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Case report

# Intraoperative bladder perforation during primary total hip arthroplasty

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ABSTRACT

We present a unique case of bladder perforation occurring intraoperatively during primary total hip arthroplasty. It is suspected that the patient's aberrant bladder anatomy, with idiopathic erosion of the quadrilateral space, predisposed the patient to bladder injury. Several preoperative risk factors for bladder injury were identified in the literature. These factors include cemented acetabular components, previous history of hip arthroplasty, history of pelvic trauma or intrapelvic surgery, and poor bone quality. Management of bladder injury, should it occur, includes bladder decompression with a Foley catheter, antibiotic administration, hemodynamic monitoring, and urology consult with close follow-up. This case reinforces the importance of urologic preoperative evaluation for anatomic variations of the bladder. In such cases, intraoperative Foley catheters to prevent distension may reduce the risk of perforation.



## Introduction

Primary total hip arthroplasty (THA) is among the most commonly performed orthopaedic procedures. In 2010, approximately 332,000 THAs were performed in the United States [1]. There are many reported complications of THA, but intrapelvic complications are among the least commonly reported. Of intrapelvic injuries associated with this procedure, bladder injuries have infrequently been described.

The few case reports and series that document bladder injuries secondary to THA primarily describe delayed presentations and theorize etiologies related to hardware migration, medial screw and wire placement [2-4], intrapelvic cement extension, thermal necrosis [2,5-8], or subsequent adhesions [9]. There are no prior case reports describing bladder perforation relating to erosion of the pelvic floor and cotyloid fossa occurring intraoperatively during primary THA (Tables 1 and 2).

We present a unique case of bladder perforation occurring intraoperatively during primary THA. It is suspected that the patient's aberrant bladder anatomy, with idiopathic erosion of the quadrilateral space, predisposed the patient to bladder injury during primary THA. This case reinforces the importance of tailored urologic preoperative evaluation for anatomic variations of the bladder and may serve to heighten surgeon awareness of this unusual complication. In such cases, intraoperative use of Foley catheters to prevent distension of the bladder may reduce the risk of perforation.

## Case history

The patient is 67-year-old female who presented with long-standing left hip pain. The patient was a native of Angola and had recently moved to the United States. Her pain was mostly located in the groin and buttock region and recently had progressed. Radiographs taken at first evaluation showed a dysplastic hip, subluxation of the femoral head, and a flattened medial wall (Fig. 1). A preoperative computed tomography (CT) scan was therefore ordered, revealing flattening of the quadrilateral space in the axial

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**Table 1**
Risk factors for intra- or postoperative bladder perforation secondary to THA surgery.

| Patients at elevated risk of bladder perforation secondary to THA |
|---|
| – Cemented acetabular components |
| – Previous pelvic trauma |
| – Previous ipsilateral THA |
| – Previous intrapelvic surgery |
| – Intrapelvic radiation |
| – Poor bone quality |

plane with minimal cortical bone between bladder and joint space (Fig. 2). The patient was worked up for a potentially infectious cause of her arthritis; however, her C-reactive protein (11 mg/L) and erythrocyte sedimentation rate (4.11 mm/h) were within normal limits. She gave verbal and written consent to proceed with THA after a lengthy discussion involving the risks, benefits, and alternative options.

On the day of the procedure, the patient was seen in the preoperative holding area, was marked and brought back to the operative suite. General anesthesia was induced, a Foley catheter was not placed consistent with our institute's policy for a primary joint replacement, and the patient was placed in the lateral decubitus position with the left side up using Stuhlbergs. The patient was prepped and draped in a sterile fashion. Preoperative antibiotics (1 gram cefazolin) were given. A standard posterior approach to the hip was made with sharp dissection taken through skin, subcutaneous fat, and fascia. The gluteus maximus was bluntly dissected in line with the fibers to minimize iatrogenic damage. A Charnley retractor was put in place and the exposure was assessed. The decision was made to bluntly extend the exposure more proximally to allow appropriate visualization for the femoral preparation. A large amount of bleeding was noted in the posterior aspect, with likely violation of a small branch of the superior gluteal artery. Further careful dissection was performed to assess the source of bleeding. The decision was made to pack the region with a hemostatic matrix gel and left for 15 minutes. Reassessment determined that the bleeding had indeed stopped.

Attention was then brought back to the proximal femur and an electrocautery was used to take down the short external rotators and the capsule from the posterior aspect of the greater trochanter, as one sleeve, and were tagged with sutures for later reattachment. The femoral neck was clearly defined down to the level of the lesser trochanter using electrocautery. With the femoral head exposed, the hip was dislocated with flexion and internal rotation. A standard neck cut was performed, the femoral head removed, and the acetabulum visualized. Exposure of the acetabulum was gained with an anterior femoral retractor, a superior 90° Hohmann that was malleted into the ilium, a 90° Hohmann in the ischium before a blunt cobra was placed at the inferior aspect of the acetabulum, under the transverse acetabular ligament.

