Original Article

Maternal Urinary Tract Infection: Is It Associated With Neonatal Urinary Tract Infection?

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Abstract

Objective: Maternal urinary tract infection is associated with intrauterine growth restriction, preterm delivery and low birth weight. The purpose of this study was to evaluate whether maternal urinary tract infection is related to neonatal urinary tract infection.

Materials and methods: The present prospective study included 230 singleton neonates. The participants were divided into two groups based on in utero exposure to maternal urinary tract infections. The study group (exposure to maternal urinary tract infection) included 115 neonates and the control group (without exposure to maternal urinary tract infection) included 115 healthy neonates. Physical examination, urinalysis, urine culture and urinary system ultrasonography were carried out for all neonates.

Results: There were 153 deliveries by cesarean section and 77 vaginal births. There was no statistically significant difference between the groups in terms of gender distribution, maternal age, birth weight, mode of delivery, gravida and gestational age. Although the difference was not significant, the incidence of low birth weight and preterm delivery were higher in the study group in comparison to that in the control group. There was a statistically significant higher rate of neonatal urinary tract infection in the study group compared with control group (25.2% vs. 7.8%, $p<0.001$). The most commonly discovered pathogens were Escherichia coli, followed by Klebsiella spp., Proteus spp., and Serratia spp. in the study group.

Conclusion: The results of this study showed that the presence of maternal urinary tract infection may contribute to increased urinary tract infection frequency in the neonatal period. Neonates at risk for a urinary tract infection should be regularly monitored due to nonspecific clinical presentation.

Keywords: Urinary Tract Infection; Pregnancy; Newborn; Culture; Ultrasonography

Introduction

Urinary tract infections (UTIs) are the most frequent type of infection during pregnancy (1). A UTI may manifest as acute cystitis, asymptomatic bacteriuria or pyelonephritis. Pregnant women are at raised risk of UTIs due to anatomical and hormonal changes, which lead to ureteral dilatation and urinary stasis (2, 3). All women should be screened for UTI during

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pregnancy and subsequently treated with antibiotic therapy. Maternal UTI is associated with intrauterine growth restriction (IUGR), preterm delivery and low birth weight. Asymptomatic bacteriuria is also more likely to deliver preterm neonate (4).

UTI is a frequent clinical problem in children of all age groups, comprise 1/3 bacterial infections in newborn infants. Appropriate diagnosis and treatment restrain complications such as proteinuria, urosepsis, hypertension and end stage renal disease (5, 6). Immaturity of local immunity including low secretory IgA level, low uroepithelial bactericidal activity, decreased renal acidification and severe periurethral colonization are the major risk factors for raised susceptibility to UTI in the neonatal period (7).

UTI may occur via hematogenic or ascendant routes. Uropathogens that have colonized the periurethral area ascend to the bladder and lead to the UTI (8, 9). Pathogens can diffuse to the kidney and bloodstream from the bladder. The ascendant route consists of the migration, fixation and proliferation of uropathogens in the urinary tract. Bacteria ascend the urinary tract against urine flow and make infection by several mechanisms (8, 9). Newborn babies with UTIs often present with poor feeding, fever, tachypnea, lethargy, jaundice, diarrhea and vomiting (10, 11). Newborn babies are characterized by very subtle symptoms of a UTI. The same symptoms can be seen in healthy neonates. Diagnosis of UTI is based upon a positive urine culture from a urine sample which is collected by suprapubic aspiration, urine bag or bladder catheterization. A positive result is based on defining an uropathogenic bacteria and achieving a threshold of number of colony forming units that grow on the culture medium.

In a recent study, the effect of maternal urinary tract infection was investigated. Maternal urinary tract infection was found to be associated with prematurity (12). Howley et al. examined the effect of maternal urinary tract infection on birth defects (13). Birth defects were found more common in babies exposed to maternal UTI. Delzell et al. demonstrated several adverse maternal and perinatal outcomes as a result of maternal UTI including low birth weight, prematurity, intrauterine growth retardation, pre-eclampsia, amnionitis and perinatal death (14). However, the relationship between maternal UTI and neonatal UTI has not been investigated in the above studies.

