

## Original Article

### Diagnosis and Prognosis of Neonatal Septic Arthritis from It's Early Clinical Characteristics: Experience from a Tertiary Care Hospital

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#### Abstract

Neonatal septic arthritis (NSA) is an unusual illness, but fatal clinical condition and must be diagnosed and treated properly in order to save the neonate's joints and life. High rate of morbidity and mortality may result from NSA if left untreated. Majority of NSA cases in developing countries present themselves late at the health care facilities, making the diagnosis difficult and sometimes overlooked by health care providers. Although septic arthritis has already been investigated but cases of NSA from developing countries are under reported. The goal of the study was to better understand the clinical and microbiological characteristics of neonates with septic arthritis as well as their prognosis of treatment. This prospective observational study was conducted in Neonatal Intensive Care Unit (NICU) of Department of Neonatology and Out Patient Department (OPD) of Orthopaedics, Banga bandhu Sheikh Mujib Medical University (BSMMU). Total 30 neonate presented with acute septic arthritis were included in this study. Data were collected by reviewing record from NICU and disease course, investigation profiles, treatment record of neonates were noted as recorded during the time of hospital stay or attending in OPD. For the assessment of prognosis clinical and radiological findings of all cases were followed-up for 12 months of age. Collected data of neonates with septic arthritis from record review were processed and analyzed by Statistical Package for the Social Sciences (SPSS) and result of analyzed, finally data were presented as in tables

and graphs. This study finds that nearly two-third (63%) of the neonates were male and knee joint was most frequently involved, accounting more than two-third (67%) of all single joint involvements. All of the cases were anemic and had high C-reactive protein (CRP) level. Joint aspirate samples culture showed that the most prevalent (41%) organism was *Klebsiella*, followed by *Acenotobacter* and *Serratia*. Gram-negative bacteria predominated (91%). Most of the patient (76%) had favorable prognosis after treatment. Clinical evaluation and start of intravenous antibiotics should be given priority in suspected cases. Prompt surgical intervention and consistent follow-up in a tertiary hospital are necessary for the best results.

**Keywords:** Neonate; Septic arthritis, Arthrotomy, outcome.

#### INTRODUCTION

Septic arthritis is one of the most incapacitating illnesses for people of all ages. Infants and children are more likely to develop septic arthritis due to innate impairments and limits in defensive mechanisms. Despite being uncommon in newborn sepsis, bone and joint infections account for a considerable proportion of cases in developing countries.<sup>1</sup> "The incidence of neonatal septic arthritis is approximately 0.3 per 1000 live births worldwide, while it has been estimated that the rate in India is 0.6 per 1000 live births."<sup>2</sup> Due to the lack of initial signs and symptoms, neonatal septic arthritis usually goes untreated, yet it can have serious consequences, including the newborn's death. The most prevalent organism in culture is *Staphylococcus aureus*, However, other species such as *Klebsiella pneumoniae*, Group B streptococci, *Escherichia coli*, *Enterobacter* sp., *Kingella kingae*, and *Candida* sp have been isolated in culture.<sup>3</sup> Secondary hematogenous seeding of infectious organisms is a common mechanism of infection. The increased vascular supply and lack of synovial basement membrane in newborn infant joints predispose to this condition.<sup>4</sup> Due to the immaturity of a newborn's immune system, the illness has a high potential to spread swiftly and result in a number of terrible outcomes, including as sepsis, osteomyelitis, meningitis, the creation of abscesses in tissue gaps, and urinary tract infections. Such individuals may experience long-term

