Pathogenesis and Sequels of Septic Arthritis of Hip in Children

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Abstract
Septic arthritis of hip joint is a relatively common infection in neonates and infants. The most common organism causing it is gram positive cocci. High index of suspicion is necessary for the diagnosis. Early diagnosis and prompt treatment can prevent long term complications. Our objective is to describe the pathogenesis and sequel of septic arthritis of hip in children of various ages.

INTRODUCTION
Septic arthritis most commonly affects hip joint. It is more commonly seen in neonates, infants and young children [1]. The most common route of infection is haematogenous [1-4]. It can also occur as a direct extension of proximal femur osteomyelitis since proximal metaphysis of femur is intra-articular. Exogenous infection can occur via arthrotomy [1]. Most of the infections are caused by staphylococcus aureus, group B streptococcus, haemophilus influenza [1,5-8]. MRSA infection prevalence has increased with the continuously increasing amount of antibiotic resistance which also associated with more complications, longer duration of antibiotics, and increased mortality [9]. Rarely, organisms like pnemococci, gonocococci and Candida albicans also cause septic arthritis [1,6]. Primary focus of infection is the genitourinary tract, gastrointestinal tract, respiratory tract or in the ENT area in most children [1,10,11]. In neonates and young infants umbilical vein catheterisation, femoral venepuncture can be the source of infection [1,9]. Diagnosing septic arthritis in children is not a big deal but sometime may be confusing. The differential diagnosis that should be considered are Aseptic synovitis of the hip, Viral arthritides, Osteomyelitis, Juvenile rheumatoid arthritis, Legg-Calve-Perthes disease, Lyme disease (borreliosis), Slipped capital femoral epiphysis, Reactive arthritis and Sickle cell anemia [12].

PATHOGENESIS
The infecting organism produces infection in the synovium. Bacteria will be deposited in the sub synovial plexus leading to synovial inflammation. Synovial fluid containing large quantities of neutrophils and fibrin fill the joint cavity, which gets distended. If proper treatment is given at this stage or the host defence mechanism is able to contain the infection at this stage, there will not be permanent joint damage. If infection continues mesothelium lining the synovial membrane is destroyed and replaced by granulation tissue. As a result pannus formation and articular cartilage damage can occur. Subsequently growth plate damage or dislocation of joint, avascular necrosis with bony or fibrous ankylosis can occur [13-16].

The vascular tamponade produced by increased intra-articular pressure is the main cause of avascular necrosis of capital femoral epiphysis. Doud et al. (1993), showed Meta phseal osteomyelitis, producing subperiosteal abscess in the poster superior aspect of the femoral neck, can occlude the retinacular vessels leading to avascular necrosis.

The proteolytic enzymes released during the breakdown of neutrophils can destroy the articular cartilage. It occurs maximally at the points of contact between the opposing areas, especially in hip joints. The glycosaminoglycan breakdown can occur due to collagenase produced from synovial lining cells. The enzyme plasmin is produced by the activation of plasminogen in the blood. Plasminogen activation is by the streptokinase and staphylokinase released by the organism. Plasmin causes break down of protein - chondroitin sulphate complex of the cartilage. Lastly, the release of acid and neutral proteases from chondrocytes, when stimulated by bacterial lipopolysaccharides or by interleukin 1, is another reason for articular cartilage damage. Both avascular necrosis and cartilage destruction can lead to damage to the growth plate [15,16].

