DOI: https://doi.org/10.53350/pjmhs2023171687

ORIGINAL ARTICLE

Prevalence, Etiology, Antimicrobial Susceptibility Testing and Predictors of Urinary Tract Infection among Neonates with Clinical Sepsis

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ABSTRACT

Background and Aim: The most common pediatric infection is urinary tract infection (UTI). Neonates who suffer from neonatal sepsis remain among the most vulnerable to death and morbidity, especially in developing countries. The present study aimed to determine the prevalence, etiology, and susceptible antimicrobial agents of UTIs among neonates with clinical sepsis.

Patients and Methods: This cross-sectional study was carried out on 128 sepsis diagnosed neonates admitted to the Department of Pediatrics**,** Microbiology and Infectious Diseases, Niazi Welfare Teaching Hospital, Sargodha from September 2021 to May 2022. All neonates aged ≤ 28 days diagnosed of clinical sepsis and consent provided by their parents/guardian were enrolled. An interviewed based questionnaire was used for data collection from neonate's parents or caregiver. The questionnaire included information on the socio-demographics and clinical presentations of neonates, as well as maternal history and laboratory examinations. The history is taken from prenatal to postnatal, including birth weight analysis and birth conditions. Neonates underwent general and local examinations to determine their state of consciousness, vital signs, and weight. We examined the abdomen (for tenderness and abdominal distention) and the nervous system (to elicit suckling and motor reflexes). A hematological analyzer was used to test the full blood picture (FBP). SPSS version 27 was used for data analysis.

Results: Of the total 128 neonates, there were 76 (59.4%) females and 52 (40.6%) male neonates. The overall mean age was 6.4 ± 0.36 days with majority of neonates 112 (87.5%) were < 7 days. The low birth weight and low Apgar score were found in 13 (10.2%) and 16 (12.5%) neonates respectively. Of all neonates, the failure to breastfeed was found in 26 (20.3%) being the most common clinical symptom followed by an increase in breathing rate 21 (16.4%), diarrhea 19 (14.8%), gritting 16 (12.5%), altered mental status 12 (9.4%), and jaundice 11 (8.6%). The incidence of UTI was 20.3% (n=26). The prevalence of separated bacterial agents such as Klebsiella pneumonia and Enterobacter spp. was 61.5% (n=16) and 38.5% (n=10) respectively. Ciprofoxacin and amikacin were both effective against 90% and 60% of the bacterial isolates, respectively. The UTI potential predictors involved prolong labour, positive leucocyte esterase test, Low Apgar score, and positive urine nitrite test.

Conclusion: The present study found that the prevalence of UTI was 20.3%. Failure to breastfeed was the most common clinical symptom followed by an increase in breathing rate, diarrhea, gritting, altered mental status, jaundice, convulsion, and cyanosis. Klebsiella pneumonia and Enterobacter spp. were the most prevalent separated bacterial agents. Ciprofoxacin and amikacin were both effective in bacterial isolates.

Keywords: UTI, Clinical sepsis, Neonates, Antibiotic sensitivity

INTRODUCTION

Bacteria, parasites, viruses, and fungi are different infectious agents that causes urinary tract infections (UTIs) that exist and proliferate in urinary system sections such as urethra urethritis, bladder cystitis, urine bacteriuria, and kidney pyelonephritis [1]. UTIs might be symptomatic or asymptomatic infections that can transpire in complicated or uncomplicated individuals [2]. UTIs is one of the most prevalent causes of febrile illness in children, with a global frequency of 2-20% [3, 4]. They can cause significant morbidity and long-term consequences include renal scarring, hypertension, and chronic renal failure [5, 6]. Many pediatric UTI infections go undiagnosed due to a lack of specific symptoms and indications, particularly in newborns and young children [7]. It is believed that around 50% of UTIs in children are overlooked [8]. Early detection and treatment reduce the incidence of renal scarring and associated consequences [9]. Empirical antibiotics are frequently used for this purpose even before culture results are available. Antibiotic resistance in urinary tract infections, on the other hand, has been growing internationally [10].

