

Arthroscopic treatment of septic arthritis of the knee using a trans-septal portal in an infant: a case report

Ki-Cheor Bae, Ji-Hoon Kim, Du-Han Kim

Department of Orthopedic Surgery, Keimyung University School of Medicine, Daegu, Korea

Acute septic arthritis in infants is considered an orthopedic emergency. Ineffective treatment and diagnostic delay can result in devastating damage to the joint with potential for lifelong disability. A 12-month-old infant was referred to our emergency room for fever and swelling of the left knee. The laboratory test showed high levels of C-reactive protein and white blood cell (WBC) count. Thick, yellowish pus-like synovial fluid was aspirated on the suprapatellar pouch on the left knee, revealing WBC count of 226,800/ μ L and 95% neutrophils. Using elbow arthroscopy equipment, arthroscopic synovectomy and debridement were performed in both the anterior and posterior compartments using a trans-septal approach. After the surgery, the patient's condition improved rapidly, and the results from the infection laboratory indicated a return to normal values 1 week postoperatively. At the final 16-month follow-up, the patient had completely healed without complications.

Keywords: Arthritis, infectious; Arthroscopy; Posterior trans-septal portal; Infant; Knee

INTRODUCTION

Septic arthritis in infants is relatively uncommon and is considered an orthopedic emergency. Early diagnosis can be difficult because infants cannot articulate their pain or communicate with physicians. Typical symptoms in infants include the inability to bear weight on the involved limb, painful decreased joint mobility, general irritability, and fever. Timely diagnosis and treatment are essential to reduce the risk of devastating complications, accompanying avascular necrosis, epiphyseal damage, physeal growth anomalies, systemic sepsis, and premature destruction of joints. Septic arthritis of the knee is the most common form in children. Although arthroscopic synovectomy and drainage are standard treatments for adults with knee septic arthritis, the literature on the satisfactory outcomes using this approach in children is limited. This study aimed to report on a case of septic arthritis of the knee in an infant and discuss the efficacy of a posterior

trans-septal portal in drainage and synovectomy. The informed consent was obtained from the participant.

CASE REPORT

A 12-month-old boy was referred to our emergency room for fever and left knee swelling. He was healthy without previous illness and family history. Swelling and irritability occurred in the left knee after jumping off the couch 10 days from presentation. His symptoms, including fever and rhinorrhea, started 2 weeks earlier. Fever persisted even if antibiotic therapy was initiated before admission. On physical examination, visible effusion and tenderness were observed on the left knee. His pediatrician confirmed the absence of other systemic symptoms. The results of the laboratory test were as follows: white blood cell (WBC) count of 12,830/ μ L, C-reactive protein (CRP) level of 6.5 mg/dL, and erythrocyte sedimentation rate (ESR) of 120 mm/h. Moreover, 10 mL of thick yellowish pus-like

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Correspondence to: Du-Han Kim, <https://orcid.org/0000-0002-6636-9340>

Department of Orthopedic Surgery, Keimyung University School of Medicine, 1035 Dalgubeol-daero, Dalseo-gu, Daegu 42601, Korea.
Tel: +82-53-258-4772, Fax: +82-53-258-4773, E-mail: osmdkdh@gmail.com

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synovial fluid was aspirated on the suprapatellar pouch on the left knee (Fig. 1), and its analysis revealed WBC count of 226,800/ μ L and 95% neutrophils. A simple radiograph showed soft tissue swelling without bony involvement. Preoperative magnetic resonance imaging (MRI) showed a large rim-enhanced fluid collection on the suprapatellar pouch and knee joint including the posterior compartment. Although no subperiosteal abscess or osteomyelitis was detected, mild bone marrow infiltration was observed in the distal femoral epiphysis (Fig. 2). Given the persistent fever and elevated WBC count in the synovial fluid, septic arthritis of the left knee was confirmed.

