Infectious Diseases in Hip Joint

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9.1 Suppurative Arthritis of the Hip Joint

Suppurative arthritis refers to the joint suppurative inflammation caused by various pathogenic bacteria. Suppurative arthritis of the hip joint is a serious joint infection that often occurs in infants and adolescents. In recent years, the adult incidences of suppurative arthritis (especially in the elderly) are gradually increasing, account for more than 50% of suppurative arthritis, adults often occur in immunocompromised, alcoholism, diabetes, sickle cell anemia, lupus erythematosus, intravenous drug users, and rheumatoid arthritis. Due to the deep location of the hip joint and abundant surrounding muscles, children are often uncooperative for physical examination. The nerve that dominates the hip is multi-source. The symptoms vary widely, which often lead to misdiagnosis and mistreatment. If not recognized and treated properly the disease can cause stiffness of the joints and even disability.

Acute suppurative hip infection in children is more severe than in adults, and serious complications are more common in children. In many patients, infection begins at the metaphysis or epiphysis and then spreads into the hip joint. Due to the special blood supply to the femoral head, the suppurative infection of the hip joint significantly increases the risk of ischemic necrosis of the femoral head. In children, suppurative arthritis of the hip joint leads to epiphysis separation of the femoral head. If hip joint infection occurs in infants and is not diagnosed and treated promptly, it may cause pathological dislocation. Therefore, the hip should remain in the abducent position to reduce the risk of pathological dislocation. Bilateral suppurative arthritis of the hip joint is more common than other joints, occasionally accompanied by spinal infection. In recent years, the incidence of acute hematogenous osteomyelitis and suppurative arthritis has decreased, clinicians are less alert to this disease. Misdiagnosis and mistreatment can lead to serious consequences.

9.1.1 Etiology

The most common pathogenic bacteria in the clinic is *Staphylococcus aureus*, accounting for more than 75%. Next is hemolytic *Streptococcus*, white *Staphylococcus*, *Escherichia coli*, parenteral *Escherichia coli*, pneumococcus, and influenza *Bacillus*, etc. Infant suppurative arthritis is mostly hemolytic *Streptococcus* infection. Young children are mostly infected with *Staphylococcus aureus*. By the spread of osteomyelitis on the upper end of femur, most of them are caused by *Staphylococcus aureus*. Therefore, when cultivating *Staphylococcus aureus* in the joint solution, we should pay attention to whether it is coming from osteomyelitis. Both diseases present with severe symptoms.

Bacteria invade the joints in the following three ways. (1) Hematogenicity: there is a focal point of infection somewhere in the patient's body, such as furuncle swollen, abscess, wound infection, otitis media, respiratory tract infection, and infection of neonatal umbilical cord. If the focal do not handle promptly or properly, the body and joint resistance are reduced or infected with high virulence of bacteria, the bacteria can be transmitted to the hip joint by blood circulation and resulting in acute suppurative hip arthritis. (2) Local diffusion: the femoral head and neck of the upper femur are located in the joint capsule, the metaphysis osteomyelitis of femur and epiphysitis of femoral head can penetrate bone cortex and enter hip joint to cause suppurative arthritis. (3) Direct infection: open and iatrogenic injuries directly cause infection of hip joint, such as traffic accident, hip joint operation, and joint puncture.

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9.1.2 Clinical Manifestation and Laboratory Examination

Children usually suffer from the sudden onset. General discomfort, sudden high fever and shiver, body temperature can rise up to 38–39 °C, even convulsions, acute anemia, etc. Patients who are too weak or have poor circulation do not have fever or body temperature. Cold limbs, even appear the nerve spirit symptom such as unconsciousness, and delirium can also be found. For adult patients, systemic toxemia is relatively mild and is characterized by local symptoms.

The surrounding muscles of the hip joint are abundant, so the early local symptoms are less obvious. Check carefully you can find that the surrounding tissues of the hip are swelling, tenderness is obvious and skin temperature increases significantly. In the early stage, hip movement was restricted and pain increased during exercise. There is radiating pain along the medial side of the thigh to the medial side of the knee joint. In the late stage, due to muscle contracture, the hip joint is often placed in the nonfunctional position of flexion, external rotation, and abduction, there is even pathological dislocation or semi-dislocation. Activity will be extremely painful, patients refuse to touch by others. In some infants with suppurative arthritis, when the condition is still and stable, the femoral head and neck of the femur can be completely absorbed to form a false joint.