Only a few studies have investigated the association between maternal UTI and neonatal UTI (15, 16). The purpose of this study was to evaluate whether maternal UTI is related with neonatal UTI.

Materials and methods

The present prospective study included 355 singleton neonates who were admitted to the Neonatology Unit of Dumlupinar University, from July 2017 to January 2018. A total of 230 babies were considered eligible for the analysis. Ethics Committee approval and informed consent of the mothers were obtained before any study procedure.

The medical records of the mothers were retrospectively reviewed, and the participants were divided into two groups based on in utero exposure to maternal urinary tract infections. National health services in Turkey provided comprehensive perinatal care for all pregnant women and urine cultures were carried out as part of the routine prenatal care. The study group (maternal UTIs exposure) included 115 neonates (55 girls and 60 boys), and the control group (without maternal UTIs exposure) included 115 healthy neonates (51 girls and 64 boys).

All singleton births between July 2017 and January 2018 were included. The exclusion criteria were as follows: 1. maternal chorioamnionitis, 2. maternal sepsis, 3. maternal pneumonia, 4. meconium-stained amniotic fluid, 5. placental abruption, 6. neonates lacking prenatal care, 7. multiple gestations, 8. women who delivered their fetus after medical induction. Maternal age, maternal parity, gestational age, birth weight, delivery mode, and gender of each infant were recorded. In addition, the trimester in which UTI had occurred, was recorded. Gestational age was estimated based on the last menstrual period.

Urine samples were taken from the patients before they were discharged. Patients were also invited for routine control on the postnatal 7th day. Physical examination, urinalysis, urine culture and urinary system ultrasonography were carried out for all neonates. All ultrasound examinations were performed by the same experienced ultrasonographist. All neonates were taken samples for urine culture on the second day and seventh day of their life. Those with positive results of urinalysis were taken one additional sample to increase sensitivity. UTI was determined the growth of more than 10^5 colony-forming units per milliliter of one organism. Urine samples for culture were collected using urine collecting bags. The urine bags were kept attached to the neonates for 30 minutes. If a neonate did not urinate, a new bag was

placed. All urine samples were transported immediately to the laboratory.

Statistical Analysis: All statistical analyses were performed using the SPSS software (SPSS Ver. 16.0; SPSS Inc., Chicago IL, USA). The results of tests were expressed as the number of observations (n), minimum-maximum values, mean ± standard deviation and median. Kolmogorov-Smirnov test was used to test for normal distribution of the data, and Levene's test was used to test for homogeneity of variance. Categorical data were analyzed with Fischer's Exact Test and Chi-square test. Student's t-test was used for the comparison of two groups with normally distributed variables, and the Mann-Whitney U-test was used for data not normally distributed. The correlations among numerical data were analyzed by the Pearson correlation coefficient (r). The statistical significance level was set at $p<0.05$.

Results

Two hundred and thirty infants were included in the study, among whom 115 neonates had mothers with a history of UTI during pregnancy, considered as the study group. There were 153 deliveries by cesarean section and 77 vaginal births. Table 1 summarizes the demographic characteristics of the study population. There was no statistically significant difference between the groups in terms of gender distribution, maternal age, birth weight, mode of delivery, gravida and gestational age (Table 1).

Table 1: Demographic characteristics of the study population

	Study group (n=115)	Control group (n=115)	P value
Maternal age (years)	28.83±5.07	29.05±4.73	0.73
Gravida	2.09±0.81	2.15±0.96	0.60
CS/VD	75/40	78/37	0.67
Gestational age	38.59±1.37	38.87±1.22	0.09
Birth weight	3177.26±445	3259.04±360	0.12
Female/male	52/63	58/57	0.42
LBW	9	5	0.27
Preterm delivery	12	6	0.14

CS: Cesarean section; VD: Vaginal delivery; LBW: Low birth weight. Data are presented as mean± standard deviation or numbers/number, where appropriate.