Surgical technique

The patient underwent an emergency operation. He was placed on a supine, table-flat position without a leg holder. Considering the patient's size, a 2.7-mm 30° elbow arthroscopy equipment was inserted (Fig. 3). After the introduction of a standard anterolateral portal, pus-like

joint fluid was collected for further culture. Anteromedial and superolateral portals were then made. Synovectomy of the inflamed synovium was performed using a shaver (Fig. 4). To clear the posterior compartment, a posterior trans-septal portal was created. Using the anteromedial portal, the scope was passed through the intercondylar notch and then inserted posteriorly. While observing the posteromedial aspect, an 18-G needle was inserted just posterior to the femoral condyle externally. After verifying the needle tip, a posteromedial portal was created at 90° flexion. Through this portal, a switching stick was inserted, passed through the posterior septum, and entered the lateral compartment to create the posterolateral portal. The anterior portion of the posterior septum was removed using a shaver introduced through the posteromedial portal. Starting from the anterior aspect of the septum and progressing posteriorly to avoid injuring the popliteal vessel, the posteromedial and posterolateral compartments were connected (Fig. 5). Synovectomy and irrigation were



Fig. 1. Thick yellowish pus-like synovial fluid was aspirated on the suprapatellar pouch of the left knee.



Fig. 3. A 2.7-mm 30° elbow arthroscopy equipment was inserted with consideration of the patient's size. (A) 4.0-mm knee arthroscope, (B) 2.7-mm elbow arthroscope.

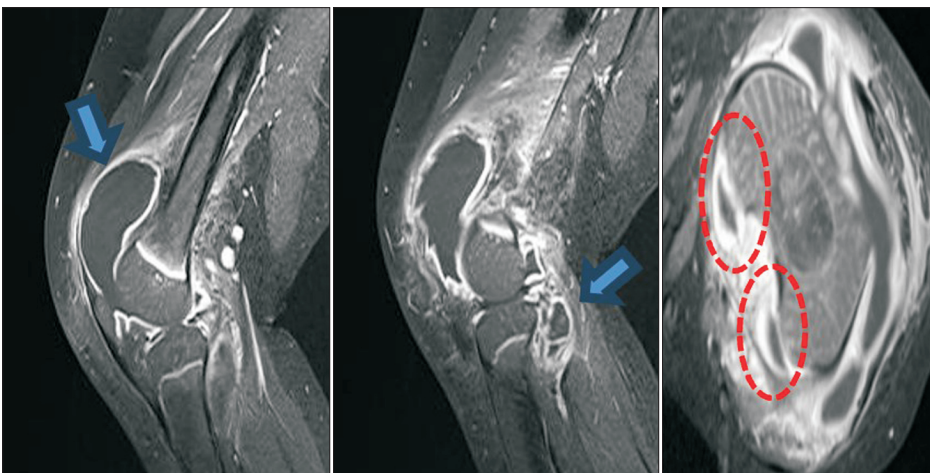


Fig. 2. Magnetic resonance imaging showing a large rim-enhanced collection of fluid on the suprapatellar pouch and posterior compartment (blue arrows and red circles). On the femoral distal epiphysis, mild bone marrow infiltration was observed; however, subperiosteal abscess and osteomyelitis were not detected.