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morbidity from septic arthritis due to restrictions on normal joint motion, as well as the deterioration of articular cartilage and ossification sites.<sup>5</sup> It is an orthopedic emergency, and if it is not treated quickly, there could be major morbidity and fatality. The diagnosis of septic arthritis is extremely important and difficult. Joint injury, subluxation, dislocation, and other catastrophic consequences might result from delayed diagnosis and treatment. Age, the type of organisms, their virulence, patterns of resistance, and the length of the infection all play a role in the outcome. Compared to wealthy nations, septic arthritis is more prevalent in underdeveloped nations.<sup>6</sup> Early detection and the use of appropriate care result in favorable outcomes. Delays in treatment worsen the prospects for recovery.<sup>7</sup> Neonatal septic arthritis is underreported in developing countries despite being extensively researched in paediatric age group.<sup>8,9</sup>

There is limited literature evidence exists from Bangladesh on neonatal septic arthritis. So, we tried to investigate along with the outcomes of long-term follow-up, the clinical and bacteriological profiles.

## MATERIALS AND METHODS

From January 2021 to December 2022, this prospective observational study was carried out in the Department of Neonatology and OPD of the Department of Orthopaedic Surgery at the Bangabandhu Sheikh Mujib Medical University (BSMMU), Shahbag, Dhaka, Bangladesh. This study covered all term and preterm neonates who displayed the signs of septic arthritis. This study excluded neonates with congenital bone abnormalities and other congenital defects. A case was considered to be neonatal septic arthritis if presented with swelling of joints or met Morrey's diagnostic criteria of septic arthritis. "Morrey's criteria was satisfied with at least 2 of major criteria, namely, pus aspirated from the joint, marked elevation of erythrocyte sedimentation rate, specific roentgenographic changes in the involved site, and at least 5 of the minor criteria such as fever greater than 38.3°C, pain (localized to the joint) made worse by gentle passive motion, swelling of the involved joint, systemic symptoms of lethargy, malaise, irritability, no other demonstrable pathological process, satisfactory response to antibiotic therapy, and supportive evidence of ultrasound showing joint fluid collection"<sup>10</sup>. Informed consent was obtained from the parent of all the neonates. Those neonates who were admitted in NICU of BSMMU, clinical profile were collected in pre-designed data sheet from medical records. Birth weight,

comorbidities, gestational age, success of surgical and antibiotic therapy, and organisms cultured had all been noted. After initial treatment follow up and further management given at OPD of Department of Orthopaedic surgery in BSMMU. Those who were directly attended in OPD of Department of Orthopaedic surgery, BSMMU after initial treatment taken from outside details history, investigation profile and management history were collected from previous medical records.

Following discharge, all cases were followed up with three times a month until the child was 12 months old. Clinical evaluations were performed on all patients, including joint examination, range of motion (ROM), and pain level. Every appointment also included a check for mobility restriction, persistent joint deformity, and limb length discrepancy. Plain roentgenographic evaluation of the affected joint was performed every three months, along with a haematological test, and the ultimate outcome was graded after one year. Clinical examination and/or radiological findings such as absence of epiphyseal ossification, presence of a small epiphysis, metaphyseal widening, dislocation, or subluxation noted on follow-up were used to define poor outcomes as limb length discrepancy of more than 1 cm or restricted joint mobility. Institutional review board approval was waived for this study as data were collected from medical records.

Data were analyzed using IBM SPSS software package version 25.0 (IBM Corp, Armonk, New York, USA). The mean, standard deviation (SD), median, and range for numerical variables, and counts and percentages for categorical variables, were used to summarize the data using conventional descriptive statistics.

## RESULT

We collected 36 infants with neonatal septic arthritis from actual medical records. Thirty of these 36 newborns were available for follow-up. Out of 30 infants 18 neonate got treatment in NICU of BSMMU and 12 neonate attended OPD for follow up who got initial treatment outside the BSMMU. Two infants died after discharge, while one infant passed away while in the hospital. We monitored the remaining 30 infants, by clinical and radiological examinations, and recorded our findings for a 12-month period.

