CASE REPORT

Nagoya J. Med. Sci. **83**. 353–359, 2021
doi:10.18999/nagjms.83.2.353

Arterial embolism due to massive cement leakage during total hip arthroplasty revision

Yusuke Kazama, Yasuhiko Takegami, Yusuke Osawa, Kazuya Makida and Taisuke Seki

Department of Orthopaedic Surgery, Nagoya University Graduate School of Medicine, Nagoya, Japan

ABSTRACT

Total hip arthroplasty with cementing techniques leads to good clinical outcomes, but critical vascular complications can sometimes occur due to cement leakage into the pelvis. In this report, we describe a case of massive cement leakage that caused an arterial embolism. When exfoliating cement from an artery, the surgeon should note not only direct injury to the vessels but also the potential for arterial embolism.

Keywords: arterial embolism, cement, complication, revision, total hip arthroplasty

Abbreviations:
THA: total hip arthroplasty
CT: computed tomography

INTRODUCTION

Although several reports have shown good clinical outcomes[1-3] following total hip arthroplasty (THA) with cementing techniques, critical vascular complications associated with the leakage of bone cement into the pelvis have been reported. Massive bleeding due to pseudoaneurysm[4] and perforation of a vessel by the cement are known vascular complications.[5] These complications were due to direct injury of the vessels by leaked cement. To our best knowledge, there are few reports of vessels complications due to indirect injury by cemented THA. In this report, we describe a case of arterial embolism as a complication due to massive leakage of cement used in THA.

CASE REPORT

Written consent was obtained from the patient for the publication of this report. A 70-year-old woman with hip osteoarthritis experienced left hip pain and gait disturbance. She was healthy

Received: June 10, 2020; accepted: September 25, 2020
Corresponding Author: Yasuhiko Takegami, MD, PhD
Department of Orthopedic Surgery, Nagoya University Graduate School of Medicine, 65 Tsurumai-cho, Showa-ku, Nagoya 466-8550, Japan
Tel: +81-52-741-2111, Fax: +81-52-744-2260, E-mail: takegami@med.nagoya-u.ac.jp

without internal comorbidities including diabetes mellitus or obstructive arteriosclerosis. She had never smoked. Her previous medical history included a varus osteotomy at age 26 years old on her left hip, and right THA at age 59 (Fig. 1a). In 2017, the surgeons at another hospital failed a primary THA on her left hip. They found massive cement leakage into the pelvic cavity on a postoperative radiograph (Fig. 1b). They performed contrast-enhanced 3-dimensional computed tomography (CT). This imaging showed that the cement involved her left external iliac artery (Fig. 1c). However, there was no pseudoaneurysm or hemorrhage at that time, nor was there evidence that the cement leakage had injured other organs such as her bowel, bladder, or uterus (Fig. 1d). She moved to our hospital to receive revision surgery. On our examination, we found a solid, pulseless, tennis-ball-sized mass in her left inguinal region. The left femoral artery was not palpable at the groin, but the dorsal artery of her left foot was palpable. Hip flexion was right 50°/left 40°, abduction right 0°/left 0°.