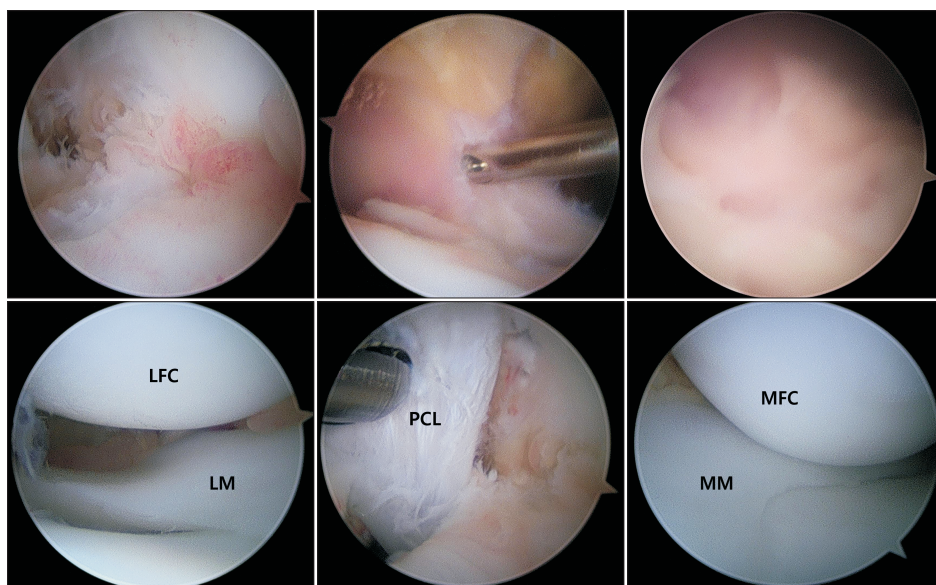


Fig. 4. Synovectomy of the inflamed synovium was performed using a shaver. Intact cartilage and meniscus were noted. LFC, lateral femoral condyle; LM, lateral meniscus; PCL, posterior cruciate ligament; MFC, medial femoral condyle; MM, medial meniscus.

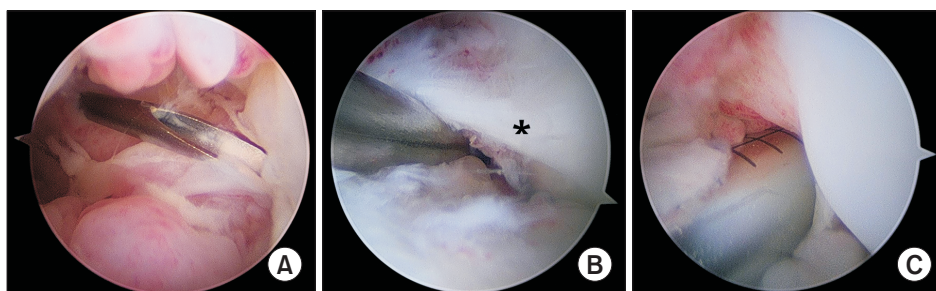


Fig. 5. (A) A posteromedial portal was created. (B) The inserted switching stick passes through the posterior septum (asterisk) and enters the lateral compartment. (C) Posteromedial and posterolateral compartments were connected.

performed through the posterior portal. Finally, under arthroscopic guidance, drainage tubes were inserted on the suprapatellar pouch and posterior compartment.

Postoperative management and outcomes

Postoperatively, active range of motion was allowed as tolerated. Drains were removed after approximately 7 days with consideration of the amount of drainage. Preoperative and intraoperative joint fluid and synovium cultures were negative. After consultation with the pediatrician, empirical antibiotics as intravenous vancomycin therapy for targeting methicillin-resistant *Staphylococcus aureus* (MRSA) were adapted. At 1 week operatively, the CRP value returned to the normal level of 0.2 mg/dL. The patient was discharged in good general condition without irritability, and oral cefuroxime therapy was administered for 5 weeks. Two months after surgery, the patient can perform full range of motion with no irritability. At the final 16-month follow-up, the patient had healed completely with a normal gait. On a final simple radiograph,

no limb-length discrepancy, evidence of joint degeneration, epiphyseal damage, or physeal growth anomalies were observed.

DISCUSSION

In the presented case, considering the 10-day duration of clinical symptoms, making a prompt diagnosis can be challenging, particularly in cases of septic arthritis of the knee. In 1999, Kocher et al. [1] highlighted four criteria, including history of fever $\geq 38.5^{\circ}\text{C}$, non-weight-bearing status, ESR of ≥ 40 mm/h, and serum WBC count of $\geq 12,000/\mu\text{L}$, in differentiating septic arthritis from transient synovitis. In 2006, CRP was evaluated as the fifth criterion. Regarding septic arthritis of the hip, as a result of development of the Kocher criteria and its modified form, physicians can more predictably identify high-risk cases requiring immediate surgical intervention. However, no studies have demonstrated the reliability of the Kocher criteria and its modification for the evaluation of pediatric

septic knee compared with septic hip [2,3]. Instead of the Kocher criteria, Baldwin et al. [4] reported that a subjective history of fever, pain with $< 30^\circ$ of motion (referred to as short arc motion), CRP of ≥ 4.0 mg/L, and age of < 2 years were predictive factors helpful in differentiating septic arthritis of the knee from Lyme arthritis, which is a late manifestation of Lyme disease, caused by spirochete *Borrelia burgdorferi*, and has common clinical features with septic arthritis.

