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Multidisciplinary approach to the treatment of patients with periprosthetic joint infection of the hip complicated by injury to the great vessels

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Abstract

Introduction Total counts of total hip arthroplasty (THA) have been increasing for several decades, and the procedures are associated with considerable risk of intra- and postoperative complications. Vascular complications are defined as multiple pathological conditions. They are subdivided into acute adverse events such as intraoperative bleeding, acute ischemia and hematoma and chronic complications such as pseudoaneurysms and arteriovenous fistulas which can cause late ischemic events. A specialized and well-trained multidisciplinary team is required to perform surgical interventions due to the small number of intravascular lesions. The objective was to demonstrate findings of clinical, instrumentation methods and staged treatment of patients with periprosthetic joint infection (PJI) of the hip and complications associated with injury to the great vessels. **Material and methods** We report two cases of vascular complications in patients with PJI and migration of femoral components into the lesser pelvis. **Results** An integrated approach to the diagnosis and treatment of patients with PJI and complications associated with injury to the great vessels helped to avoid lethal outcomes of the Girdlestone operation. **Discussion** Revision THA requires careful planning and an interdisciplinary approach with the help of a clinical pharmacologist, microbiologist, plastic or angiosurgeon. PJI is associated with a high risk of recurrence that would require two-stage, three-stage surgical interventions. With the bone deficiency of the acetabulum and the proximal femur the Girdlestone operation is performed as the final procedure with resultant significant decrease in the functional adaptation of patients. **Conclusion** Careful preoperative preparation of patients with unstable hip replacement components including migration of the acetabular component into the pelvic cavity and associated PJI would help to avoid such a devastating complication as great vessel injury.

Keywords: revision arthroplasty, vascular injury, periprosthetic joint infection of the hip, Girdlestone operation

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INTRODUCTION

Vascular injury following primary and revision total joint replacement is relatively rare with a reported incidence rate of 0.2 % and cab be associated with adverse consequences for the patient and can lead to amputation or death [1-4]. In 1990, A. Norman et al. reviewed retrospectively the experience of five cases of vascular injuries with total joint replacement and cases in the literature with a limited English-language Medline search. There were 63 cases of vascular injury associated with total hip arthroplasty. Risk factors included revision procedures, left-sided procedures, and intrapelvic migration of the acetabular component of the hip prosthesis [5].

The study performed by J. Parvizi et al in 2008 evaluated the circumstances, frequency, nature and outcomes related to vascular injuries after hip and knee arthroplasty. Eleven injuries occurred after total knee arthroplasty (TKA) and 5 after total hip arthroplasty (THA). Indirect injury was the most common mechanism in TKA. In contrast, direct injury was most prevalent in THA [6]. Diagnostic imaging including radiography of the pelvis with anteroposterior, lateral and oblique views, CT scan in angiomode, MRI of the small pelvis, angiography of small pelvic vessels is practical for revision arthroplasty in cases of prolapse of the acetabular component and defects of the acetabulum. Instability of the hip implant can be caused by infection in the joint area, impaired implantation technique, lack of specialized surgical care and dysplastic coxarthrosis [7].

The combination of deep periprosthetic joint infection and migration of the acetabular component into the pelvis is associated with a high risk of injury to intrapelvic vessels [8, 9].

The etiology and clinical presentation of acute vascular lesions in THA can range from mechanical compression to thermal cement injury, from placement to removal of retractors and components

(the acetabulum, in particular) or from hypovolemic shock, from pulsatile bleeding to progressive hypotension, limb ischemia, pain or pseudoaneurysms [8]. Vascular injury can be treated by iliofemoral, femoral-femoral bypass, primary vascular plasty, thrombectomy, embolectomy and/or ligation [5]. Early diagnosis and treatment of intraoperative vascular lesions can be produced in a high-level institution with the availability of experienced orthopaedic surgeons, qualified anesthesiologists and vascular surgeons to perform both endovascular and open procedures [10]. The objective was to demonstrate findings of clinical, instrumentation methods and staged treatment of patients with periprosthetic joint infection (PJI) of the hip and complications associated with injury to the great vessels.