Neonatal sepsis is defined as a clinical illness marked by systemic signs and symptoms of bacterial infection in the first 28 days of life [11]. It is a medical emergency that requires immediate diagnosis and treatment to avoid death [12]. Globally, it is estimated that 3 million babies die from sepsis each year, with neonatal sepsis accounting for 30% of all fatalities in children under the age of five [13]. Due of their immature immune system, newborns are especially vulnerable to infectious pathogens. The systemic inflammatory response to infection is decreased in newborns due to low immunoglobulin levels, poor complement activation, low neutrophil storage, and impaired neutrophil migration from the circulation to infection sites [14].

The diagnosis of newborn UTI is commonly neglected since the symptoms are typically vague and obtaining clean samples is difficult. Systemic signs of UTI in the infant include prolonged jaundice, poor weight growth, temperature irregularity, lethargies, inability to breastfeed, and abdominal distension [15]. Escherichia coli is the most frequent bacterium that causes UTI in newborns and babies, accounting for 90% of cases [16]. Klebsiella pneumoniae and enterococci are two more bacteria. These species are located mostly in the proximal gastrointestinal tract and inhabit the perineum [17]. The absence of UTI was not ruled out by negative microscopic results for dipstick tests for nitrite and leukocyte esterase [18]. Gestational age, male gender, birth weight, chronological age, feeding exposure, UTI, and poor Apgar score >7 at 5 minutes are all predictors of UTI in a neonatal population [19].

METHODOLOGY

This cross-sectional study was carried out on 128 sepsis diagnosed neonates admitted to the Department of Pediatrics**,** Microbiology and Infectious Diseases, Niazi Welfare Teaching Hospital, Sargodha from September 2021 to May 2022. All neonates aged ≤ 28 days diagnosed of clinical sepsis and consent provided by their parents/guardian were enrolled. An interviewed based questionnaire was used for data collection from neonate's parents or caregiver. The questionnaire included information on the socio-demographics and clinical presentations of neonates, as well as maternal history and laboratory examinations. The history is taken from prenatal to postnatal, including birth weight analysis and birth conditions. Neonates underwent general and local examinations to determine their state of consciousness, vital signs, and weight. We examined the abdomen (for tenderness and abdominal distention) and the nervous system (to elicit suckling and motor reflexes). A hematological analyzer was used to test the full blood picture (FBP). Blood of two milliliters were taken aseptically and placed in clot activator tube and allowed for at least 15 minutes to guarantee that it clotted. The serum was drained, placed in the disc, and then placed in the machine.

A container comprised of urine specimen were stored and transported to laboratory in order to prevent organism growth in those samples. This technique was completed within 1 hour of the sample being collected. In cases where test was not performed immediately, it was chilled at temperatures ranging from 4 to 8 °C, and the procedure was completed within 4 hours. For data analysis, SPSS version 27 was used. For continuous data, the mean was computed. Chi-square test was used for comparative association between categorical variables. Multivariate regression analysis was done to define the UTIs associated independent factors among neonates with clinical sepsis.

RESULTS

Of the total 128 neonates, there were 76 (59.4%) females and 52 (40.6%) male neonates. The overall mean age was 6.4 ± 0.36 days with majority of neonates 112 (87.5%) were < 7 days. The low birth weight and low Apgar score were found in 13 (10.2%) and 16 (12.5%) neonates respectively. Of all neonates, the failure to breastfeed was found in 26 (20.3%) being the most common clinical symptom followed by an increase in breathing rate 21 (16.4%), diarrhea 19 (14.8%), gritting 16 (12.5%), altered mental status 12 (9.4%), and jaundice 11 (8.6%). The incidence of UTI was 20.3% (n=26). The prevalence of separated bacterial agents such as Klebsiella pneumonia and Enterobacter spp. was 61.5% (n=16) and 38.5% (n=10) respectively. Ciprofoxacin and amikacin were both effective against 90% and 60% of the bacterial isolates, respectively. The UTI potential predictors involved prolong labour (AOR= 5.41, 95% CI, 1.30-20.46, p=0.001), positive leucocyte esterase test (AOR= 6.59, 95% CI, 1.51-30.26, p=0.015), Low Apgar score (AOR = 11.82, 95% CI = 4.21–38.92, p<0.001), and positive urine nitrite test (AOR = 25.74, 95% CI = 7.82–90.69, p<0.001). The demographic and clinical details of neonates and maternal is shown in Table-I and Table-II. Participants' clinical features are shown in Table-III. Urine culture test was performed on positive and negative neonates on urine dipstick test and it was observed that 20.3% (26/128) of the neonates had positive urine culture and 79.7% (102/128) of the neonates had negative urine culture findings. Klebsiella pneumoniae accounted for 61.5% (n=16) of the pathogenic organisms identified in neonates urine culture among, followed by Enterobacter spp., which accounted for 38.5% (n=10) as depicted in Figure-1. Ciprofoxacin, meropenemamikacin, and nitrofurantoin were shown to be susceptible to Klebsiella pneumoniae and Enterobacter spp., whereas ampicillin, ceftriaxone, and gentamycin were completely resistant to the isolated organisms as shown in Figure-2. Predictors of neonatal urinary tract infection (UTI) are represented in Table-IV.