The follow-up group received an average of 3 visits. 23 (76%) of the 30 newborns had good prognosis. During clinical assessment, we noticed that 7 newborns (24%) had

unsatisfactory clinical outcomes, including length disparity (14%), restricted range of motion (31.4%). Seven infants were found to have poor radiological outcomes, including tiny epiphyses, absence of epiphyseal ossification, dislocations, subluxations, metaphyseal widening, and persistent osteomyelitis. Although one infant's X-ray results was abnormal, but clinically well.

Table I shows that among the patient's male was most prevalent 19 (63.3%). The median (range) birth weight age was 2.7(1.2-3.4) and gestational age was 37(29-40). Among them 36% was preterm and 40% was low birth weight baby. Age of presentation was 27.6±4.3 days. 70% of infants had comorbidities, and 80% of them had a history of hospitalization. Venous lines were used during the previous hospitalization of 20 (66.6%) newborns.

**Table- 1: Baseline characteristics of the enrolled cases (n= 30)**

Background characteristics	Neonate n=30 (%)
Male	19 (63.3)
Birth weight(kg)†	2.7 (1.2-3.4)
Low birth weight	12 (40)
Gestational age(weeks)†	37 (29-40)
Preterm	11 (36.6)
Age at presentation(days)*	27.60 (4.3)
Comorbidities	21 (70)
History of previous hospitalization	24 (80)
History of previous I/V medication	20 (66.6)
Exchange transfusion	2 (6.6)
History of previous surgery	2 (6.6)
Mechanical ventilation	3 (10)

\* mean±SD, † median(range)

Table II contains that joint swelling, tenderness and excessive cry were found as predominant symptoms. Single joint involvement was found common. Knee joint found more in our study (50%). Low haemoglobin, high CRP were found. 76% of blood culture and sixty percent of joint aspirate showed positive. Soft tissue swelling was found as most predominant feature in X ray.

**Table- II: Clinical profile of the enrolled neonate (n=30)**

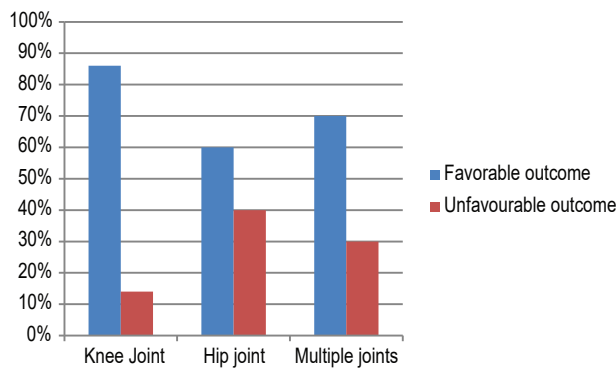
Variables	Neonate n=30 (%)
Fever	24 (80)
Joint swelling	28 (93)
Redness of overlying swelling	20 (66.6)
Tenderness	28 (93.3)
Poor feeding	18 (60)
Excessive cry	28 (93.3)
Joint distribution	
Knee	15 (50)
Hip	5 (17)
Multiple	10 (33)
Haematological parameter	
Haemoglobin gm/dl*	9.47 (1.79)
Total leucocyte count WBC/mm <sup>3</sup> †	13,950 (11000-38,000)
CRP†	73.5 (12-158)
Positive blood culture (n=30)	23 (76.6)
Positive joint aspirate culture (n=20)	12 (60)
Radiological findings	
Soft tissue swelling	29 (96.6)
Increased joint space	12 (40)
Osteomyelitis	8 (26)

\*Mean (Standard deviation), †median(range)

Table III represents the distribution of organisms isolated from the culture of blood and aspirated fluid of joint. Here blood cultures were done among 30 cases and 23 (76.67%) cases were found positive for *klebsiella*, *Acinetobacter*, *Serratia*, *Pseudomonas*, *E coli* and *Candida*; but joint fluid cultures were done among 20 cases and 12 (60%) cases were found positive for all the organisms as blood culture except *E coli*. *Klebsiella* was found in 40% cases from blood culture and in 42% cases from joint fluid culture.

