

Case Series

Long term outcomes of neonate septic arthritis of the shoulder

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ABSTRACT

Upper limb palsy in the newborn may be caused by a large number of pathologies, such as fracture, brachial plexus palsy or infection. The diagnosis of neonatal osteoarticular infection is extremely challenging, especially in the shoulder joint. The lack of obvious clinical signs can frequently result in a delay in the diagnosis, which can lead to important sequelae. A retrospective study of nine patients with a history of neonatal septic arthritis of the shoulder was performed. All patients were treated at the same institution.

Keywords: Septic arthritis, Neonatal, Shoulder, Diagnosis

INTRODUCTION

Septic arthritis is a rare condition in neonates. The global incidence is estimated to be around 1 to 37 cases per 100,000 persons, with male children being predominantly affected, at a rate of approximately 2:1.^{1,2}

Neonatal septic arthritis is a serious condition that can result in dysfunction or deformity of the affected limb(s). There are few studies regarding this topic in the literature, but the reported incidence of neonatal septic arthritis varies between geographical regions. In Singapore, Ho et al reported an incidence of 0.12/1000 live births or 0.67/1000 admissions to the neonatology inpatient service.³ Other authors, like Narang et al determined a much higher incidence of 1/1500, in India.⁴

Neonatal septic arthritis of the shoulder is diagnosed less frequently than other joints, representing 2 to 7% of all neonatal septic arthritis, according to the available studies.^{1,2,5-10} Polyarticular involvement occurs in approximately half of the cases¹¹ and concomitant osteomyelitis is common, especially in joints with an

intracapsular metaphysis, such as the femur, humerus, proximal radius and the lateral region of the distal tibia.

The low incidence rate, associated with the scarcity of clinical signs and symptoms in neonatal age make this pathology very hard to diagnose, especially in the early stages.

The timely diagnosis and the initiation of early appropriate treatment are essential to obtain favorable clinical results and avoid sequelae.¹²

The objectives of the present study are to review the long term clinical and radiological outcomes of all patients of neonatal age (in the first 30 days after birth) diagnosed with septic arthritis of the shoulder, treated and followed at our institution.

It should be noted that there are several studies about this pathology in pediatric patients (<18 years) but few of those focus on the neonatal age, and the majority are case reports.

CASE SERIES

Case 1

This is the case of a twenty eight-day-old baby boy, medically free, who presented with his parents to the emergency department (ED) of our hospital with a painfully limited range of motion of the left shoulder.

The neonate's analytical results showed elevated leucocytes (WBC): $16.60 \times 10^9/l$; automated neutrophils: 33% (reference range: 50%-70%); and platelet count: $63 \times 10^9/l$ (reference range: 150-400/l). Also, the erythrocyte sedimentation rate (ESR) test result was 40 $\mu\text{mol/l}$ (reference range: 3-10 $\mu\text{mol/l}$) and C-reactive protein (CRP) was 5.78 mg/dl. The blood culture was negative.

A shoulder ultrasound of the patient showed fluid in the subacromial bursa and a magnetic resonance imaging (MRI) revealed extensive peri-articular edema and no apparent signs of bony extension of the infectious process.

The orthopedic team decided for urgent surgical irrigation and debridement (I and D) at day 2. *E. Coli* was isolated in the synovial fluid. Intravenous antibiotic therapy was performed with flucloxacillin and cefotaxime and then switched to oral cefixime.

At the time of the last follow-up, six years since the diagnosis the patient presented an upper limb length asymmetry of 10 mm, assessed in relation to the contralateral.

Case 2

This is the case of a thirty-day-old baby girl, medically free, who presented with his parents to the ED with fever and a painfully limited range of motion of the left shoulder.

The neonate's analytical results showed elevated leucocytes (WBC): $19.52 \times 10^9/l$; automated neutrophils: 48.4% (reference range: 50%-70%); and CRP was 3.38 mg/dl. The blood culture was positive for *Streptococcus agalactiae*.