SEQUELS OF SEPTIC ARTHRITIS OF HIP
There are many sequel to the septic arthritis in childhood. The sequel developed depend on the age of occurrence and the delay in getting treatment [17]. In neonates and up to six months of age, the proximal femoral epiphysis may not develop and an untreated septic arthritis at this age can lead to complete destruction of proximal femoral epiphysis leading to unstable hip [18-21]. After the development of capital femoral epiphysis the sequel can be a completely normal hip if diagnosed early and
treated properly [22,23]. Sometimes, due to increased vascularity there can be coxamagna [24]. Infection can lead to physeal growth arrest which can lead to shortening of femoral neck coxabreva, shortening of the femur there by limb length discrepancy and/or abnormal shape of the proximal femur resulting in breaking of the femoral neck. Various deformities like coxa vara, coxa valga can develop as sequels [25,26]. Pseudarthrosis of the neck of femur can occur associated with coxa vara [23]. In older children, the main sequel is pathological dislocation. The head in a dislocated hip can be either normal or avascular. Rarely, there can be dislocation of a sequestrated femoral head. In older children untreated septic arthritis of hip can lead to stiff hip due to bony ankyloses [20,27,28].

The treatment of the sequela of septic arthritis of hip needs to be delayed. There is high chance for remodelling, due to growth of some of the minor deformities getting corrected by remodelling. The shape and vascularity of femoral head and neck are better known after remodelling. There is chance of reactivation of infection if interventions are done early. Besides, the strength and quality of bone may improve over time [26]. Choi et al., described a classification for the sequels of septic arthritis in neonate hip joint following evaluation of 34 children who had septic arthritis before the age of one [28] (Figure 1).

**Type I:** This group consisted of those patients with a normal radiographic appearance (Ia), and those with evidence of avascular necrosis.

1a-Normal radiograph
1b-Avascular necrosis

**Type II:** Involvement of the epiphysis, physis, and metaphysis: This type results from avascular necrosis, with or without significant damage to the capital femoral physis.

2a-Coxabreva
2b-Coxa vara/Coxavalga

**Type III:** Damage to the femoral neck.

3a-coxa vara, coxa valga, with or without excessive femoral anteversion or retroversion
3b-pseudarthrosis of the femoral neck

**Type IV:** Loss of the femoral head/neck

4a-segment of the femoral neck is preserved
4b-no femoral neck remnant

**TREATMENT PRINCIPLES**

Treatment of septic arthritis ranges from a intravenous antibiotics, simple joint aspiration under ultrasound guidance, formal arthrotomy and arthroscopic lavage based on patients general condition and surgeon’s preference. But once acute condition is not managed properly, it will leads to sequelae which are having poor outcome even at best hands [29].

A moderate degree of coxa magna, coxa vara of less than 10 degrees and valgum of 15 degree can be left alone. Coxa magna with uncoverage of femoral head needs to be contained. Deformities can be treated either by open or closed wedge osteotomy. Coxabreva can be managed by trochanteric epiphysodesis. Pseudarthrosis may require bone grafting with or without osteotomy [26,27,30-32].

Pathological dislocation can be reduced. Sometimes femoral varus rotational osteotomy or salter or chairi osteotomy is helpful in reducing the pathological dislocation. Rarely, stabilisation procedures like Schanz pelvic support osteotomy, is done. Colonna greater trochanteric arthroplasty by placing the trochanteric apophysis into the acetabulum and distal transfer of abductors into the shaft for improving the abductor muscle function. This osteotomy is followed by a varus osteotomy at the subtrochanteric region later [33,34]. A sound bony ankylosis in functional position can be accepted, where as a sound ankylosis in non functional position requires a femoral osteotomy to make it in to a functional position [31,32]. Limb length discrepancy can be treated by epiphysodesis of the opposite limb or lengthening of ipsilateral limb at appropriate age.

**CONCLUSION**

Acute septic arthritis of hip is a relatively common osteo-

![Diagrammatic representation of Choi et al., classification of hip septic arthritis sequelae](image)
articular problem in neonates and infants. It can produce many sequelae. The prevention of such complications is better than its treatment. Early diagnosis and prompt treatment is the way to prevent it.

CONFLICT OF INTEREST

We have no conflict of interest for this manuscript and we have not accepted any financial assistance from within or outside of our institution for collecting data, writing manuscript and for its publications.

REFERENCES