MATERIAL AND METHODS

We report two cases of vascular complications in patients with PJI and migration of hip replacement components into the pelvic cavity. In the preoperative period, patients underwent laboratory (CBC, microbiological and histological examination of intraoperative material) and instrumentation studies (radiography of the pelvis, duplex scanning of the vessels of the lower extremities, CT angiography). The material was not submitted with the Ethics Committee, since the clinical cases were analyzed retrospectively, and the treatment was covered with compulsory heath insurance. Informed consent for the treatment of patients was signed during hospitalization.

Case report 1

Patient S., born in 1967, was admitted to the Trauma and Orthopaedic Department of the Moscow Regional Research and Clinical Institute (MRRCI) on February 8, 2018 and diagnosed with chronic osteomyelitis of the bones forming the hip joint, severe destruction of the acetabulum and femur on the left, PJI of the left hip, unstable and dissociated implant components, protrusion of the acetabulum, combined defect of the left acetabulum, right-sided dysplastic coxarthrosis.

Her past medical history included total hip arthroplasty on the left joint and shortening osteotomy of the femur offered by T. Paavilainen performed on April 17, 2014 due to dysplastic coxarthrosis. The postoperative period was uneventful. She fell at home on June 6, 2014, felt a sharp pain at left hip that resulted in limited range of motion. X-ray of the left hip joint was performed at the place of residence and showed dislocated implant and dislocated greater trochanter. Open reduction of the dislocation and osteosynthesis of the femur were performed on June 18, 2014. She developed a pronounced pain and limited ROM in the left hip in 2016. She developed fistulous tract with abundant serous discharge in December 2017 and was admitted to the Central District Hospital at the place of residence. She was treated conservatively and had a temporary positive effect. The fistula tended to close. Then her body temperature rose to 38 degrees. Bacteria was not identified with bacteria culture test at the place of residence. She was admitted to the of Trauma and Orthopaedic Department for surgical treatment due to the recurrent PJI. X-ray showed protrusion of the pelvis with the acetabular component, craniomedial migration and a combined acetabular defect. Contrast-enhanced CT scan demonstrated the neurovascular bundle intimately attained to the migrated acetabular component.

An operation was performed on February 21, 2018 with the help of angiosurgical team. Pirogovsky's retroperitoneal access to the neurovascular bundle was performed on the first stage. The iliac arteries and veins were sequentially released, displaced laterally off the migrated acetabular component. The dome of a metal cup stood out with the cavity of the small pelvis with the component being stable. The cup was separated from the bone with revision chisels and removed through the pelvic access. Then the proximal femur was exposed using the lateral access to the left hip and the fistulous tract excised. A fragment of the greater trochanter was mobile. A release was produced with the implant being deep in the pelvis and the absence of the hip gap and the anterior cavity defect could be visualized. Partial osteotomy of the superior edge of the acetabulum was produced and the iliac body sawn through. The metal head was knocked off the implant cone. The femoral component was destabilized with the revision chisel and removed. The metal head was removed from the cavity. The proximal femur was placed at the entrance to the acetabulum and iliofemoral neoarthrosis formed, the joint stabilized due to the plasty with local tissues. The wound was drained. The wound of the hip and inguinal region was sutured. The operating time was 5 hours 50 minutes. The blood loss was 600 ml.

The patient was transferred to the intensive care unit after the operation. The patient developed severe

pain of the left lower limb on February 22, 2018. She had decreased sensitivity in the left leg and the foot with no pulsation on a. d. pedis. DUSS + CFM performed for the arteries of the lower limbs showed thrombosis of the femoral artery on the left. The patient was urgently taken to the operating room.