A shoulder ultrasound of the patient showed slight deltoid densification, nonspecific reactive axillary nodes and a MRI revealed signs of probable septic involvement of the shoulder joint with peri-articular phlegmonous uptake, without significant joint effusion and an osteomyelitic process.

The patient did not undergo surgical treatment. Intravenous antibiotic therapy was performed with flucloxacillin, cefotaxime and gentamicin and then switched to penicillin G and cefuroxime when a microorganism was isolated in cultural studies.

There is no data about upper limb length asymmetry in this child.

Case 3

This is case of a twenty eight-day-old baby boy, medically free, who was born and initially treated in another institution before referral to consultation at 10 years old due to reduced right shoulder mobility.

Patient records at the original hospital showed that, on initial admission, the analytical results showed leucocytes (WBC): $22.40 \times 10^9/l$; automated neutrophils: 53% (reference range: 50%-70%); and CRP was 3.4 mg/dl. The blood culture was negative.

Regarding his imagiologic studies, a shoulder x-ray and an ultrasound were normal.

The patient did not undergo surgical treatment. Intravenous antibiotic therapy was performed with ampicilin, gentamicin and flucloxacillin.

At the time of the last follow-up, seven years since the first consultation at our institution and at 17 years old, the patient presented an upper limb length asymmetry of 20 mm, assessed in relation to the contralateral.



Figure 1: Patient 3; antero-posterior radiograph of shoulders.

Case 4

This is the case of a five-day-old baby boy, medically free, who was born and initially treated in another institution before referral to consultation at 3 years old due to reduced left shoulder mobility.

According to clinical records, the patient presented to the ED with septic shock, fever and hypotension and painfully limited range of motion of left shoulder, hip and knee.

The neonate's analytical results showed leukopenia and CRP was 1.0 mg/dl. The blood culture was negative. There is no data about his imagiologic studies.

The patient did not undergo surgical treatment. Intravenous antibiotic therapy was performed with vancomycin and cefotaxime.

At the time of the last follow-up, seven years since the first observation at our institution and at 10 years old, the patient presented an upper limb length asymmetry of 70 mm, assessed in relation to the contralateral.

