



Traumatic necrosis of femoral head: a case report

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Abstract: Avascular necrosis of the femoral head is a common and challenging orthopedic disease. Clinically, it is divided into traumatic avascular necrosis and non-traumatic avascular necrosis. Traumatic avascular necrosis of the femoral head is often caused by hip trauma, and the risk of necrosis is positively correlated with the severity of the trauma and the delay in treatment. Here, we report the diagnosis and management of a case of complex traumatic avascular necrosis of the femoral head in a 64-year-old male, with the hope that this case can provide a reference for clinicians in dealing with similar severe post-traumatic femoral head necrosis.

Keywords: traumatic necrosis of femoral head; total hip replacement; infection prevention and control

1. Introduction

Osteonecrosis of the femoral head (ONFH) is a common and challenging disease in the field of orthopedic joint surgery. The pathogenesis and causes of ONFH are diverse and complex[1]. Epidemiological surveys indicate that the incidence of ONFH is increasing year by year[2].

At present, the etiology of ONFH is not completely clear, and ONFH is habitually divided into traumatic and non-traumatic types in clinic, both of which focus on "blood supply disorder of femoral head" [3]. Among them, traumatic-induced osteonecrosis of femoral head accounts for about 20%-30%. In recent years, the incidence of TIONFH is also increasing year by year. It is mainly caused by the interruption of blood supply to the femoral head caused by direct or indirect trauma. Common causes include femoral neck fracture, dislocation of hip joint, acetabular fracture, pelvic fracture, etc. The severity of trauma and treatment delay time are positively correlated with the risk of necrosis [4-5].

2. Case report

The patient, a 64-year-old male worker, was admitted to the hospital on November 17, 2023 because of "left hip pain caused by traffic accident trauma and limited activity for 3 hours". Physical examination: The patient was conscious, with acute face, passive posture, limited movement of left hip joint, adduction and pronation deformity. Imaging examination: pelvis X-ray (Figure 1) and pelvis CT plain scan+three-dimensional reconstruction: left acetabular and ischial fractures with left hip dislocation (Figure 2). Diagnosed as 1. Left pelvic fracture; 2. Left acetabular fracture; 3. Dislocation of left hip joint. On November 23rd, 2023, under general anesthesia, open reduction and internal fixation of acetabular posterior wall fracture and external rotation muscle group suture of hip joint were performed. After 2cm below the left posterior superior iliac spine to the greater tubercle of femur, a surgical incision with a length of about 20cm was taken distally along the femur to expose the acetabular posterior wall. See comminuted fracture of posterior wall, with 3 large free bone pieces, several small free bone pieces and 1 free bone piece at the bottom of the quadrilateral. Clean up the fracture end, and see local compression fracture under the femoral head. And dislocated backward and upward, with multiple free bone blocks in acetabulum, stripped below to expose ischial tubercle, protecting sciatic nerve, exposed iliac bone above, reset larger free bone block, fixed with mousse thread after drilling, shaped calcaneal bone plate, fixed with 2 screws at the top of acetabulum, fixed with 2 screws at the proximal end and iliac bone, reset with 1 screw at the bottom of quadrangle, shaped bone plate, fixed with 2 screws at the distal end of ischial tubercle and 2 screws at the proximal end to iliac bone. Postoperative follow-up, the patient reported that there was pain in the left hip joint four months after operation, and the pain was confined to the hip joint area. The pain was aggravated during weight-bearing activities, and there was no radiation pain. The pain symptoms tended to increase gradually and the mobility of the hip joint decreased. The patient failed to reexamine according to the prescribed time, and X-ray film (Figure 3) and pelvic CT plain scan+three-dimensional reconstruction showed that the left femoral head was unclear after 10 months of operation (Figure 4). Diagnosis: Necrosis of femoral head after trauma. On October 12, 2024, it was planned to take out the pelvic internal fixation device and total hip replacement under epidural anesthesia.

