

A novel case of a pseudoaneurysm due to thermal injury from a cement hip spacer

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ABSTRACT

Vascular injuries sustained during total hip replacements are associated with life- and limb-threatening complications. In the present report, we have described a novel vascular injury of an external iliac artery pseudoaneurysm repaired with an interposition vein graft. The vascular injury had been caused by heat from the curing process of a nearby cement hip spacer. During the curing process of bone cement, in vivo temperatures of $\leq 70^{\circ}\text{C}$ can be reached, with such temperatures creating the potential for vascular injury. This case highlights the importance of limiting the exposure of surrounding neurovascular structures to bone cement to reduce the risk of thermal injury. (*J Vasc Surg Cases and Innovative Techniques* 2021;7:239-42.)

Keywords: Aneurysm; Arthroplasty; Bone cement; False; Femoral artery; Hip; Iliac artery; Replacement

Vascular injuries, although infrequently associated with total hip replacement (THR), are associated with life- and limb-threatening complications when they occur. Vascular injuries can broadly be classified into one of four categories. However, thermal injury to a vessel wall from the use of bone cement has not previously been reported. In the present case report, we have described a novel injury of a pseudoaneurysm secondary to thermal damage of the iliac vessel wall in a patient undergoing a two-stage revision hip arthroplasty.

CASE REPORT

A 62-year-old woman was referred to our institution from a rehabilitation hospital after a computed tomography (CT) venogram, performed for increasing right lower leg swelling and hip pain on mobilization, had demonstrated a large right external iliac artery pseudoaneurysm. She was hemodynamically stable and had no systemic features of sepsis, erythema or fluctuance of the right groin or thigh, and no pulsatile groin mass on examination. Her white blood cell count was $7 \times 10^9/\text{L}$, and the C-reactive protein was 56 mg/L. Repeat CT angiography demonstrated a $50 \times 40 \times 23$ -mm pseudoaneurysm arising from the posterior aspect of the junction of the right external iliac and common femoral arteries (Fig 1).

She had an extensive history of interventions to her right hip, including a THR in 2006 for osteoarthritis, with three

subsequent revisions because of acetabular loosening, open reduction of a dislocation, and recent excision of the prosthesis with placement of a cement spacer. Her medical history also included right femoral and external iliac venous thromboses and pulmonary emboli (for which she was receiving rivaroxaban), type 2 diabetes, Turner syndrome, a previous right knee replacement, hypertension, and hypercholesterolemia.

She remained hemodynamically stable on arrival to our institution; thus, intervention was delayed for 24 hours given the rivaroxaban therapy. A diagnostic angiogram was performed (Fig 2) to assess her suitability for endovascular intervention. Endovascular intervention was found not to be suitable owing to both the dimensions of the pseudoaneurysm neck and the location of the pseudoaneurysm. The pseudoaneurysm originated from the distal external iliac artery, just proximal to the common femoral bifurcation, which was 5 mm distal to the inguinal ligament (high bifurcation). The diameter of the pseudoaneurysm neck was ~ 5 mm, with a length of < 1 mm. The patient subsequently underwent open repair of the pseudoaneurysm under general anesthesia. A longitudinal right groin incision was made, with control of the right external iliac, superficial femoral, and profunda arteries obtained via this incision. Because of the high bifurcation, the inguinal ligament was divided, 5000 IU of heparin was administered, and the vessels were clamped. The pseudoaneurysm was decompressed, revealing a large cavity posterior to the artery with bone cement at the base, fed by a 5×5 -mm defect in the posterior aspect of the distal external iliac artery. On inspection, the artery demonstrated significant degeneration and staining. Because of the extent of arterial damage, an interposition graft was placed using an ipsilateral reversed long saphenous vein, end-to-end from the healthy external iliac artery to the profunda artery. The superficial femoral artery was reimplanted into the anterior aspect of the vein bypass using 5-0 Prolene suture. The pseudoaneurysm cavity was washed out, a drain was left in situ, the inguinal ligament repaired, and the wound was closed in layers. Histopathologic examination of the involved iliac artery revealed

