dolens: A report of limb salvage with open thrombectomy and modified Palma procedure

Melissa C. Hetrick, DO,[a] *and* Graham W. Long, MD, FSVS,[a,b] *Royal Oak and Rochester, MI*

ABSTRACT

A 57-year-old man presented after a fall, which resulted in acetabular and pelvic fractures. He underwent fracture fixation, which was complicated by iliac vein occlusion, leading to phlegmasia cerulea dolens. He underwent lower extremity surgical venous thrombectomy, contralateral iliac vein stent placement, and modified Palma procedure with an expanded polytetrafluoroethylene venous crossover bypass and arteriovenous fistula creation. His postoperative course was unremarkable and he regained full function of the extremity without significant stasis complications. The bypass and stent remain patent 3 years postoperatively. Although iliac vein injury during acetabular fracture repair is rare, prompt recognition and intervention prevent limb loss. (J Vasc Surg Cases Innov Tech 2024;10:101544.)

Keywords: Limb salvage; Postphlebitic syndrome; Thrombectomy; Iliac vein; Stent

Vascular injury during internal fixation of acetabular fractures is rare with only a few documented case reports. Mechanisms for these injuries include direct vessel puncture by fracture fragments, extrinsic compression or vessel penetration by orthopedic hardware, or from vessel elongation and torsion. We present a case of iliac vein occlusion during acetabular and pelvic fracture repair resulting in acute phlegmasia cerulea dolens (PCD). The patient provided consent for publication of his case details and imaging.

CASE REPORT

A 57 -year-old man with no significant past medical history presented to the emergency department after a mechanical fall onto his left hip. Physical exam was notable for left hip ecchymoses with palpable dorsalis pedis and posterior tibial pulses. Left lower extremity (LLE) sensation and motor function were intact. A computed tomography scan revealed a displaced, comminuted left acetabular fracture involving the anterior and posterior columns with extension into the obturator ring (Fig 1). He was placed in traction and taken to the operating room for open reduction and internal fixation. On completion, the patient had palpable dorsalis pedis and posterior tibial pulses.

Several hours postoperatively, the patient reported worsening lower left extremity (LLE) swelling and pain. Physical examination revealed decreased sensation and only Doppler signals in the left foot. Compartment pressures were >60 mm Hg in the calf and thigh. He underwent emergent four-compartment fasciotomies of the calf and anterior thigh. Venous duplex ultrasound revealed extensive LLE deep vein thrombosis involving the inferior vena cava (IVC), left common and external iliac, femoral, popliteal, and tibial veins. Arterial duplex ultrasound examination revealed no significant disease. Computed tomography angiogram to rule out a pulmonary embolism was negative. Therapeutic intravenous heparin was started. However, progressive LLE swelling developed with diminished motor function and pulses in the left foot, consistent with PCD.

To restore venous outflow, the patient underwent urgent percutaneous mechanical venous thrombectomy. He was positioned prone and the bilateral popliteal veins were accessed percutaneously. From the left, a wire was unable to be passed beyond the orthopedic hardware into the IVC (Fig 2). From the right, a wire and catheter were passed into the IVC and an iliocavagram performed. No thrombus within the IVC was detected. The left iliac vein was occluded by hardware and unable to be accessed from the right iliac vein. The right common iliac vein (CIV) was extrinsically compressed by a pelvic hematoma (Fig 3, *A*). Intravenous ultrasound examination assessed the degree of right iliac vein compression, confirming a high-grade >70% stenosis (Fig 3, *B*). To restore venous outflow to the left leg, the decision was made to place a right iliac vein stent, followed by femoral-femoral venous crossover bypass. Using intravenous ultrasound, the right iliac vein diameter was measured (native CIV 14 × 18 mm, stenosed to 4 × 14 mm) and a Venovo 16 × 80 mm self-expanding stent (C.R. Bard,

From the Corewell Health William Beaumont University Hospital, Royal Oak[a]; and the William Beaumont Oakland University School of Medicine, Rochester.[b]

Presented at the 2023 Midwestern Vascular Surgical Society annual meeting. Minneapolis, Minnesota, September 7-9, 2023.

Correspondence: Graham Long, MD, 3601 W 13 Mile Rd, Royal Oak, MI 48073 (e-mail: graham.long@corewellhealth.org).

The editors and reviewers of this article have no relevant financial relationships to disclose per the Journal policy that requires reviewers to decline review of any manuscript for which they may have a conflict of interest.