Incision was made in the original surgical incision to expose the internal fixation bone plates and screws, and 9 screws and 2 bone plates were removed. Through fluoroscopy, the internal fixation was completely removed, and liquid necrotic substances in the acetabulum and around the femoral head were found. Considering the suspected low-toxicity chronic infection, the surgical plan was changed during the operation, and the pelvic internal fixation device was removed and the hip joint antibiotic cement placeholder was placed (Figure 5). Bacteria were cultured in different positions in three incisions, and vancomycin was mixed with bone cement. After stirring, it was filled in the acetabulum, and the wound was washed to stop bleeding completely. A negative pressure drainage tube was placed in the wound, and the wound was sutured layer by layer, wrapped with sterile dressing, and traction was performed on the supracondylar bone of femur. After the operation, he returned to the ward safely. After operation, the patient was given cefazolin sodium by intravenous prophylaxis, and the return of bacterial culture on the third day after operation suggested that it was negative. After dressing change, the incision healed well, and the preventive use of antibiotics was stopped. Fourteen days after stopping using antibiotics, the hip joint effusion was punctured under the guidance of ultrasound, and bacterial culture was carried out. The results showed that it was negative, and the inflammatory indexes in the laboratory were within the normal range, so the infection was ruled out. Pelvic ct scan was performed with a density of 0.5 mm, DICOM format data were copied, and the data were imported into image processing software to build a 3D model, and the preoperative acetabular reconstruction was simulated (Figure 6-7). Total hip replacement was performed under epidural anesthesia on November 8, 2024. Take the posterolateral approach of hip joint, take out the antibiotic bone cement retained in the previous operation, and take 10ml of joint effusion for bacterial culture. Clean the articular capsule and soft tissue at the edge of acetabulum, grind the acetabulum after the acetabulum moves inward and locates, so that the acetabulum wall oozes blood. After determining the size, drive the acetabulum prosthesis into the true acetabulum, strengthen the fixation with a long nail and two short screws, and install the lining. The femoral end was reamed and reamed, the femoral stem prosthesis was driven, the ceramic femoral head prosthesis was installed and the hip joint was reset. The joint cavity was rinsed again, and the drainage tube was placed. The abductor muscles of the patient's hip were damaged due to trauma and repeated operations. Two polyetheretherketone belt anchors were used to suture and reconstruct the abductor muscles. Suture the skin layer by layer, and wrap it with alcohol and sterile auxiliary materials. The patient returned to the ward safely after operation. Postoperative patients were treated with cefazolin sodium and rifampicin capsules. He can get out of bed and walk on crutches on the second day after operation. During the 6-month follow-up after operation, the patient did not have symptoms such as hip discomfort (Figure 8).