Laboratory examination can find increased white blood cells and neutrophils, rapid erythrocyte sedimentation rate, and positive C-reactive protein test. Positive coagulase test is an important biological characteristic of *Staphylococcus*, which is more significant than colony color and hemolytic property. Joint puncture examination plays an important role in the diagnosis and treatment of suppurative arthritis. According to the different stages and severity of suppurative arthritis, the joint fluid can be developed from early serous oozing to thick and turbid joint fluid, and finally the joint fluid is completely purulent secretion.

9.1.3 Imaging Examinations

Bone destruction in suppurative arthritis of the hip joint usually occurs 2 weeks after onset. X-ray examination was not considered to be of great help for early diagnosis. However, in recent years, it has been found that soft tissue shadows can appear on X-ray 3–7 days after onset, which is helpful for early diagnosis. Therefore, X-ray examination is feasible 3 days after onset. If there is no change, recheck after 2–3 days.

9.1.3.1 X-Ray

- Early phage (2–4 days after onset): The soft tissue around the joint expands in shadow. The capsule expands, the fat outside the capsule swells to both sides, the iliopsoas swells, and the interarticular space widens. Generally, the internal obturator muscle is swollen over 0.5–0.8 cm in children, should be noticed. If the shadow is more prominent than the opposite side, which has diagnostic meaning. The obturator externus is swollen, normally its shadow is overlapped under the lower margin of the ramus of ischium. It has been reported that hip dislocation might occur within 1 week for the children less than 2 years. Therefore, it is considered that hip joint dislocation is one of the early signs of suppurative arthritis in children. Attention should be paid to the differential diagnosis of congenital dislocation of hip joint.
- Medium-term (5–10 days after onset): The articular cartilage is damaged, the joint space narrows. After that, the subchondral bone is degenerated and destroyed. The damage of the joint weighting area is most obvious. In severe cases, bone infection and necrosis in metaphysis can result in pathological dislocation.
- Later stage: Periarticular margin is eroded and destroyed. Suppurative lesions invade bone tissue from the attachment of the capsule ligament of the joint, indicating rapid progress of the lesion. Subsequently, the articular cartilage is extensively damaged, the joint space is narrowing or disappear. The femoral head and neck are absorbed and the joints are ankylosis eventually, resulting in shortened limbs.

9.1.3.2 CT

Early signs of swelling of the soft tissue around the hip joint can be seen. Enhanced scan can show the swelling of the hip joint capsule and ring enhancement of the hip joint surrounding the synovial sac. Small acetabular and femoral bone fractures, necrosis, and hyperplasia can be clearly demonstrated.

9.1.3.3 MRI

MRI can clearly show the early synovial lesions of suppurative arthritis of hip joint, such as swelling and effusion of joint capsule. The thickening of the synovial membrane is a medium signal in T1WI, and a slightly higher signal in T2WI. After enhancement, ring strengthening is obvious; swelling and effusion of the joint capsule are shown in long T1 signal and long T2 signal. The articular cartilage becomes thin and defective. Subchondral bone is eroded and damaged. MRI showed that subchondral bone was replaced by T1WI low signal and T2WI high signal, and subchondral bone marrow was also replaced by long T1 and long T2 signals.

9.1.4 Diagnosis

For acute suppurative hip arthritis, early diagnosis is the key to successful treatment. Most patients have a history of

trauma or infection in other parts of the body before onset, for example, otitis media, pharyngeal isthmus, tonsillitis, or skin infection. The elderly may have urinary system infections. Newborns may have umbilical cord infection. The location of the hip joint is deep and is covered by fat and thick muscles. So the swelling is not obvious, especially the crying and restlessness of the newborn, which brings inconvenience to the examination. In conclusion, when the child has systemic infection symptoms, the whole body joints should be examined, especially whether the hip joints have activity restriction or pain, if necessary, the hip puncture and drainage examination is feasible. If the hip puncture fails to draw out the fluid, it can be replaced with another part for puncture or re-puncture the next day.

The most important diagnostic criteria for acute suppurative arthritis of the hip joint are puncture and drainage examination, including Gram stain, culture, antibiotic sensitivity test, leukocyte count, and classification. The following three examinations are helpful for diagnosis.

Leukocyte count and classification: The total number of white blood cells in normal synovial fluid is less than 200×10^6/L, and the classification count of polynuclear white blood cells is generally less than 25%. In suppurative arthritis, the total number of white blood cells can reach $50{,}000 \times 10^6$/L, and polynuclear cells account for 90%. If the total number of leukocytes is up to $100{,}000 \times 10^6$/L, it can be clearly diagnosed. In acute gout arthritis and rheumatoid arthritis, the total number of white blood cells can reach $50{,}000 \times 10^6$/L, but the number of polynuclear white cells rarely reaches 90%.