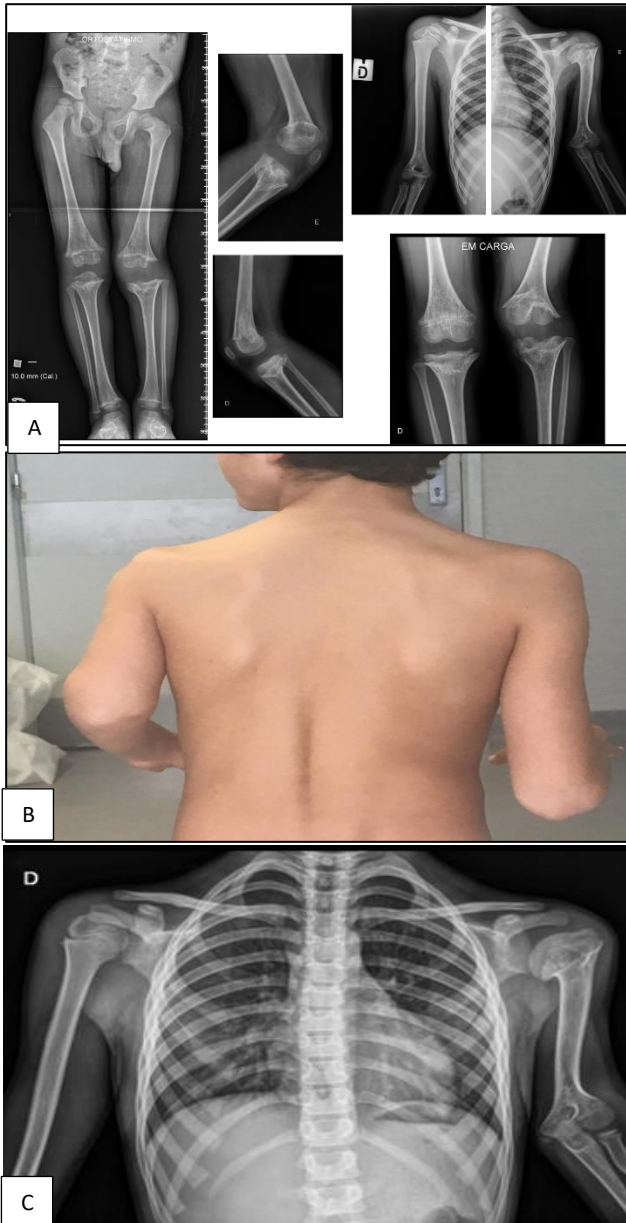


Figure 2 (A-C): Patient 4; full length lower limb radiograph; antero-posterior and lateral radiographs of the knees; antero-posterior radiographs of the shoulders; posterior picture of the patient and antero-posterior radiographs of the shoulders.

Case 5

This is the case of a eleven-day-old baby girl, who was born and initially treated in another institution before referral to consultation at 12 years old due to bilateral shoulder asymmetry.

According to clinical process, he presented to the ED of the other hospital with absent moro reflex, hypotonia, food refusal and pain with shoulder mobilization. The patient was diagnosed at the time with neurosyphilis and treated for that pathology.

The patient did not undergo surgical treatment. Intravenous antibiotic therapy was performed with penicilin and gentamicin.

At the time of the last follow-up, five years since the first observation at our institution and at 17 years old, the patient presented an upper limb length asymmetry of 50 mm, assessed in relation to the contralateral.

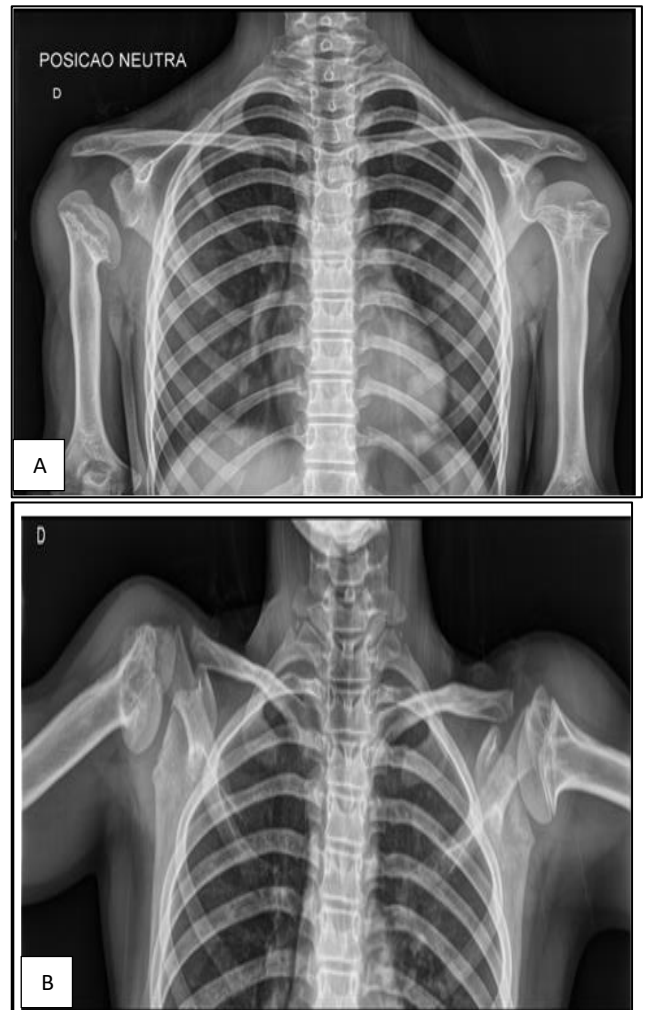


Figure 3 (A and B): Patient 5; antero-posterior radiographs of the shoulders in a neutral position and antero-posterior radiographs of the shoulders in abduction.