2468-4287

https://doi.org/10.1016/j.jvscit.2024.101544

Journal of Vascular Surgery Cases, Innovations and Techniques
October 2024

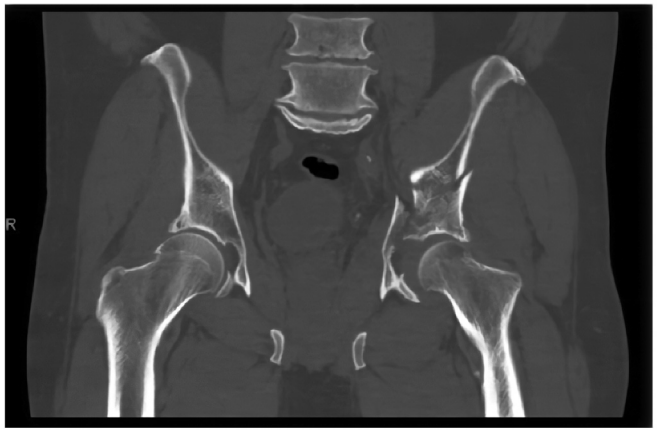

Fig 1. Computed tomography scan demonstrating a displaced and comminuted left acetabular fracture involving the anterior and posterior columns with extension into the obturator ring.

Fig 2. From the left popliteal vein, a wire was unable to be passed beyond the inguinal ligament into the inferior vena cava (*IVC*).

Murray Hill, NJ) was placed into the right CIV, extending into the external iliac vein to provide additional stent support and prevent migration (Fig 4).

After stent placement, the patient was positioned supine and a left groin incision was used to control the left common femoral, femoral, profunda femoral, and great saphenous veins. A common femoral vertical venotomy was performed adjacent to the saphenofemoral junction. The left leg was wrapped with sterile 6-inch Esmarch and serially compressed in a distal to proximal fashion to express thrombus. The right common femoral vein and bifurcation were exposed and a suprapubic tunnel created. Given the size of the native femoral vein, it was felt that the great saphenous vein would not be of sufficient caliber to decompress the LLE. Therefore, a 10-mm ringed expanded polytetrafluoroethylene (ePTFE) graft was anastomosed end-to-side to both common femoral veins. An arteriovenous fistula (AVF) was created using a 2.5-mm vein branch from the left saphenofemoral junction anastomosed to the superficial femoral artery (Fig 5).

The patient's postoperative course was unremarkable, and he regained full function of the LLE. He walks unassisted with no significant stasis complications and minimal residual thrombus in the calf veins. He continues to wear knee-high medium compression stockings daily and was prescribed lifelong anticoagulation with warfarin and aspirin. The bypass graft, iliac vein stent, and AVF remain patent on surveillance duplex ultrasound studies 3 years postoperatively.

DISCUSSION

The Palma procedure was first described in 1958 as an extra-anatomic venous reconstruction option for management of postphlebitic syndrome from chronic iliac venous occlusion.[1,2] The original technique was described as a cross-over saphenous vein bypass with the distal contralateral great saphenous vein transposed into a suprapubic tunnel and anastomosed to the femoral vein of the symptomatic leg in an end-to-side configuration.[3] Early studies reported 4-year primary and secondary patency of 77% and 83%, respectively, with some reports of patency exceeding 20 years.[4,5]

Several modifications to the Palma procedure have been described, including the addition of an AVF and use of prosthetic conduit as an alternative to autogenous saphenous vein. The AVF improves bypass graft flow volumes, which theoretically decreases the risk of bypass thrombosis, but data remain limited.[4] Cross-over venous bypasses using ePTFE have a lower reported patency rate compared with saphenous vein conduits, despite the addition of an AVF, although data are again limited.[4] Our case study represents a novel hybrid solution to acute iliac venous occlusion using a stent in the outflow iliac vein to support bilateral lower extremity venous outflow, combined with a modified Palma procedure consisting of a cross-over ePTFE bypass with AVF creation.

The Palma procedure as classically described was designed for chronic post-thrombotic syndrome from iliac vein occlusion, but has been adapted to use for acute venous occlusion, particularly in the trauma setting.[1,3,6] Iliac vein injuries associated with abdominal and pelvic trauma are well-described.[7] Pelvic fractures involving the acetabulum place the adjacent iliac vessels