Table-1: Neonatal baseline and medical features (n=128)

Features	Frequency N	Percentage %
Neonates age (days)		
<7	112	87.5
≥7	26	12.5
Gender		
Male	52	40.6
Females	76	59.4
Birth weight (g)		
Normal (≥2500)	114	89.1
Low (<2500)	14	10.9

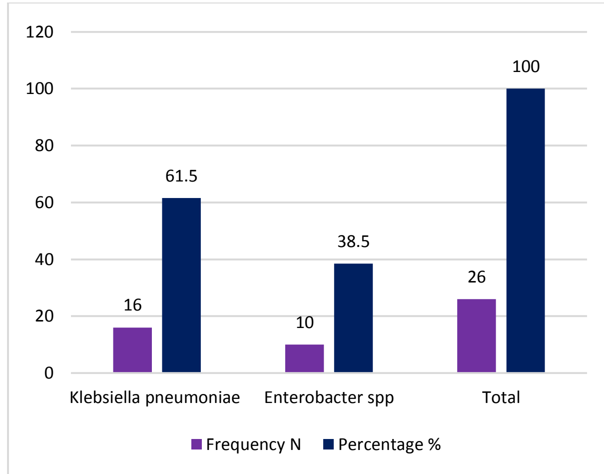

Figure-1: Prevalence of UTIs (n=26)

Table-2: maternal baseline and medical features (n=128)

Features	Frequency N	Percentage %
Maternal age group (years)		
<20	15	11.7
21-35	92	71.9
>35	21	16.4
Maternal Occupation		
Employed	46	35.9
Unemployed	82	64.1
Gestational Age		
First trimester	12	9.4
Second trimester	92	71.9
Third trimester	24	18.8
UTI antibiotics		
Yes	5	31.3
No	11	68.7
Labour duration (hrs)		
>18	11	8.6
≤18	117	91.4
Mode of delivery		
Cesarean section	9	7.0
Spontaneous vaginal delivery	119	93

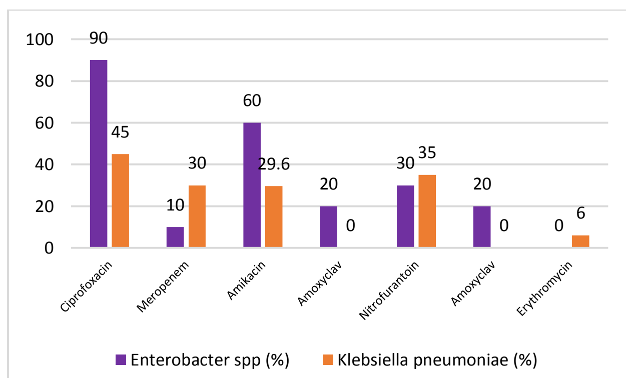

Figure-2: Patterns of antibiotic sensitivity in infants with urinary tract infection

Table-3: Participants' clinical features

Clinical features	Frequency N	Percentage %
Failure to breastfeed	26	20.3
Breathing rate	21	16.4
Diarrhea	19	14.8
Gritting	16	12.5
Altered mental status	12	9.4
Jaundice	11	8.6
Convulsion	14	10.9
Cyanosis	9	7.0
Total	128	100