Case 6

This is the case of a twenty-day-old baby girl, medically free, who presented with his parents to the ED of our hospital with a painfully limited range of motion of the right shoulder and right hip.

The neonate's analytical study revealed the following: ESR test result was 90 $\mu\text{mol/l}$ (reference range: 3-10 $\mu\text{mol/l}$) and CRP was 16.18 mg/dl. The blood culture was negative.

A shoulder X-ray showed proximal humerus osteolysis. The orthopedic team decided for surgical irrigation and debridement (I and D) at day 10. A *Streptococcus agalactiae* (Group B) was isolated in the synovial fluid culture. Intravenous antibiotic therapy was performed with ampicilin, cefotaxime and flucloxacillin.

At the time of the last follow-up, at 13 years old, the patient presented an upper limb length asymmetry of 10 mm, assessed in relation to the contralateral.

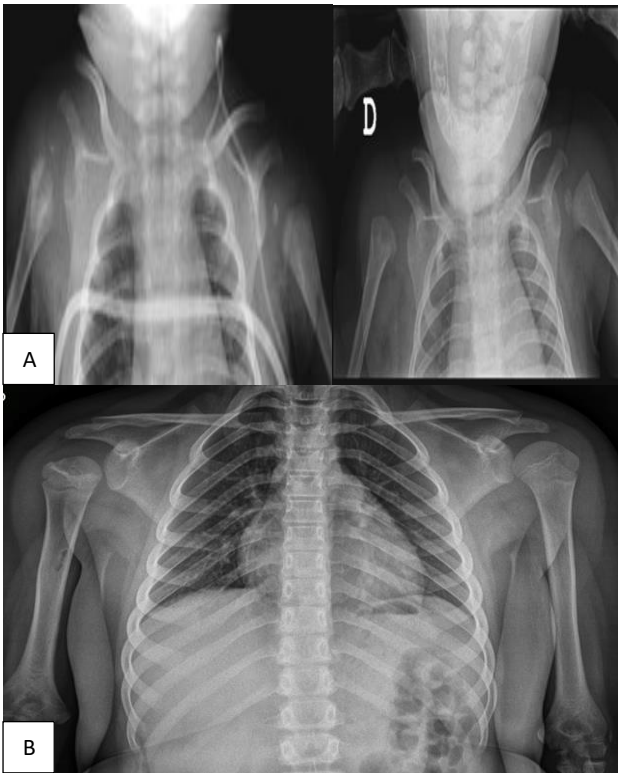


Figure 4 (A and B): Patient 6; initial antero-posterior radiographs of the shoulders; antero-posterior radiographs of the shoulders at time of last follow-up.

Case 7

This is the case of a two-day-old baby boy, medically free, who presented with his parents to the ED of our hospital with a painfully limited range of motion of both shoulders and hips, fever and food refusal.

There is not data regarding blood count (CBC) or imagiologic studies. His blood culture was positive for *E. coli*. The patient did not undergo surgical treatment.. Intravenous antibiotic therapy was performed.

At the time of the last follow-up, at 9 years old, the patient presented an upper limb length asymmetry of 20 mm, assessed in relation to the contralateral.

Case 8

This is the case of a nineteen-day-old baby girl, who was born and initially treated in another institution before referral to our institution at 8 years old due to right shoulder asymmetry.