Figure 1. Admission X-ray examination



Figure 2. Admission CT examination



Figure 3. Follow-up X-ray



Figure 4. Follow-up CT



Figure 5. After taking out the internal fixation device

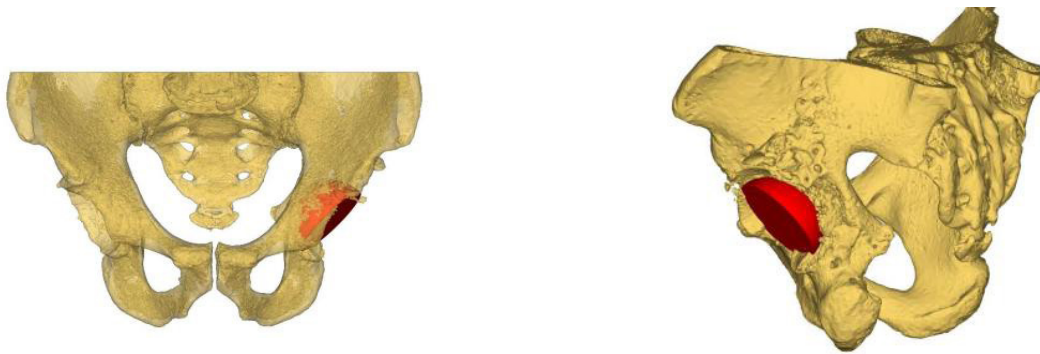


Figure 6-7. Simulation of acetabular reconstruction before operation



Figure 8. After total hip replacement

3. Discussion

TIONFH is a common complication caused by hip trauma in orthopedic clinic, and its diagnosis and treatment logic closely revolves around the chain of "trauma-ischemia-necrosis-repair". At present, most scholars believe that the essence of the disease is "the process of blood supply-dependent necrosis driven by trauma". The core pathological feature of TIONFH is that hip trauma directly or indirectly destroys the blood supply of femoral head and causes ischemic necrosis of bone tissue, which is significantly different from the "multi-factor superimposed injury" mechanism of non-traumatic femoral head necrosis (such as hormonal and alcoholic) [6-7]. After the blood supply is damaged, the period of ischemia and hypoxia (0-2 weeks): the metabolism of bone cells and bone marrow stromal cells is disordered at first, but the trabecular structure of bone has not changed significantly. Progressive stage of necrosis (2-12 weeks): Ischemia continuously leads to the imbalance of osteoblast and osteoclast activity around trabecular bone, and osteoclast excessively absorbs bone matrix, and trabecular bone gradually breaks and dissolves, meanwhile, adipocyte proliferation and fat embolism in bone marrow cavity further oppress microcirculation, forming a vicious cycle of "ischemia-embolism-more ischemia". The final stage of collapse (6-12 months): When the area of trabecular disintegration exceeds 30% of the weight-bearing area of the femoral head, the subchondral bone support of the femoral head decreases, and collapse occurs under the weight load (mostly in

the anterolateral weight-bearing area of the femoral head). At this time, the cartilage surface ruptures and the joint space narrows, which eventually develops into secondary osteoarthritis. The patient suffers from persistent hip pain and limited hip joint activity (the flexion and extension range is reduced to less than 90, and abduction is more limited). Clinical data show that the fracture line of femoral neck fracture is easy to involve the branches of the main blood supply artery of femoral head-medial femoral circumflex artery (such as femoral head ligament artery and metaphyseal artery). When the fracture displacement exceeds 3mm, the continuity of the intra-capsule arterial network is completely destroyed, the blood supply interruption rate can reach above 85%, and the incidence of TIONFH is 10%-30%. After dislocation of hip joint, the femoral head moves backward and upward, which will directly pull or tear the femoral head branch of lateral femoral circumflex artery, accompanied by tearing of joint capsule, further aggravating the blood supply obstacle. The incidence of TIONFH climbs to 20%-40%, and if the dislocation lasts for more than 12 hours, the probability of blood supply recovery will be reduced by 50%. This confirms the law that "the intensity of trauma, the degree of blood supply damage and the timeliness of treatment directly determine the outcome of necrosis" [8-9]. The acetabular fracture combined with dislocation of left hip joint greatly increased the risk of femoral head necrosis after postoperative trauma.

In this case, most patients with TIONFH have a history of hip surgery, and there may be occult low-toxic infection (such as *Staphylococcus epidermidis* infection) locally, but THA has poor tolerance to infection. If infection is not ruled out before operation, the incidence of infection after prosthesis implantation can reach 5%-10%, which may easily lead to prosthesis loosening, sinus formation and even require multiple surgical debridement [10-11]. For the prevention and control of complications, especially infection, it is difficult to completely eliminate infection only by inflammatory indicators such as blood routine, C-reactive protein (CRP) and ESR, and joint fluid stab culture and ultrasound-guided tissue biopsy are needed [12]. Therefore, during the operation, the patient temporarily changed the operation mode, placed a placeholder of antibiotic bone cement in the hip joint, and further ruled out the infection and then underwent total hip replacement.

4. Conclusion

It is suggested that a stratified long-term follow-up mechanism should be established, and a personalized follow-up plan should be made according to the severity of trauma: high-risk groups (such as patients with femoral neck fracture and dislocation of hip joint): regular follow-up at 1 month, 3 months, 6 months and 12 months after operation, with MRI+ clinical symptom evaluation of hip joint as the main task in the first 6 months, and X-ray film after 6 months; Middle-low risk population (patients without displaced femoral neck fracture and hip soft tissue injury): 3 months, 6 months and 12 months after operation, X-ray film and clinical symptom evaluation are the main methods, and MRI of hip joint should be added in time if the hidden pain of hip becomes worse. If the patient needs hospitalization, make dynamic decision before and during operation, and break through the "fixed diagnosis and treatment mode". I hope this case can provide reference for clinicians to deal with the same kind of femoral head necrosis after severe trauma.

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