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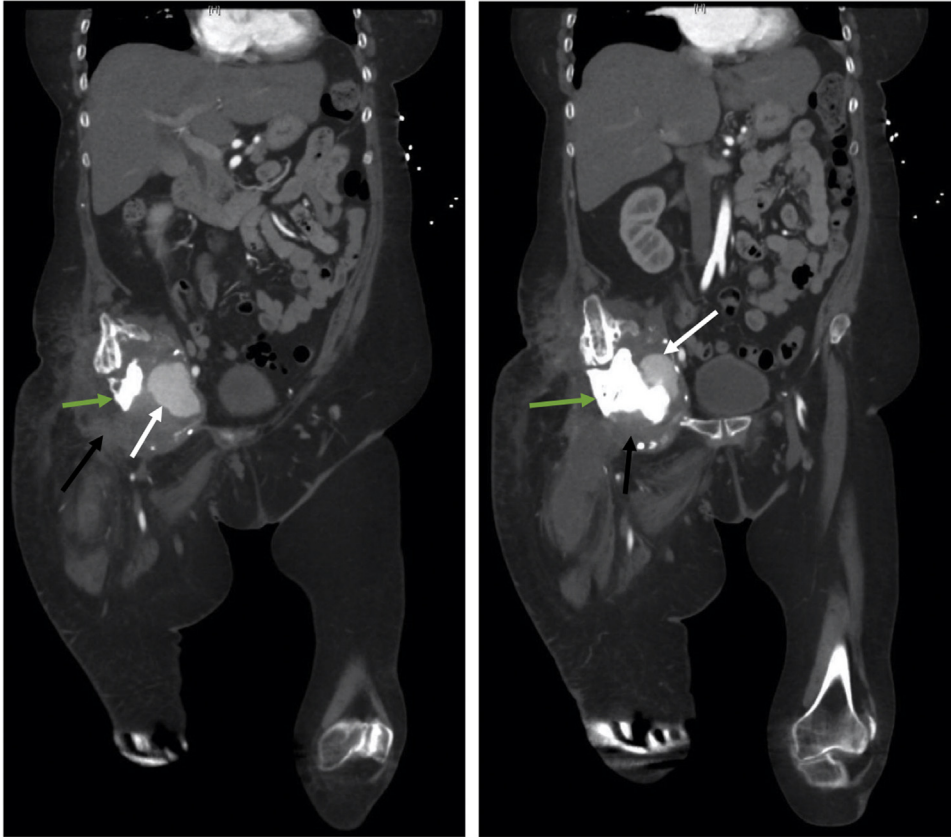


Fig 1. Sagittal computed tomography (CT) angiogram slices demonstrating a large pseudoaneurysm (*white arrow*) arising from the posterior aspect of the junction of the right external iliac and common femoral arteries. A significant hematoma (*black arrow*) surrounds this, with bone cement seen posterior to pseudoaneurysm (*green arrow*).

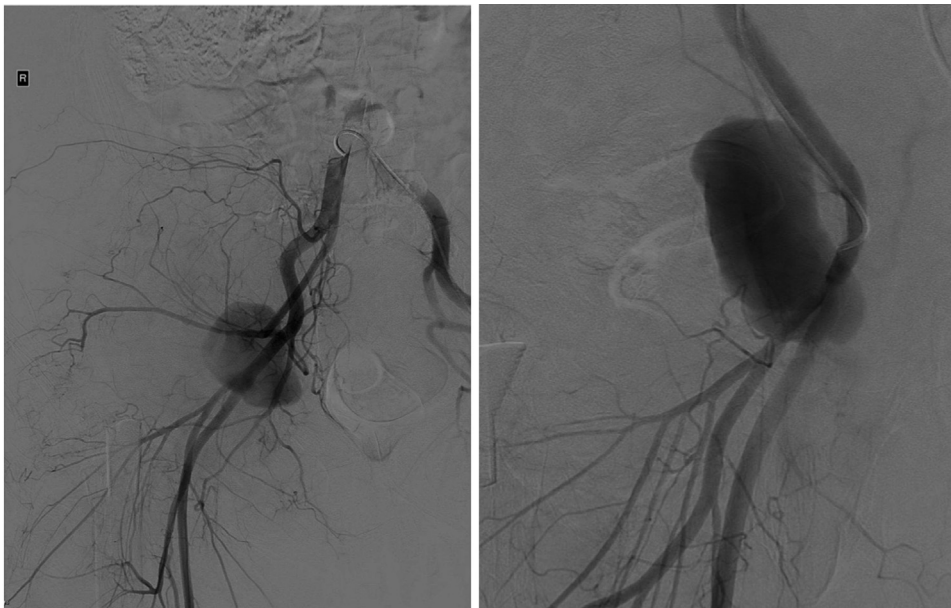


Fig 2. Diagnostic angiogram of right leg pseudoaneurysm, via left up-and-over approach, confirming the presence of a large pseudoaneurysm, with a short and wide neck, not amenable to endovascular intervention.

organic debris and metallosis. Microbiology (including for mycobacteria) revealed no growth. She recovered well and was discharged on day 22 postoperatively. Repeat CT angiography at 6 and 12 weeks postoperatively demonstrated no pseudoaneurysm and patency of her bypass.

The patient provided written informed consent for the report of her case and clinical images.

DISCUSSION

Although described infrequently in the literature, vascular injuries in patients undergoing THR are arguably the most life- and limb-threatening complications associated with the procedure.¹⁻⁴ The risk factors for vascular injury include revision procedures, left-sided procedures, and intrapelvic migration of the acetabular components of the prosthesis.^{3,5} Four broad classifications of vascular injury have previously been described: (1) intimal tears with subsequent thrombotic arterial occlusion; (2) injury of major arteries occurring during hip replacements (ie, puncture injuries or arterial lacerations); (3) false aneurysms; and (4) heat-induced arterial thrombosis due to polymerization of bone cement.^{4,6-8} The clinical signs and symptoms of these injuries can arise within the immediate postoperative period or in delayed fashion as demonstrated by our case. The most common manifestations of vascular injuries include intraoperative hemorrhage, postoperative ischemic symptoms from impaired flow or acute thrombosis, and delayed joint pain and soft tissue swelling from pseudoaneurysm formation.⁵

A literature review of the 112 reported cases revealed 135 vascular injuries after hip replacements. Of these, pseudoaneurysms were the most frequently described (38% of cases). Although many of the reports outlined thermal damage as a common etiology of the vascular injury, no studies had reported the occurrence of such an injury. Most cases with cement-related injuries detailed puncture or laceration to adjacent arteries from spicules of bone cement. A case report by Frias Pérez et al⁹ was the sole article outlining a case of common femoral artery thrombosis secondary to thermal coagulation from the heat produced in the curing process of the bone cement.