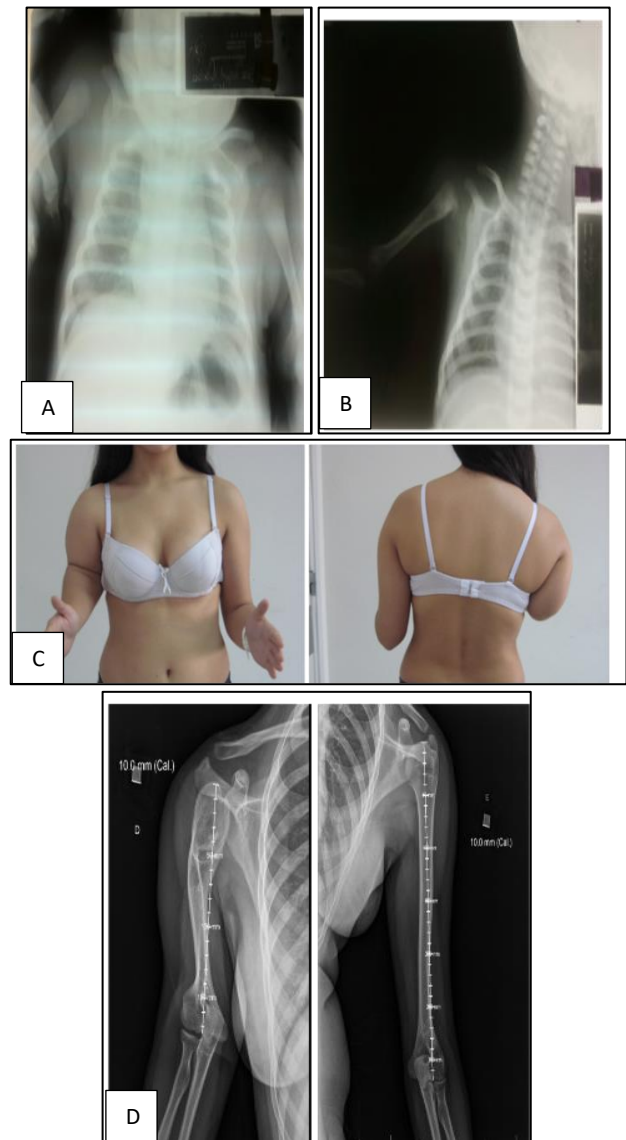


Figure 5 (A-D). Patient 8; initial antero-posterior radiographs of the shoulders; anterior and posterior picture of the patient and antero-posterior radiographs of the shoulders at time of last follow-up.

According to clinical records, the neonate's blood results showed elevated leucocytes (WBC): $15.60 \times 10^9/l$; automated neutrophils: 70% (reference range: 50%-70%); and CRP was 5.09 mg/dl. The blood culture was positive for *Streptococcus agalactiae* (Group B). Regarding his imagiologic studies, a shoulder ultrasound of the patient was normal.

The patient was diagnosed with an urinary tract infection. She did not undergo surgical treatment. Intravenous antibiotic therapy was performed with cefotaxime and penicilin G.

At the time of the last follow-up, nine years since admission at our institution and at 19 years old, the patient presented an upper limb length asymmetry of 170 mm, assessed in relation to the contralateral.

Case 9

This is the case of a thirteen-day-old baby boy, medically free, who presented with his parents to the ED of our hospital with fever and a painfully limited range of motion of the right shoulder.

The neonate's blood results revealed the following: leucocytes (WBC): $25.60 \times 10^9/l$; automated neutrophils: 60% (reference range: 50%-70%); and CRP was 6.02 mg/dl. The blood culture was negative.

An ultrasound of the shoulder showed joint effusion in the posterior recess of the glenohumeral joint and a MRI showed inflammatory changes compatible with arthritis, probably septic.

The orthopedic team decided for surgical irrigation and debridement (I and D) at day 3. A methicilin-sensitive *Staphylococcus aureus* was isolated in the synovial culture. Intravenous antibiotic therapy was performed with gentamicin and flucloxacillin.

At the time of the last follow-up, at 4 years old, the patient presented an upper limb length asymmetry of 25 mm, assessed in relation to the contralateral.