An operation performed on February 22, 2018 included thrombectomy from the femoral artery, reconstruction of the deep femoral artery. Pulsation on a. d. pedis was distinct. The control DUSS + CFM showed the great blood flow. Fasciotomy of the left leg was performed on February 22, 2018 to prevent ARF. Plasmapheresis was performed considering the high level of myoglobin (more than 1000). Anticoagulant therapy, local treatment of postoperative wounds, antibiotic therapy (cefoperazone-sulbactam, linezolid) were administered for the patient. She was transferred to the Trauma and Orthopaedic Department on February 24, 2018. The patient developed a decreased level of myoglobin to normal values. Creatinine and urea levels did not increase over time. The drains were removed at the sites of vascular accesses. The drainage was removed from the site of the left hip joint on February 27, 2018. Bacteria was not identified with intraoperative bacteria culture test.

The patient was postoperatively diagnosed with compression-ischemic neuropathy of the sciatic, peroneal and tibial nerves on the left and severely impaired motor function. The patient had neuropathic pain.

Local treatment of postoperative wounds was produced at the Trauma and Orthopaedic Department MRRCI included immobilization of the left lower limb with a derotation boot cast, antibiotic therapy (cefoperazone-sulbactam 2 g / 3 times/day, linezolid 600 mg/2 times/day), anticoagulant therapy (bemiparin sodium 0.6 U 1 time/day), antihypertensive therapy (amlodipine 10 mg 1 time/day, Enap 5 mg 2 times/day, acetylsalicylic acid 100 mg 1 time/day, therapy prescribed by a neurologist, pain relief, prevention of bedsores, prevention of congestion in the lungs, and exercise therapy The patient was activated and instructed to walk using a walker (Fig. 1, 2).

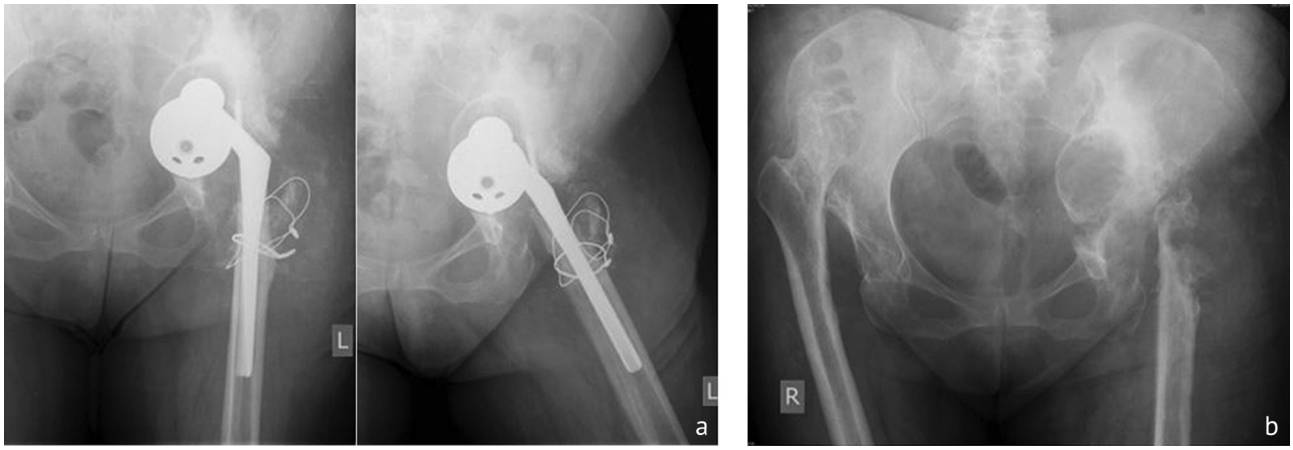

Fig. 1 Radiographs of the pelvis of patient S. diagnosed with unstable and dissociated components of the hip implant on the left and protrusion of the acetabulum, a combined defect of the left acetabulum, right-sided dysplastic coxarthrosis: (*a*) preoperatively; (*b*) postoperatively

Fig. 2 Radiograph of the pelvis of patient S. one year after the Girdlestone operation

Case report 2

Patient Sh., born in 1954, was admitted to the Trauma and Orthopaedic Department of MRRCI on November 26, 2020 and diagnosed with the reinforcing construct migrated into the pelvic cavity, instability and destruction of the Burch-Schneider protrusion ring flange and PJI of the left hip. The patient had concomitant pathology: hypertension stage 2, risk 3, gastric ulcer, remission, superficial gastritis, without exacerbation, posthemorrhagic anemia.