The acetabulum was sequentially reamed. It was at this time a large amount of blood welled up from below the medial wall. Even with suction and packing, it was not possible to identify a vessel responsible. Because of the excessive nature of the bleeding, the region was covered with a hemostatic matrix gel and packed. The vital signs remained stable, but given that the patient had two significant bleeds, and concerns for injure to the Obturator artery, an intraoperative vascular consult was called. The packing was held for 15 minutes without disturbance. Once the packing was removed, the bleeding had stopped and vascular surgery deemed no intervention was warranted. The case continued without incident, and the acetabulum component was malleted in place.

**Table 2**
Outline summarizing the intra- and postoperative management of bladder perforation secondary to THA surgery.

| Management of bladder perforation |
|---|
| – Monitor hemodynamics to discern source |
| – Urology consult |
| – Prophylactic antibiotics |
| – Foley catheter placement for decompression |
| – Close postoperative observation |

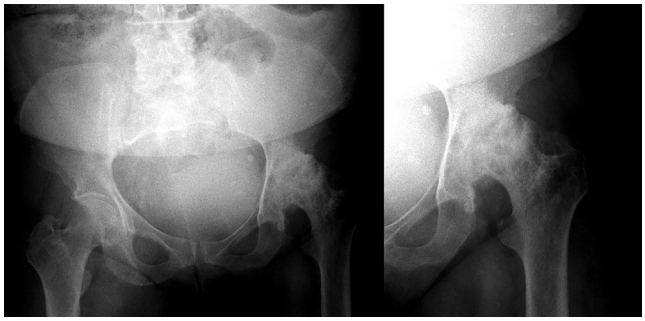

**Figure 1.** Anteroposterior (AP) pelvic x-ray (left) and AP left hip x-ray (right) of a 67-year-old female with left sided hip osteoarthritis.

The femur was broached and the final component was put into place. A small, nondisplaced crack was noted on final impaction of the stem, but given that it did not extend past the lesser trochanter and could be clearly defined, the decision was made to cerclage the proximal femur. The wound was thoroughly irrigated and a standard wound closure was performed. The patient's vital signs remained stable throughout, without need for volume expanders or pressors. A sterile dressing was put into place and the position was returned to the supine position for radiographic assessment of the hip (Fig. 3). Given the concern for significant blood loss (1200 mL estimated blood loss) and large resuscitation volume (4 L crystalloid and 2 units packed red blood cells), the decision was made to send the patient to the step-down unit for closer monitoring. As protocol dictates, a Foley catheter was then placed to allow for accurate measurement of the patient's input and output. On nontraumatic insertion of the Foley, large clots and gross hematuria was noted into the Foley bag. It was at this point concern regarding injury to the bladder prompted a urologic consult. A cystogram showed communication with the joint (Fig. 4) confirming an extraperitoneal bladder injury. On further review of the preoperative CT, aberrant bladder anatomy with protrusion of the bladder can be appreciated anterior to the pubic symphysis (Fig. 5).

**Figure 2.** Preoperative CT scan revealing flattening of the quadrilateral space in the axial plane with minimal cortical bone between bladder and joint space.

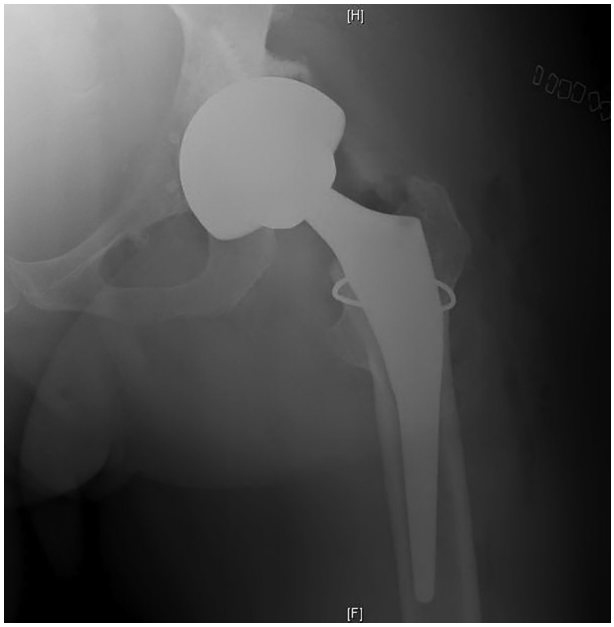


**Figure 3.** Postoperative AP hip x-ray showing an ML taper system, size 7.5 femoral stem, size 60 cup with inner diameter of 36. A proximal tension cable can also be visualized.