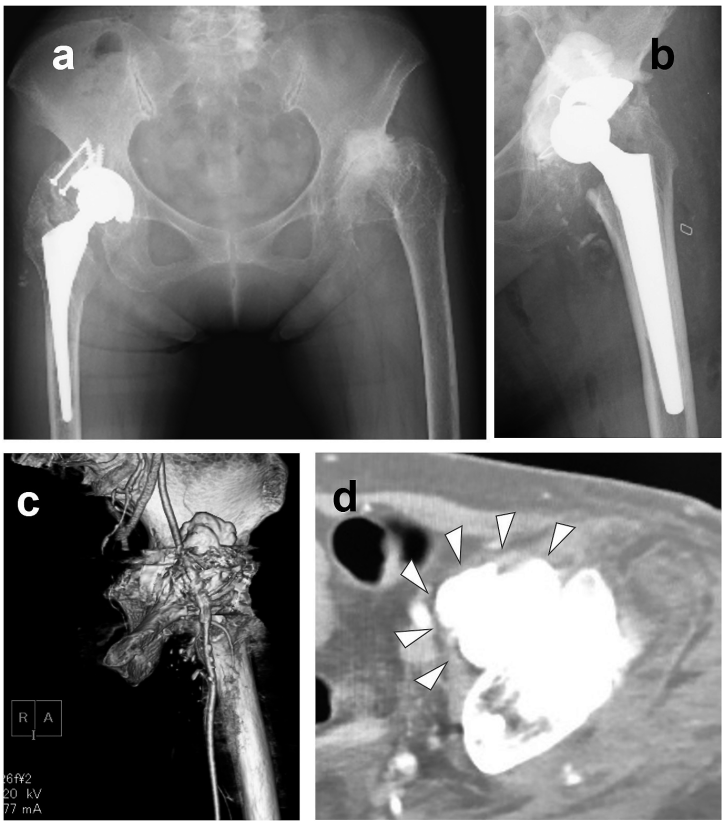

Fig. 1 Radiographs before first revision surgery

Fig. 1a: Anteroposterior (AP) plain radiography before primary total hip arthroplasty (THA).

Fig. 1b: AP plain radiograph after primary THA.

Fig. 1c: 3-dimentional computer-tomography after primary total hip arthroplasty demonstrated the cement surrounds the vessels. (The white arrow showed the leakage of cement, the black arrows showed the external iliac artery)

Fig. 1d: The enhanced computer-tomography showed the location between the cement and the external iliac artery. (The white arrow showed the leakage of cement)

The first revision surgery was performed four weeks after the primary THA. We incised through the inguinal ligament and the external oblique muscle via the ilioinguinal approach. We recognized that the external iliac artery and vein were compressed anteriorly by cement (Fig. 2a). A thin fascia lay between the blood vessels and the cement. There was no obvious vascular injury (Fig. 2b). We were gradually delaminating the cement from blood vessels.

When incising the fascia, the cement could easily be removed manually. After its removal, we retrieved the previous cup. When we checked the blood flow to her leg after we closed the surgical incision, we found no pulse in her dorsal artery by ultrasound Doppler and diagnosed acute arterial embolization of the external iliac artery. We re-incised the skin and inserted a Fogarty catheter directly into the external iliac artery. We were able to remove a 7-cm-long thrombus, and flow to the artery was recovered. After that, we remove the femoral component in a decubitus position. Three days after the operation, we performed a routine ultrasonography check for deep vein thrombosis and found deep vein thrombosis in the lower limbs from the mid-level of the femur to the proximal part of the calf. After consulting the vascular surgeon, We administered edoxaban tosilate hydrate until the next revision surgery. When assessing the bone defect of the acetabulum, we recognized a widely deficient area of the anterior acetabular wall (Fig. 3).

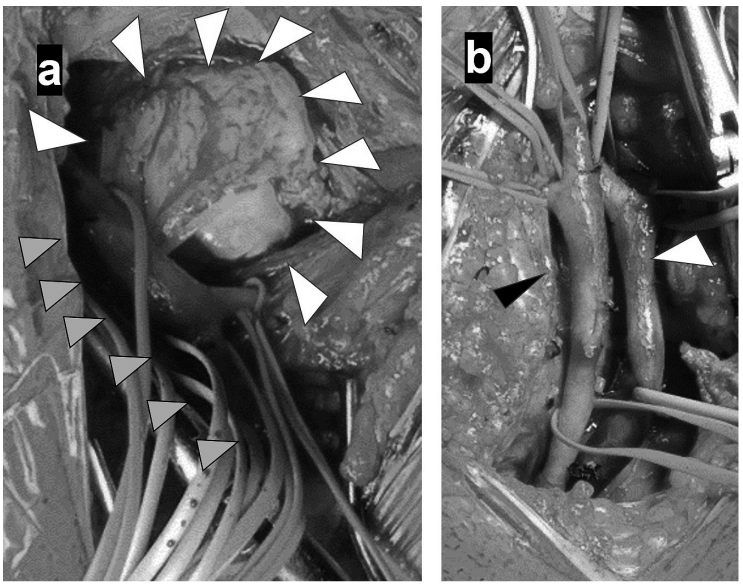

Fig. 2 Operative findings

Fig. 2a: The cement leakage compressed the vessels behind them. (The white arrows showed the cement leakage, the grey arrows showed vessels)