Her medical history included total hip arthroplasty on the left performed at the Federal Center for coxarthrosis of the left hip joint in 2006. Postoperative period was uneventful. She developed pain in the left hip joint in 2010. She sought no medical care. Instability of the acetabular component was radiographically detected in 2012. Revision THA and placement of a reinforcing construct on the left was performed at the same hospital in 2013 due to instability of the acetabular component and a large cavity. She developed fistulous tract with serous-purulent discharge at 2 weeks. The patient was treated conservatively, and the fistula closed in a month. The pain persisted and she walked with crutches from 2013 to 2020. She sought no medical care. The patient came to a local hospital at the place of residence on October 14, 2020 because of pain in the left hip. She was treated as an outpatient with a puncture of the left hip with a large amount of hemorrhagic fluid evacuated and recommended supervision of a traumatologist at the place of residence. She was hospitalized to the Central District Hospital for anemia on October 25, 2020 and treated conservatively with, transfusion of erythrocyte mass with no positive dynamics. She was transferred to the trauma department with PJI of the left hip joint on November 6, 2020. The abscess was exposed and drained. Antibiotic therapy, local treatment was conducted. Esophagogastroduodenoscopy of 11/17/2020 exhibited gastric ulcer, and esophagogastroduodenoscopy of 11/24/2020 showed superficial gastritis. The patient was transferred to the Trauma and Orthopaedic Department of MRRCI on November 26, 2020 and underwent ultrasound examination of the vessels of the lower limbs and CT scan of the pelvis in angio mode. Additional examination indicated injury to the extrenal iliac artery, ileofemoral thrombosis on the left and operation was performed for emergency indications on November 27, 2020. The team of vascular surgeons performed right-to-left femoral-femoral shunting, the left external iliac artery (LIA) was ligated and sutured from the lumbotomy access at the site of the posterior wall defect at the first stage. Then the orthopaedic team removed the reinforcing construct of the acetabulum on the left. The stable stem on the left was not removed considering the operating time and to avoid blood loss. The operating time was 6 hours 10 minutes. Blood loss measured 1300 ml. Intraoperative culture indicated *P. Mirabilis*. Postoperative treatment included local care of the wound, antibiotic therapy (tigecycline from 11/28/2020, cefoperazone-sulbactam from 12/03/2020), thromboprophylaxis (heparin from 11/28/2020 to 12/2/2020, eliquis 5 mg × 2 times/day from 12/02/2020, aspirin since 03.12.2020), infusion and exercise therapy.

Ultrasound examination of the vessels of the lower limbs performed on December 1, 2020 showed the blood flow on the left being closer to the great flow and ileofemoral thrombosis of the left lower extremity being persistent. The patient developed a recurrent PJI of the left hip and was admitted to the Trauma and Orthopaedic Department of MRRCI on July 12, 2022 for removal of the femoral component with supporting neoarthrosis being formed. The culture indicated *S. aureus*. The operation performed on July 15, 2022 included extended trochanteric osteotomy of the left femur, removal of the stable femoral component on the left, thorough surgical debridement of the septic inflammation, stabilization of the joint with local tissues and formation of iliofemoral neoarthrosis. Local treatment of the postoperative wound, antibiotic therapy (clindamin 600 mg × 3 times a day; ciprofloxacin 400 mg × 2 times a day), thromboprophylaxis (parnaparin sodium 0.4 U × 1 time per day), infusion-transfusion therapy, exercise therapy were administered postoperatively. The patient could use walkers (Fig. 3).