To measure the difference between blood glucose and glucose content in exudate, the amount of glucose in the joint exudate decreased due to the decomposition of white blood cells to glucose and the consumption of bacteria in suppurative arthritis. Normally, the difference between the two is no more than 20%. If the difference is more than 40%, the diagnosis can be confirmed.

Mucous protein acetic acid precipitation test: A small amount of joint solution was added to 20 mL of 5% acetic acid solution, and the normal synovial fluid showed dense cluster precipitate, and the surrounding solution was clarified. In suppurative arthritis and rheumatoid arthritis, the sediment is loose like flocculation and the surrounding fluid is cloudy, so this test is not specific.

Because the nerve of the hip joint capsule innervates the anterior branch of the obturator nerve, and the posterior branch is distributed downward in the knee joint capsule, about 30% of patients with hip joint disease may cause pain related to the ipsilateral knee joint. At this time, there is no limitation of knee movement and no tenderness, the hip joint on the same side is limited in activity and is painful.

9.1.5 Differential Diagnosis

The suppurative arthritis of the hip joint should be distinguished from the following diseases.

9.1.5.1 Acute Rheumatic Fever

Early signs of joint redness, swelling, heat, and pain are similar to those of acute suppurative hip arthritis. However, the following characteristics of rheumatic fever should be observed in the course of disease development: (1) whether there is a history of hemolytic streptococcus infection 1–4 weeks before onset or not, such as pharyngitis and tonsillitis. (2) Characteristics of acute wandering arthritis. (3) Rheumatic fever is often accompanied by other diseases, such as myocarditis and subcutaneous nodules. (4) Serum anti-streptococcus hemolysin "O" agglutination titer increased. (5) Whether there are no pus cells and no bacterial growth in the joint fluid or not. (6) It has good therapeutic effect on salicylic acid.

9.1.5.2 Rheumatoid Arthritis

The age of onset is 20–45 years, most are female patients. The onset of the disease is generally slow, often without acute appearance. A few cases are acute onset with fever, general discomfort, joint red, swelling, heat, and pain. It is difficult to distinguish from acute hip joint suppurative arthritis through the blood leukocytosis. The joint exudate has little serous fibrin fluid, and the cultivation is negative. In rheumatoid arthritis patients, the affected joints are mostly bilateral and symmetrical. Wrist, palmar, and proximal interphalangeal joints more common. Physical examination shows joint swelling and subcutaneous nodules. Rheumatoid factors are mostly positive. Joints are clear deformity and dyskinesia in the later stage.

9.1.5.3 Osteomyelitis of the Upper Femur

If the disease is combined with hip joint effusion, it is difficult to distinguish it from the hip joint suppurative arthritis. In general, the pain point of osteomyelitis is located in the metaphysis end, and the pain and activity range are limited. The symptoms and signs of osteomyelitis are lighter than those of suppurative arthritis of the hip joint.

9.1.5.4 Transient Synovitis of the Hip

Only local pain, walking with a slight limp, body temperature is not elevating. Erythrocyte sedimentation rate is normal or slightly high. If the patient's activity is severely restricted, X-ray film swelling of the joint capsule and lateral displacement of femoral head, serum anti "O" titer and rheumatoid test are negative, it should be considered as suppurative arthritis of hip joint.

9.1.5.5 Osteochondritis of Femoral Head

It is also called aseptic necrosis or ischemic necrosis of the femoral head. The conditions of patients are OK, no symptoms of infection poisoning, only a slight limitation of hip movement. X-ray examinations of femoral head in children show that femoral head epiphysis is dense, broken, and flat.

9.1.5.6 Tuberculous Hip Osteoarthritis

There may be a large amount of abscess in the joint cavity, but the pathogenesis of tuberculous infection, the symptoms of tuberculosis poisoning to the body are quite different from a purulent infection.

9.1.6 Treatment

The earlier the treatment, the better the effect. For the suspected acute suppurative arthritis of hip joint, the diagnostic treatment can be carried out temporarily to avoid delaying the best treatment opportunity.

At present, most scholars believe that the systemic application of sensitive antibiotics is the main treatment of suppurative arthritis. However, due to poor blood supply, the antibiotic is not easy to reach lesions. It is still necessary to perform joint puncture and open drainage, hip joint lesion laminectomy to treat suppurative arthritis of hip joint.