Fig. 2b: There is no evidence that the vessels were injured directly after the removal of cement. (The white arrow showed External iliac artery, the black arrows showed External iliac vein)

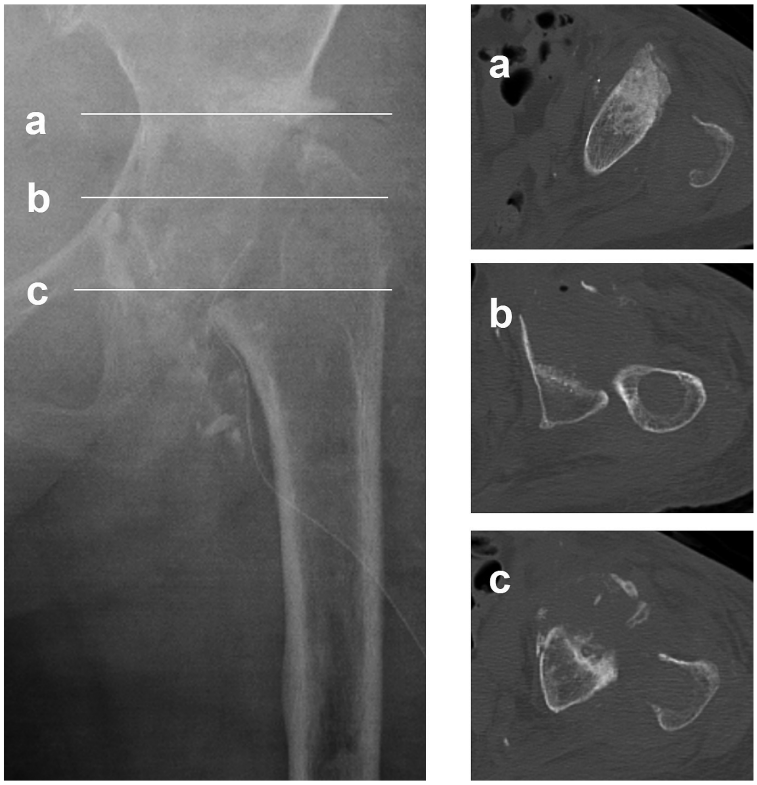

Fig. 3 Radiographs before second revision surgery
AP radiography after removing cement and implants. CT images showed that the anterior wall of the acetabulum widely defects. The axial CT each level as below; a. the teardrop level b. the center of acetabulum level, c. the upper level of acetabulum level.

The second revision operation was performed 8 weeks after the first THA via the posterior approach. When we exposed the bottom of the acetabulum, massive bleeding occurred from the acetabular branch of the obturator artery. We called the vascular surgeons in an emergency. They ligated the artery. After that, we reconstructed the acetabulum with a KT plate (Kyocera, Osaka, Japan)[6,7] and X3 Rimfit (Stryker, Mahwah, NJ) and repaired the anterior wall with an allograft. We used an EXETER stem (Stryker) as the femoral component. The operation time was 290 minutes, and the blood loss was 2,591 mL. At the final follow up one year after these operations, the patient was able to walk with a cane but felt mild hip pain and numbness on her anterior thigh. There was no evidence to indicate failure of blood circulation in her leg. Her Harris Hip score was 65 points. The CT images obtained at the final follow-up are shown in Fig. 4.