Table 1: Operative treatment and non-operative treatment.

| Mean values | Age | Follow-up | Dysmetria |
|--------------------------------------|---------|-----------|-----------|
| Operative treatment (33%) | 20 days | 8 years | 66 mm |
| Non-operative treatment (66%) | 16 days | 7 years | 15 mm |

DISCUSSION

The long-term consequences of late diagnosis of neonatal septic arthritis of the hip and knee have been widely studied. The poor prognostic factors associated with septic

arthritis of the hip can be applied to the shoulder.¹³ Late diagnosis and treatment, age less than one year, prematurity, longer duration of symptoms before starting antibiotic therapy (>4-7 days), involvement of the hip or shoulder with concomitant osteomyelitis and the virulence of the microorganism are the most relevant.¹³ Approximately 80% of humeral growth occurs in the proximal physis.¹⁴ A delayed diagnosis can cause injuries to this structure, resulting in shortening of the upper limb and deformity of the humeral head.

The diagnosis is dependent on a through clinical history and physical examination, which are extremely challenging in newborns. Typically, there is a combination of diminished mobility and dysfunction of the affected limb, associated with fever, pain and easy crying.¹⁵ Around 20% of children have a history of previous trauma or a non-specific fall before resorting to the health service.¹⁶ In the series of clinical cases presented, decreased mobility and fever were the most common clinical presentation.

The association of laboratory and imaging studies is of paramount importance. The initial laboratory study should include complete blood work with differential cell count, CRP, ESR and blood cultures. Despite its importance, the analytical study in isolation is insufficient to establish a diagnosis. According to some authors, CRP is a more valuable independent predictor of infection than ESR; if CRP<1.0 mg/dL, the probability of the patient not having septic arthritis is 87%.¹⁷ In the series presented, CRP presented values greater than 1.0 mg/dl in six of the nine patients studied, in the initial evaluation. Data was unavailable in two patients.

Radiographs have low sensitivity and specificity in diagnosing septic arthritis, especially in this age group, whereas ultrasound has been established to be particularly useful in the shoulder and hip.¹⁶ Approximately 15 to 50% of osteoarticular infections involve bone tissue and adjacent joints so MRI with or without contrast can be of great importance in the diagnosis. Rosenfeld et al suggested an algorithm to help identify patients at risk of adjacent infection, who would benefit from the use of MRI.¹⁸ Five variables (age greater than 3.6 years, CRP >13.8 mg/l, duration symptoms >3 days, platelet count <314×10 cells/microl and absolute neutrophil count >8.6×10 cells/microl) were identified as being predictive of adjacent infection. Patients with 3 or more variables, are considered as high risk and should undergo MRI. Septic arthritis of the shoulder and elbow are commonly associated with concomitant osteomyelitis benefiting from MRI study.¹⁸⁻²⁰

In our series, none of the patients with available data was considered as high by Rosenfeld et al.¹⁸ Ernat et al presented a series of 22 cases of septic arthritis of the shoulder, in which 15 were diagnosed concomitantly with osteomyelitis of the proximal humerus.²⁰ Street et al studied 49 cases of osteomyelitis of the humerus, where seven patients had concomitant septic arthritis of the

shoulder or elbow. These studies, however, include children of all ages.²¹

A definite diagnosis of septic arthritis is established by isolating a microorganism in the joint fluid. Around 35% of cultures can be negative, even in patients with positive blood cultures.²² In such cases, PCR (polymerase chain reaction) analysis is an important auxiliary tool, despite its restricted availability.^{20,23,24} In our series, all three patients in whom surgical debridement was performed had positive synovial culture results and blood cultures were positive in three patients.