Table-4: urinary tract infection (UTIs) predictors of neonates

UTIs predictors	AOR, 95% CI	P-value
Prolong labour	5.41 (1.30-20.46)	0.001
Positive leucocyte esterase test	6.59 (1.51-30.26)	0.015
Low Apgar score	11.82 (4.21–38.92)	<0.001
Positive urine nitrite test	25.74 (7.82–90.69)	<0.001

DISCUSSION

The present study mainly focused on the incidence, etiology, and susceptible antimicrobial agents of UTIs among neonates with clinical sepsis and found that UTI was found in 20.3% of neonates. The most prevalent clinical sign was failure to breastfeed, followed by an increase in respiratory rate, diarrhea, gritting, changed mental state, jaundice, convulsion, and cyanosis. Enterobacter spp. and Klebsiella pneumonia are the most prevalent separated bacterial agents. Both ciprofloxacin and amikacin were effective against bacterial isolates. UTI is the most prevalent bacterial infection, affecting primarily children, and can have serious consequences in cases if not cured promptly. Disease established scope, predictors of risk factors, and causative agents for infection are all critical steps in the therapeutic therapy of newborns.

The frequency of UTI among newborns was found to be 20.3%, and the only bacterial isolates involved in causing UTI were Klebsiella pneumoniae and Enterobacter spp. Ampicillin, gentamycin, and ceftriaxone were all completely ineffective against the isolated bacteria in the research; however, ciprofloxacin showed response to both isolates. Moreover, the UTIs independent predictors were leucocytes, lower Apgar score, and nitrite positive test. The incidence of UTI among newborns in our study was 20.3%, which was comparable to the incidence of 18% reported by Fatima et al. in India among neonates (< 4 weeks) [20].

The incidence of UTI discovered in this investigation was greater than the prevalence of 6%, 6.4%, 7.2%, 12.5%, and 14.5% recorded in various studies [21-25]. The difference in prevalence between studies might be attributed to differences in technique. The UTIs most prominent cause in the present study was Klebsiella pneumonia, which is consistent with the findings in our study [26, 27]. In terms of antibiotic sensitivity, nitrofurantoin, ciprofloxacin, and amikacin showed significant resistance to Enterobacter spp. In contrast, Klebsiella pneumoniae was sensitive to Cipro, nitrofurantoin, and amikacin. A Nigerian based study reported that Klebsiella pneumoniae was the most prevalent bacterial isolated among neonates followed by Enterobacter spp. The former was sensitive to gentamicin (33.3%), nitrofurantoin (83.3%), and ciprofloxin (33.3%) [28].

Low Apgar score neonates were 12 to 13 times more prone to UTI as compared to normal Apgar score and their association was found statistically significant [29]. The majority of neonates delivered with low Apgar scores are owing to difficulties in the delivery process, particularly delays during the 2nd stage of labour. Furthermore, UTIs among neonates have been associated with maternal diseases such as anemia and malaria [30].

Anorectal abnormalities and gastrointestinal issues have also been observed to enhance the odds of newborns developing UTI. Vesicoureteral reflux, for example, has been shown to occur in 20-47% of children with anorectal abnormalities [31]. Furthermore, the risk of UTIs rises with increased vesicoureteral reflux, which can contribute to renal impairment due to renal scarring. [32].

E. coli was the most prevalent bacterium linked with pediatric UTI. Our findings are comparable with those of other research [33, 34]. E. coli is the most frequent etiological agent for UTI, regardless of age, community, and gender accounting for 50-90% of infections. Uropathogenic E. coli (UPEC) enter the bladder through the urethral orifice after emerging from the intestinal flora [35].

CONCLUSION

The present study concluded that the prevalence of UTI was 20.3%. Failure to breastfeed was the most common clinical symptom followed by an increase in breathing rate, diarrhea, gritting, altered mental status, jaundice, convulsion, and cyanosis. Klebsiella pneumonia and Enterobacter spp. were the most prevalent separated bacterial agents. Ciprofoxacin and amikacin were both effective in bacterial isolates.

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