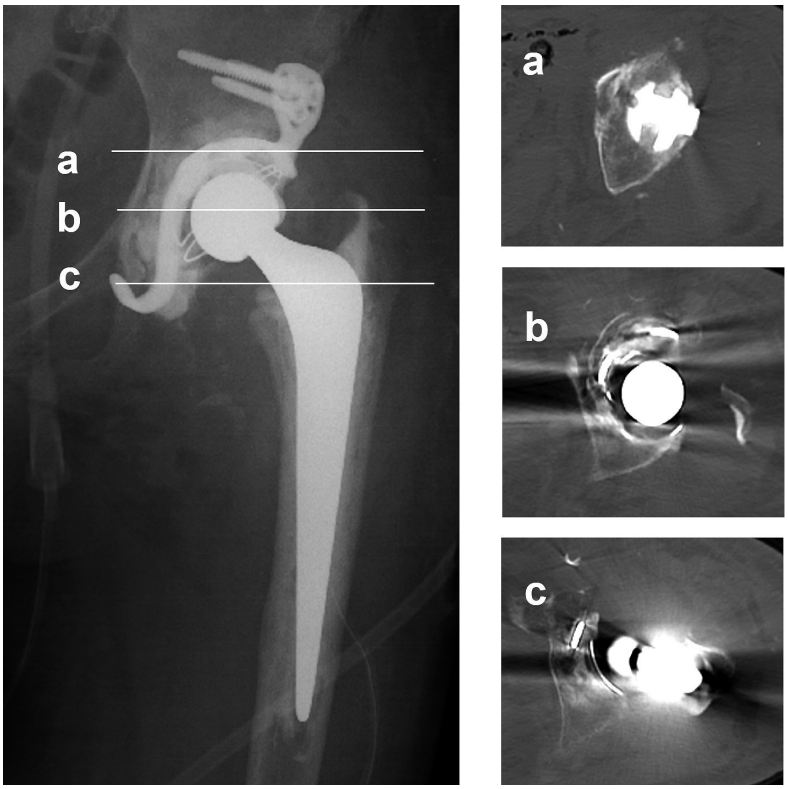

Fig. 4 Radiographs after second revision surgery
AP radiography after the revision arthroplasty. CT images showed that the anterior wall of the acetabulum was reconstructed. The axial CT each level as below; a. the teardrop, b. the center of acetabulum, c. the upper level of acetabulum.

DISCUSSION

There are some reports of vascular damage caused by the leakage of cement.[4,8,9] Prior reports showed the massive hemorrhage occurred because of the direct vessel injury by cement[8] or a pseudoaneurysm, which is made by the friction of the vessel wall against the cement.[4] In our case, the huge leakage of cement result in an arterial embolism and deep vein thrombosis indirectly. To our best knowledge, there are few reports of arterial embolism by cement during THA. Vascular embolisms are known to be one of the severe intraoperative complications in total knee arthroplasty with cement.[10] The mechanism of vascular embolism in total knee arthroplasty with cement is considered to be as follows: first, the thermal injury from bone cement damaged the arterial endothelial cells. It can be a significant trigger for thrombus formation. Second, reduced blood flow by compressing the vessels activates the endothelial cells.[11] The activated endothelial cells bound to monocytes or neutrophils. These leucocytes trigger inflammation and make blood clots.[12,13] Unlike total knee arthroplasty, in total hip arthroplasty, the vessels are rarely severely compressed because there is sufficient space in the pelvic cavity. However, the blood vessels could not escape the cement because huge leaked bone cement in this case.

A prior study reported that preoperative risk factor for leaking cement is severe acetabular deformity, such as traumatic arthritis of hip, dislocated hip or any revision hip surgery.[14] To

prevent the cement complication, it is recommended that the surgeons do not excessively ream, retain the transverse ligament in the acetabulum, and remove excess cement immediately.[15,16] If the surgeon broke the acetabular wall, the surgeons should reconstruct the defect in the acetabulum with autograft or allograft bone.[17,18]

We experienced the major hemorrhage at the second stage revision because the external iliac artery had adhered to the inner wall of the acetabulum. It is well known that the external iliac artery lies close to the inner wall of the acetabulum.[19] In revision surgery, sometimes it is impossible to follow all blood vessels because halation in the CT images by implants (Fig. 1d). In such cases, it is necessary to consult with a vascular surgeon and consider the preparation of catheters and vascular prostheses to salvage the blood flow.

CONCLUSION

We experienced a case in which arterial embolism occurred following the leakage of a large amount of cement during a THA procedure. When exfoliating the cement from an artery, the surgeon should note not only direct injury to the vessels but also the potential for arterial embolism.

AUTHOR DISCLOSURE STATEMENT

None of the authors have conflicts of interest to declare.