Septic arthritis is an emergency and immediate drainage must be performed. Needle aspiration (single or serial) can be an alternative to arthrotomy. Open surgical treatment is essential when a concomitant adjacent infection or subperiosteal abscess is diagnosed. Smith et al in a prospective study of 61 pediatric patients with septic arthritis of the shoulder, compared two groups, one undergoing needle aspiration and the other undergoing arthrotomy, and concluded that there were no significant differences in the results.²⁵ However, the follow-up time was short (six months to one year) and changes in the physes were not evaluated. Saisu et al also reported no radiographic differences between the two treatment methods in the first year of follow-up.²⁶

Arthroscopic treatment can also be an option - recent publications showed favorable results in children aged between six weeks and six years, for the treatment of septic arthritis of the hip, knee, ankle and shoulder.^{27,28} Only one case report of arthroscopic treatment of septic arthritis of the shoulder, with more than 1 year of follow-up, is published. Hasegawa et al.²⁹ reported a 1-month-old infant with good clinical and radiographic outcomes at 2 years after arthroscopic debridement and synovectomy. Despite constant evolution in the field of arthroscopy, the performance of this procedure in neonates is highly challenging.

Although the surgical approach is widely used in the treatment of septic arthritis, there are no comparative studies of surgical versus conservative treatment in septic arthritis in neonatal age. Frederiksen et al.³⁰ presented a series of 25 children in neonatal age with septic arthritis treated conservatively with intravenous antibiotics, with favorable results, without sequelae, in 67% of patients. Li et al in a retrospective study of 48 patients in neonatal age, diagnosed with septic arthritis and an average follow-up time of 4.5 years, concluded that there was no statistically significant difference between surgical and conservative treatment.¹² However, the authors recommended surgical treatment when the diagnosis is made early and a conservative approach when the diagnosis takes more than two weeks.

In the majority of series presented, the most frequently isolated microorganism in the synovial fluid is *S. aureus*. *Streptococci* (especially group B beta-hemolytic strains) and Gram-negative bacilli are also common at a neonatal

age. Strains of *Kingella kingae* have become increasingly recognized as a cause of septic arthritis in childhood. There are series of clinical cases reporting this microorganism as being the most frequently isolated, especially in children aged less than four.¹⁶ In our series, of three patients undergoing surgery, all presented with a different etiological agent *E. coli* in patient (1), *Streptococcus agalactiae* in patient (6) and *S. aureus* in patient (9), which is in line with what is described in the literature.

Several articles report a favorable prognosis for septic arthritis of the shoulder. However, a significant number of radiographic changes become evident as the follow-up period increases. Bos et al in a study with long-term follow-up of eight patients diagnosed with neonatal septic arthritis (ten shoulders) showed a maximum value of humeral shortening of 10 cm in three patients (five shoulders), almost all of them without functional limitations, despite aesthetic concerns.³¹ Schmidt et al in a series of nine cases with a follow-up of one to three years, showed no humeral shortening and a favorable functional prognosis.¹ Saisu et al in a retrospective study, found that inferior subluxation of the shoulder associated to shortening of more than 3 cm only occurred in patients who did not undergo arthrotomy in the first 10 days after the onset of the infection.²⁶ The amount of shortening was maximized in patients who did not undergo arthrotomy.

In our series, mean shortening was 66 mm in patients who did not undergo arthrotomy and 15 mm in patients who were treated surgically. However, since this association was not statistically studied due to the small sample size, this data should be interpreted with caution. There are few published reports of cases of humeral lengthening due to infectious sequelae and those that do exist have a relatively short follow-up period.^{32,33} Septic arthritis is considered an orthopedic emergency that requires early diagnosis and treatment to avoid irreversible damage. In newborns, this diagnosis is even more challenging given the frequent absence of obvious clinical signs.

CONCLUSION

Septic arthritis occurs frequently in pediatric age. However, its diagnosis in neonatal age is rare, and the shoulder is one of the least frequently involved joints.

Polyarticular involvement occurs in about half of cases and concomitant osteomyelitis is common. The lack of obvious clinical signs results in a frequent delay in diagnosis in this age group. Furthermore, the newborn's immune system is immature, meaning laboratory findings are not conclusive. Adequate treatment consists of surgical exploration and/or antibiotic therapy. Delayed diagnosis and treatment can result in long-term sequelae, like humeral head deformity and shortening, that generally do not reflect into important functional limitation.

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