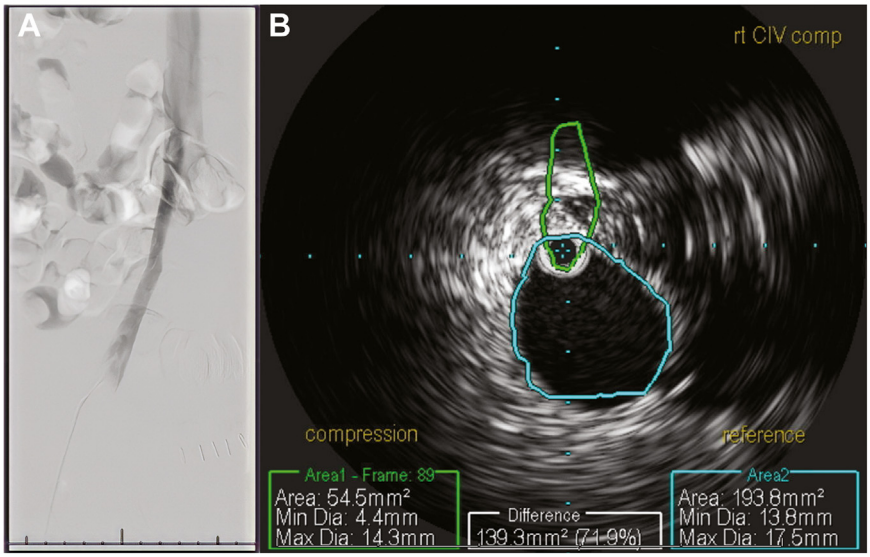

Fig 3. (A) Venogram from the right popliteal vein reveals right common iliac vein (*CIV*) stenosis. **(B)** Intravascular ultrasound (*IVUS*) image of the compressed segment of the right CIV (*green*) superimposed over the normal native right CIV (*blue*).

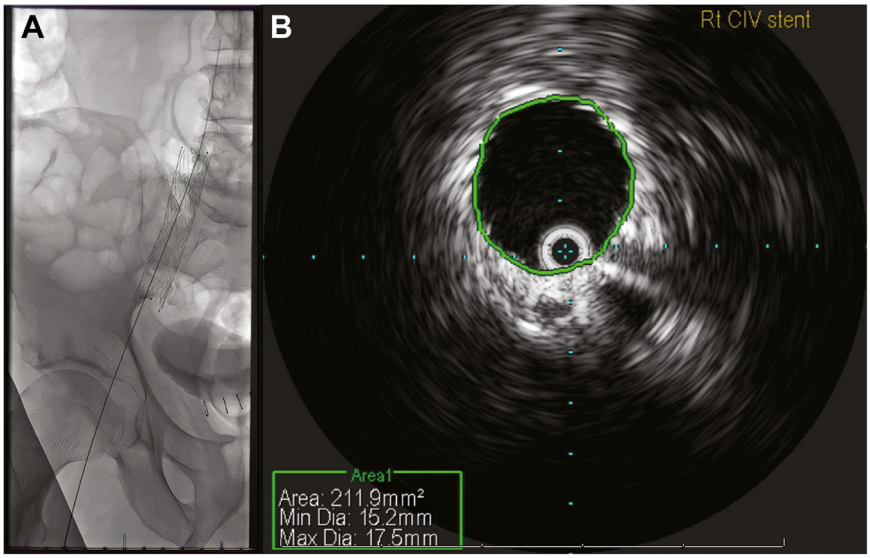

Fig 4. (A) Fluoroscopic image of a fully-expanded right common iliac vein (*CIV*) stent extending into the external iliac vein (*EIV*). **(B)** Intravascular ultrasound (*IVUS*) image of the right CIV after Venovo 16 × 80 mm self-expanding stent placement (C.R. Bard, Murray Hill, NJ).

at risk for injury, particularly high acetabular fractures caused by lateral forces from the femoral head.[8] Iatrogenic injuries to the iliac vessels can also occur during fracture fixation and are predominantly caused by orthopedic instrumentation.[9] Most case reports describe rupture, thrombosis, or compression of the adjacent iliac artery[10] with fewer reports of iatrogenic venous injuries.

In unstable trauma patients with severe injuries, including iliac vessel injury, iliac vein ligation may be necessary as a damage control maneuver to control bleeding.[7,11] This procedure can lead to chronic venous hypertension and post-thrombotic syndrome. Traditionally, these patients are managed conservatively with compression therapy; however, delayed reconstruction with a modified Palma procedure to preserve venous outflow has been described.[3] In rare cases, acute limb threat may arise from the development of PCD. PCD occurs when complete venous obstruction impairs arterial inflow with resultant limb threat. PCD carries a mortality rate of 25% to 40% and an amputation rate of 20% to