REFERENCES

1 Kavanagh BF, Wallrichs S, Dewitz M, et al. Charnley low-friction arthroplasty of the hip: Twenty-year results with cement. *J Arthroplasty*. 1994;9(3):229–234. doi:10.1016/0883-5403(94)90076-0.
2 Kavanagh BF, Dewitz MA, Ilstrup DM, Stauffer RN, Coventry MB. Charnley total hip arthroplasty with cement. Fifteen-year results. *J Bone Joint Surg Am*. 1989;71(10):1496–1503.
3 Schulte KR, Callaghan JJ, Kelley SS, Johnston RC. The outcome of Charnley total hip arthroplasty with cement after a minimum twenty-year follow-up. The results of one surgeon. *J Bone Joint Surg Am*. 1993;75(7):961–975. doi:10.2106/00004623-199307000-00002.
4 Tkaczuk H. False aneurysm of the external iliac artery following hip endoprosthesis. *Acta Orthop Scand*. 1976;47(3):317–319. doi:10.3109/17453677608991998.
5 Fruhwirth J, Koch G, Ivanic GM, Seibert FJ, Tesch NP. Vascular lesions in surgery of the hip joint. *Unfallchirurg*. 1997;100(2):119–123. doi:10.1007/s001130050102.
6 Kokubo Y, Oki H, Takeura N, et al. Reconstruction of acetabulum in revision total hip arthroplasty for pelvic discontinuity: report of a difficult case requiring four revision arthroplasty. *Springerplus*. 2016;5:597. doi:10.1186/s40064-016-2247-9.
7 Baba T, Shitoto K. Revision of total hip arthroplasty using the Kerboull and KT plates. *Int Orthop*. 2010;34(3):341–347. doi:10.1007/s00264-009-0789-y.
8 Janssen D, Srinivasan P, Scheerlinck T, Verdonschot N. Effect of cementing technique and cement type on thermal necrosis in hip resurfacing arthroplasty—a numerical study. *J Orthop Res*. 2012; 30(3):364–370. doi:10.1002/jor.21512.
9 Heller KD, Prescher A, Holbeck M, Forst R. Bone cement penetration of the acetabulum in total hip replacement. An experimental study. *Int Orthop*, 1996;20(5):315–320. doi:10.1007/s002640050085.
10 Inomata K, Sekiya I, Otabe K, et al. Acute arterial occlusion after total knee arthroplasty: a case report. *Clin Case Rep*. 2017;5(8):1376–1380. doi:10.1002/ccr3.1075.
11 Jackson SP. Arterial thrombosis--insidious, unpredictable and deadly. *Nat Med*. 2011;17(11):1423–1436. doi:10.1038/nm.2515.
12 Parmet JL, Horrow JC, Singer R, Berman AT, Rosenberg H. Echogenic emboli upon tourniquet release

during total knee arthroplasty: pulmonary hemodynamic changes and embolic composition. *Anesth Analg*. 1994;79(5):940–945. doi:10.1213/00000539-199411000-00021.

13 von Brühl M-L, Stark K, Steinhart A, et al. Monocytes, neutrophils, and platelets cooperate to initiate and propagate venous thrombosis in mice in vivo. *J Exp Med*. 2012;209(4):819–835. doi:10.1084/jem.20112322.

14 Zhang L, Zhou Y, Li Y, Xu H, Guo X, Zhou Y. Total Hip Arthroplasty for Failed Treatment of Acetabular Fractures. A 5-Year Follow-Up Study. *J Arthroplasty*. 2011;26(8):1189–1193. doi:10.1016/j.arth.2011.02.024.

15 Yang I-H. Neurovascular Injury in Hip Arthroplasty. *Hip Pelvis*. 2014;26(2):74–78. doi:10.5371/hp.2014.26.2.74.

16 Reilingh ML, Hartemink KJ, Hoksbergen AW, Saouti R. Occlusion of the common femoral artery by cement after total hip arthroplasty: a case report. *J Med Case Rep*. 2009;3:86. doi:10.1186/1752-1947-3-86.

17 Cameron HU, MacDiarmid A. Major acetabulum reconstruction using autograft bone in cemented hip arthroplasty. *Orthop Rev*. 1987;16(11):845–850.

18 Knight JL, Fujii K, Atwater R, Grothaus L. Bone-grafting for acetabular deficiency during primary and revision total hip arthroplasty. A radiographic and clinical analysis. *J Arthroplasty*. 1993;8(4):371–382. doi:10.1016/s0883-5403(06)80035-5.

19 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(4):397–406. doi:10.1007/s00776-012-0227-7.