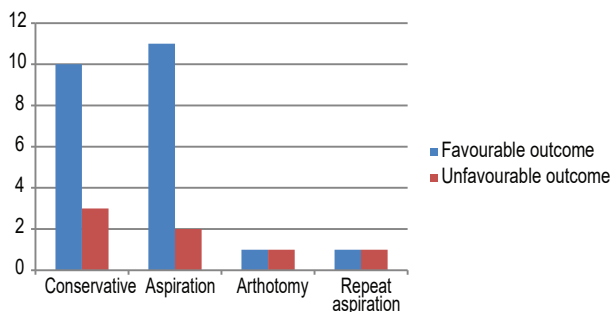
**Table-III : Organism isolated from the cultures of blood and joint fluid aspirate**

Organism	Blood (n= 23)	Aspirated joint fluid (n= 12)
Klebsiella	7 (30.43%)	5 (41.67%)
Acinetobactor	5 (21.74%)	3 (25.00%)
Serratia	4 (17.39%)	1 (8.33%)
Pseudomonas	2 (8.70%)	1 (8.33%)
E coli	3 (13.04%)	0 (0.00%)
Candida	2 (8.70%)	2 (16.67%)



**Fig 1:** Prognosis of neonatal septic arthritis according to joint involvement after one year followup (n=30)

Figure 1 illustrate the prognosis of neonatal septic arthritis according to joint involvement after one year follow up, 86% of neonate who presented with knee joint involvement and 70% of multiple joint involvement had better outcome. Favourable outcome was found in 60% of neonate with hip joint involvement.



**Figure- 2:** Prognosis according to mode of treatment (n=30)

Figure 2 represent the prognosis of neonatal septic arthritis according to mode of treatment; here 10 (76.9%) and 11 (84%) neonates had satisfactory outcomes who treated

conservatively and aspiration respectively. Another 2 neonates who needed repeat aspiration and 50% of them had favourable outcome. Among the neonates who treated with arthotomy, 50% of them found favourable outcomes.

## DISCUSSION

Neonates with septic arthritis require special care because of its modest signs and symptoms and severe effects. Septic arthritis in neonates is difficult to diagnose and often missed and leads to seriously disabling sequelae which can be prevented if promptly treated in early stage of infection. We can take preventative measures and determine prognosis with the help of result from our study.

In terms of sex preference, the previously reported data was male-predominant.<sup>1,7</sup> Our cohort had also male sex (63 %) predilection. Female predominance found 2 studies.<sup>11,12</sup> The majority of recent research on newborn septic arthritis focuses on preterm infants.<sup>7,11,12</sup> 64% of the participants in our study were term neonate who were sent to our institution from the outlying areas. Similar kind of findings were observed by Usa et al (63%).<sup>1</sup> Age at presentation was on average 27.6 ±4.3 days in our study. After being exposed to numerous risk factors for blood stream infection either during, prior hospitalization or from the community, babies began to exhibit symptoms after the second week of life. The mean age of onset of symptoms were found 15 days onward in other studies.<sup>1,7,11,13</sup>

Comorbidities and neonatal resuscitation enhance the risk of septic arthritis.<sup>1,13</sup> We observed that the majority (80%) of the newborns were admitted to the NICU for various medical reasons.

The lower limb assumes a flexion, abduction, and external rotation posture with swelling when suffering from newborn septic arthritis.

Pseudoparalysis, or decreased active movement, was present in all the newborns in our series.