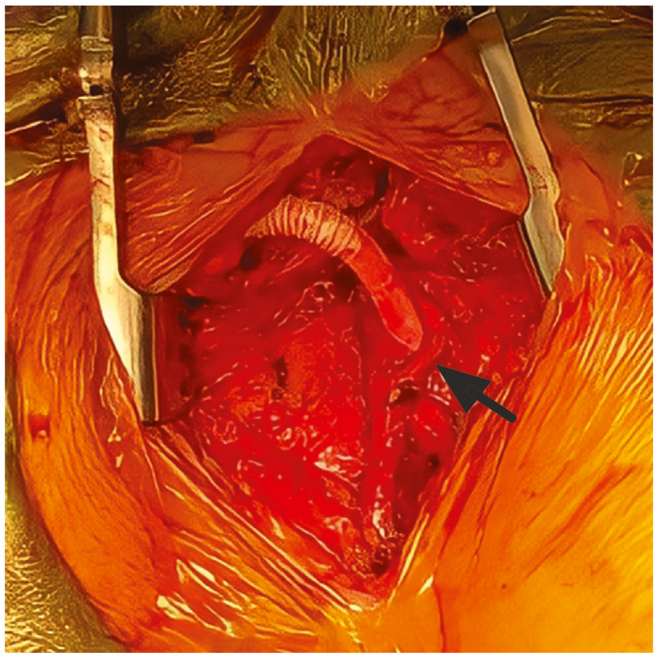

Fig 5. A 10-mm ringed polytetrafluoroethylene (*PTFE*) graft anastomosed to the common femoral vein in an end-to-side configuration with creation of an arteriovenous fistula (*AVF*) using a vein branch from the left saphenofemoral junction anastomosed to the superficial femoral artery. *Arrow* depicts the AVF.

50%.[6] Our case represents a rare presentation of PCD owing to iliac vein occlusion by orthopedic hardware.

We present a case of acute iliac vein compression resulting in extensive iliofemoral deep vein thrombosis and PCD necessitating urgent surgical intervention. We successfully combined deployment of an outflow iliac vein stent, open surgical venous thrombectomy, and placement of a femoral-femoral ePTFE venous bypass with AVF creation in the management of an acute venous occlusion for limb salvage. Assessment of the outflow iliac vein to confirm adequate luminal diameter for bilateral lower extremity venous outflow is important for prevention of bypass graft thrombosis.

DISCLOSURES

None.

REFERENCES

1. Kvasha A, Kvasha V, Fajer S, Eyal A, Carmeli R. Palma procedure for acute intraabdominal major venous injury. *EJVES Extra*. 1991;5:549–556.
2. Palma EC, Esperon R. Vein transplants and grafts in the surgical treatment of the postphlebitic syndrome. *J Cardiovasc Surg*. 1960;1:94–107.
3. Alcocer F, Aguilar J, Agraz S, Jordan WD. Early Palma procedure after iliac vein injury in abdominal penetrating trauma. *J Vasc Surg*. 2008;48:745–748.
4. Jost CJ, Gloviczki P, Cherry KJ, et al. Surgical reconstruction of iliofemoral veins and the inferior vena cava for nonmalignant occlusive disease. *J Vasc Surg*. 2001;33:320–327.
5. Mendes BC, Gloviczki P, Akhtar N. Patency and clinical success 22 years after the Palma procedure. *J Vasc Surg Venous Lymphat Disord*. 2016;4:95–96.
6. Dua A, Heller J, Lee C. Management of post-Traumatic phlegmasia cerulea dolens via right-to-left femoral vein to femoral vein bypass (Palma procedure). *Vasc Endovascular Surg*. 2017;51:567–571.
7. Garcia A, Millan M, Burbano D, et al. Damage control in abdominal vascular trauma. *Colomb Méd*. 2021;52:e4064808.
8. Frank JL, Reimer BL, Raves JJ. Traumatic iliofemoral arterial injury: an association with high anterior acetabular fractures. *J Vasc Surg*. 1989;10:198–201.
9. Lazarides MK, Arvanitis DP, Dayantas JN. Iatrogenic arterial trauma associated with hip joint surgery: an overview. *Eur J Vasc Surg*. 1991;5:549–556.
10. Koelling E, Mukherjee D. Extrinsic compression of the external iliac artery following internal fixation of an acetabular fracture. *J Vasc Surg*. 2011;54:219–221.
11. Rotondo MF, Schwab CW, McGonigal MD, et al. 'Damage control': an approach for improved survival in exsanguinating penetrating abdominal injury. *J Trauma*. 1993;35:375–383.

Submitted Jan 16, 2024; accepted May 10, 2024.