9.1.6.1 Arthrocentesis and Incision and Drainage

Arthrocentesis must be strictly sterile to prevent injury of important tissue. The direction and position of joint puncture should be entered from the direct path of the joint. The lateral, anterior, and medial approaches of the hip can be used for joint puncture and aspiration, and the operation can be more accurate under X-ray fluoroscopy. It is advisable to use a thick needle for joint puncture. The posterior, medial, lateral, or anterior approach of the hip can be used to complete the hip arthrotomy and drainage. Usually, the affected limb can be fixed with a plaster in a moderate external position with bilateral hip mild flexion after surgery. The windows should be properly opened on the plaster tube to facilitate the observation and nursing of the wound. Teenager and adults should stay in bed under Buck's tugging and begin moving their joints after infection control.

9.1.6.2 The Hip Joint Debridement Surgery

During the operation, the joint capsule should be fully exposed, the abscess should be incised and drained. The necrotic bone and cartilage should be removed. If there is osteomyelitis in the neck and trochanter of the femur, the patient should be drilled holes for drainage. Iliac osteomyelitis may be treated with a pathological ostectomy. If the abscess has penetrated the muscle space or subcutaneous, the abscess should be scraped out to fresh tissue. After removal of the inflammatory tissue, a large amount of physiological saline is used to wash the wound and the joint cavity. Appropriate amount of sensitive antibiotics is placed in the joint cavity. Postoperative indwell irrigation and drainage tube is placed, and use skin traction braking.

From the day of surgery to the second day after the surgery, the articular cavity was irrigated with 2000–3000 mL of saline daily. For patients with a large number of abscess and necrotic tissues, 5000–10,000 mL of normal saline can be used for rinsing. The 3rd day after surgery begin to wash with antibiotics. The antibiotics are selected according to the results of sensitive bacterial culture reports. After 3–4 days of washing, if the effluent is gradually clarified, the amount of washing liquid can be reduced to 1500–2000 mL/day. Generally, 7–24 days, average 14 days is required to wash. After 2–3 times of negative bacterial culture in the exclusion solution, stop dripping into the washing solution and continue to attract negative pressure. If there is no inflammatory reaction, the drainage rinsing tube can be removed after 24 h. Remove skin traction 2–3 weeks after surgery and perform hip function exercise in bed. Walking and weight bearing with a crutch after 3–4 weeks.

9.1.6.3 Femoral Head and Neck Ostectomy

This operation is suitable for suppurative arthritis complicated with metastatic infection, ischemic necrosis of femoral head and long-term unhealed femoral neck fracture. Such cases are rare due to advances in anti-infection and comprehensive treatment.

9.1.6.4 Systemic Therapy

Patients need a high-protein, high-vitamin diet, hypothermia, fluid replacement, correction of water and electrolyte disorders, and other symptomatic support treatments. If necessary, blood products such as albumin should be supplemented to improve the anti-infection ability of the body. Use sensitive antibiotics throughout the body. In the absence of bacterial culture and susceptibility test results, the effective antibiotics for *Staphylococcus aureus* can be selected first, such as penicillin, cephalosporin, and aminoglycoside. Once the results of the drug sensitivity test are presented, the drug should be adjusted and replaced with sensitive antibiotics. If necessary, the drug can be used in combination to obtain a better curative effect and prevent the occurrence of drug resistance. The duration of antibiotic use should continue for 2 weeks after the clinical symptoms are completely controlled. Then it is changed to oral effective antibiotics for 6 weeks to avoid recurrence or deterioration after improvement.

9.1.6.5 Rest and Immobilization

Immobilization is an important therapeutic principle against infection. Local immobilization can allow the affected limb

to be fully rested, keep the damaged articular surface against the pressure induced by inflammation, relieve the myospasm and pain, as well as prevent and correct any deformity. The immobilization can be achieved by skin traction or plaster.

9.1.7 Complications

If the suppurative arthritis is not treated in time or the treatment method is improper, the complications such as pathological dislocation, osteomyelitis, pelvic abscess, fistula formation, and metastatic infection may occur.

9.2 Tuberculosis of Hip Joint

9.2.1 Introduction

The use of glucocorticoid and immunosuppressants, as well as the rise of immunodeficiency diseases, which led to a global increasing morbidity of tuberculosis (TB). Hip tuberculosis accounts for about 15% of total bone tuberculosis, only second to spinal and knee tuberculosis and rank in third place. Tuberculosis of hip joint is common in young and middle-aged people. Males have a higher mobility than females. Hip joint tuberculosis damages the cartilage and bone, resulting in joint deformation, stenosis, and even stiffness. Finally, tuberculosis leading to hip pain and dysfunction, and seriously affecting the quality of life of the patient.