Diagnosis can be supported with simple radiography and MRI. In our infant, septic arthritis of the knee was confirmed by MRI and joint aspiration findings. Marrow changes, subperiosteal abscess, and osteomyelitis were detected using MRI. Analysis of synovial fluid aspirated from the knee joint is considered the main diagnostic criterion. Definitive diagnosis is retrospective based on positive culture or purulence (WBC $> 50,000/\mu\text{L}$ and/or $> 90\%$ neutrophils) detected in the joint fluid. Despite appropriate cultures, a considerable proportion of cases (21%–55%) remain culture negative [5]. In the present case, the patient had been taking antibiotics orally for 7 days before admission, which can potentially cause a false-negative result. *S. aureus* is the most common cause of septic arthritis in pediatric patients aged > 1 month. Anti-MRSA antibiotics should be included in areas where the prevalence of community-associated MRSA is $\geq 10\%$. The duration of intravenous antibiotic therapy should never be < 2 to 5 days. When patients show clinical improvement, early transition to treatment with oral antibiotic therapy can be considered [5].

Surgical drainage and irrigation of the affected knee joint can be considered after early diagnosis. Serial arthrocentesis, open arthrotomy, and arthroscopy were reported as treatment techniques [6]. In 2021, Donders et al. [7] conducted a systematic review to determine the most effective technique for drainage of septic arthritis of the knee in children and concluded that arthrocentesis can be beneficial in the very young children because it is a simple and minimally invasive technique, whereas arthroscopy can be beneficial at all ages. They also emphasized that the risk of an additional drainage procedure might be lower for knee arthroscopy than arthrocentesis and arthrotomy. Johns et al. [8] retrospectively compared arthroscopy with open arthrotomy in 24 pediatric patients with acute septic arthritis of the knee and reported good long-term clinical and radiological outcomes in both groups without significant differences. However, better early outcomes were obtained using arthroscopy includ-

ing earlier time to weight-bearing and range of knee motion and shorter hospital stay. In addition, arthroscopy leaves less scar tissue, which enables direct visualization of the joint, and the inflamed synovium can be thoroughly debrided. Given their smaller anatomy, careful consideration of various factors is required when performing arthroscopy in infants, including the size of arthroscopic instruments, patient positioning, and portal selection. In a review article, Accadbled [9] suggested that a 4-mm arthroscope can be used in patients aged > 4 years; however, a 2.7-mm arthroscope is required for younger patients. A special pediatric arthroscope can be used as a substitute for an elbow or ankle arthroscope. Kirby et al. [10] reported that a 3.5-mm scope can be used in children aged < 4 years. Arthroscopic flow is usually set between 30 and 35 mmHg considering volume expansion of the pediatric knee. In general, a leg holder is not required in a pediatric knee, and supine positioning of the patients on the end of the bed is recommended for proper knee flexion and extension. Standard anteromedial and anterolateral portals are usually utilized, and the posterior compartment is visualized and irrigated by placing the arthroscope through the intercondylar notch. In most cases using this technique, satisfactory outcomes were obtained, with a low failure rate [6,8,11]. However, performing a posterior compartment synovectomy through trans-notch views using an anterior approach is technically difficult, and a blind zone on the medial meniscus remains. The posterior trans-septal portal technique has been used widely to access the posterior compartment, and satisfactory outcomes and safety were reported for synovectomy in adults [12]. Yu et al. [13] performed a posterior trans-septal portal technique, inserted drain in the posteromedial portal in 56 adults with pyogenic arthritis, and reported satisfactory results. They suggested that thorough debridement of the synovium in the posterior compartment alone would not be sufficient; thus, appropriate drainage of the residual fluid in the posterior compartment is necessary. Lui [14] reported that posterior knee arthroscopy, with the inclusion of a trans-septal portal, enables direct access for the debridement of the posterior compartment and drainage. This method can be beneficial as it targets the most dependent part of the joint in the supine position, facilitating better drainage. Accordingly, the posterior trans-septal portal technique was employed to allow performing posterior compartment synovectomy to avoid neurovascular injury while considering the small anatomy of infants. Drainage was also inserted in the posterior compartment

and suprapatellar pouch. Satisfactory outcomes were achieved without any complications.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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