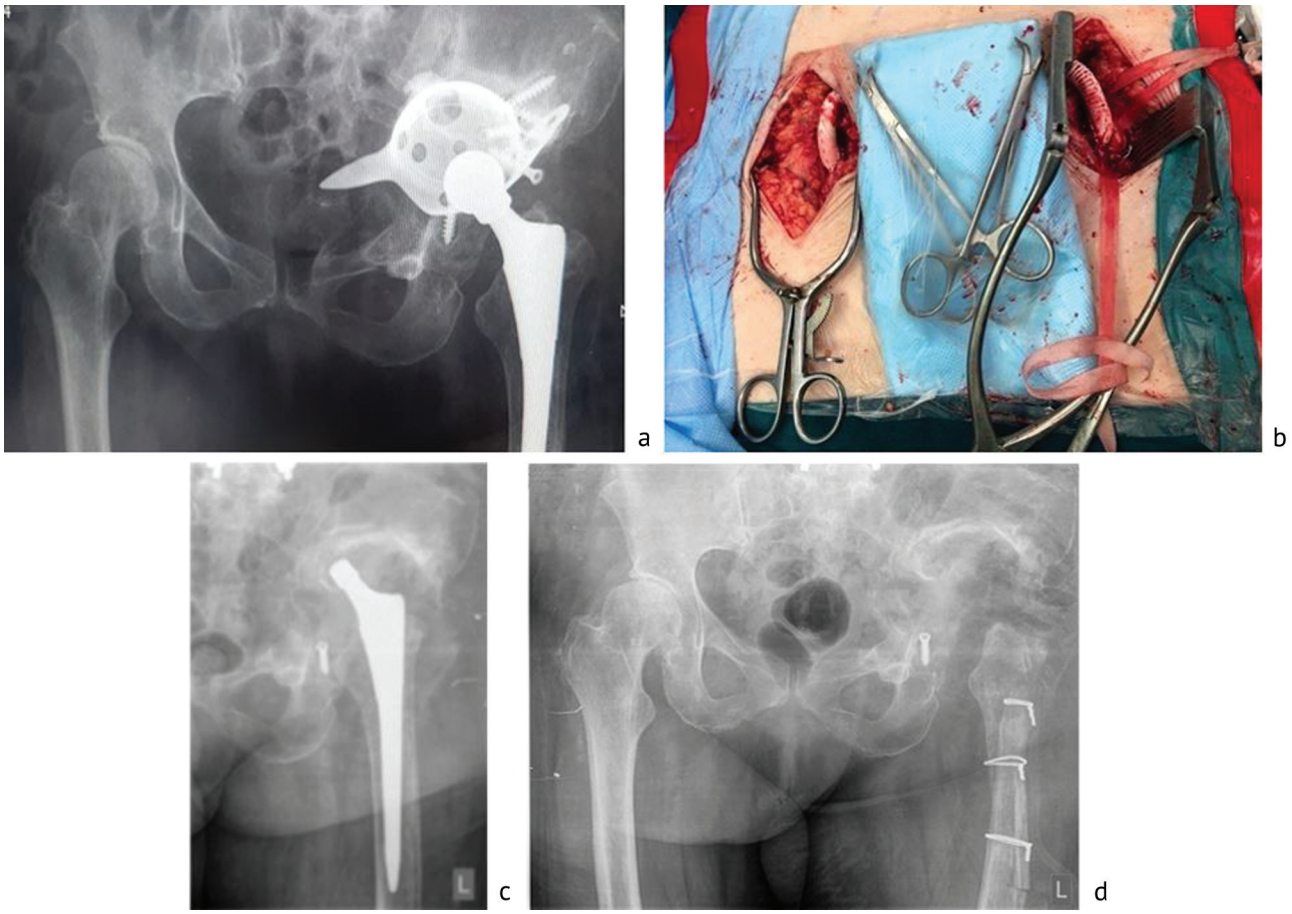

Fig. 3 Intraoperative photo and radiographs of the pelvis of patient Sh., born 1954 diagnosed with the reinforcing construct migrated into the cavity of the small pelvis, instability and destruction of the flange of the Burch-Schneider protrusion ring, condition after primary THR on the left in 2006, revision THR of the left hip in 2013: (*a*) preoperatively; (*b*) femoral-femoral right-to-left shunting; (*c*) incomplete removal of the implant components; (*d*) after removal of the stable femoral component on the left, final debridement and stabilization with soft tissues