The patient received standard postoperative antibiotics (1 gram intravenous cefazolin for 2 doses), and was then transitioned to intravenous cefepime (1 gram q12hour) for 24 hours per urology, then to intravenous vancomycin (1 gram q12hour). Postoperative urine and blood cultures were negative, and the patient's hospital course was uneventful thereafter. She was discharged on postoperative day 2 with a Foley catheter in stable condition, 500 mg oral Keflex QID until follow-up, with instructions to follow-up with urology and orthopaedic surgery. Two weeks postoperatively, the patient presented to orthopaedics with no complaints regarding her left hip. Her incision was intact, nonerythematous, and dry. Her Foley at follow-up was not having any bloody drainage. A cystogram performed at her 2-week follow-up with her urologist showed no bladder extravasation, evidence of malignancy, and her Foley was removed at the time. At her 6-week follow-up with orthopaedics, the patient's pain continued to be well-controlled, and she was undergoing physical therapy. She was planning on returning to Angola at that time to visit family. X-rays and medical records were provided to take with her to Angola.

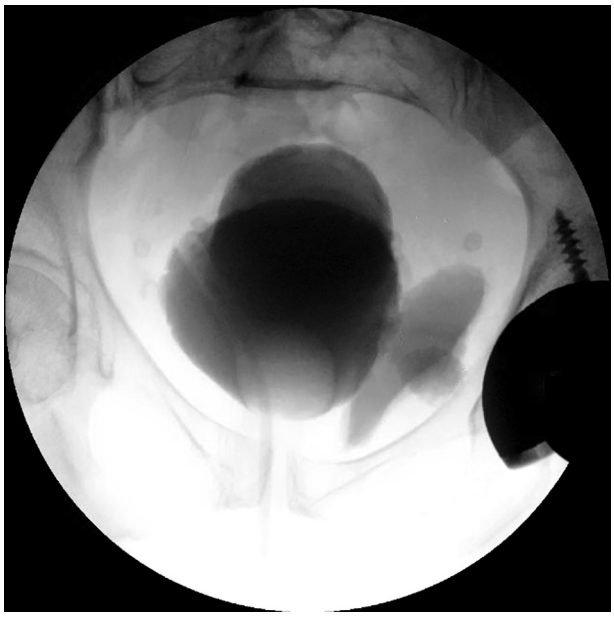

**Figure 4.** Cystogram performed 2-week status-post left THA showing no evidence of extravasation. Of note, the acetabular component can be seen violating the pelvic cavity.

**Figure 5.** Preoperative CT scan revealing aberrant bladder anatomy with protrusion of the bladder anterior to the pubic symphysis.

## Discussion

To our knowledge, the only reported instance of bladder perforation leading to immediate intraoperative complications during a THA came as the result of bladder entrapment secondary to previous pelvic trauma [10]. Similarly, an intraoperative bladder perforation has been reported by Grauer et al. in 2014 [9]; however, this case occurred during a revision THA as a result of adhesions from the primary operation. That patient underwent a revision surgery for component loosening and femur trauma to definitively correct the acetabular cup and femoral stem. The authors theorize that mechanical or thermal injury to the base of the pelvis in prior surgeries had caused adhesions to form between the acetabulum and bladder. On removal of the prosthetic acetabulum for revision, a tear was produced in the bladder. Definitive treatment was to maintain Foley decompression for 6 weeks with prophylactic antibiotics. The bladder was able to seal itself and there was no longer a communication between the urinary tract and hip joint [9].

Damage to the urogenital track, and the consequences thereof, generally have a delayed clinical presentation and do not present intraoperatively. A 1978 case series of 4 patients by Greenspan and Norman [7] studied gross hematuria in patients who sustained urogenital injury after THA. The authors theorized that the heat

generated by the exothermic polymerization of the methylmethacrylate cement caused damage to the iatrogenically thinned medial wall leading to intrapelvic cement extension and bladder injury. The average delay in symptom manifestation was 9.75 days (range 7-14 days), with all cases demonstrating intrapelvic cement extension [7]. Similarly, a 2006 case report by Kaldenbach and Roth [6] describes a patient with bladder injury secondary to intrapelvic cement extension 11 years after THA.