In other studies the lower limb, and particularly the hip, is frequently affected.<sup>1,7</sup> According to our findings, the knee joint is most frequently affected (50%). Similar results were discovered in Nishat's study.<sup>11</sup> The higher concentration of organisms at the infection site than in blood can be used to explain the higher yield from joint culture. In our study, blood cultures were positive in 76% of infants and joint fluid cultures were positive in 60% of infants. The joint culture positivity was higher than the

USA (35.7%) but lower than earlier studies by Rudra (78%) and Akash et al. (60%).<sup>1,7,15</sup> Furthermore, in comparison to previous studies, our blood culture positivity was also lower. Long-term antibiotic use while in the hospital can be blamed for these low yields. Joint fluid culture was not done in all cases due to the unavailability of expert orthopedic surgeon specially those neonate who treated outside the BSMMU. For this reason exact picture was not represent in our study. Since majority of the patients had taken broad-spectrum antibiotics before being admitted to the hospital. The majority of the organisms in our study were Gram-negative, with *Klebsiella* being the most prevalent. Gram-negative organisms were mostly documented in the majority of post-millennium studies.<sup>1,7,11,12</sup> However, it has been observed that the rates of fungal septic arthritis are increasing over a period of time due to rampant use of antibiotics. We found 2 cases of candida positive in our study. It has been observed that in the recent past gram negative organisms have replaced gram positive organisms as the most common cause of septic arthritis. Besides, the type of organism isolated from the specimen depends upon the type of hospital, local dominant flora and patient characteristics (gestational age, birth weight, postnatal age, associated conditions).<sup>16</sup>

The coexistence of osteomyelitis and septic arthritis in the newborn population is higher than in pediatric age group. This can be explained by the particular characteristics of the osteal blood supply of a neonate, in which contact between the metaphyseal and epiphyseal arteries promotes the rapid spread of infection and offers a channel for infection into the joint.<sup>1</sup> In our study, 26% of the infants had osteomyelitis or septic arthritis. 76% of the participants in our study acquired satisfactory outcomes. This is comparable to research by Akash et al. (73.3%) and Li et al. (72.9%).<sup>2,7</sup> Patients reported satisfactory results, according to Rudro et al. (43.6%) and Devi et al. (50%) reports.<sup>1,15</sup> Lee et al. reported poor outcome in 48% patients. However mean time to presentation from the onset of symptoms in this study was 4.32 days only. It is widely known that the location, age, length of the treatment, and the causative organism influence the course of septic arthritis in children.<sup>8</sup> Time of onset and delay in presentation and intervention is independent predictor of outcome in neonatal septic arthritis.<sup>1</sup>

Neonatal hip septic arthritis presentation is very non-specific, and is associated with poor prognosis, especially if the detection and intervention is delayed.<sup>17</sup> In our study those neonate who presented with hip joint

involvement had unfavourable outcome than other joint involvement.

According to Usa et al.'s study, there is a clear correlation between poor outcomes and many joints involved, preintervention duration of less than seven days, culture-positive joint aspirate, and restricted range of joint movements at discharge.<sup>1</sup> As our sample was only 30, so predictor can't be measured. Thus, an early diagnosis and prompt referral, aspirate the joint fluid in all cases is the cornerstone for optimum results.

## CONCLUSIONS

Most neonates with septic arthritis have a monoarticular involvement. The knee is the most often affected joint. Gram-negative bacteria, particularly *Klebsiella*, continue to dominate the bacteriological profile. We should focus on early referral to tertiary care facilities, rapid surgical intervention, and steps that assure optimal joint mobility at the time of discharge in addition to commencing intravenous antibiotics.

## Limitation:

The follow-up observations were three times within 12 months age of the neonates. The sample size was small. Cases were referred to other centers for orthopaedics consultation, that's why joint fluid study for all the affected joints are missing. Due to the severity of illnesses transportation was difficult and cost considerations during follow-up. Magnetic resonance imaging (MRI) or ultrasound (USG) could not be done in all patient.

## Author Contributions:

Concept –RMC, KPD ; Design –RMC, KPD; Supervision- AM; Data Collection and/ or Processing- SA; Analysis and/ or Interpretation- RMC; Literature Search – RMC, KPD; Writing Manuscript- RMC, KPD; Critical Review- RMC, KPD, AM, SCM.

## Conflict of Interest:

The authors have no conflict of interest to declare.

## Financial Disclosure:

The authors declared that this study has received no financial support.

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