RESULTS

The inflammatory process was arrested in the first clinical case, in patient S. born in 1967 with stable remission achieved. The patient had no opportunities for revision arthroplasty of the left hip due to severe loss of bone tissue, high risks of recurrent PJI, persistent neuropathy of the sciatic, peroneal, tibial nerves on the left. The patient continued to walk using a walker and received a course of rehabilitation treatment. Another patient Sh. born in 1954 had the inflammatory process arrested at the point. Revision arthroplasty could be associated with a high risk of recurrent PJI, massive bone defects in the acetabulum and proximal femur on the left. The patient continued rehabilitation treatment.

DISCUSSION

Revision THA is a procedure that requires careful planning and a multidisciplinary approach. Vascular complications in primary and revision THA can lead to patient disability or death [11]. The prevalence of vascular complications is reported as high as 0.25 % [12]. Vascular injuries are twice as common in females and most commonly affect the left external iliac artery (48 %) or the femoral artery (23 %).

Injuries consisted of thromboembolic complications leading to distal ischemia (46 %), vessel lacerations (26 %), pseudoaneurysms (25 %), and arteriovenous fistulas (3 %) [5]. With protrusion of the acetabulum, there is a risk of damage to the anatomical structures in the pelvic cavity caused by the migration of the acetabular component, cement, or even the head and stem of the implant. This is usually seen in acetabular defects classified as type III B by Paprosky [13]. A revision arthroplasty of the hip joint with an additional abdominal access is an optimal method of managing acetabular protrusion into the pelvic cavity that cannot

be managed by conventional reduction [14]. The iliac crest incision (Letournel-Judet) is the typical approach recommended in the literature. Then, the iliac muscle is dissected maintaining the integrity of the subperitoneal structures [15]. In the two cases reported, preoperative X-ray and CT scan in an angio mode were performed to rule out/confirm an injury to the external iliac artery. There was an intimate attachment of the neurovascular bundle to the migrated acetabular component in the first case. An injury to the external iliac artery was reported in the second case.

Vascular surgery interventions consist of bypass grafting, primary repair, thrombectomy, embolectomy, and/or ligation [16]. In the first clinical case, the patient developed arterial thrombosis of the femoral artery after removal of endoprosthetic components in the early postoperative period. Fasciotomy and plasmapheresis are performed after thrombectomy of the femoral artery due to ileofemoral thrombosis, in order to avoid acute renal failure and compartment syndrome [17]. Right-to-left femoral bypass was used in the second clinical case, for a patient with an injury to the external iliac artery with the left external iliac artery ligated and sutured using the lumbotomy approach. Surgical treatments of acetabular protrusion have changed over the years along with the development of technology and the acquisition of surgical experience. There are several reconstruction options being available to surgeons that were much less common ten or fifteen years ago with the effectiveness of the use having been investigated and discussed at that time [14, 18]. However, PJI has an extremely high risk of recurrence, requiring two-stage, three-stage surgical interventions. The Girdlestone operation can be recommended at the final stage with deficient acetabular bone and proximal femur and lead to a significant decrease in the functional adaptation of patients [19].

CONCLUSION

Thorough preoperative preparation of patients with unstable components of the hip implant including the acetabular component migrated into the pelvic cavity in combination with PJI is practical for avoiding such a devastating complication as injury to the great vessels. The patients should be treated in a multidisciplinary medical institution involving specialists in purulent osteology, vascular surgeons, anesthesiology-resuscitation, imaging diagnosis, endovascular surgery and clinical pharmacology.

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Shevyrev K.V. – surgical treatment, editing.
Martynenko D.V. – analysis and interpretation of the obtained data, editing.
Galkin A.G. – analysis and interpretation of the obtained data, editing.
Larkov R.N. – surgical treatment, editing.
Kolesnikov Yu.Yu. – surgical treatment, editing.
Zagarov S.S. – surgical treatment, editing.
Ostanin P.E – editing the material, preparing the text.