A 2002 meta-analysis by Bach et al. included 50 case reports of post-THA intrapelvic injury and included injury to vessels, urogenital tract, intestinal tract, nerves, and damage associated with intrapelvic mass formation [8]. The most frequent postoperative complication involved intrapelvic vessels (22 cases), but injury to the urogenital tract was cited as the second most common complication (17 cases). Of these 17 cases, the bladder was the most frequently affected structure (13 of 17 cases). The most commonly cited complication was vesicoacetabular fistula formation, and the average delay of onset was 82 months between surgery and complication manifestation. Hematuria was also a commonly presenting symptom. The mechanisms of injury most commonly cited were intrapelvic cement extension, which secondarily eroded into the bladder (10 of 17 cases), and cup migration (5 of 17 cases) [8].

One commonly cited mechanism of injury to the genitourinary system is a result of an insidious migration of hardware into the bladder. A 1983 case series by Wheeler et al. [3] describes a congenital hip dysplasia patient who underwent THA at age 21 years. During the original procedure, K-wires were used to stabilize an acetabular bone graft. One of these wires was removed a year later after migrating through the skin. The next year, a second K-wire was found to have penetrated several inches into the pelvis and was removed surgically before it could injure the bladder [3]. Similarly, a 2001 case report by O'Sullivan et al. [4] summarized the only instance in which a prosthetic acetabulum migrated fully into the bladder. An uneventful THA was performed 2 and 7-years following radiotherapy for the treatment of ovarian cancer. At 12 years follow-up, the patient had a 4-month history of cystitis and urinary tract infection. Retrospectively reviewed sequential radiographs depict the migration of the acetabular component. The authors attribute this protusio to repeated radiation of the pelvis and subsequent weakening of the irradiated bone [4].

Perioperative perforation of the bladder during THA has been previously described related to aberrant screw or wire placement; however, the complications of which developed well after the surgery. A 1999 case report by Kinmont [2] describes a revision THA with a hydroxyapatite-coated cup. For stability, two cancellous screws were placed, but one of these screws was found to protrude 14 mm into the medial pelvic wall secondary to reduced bone depth in the anterior pelvic quadrants. The patient developed a resistant urinary tract infection 4 weeks after surgery, eventually deteriorating into septic shock [2].

Although the patient in this case initially appeared to present no overt risk for intraoperative bladder injury, *post hoc* analysis of preoperative imaging does appear to demonstrate idiopathic erosion of the quadrilateral space, and thus a possible danger of intraoperative bladder damage. Recognition of this poor bone quality should initiate preoperative decompression of the bladder and close vigilance during acetabular reaming.

## Summary

Patients at elevated risk for intra- and postoperative bladder perforation include patients undergoing THA with cemented acetabular components, history of previous pelvic trauma, previous ipsilateral THA, previous intrapelvic surgery, previous intrapelvic radiation, and poor bone quality. Patients with elevated risk for bladder perforation should be thoroughly screened. Preoperative evaluation should include standard anteroposterior and lateral radiographs of the hip and pelvis, and a detailed urologic history. The orthopaedic surgeon should have a lowered threshold for ordering CT pelvis to evaluate for aberrant anatomy, thinning of the pelvic floor and cotyloid fossa, when indicated. If abnormal vesicourethral anatomy is suspected, a urologic evaluation should be obtained for possible further imaging, such as cystogram.

For patients with an elevated risk of bladder perforation, a Foley catheter should be placed to allow for perioperative decompression. If a sudden release of fluid into the acetabulum is experienced during the procedure, particularly during reaming, close hemodynamic monitoring should aide in the differential diagnoses of vesicourethral perforation vs vascular compromise. If vesicourethral perforation occurs, intraoperative urologic consultation should be considered.

Patients should be closely monitored postoperatively if an intraoperative bladder perforation occurs, or if the patient is suspected of having an increased probability of thermal damage, adhesion formation, hardware migration, or cement extrusion. In the case of vesicoacetabular fistula formation, postoperative prophylactic antibiotics covering Gram-negative bacteria should be considered and a urology referral should be placed. The orthopaedic surgeon should continue to monitor the patient at regular intervals (2 weeks, 3, 6 months, and yearly follow-ups) to monitor for hardware migration and signs of infection.

This patient's medical history exhibited no risk factors for bladder perforation and would not have warranted additional work up for anatomic aberrations. However, in the era with decreased use of Foley catheters secondary to well documented increases in infection, especially in primary arthroplasty, there is possibly a role for ensuring the patient urinates immediately preoperatively, or performing a straight catheterization before periacetabular procedures. This is especially the case if the bone quality composing the quadrilateral space appears compromised.

In planning for THA, the orthopaedic surgeon must be able to recognize patients who are at elevated risk of both peri- and postoperative perforation of the bladder. In addition, the orthopaedic surgeon must understand how to diagnose and treat this rare complication.

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