Although no vascular injuries were sustained, Lowell et al¹⁰ described a case of a bladder fistula occurring after THR. They proposed that the heat generated during the curing process in close proximity to the bladder was the cause of the fistula, suggesting that thermal injury to hollow structures is possible.¹⁰ Polymethylmethacrylate is a major component of the bone cement used in orthopedic procedures. The temperatures recorded during the exothermic polymerization reaction have differed between in vitro and in vivo studies. In vitro studies have demonstrated temperatures of 70° to 120°C, and in vivo studies have demonstrated temperatures of 40° to 50°C, with some reported data suggesting that in vivo temperatures can reach ≤70°C.^{11,12} Although few studies have investigated the effect of thermal

injury to vessel walls, Vo et al¹³ described the dermal vascular changes that occur after thermal trauma. Such changes include thrombosis, vascular occlusion, necrosis, and rupture of blood vessels when exposed to temperatures of 50°C. If these data can be extrapolated to vessels in general, it would suggest that rupture or damage to the arterial wall is possible from the temperatures created during the curing process of bone cement.

In the present case, the patient's multiple revisions were a risk factor for vascular injury, as was the anticoagulation therapy. Given the proximity of the distal external iliac artery to the cement spacer, the significant size of the defect, the degeneration and discoloration of the remaining arterial wall, and confirmation of metallosis in the histopathologic specimen, we believe that the damage sustained was secondary to thermal injury from the heat produced during the curing process of the bone cement. The nature of such an injury has not previously been described in the literature. The potential for thermal injury to vascular structures should be at the forefront of surgical consideration when using bone cement, not only for THRs, but also any surgical procedure in which it might be required. Particular care should be taken to limit the exposure of the material to the surrounding neurovascular structures to reduce this risk, as observed in the present case.

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REFERENCES

1. Barrack RL. Neurovascular injury: avoiding catastrophe. *J Arthroplasty* 2004;19(Suppl 1):104-7.
2. Kawasaki Y, Egawa H, Hamada D, Takao S, Nakano S, Yasui N. Location of intrapelvic vessels around the acetabulum assessed by three-dimensional computed tomographic angiography: prevention of vascular-related complications in total hip arthroplasty. *J Orthop Sci* 2012;17:397-406.
3. Shoenfeld NA, Stuchin SA, Pearl R, Haveson S. The management of vascular injuries associated with total hip arthroplasty. *J Vasc Surg* 1990;11:549-55.
4. An S, Shen H, Feng M, Li Z, Wang Y, Cao G. Femoral artery injury during total hip arthroplasty. *Arthroplast Today* 2018;4:459-63.
5. Bergqvist D, Carlsson AS, Ericsson BF. Vascular complications after total hip arthroplasty. *Acta Orthop Scand* 1983;54:157-63.
6. Aust JC, Bredenberg CE, Murray DG. Mechanisms of arterial injuries associated with total hip replacement. *Arch Surg* 1981;116:345-9.
7. Gbs V, Muralidhar N, Bharathidasan K. A case report: an acute thrombus in the femoral artery following total hip arthroplasty. *J Orthop Case Rep* 2016;6:55-7.
8. Nachbur B, Meyer RP, Verkkala K, Zurcher R. The mechanisms of severe arterial injury in surgery of the hip joint. *Clin Orthop Relat Res* 1979;141:122-33.
9. Frias Pérez A, Garcia Garcia FJ, Ortiz Gomez JA, Prieto Montana JR, Gonzalo Vivar F. False aneurysm in an ileofemoral Dacron graft after total hip arthroplasty. *Acta Orthop Belg* 1993;59:214-8.
10. Lowell JD, Davies JA, Bennett AH. Bladder fistula following total hip replacement using self-curing acrylic. *Clin Orthop Relat Res* 1975;111:131-3.
11. Monzon RA, Coury JG, Disse GD, Lum ZC. Bone cement in total hip and knee arthroplasty. *JBSJ Rev* 2019;7:e6.

12. Stanczyk M, van Rietbergen B. Thermal analysis of bone cement polymerisation at the cement-bone interface. *J Biomech* 2004;37:1803-10.
13. Vo LT, Papworth GD, Delaney PM, Barkla DH, King RG. A study of vascular response to thermal injury on hairless mice by fibre optic

confocal imaging, laser Doppler flowmetry and conventional histology. *Burns* 1998;24:319-24.

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