9.2.2 Clinical Manifestation

The hip joint tuberculosis can be characterized by synovial tuberculosis or bone tuberculosis. Its clinical manifestations and imaging examinations are similar to other joint diseases, such as osteoarthritis, synovitis, rheumatoid arthritis, and femoral head avascular necrosis. The incidence of the hip joint tuberculosis is relatively insidious, often involving the unilateral hip joint. Often hip joint tuberculosis is accompanied by the manifestations of systemic tuberculosis poisoning (such as afternoon low fever, fatigue, night sweats, wasting, and loss of appetite). The patient may have pain and limited movement of the hip joint. With the progression of the disease, it can form cold abscesses and accompanied by sinus formation. Due to the overlap of sensory nerve supply in the hip and knee, some patients may only experience pain in the knee.

9.2.3 Diagnostic Criteria

The diagnosis of hip tuberculosis depends on bacteriological and pathological examinations. Because of the slow growth of TB bacillus and the difficulty of in vitro culture, it is difficult to put bacteriological examination into wide use for diagnosis of hip tuberculosis. At present, the clinical diagnosis of hip joint tuberculosis requires comprehensive use of serology, immunology, molecular biology, and pathology. Some patients even need antituberculosis diagnosis and treatment to be confirmed.

Imaging examination is very important for the diagnosis of hip tuberculosis. There is no specific change in the early X-ray examination. With the progress of the disease, the X-ray can show the manifestations of osteoporosis around the joint, osteolytic lesions, narrowing of the joint space, and even fibrous rigidity. CT has unique advantages in assessing the extent of bone damage, the formation of dead bones, and the location and extent of cold abscess. MRI can detect early inflammatory signals, but it is less specific, and it needs to be identified with other diseases that cause changes in bone marrow signals. Ultrasonography has unique advantages in the evaluation of joint effusion and cold abscess, and it can guide puncture for pathological examination.

With the development of molecular biology technology, more and more new technologies have been used to diagnose joint tuberculosis. Enzyme-linked immunospot assay can be used to determine quantitatively the IFN-r release response of peripheral blood monocytes to the antigen's specificity of tuberculous bacteria in the diagnosis of tuberculous infection. Polymerase chain reaction (PCR) is a simple, fast, specific, and sensitive method for the detection of DNA from joint tuberculosis mycobacterium tuberculosis.

Tuberculin test has special significance to the diagnosis of tuberculosis. WHO recommends the use of purer, thicker protein derivative tuberculin (PPD-RT 23). The stronger the tuberculin response, the more likely that the subject will be infected with tuberculosis. Even the positive results cannot diagnose the infection of tuberculosis bacillus yet. The negative tuberculin response suggested a low probability of tuberculosis infection. Special attention should be paid to the possibility of false negatives among the elderly, severely malnourished, immunodeficient, and immunosuppressant users.

Microscopic examinations of acid-resistant bacteria and isolation culture have important significance in the diagnosis of tuberculosis. But the culture of tuberculosis bacillus takes a long time. The sensitivity and specificity are relatively low. With the emergence of new rapid culture system, the positive rate can reach about 50%.

Histopathological examination is of great value in the diagnosis of hip tuberculosis, including typical caseous necrosis, epithelioid granuloma, and Langerhans giant cells. Due to the high requirement of histopathological examination on the location and quality of samples, the sampling biopsy through hip arthroscopy provides a new and effective method for the early diagnosis of hip tuberculosis.

9.2.4 Treatment

Antituberculous drugs are principal to the treatment of hip joint tuberculosis. The principles of medication are early, combined, moderate, regular, and processed within the entire treatment. With early diagnosis and timely treatment, 90% of patients can heal and retain most of their joint function. Surgical treatment mainly includes the following methods. (1) Arthrodesis: arthrodesis is rarely used because of the use of antituberculosis drugs and the development of artificial joint replacement. (2) Arthroplasty: the function of the hip joint is preserved as much as possible on the basis of removing the tuberculosis foci, but the long-term effect is not good. (3) Artificial joint replacement: with the development of joint replacement technology and materials science, more and more cases show that hip tuberculosis is not a contraindication of artificial hip replacement. Complete surgical debridement and standardized use of antituberculosis drugs during perioperative period are important to the success of hip replacement.

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