Although the difference was not significant, the incidence of low birth weight and preterm delivery were higher in the study group in comparison to that in the control group (n:9, 7.82%, n:12, 10.43% vs. n:5, 4,34%, n:6, 5,21%, respectively) (Table 1).

There was a statistically significant higher rate of neonatal UTI in the study group compared with control group (n: 29, 25.2% vs. n: 9, 7.8%, respectively, p=<0.001) (Table 2).

Table 2: Comparison of neonatal urinary tract infection incidence between the groups

	Study group n (%)	Control group n (%)	P value
Present	29 (25.2)	9 (7.8)	
Absent	86 (74.8)	106 (92.2)	<0.001
Total	115	115	

UTI: Urinary tract infection

The most commonly discovered pathogens were E Coli (n: 15, 51.72%), followed by Klebsiella spp. (n: 5, 17.24%), Proteus spp. (n: 3, 10.34%), and Serratia spp. (n: 2, 6.89%) in the study group. In the control group, UTI was found in 9 neonates. In the study group, 4 patients were defined as mild hydronephrosis, 6 patient pelviectasis, 1 patient unilateral cortical cyst, 2 patients vesicoureteral reflux, 1 patient ectopic kidney, 1 patient ureteropelvic stenosis and one patient congenital renal agenesis. In the control group, 2 patients were described as mild hydronephrosis, 7 patient pelviectasis, 1 patient unilateral cortical cyst, 1 patient ectopic kidney and 1 patient ureteropelvic stenosis by urinary system ultrasonography.

Discussion

It has been well known that maternal UTI is associated with low birth weight, fetal mortality, IUGR and preterm delivery (4, 17 and 18). These complications occur even among women who were given antibiotic treatment. However, the relation between maternal UTI and neonatal UTI is unknown. To the best of our knowledge, only two small studies have investigated maternal UTI as a risk factor for the development of neonatal UTI (15, 16). In our study, we demonstrated that UTI during pregnancy increases the risk of UTI in the newborn.

In a recent study, 40 neonates with a diagnosis of UTI were investigated (15). For comparison, 74 newborns admitted for management of jaundice were selected as controls. Maternal UTI prevalence was investigated between groups (15). They found a higher prevalence of maternal UTI in the study group (neonates with UTI). In this study, the control group who were admitted due to jaundice may have affected

the results (15), because jaundice may be an important and even the first presenting sign of UTI (19).

In another study, 40 neonates who were exposed to maternal UTI during pregnancy and 40 neonates who were not exposed to maternal UTI were included (16). The effect of maternal UTI on neonatal UTI was examined among the groups. In this study, neonatal UTI was significantly more common in the maternal UTI exposed group (16).

Many risk factors make newborns prone to UTI. Urinary tract malformations, prematurity, male gender, VUR, no circumcision, multiple invasive procedures, intravascular catheters, parenteral alimentation, prolonged nursery course are risk factors for development of UTI in the neonates (20-25). Zorc et al. investigated clinical and demographic factors associated with UTI in a multicenter study (26). They found that no circumcision and male gender were related to UTI. Levy et al. documented that the incidence of UTI is higher in preterm infants versus term infants (27). A clear male predominance has been related to neonatal UTI, with boys making up approximately 70% to 90% of all cases. This superiority reflects the higher incidence of urinary tract anomalies in males and the raised risk of UTI in uncircumcised boys (10, 28). In our study, there was no statistically significant difference between the groups in terms of urinary tract malformations incidence, preterm delivery, gender distribution. As all the neonates in our study were uncircumcised, we could not make a comparison regarding this.

In the current study, E Coli was the most common pathogen among our newborns with UTI. Clinical manifestations of UTI are extremely variable in neonates. The majority of newborns are asymptomatic or have mild and nonspecific symptoms such as poor feeding, diarrhea, fever, vomiting, irritability and lethargy (29). The majority of our patients had nonspecific symptoms such as poor feeding, lethargy and vomiting.

There are some limitations to our study. First, although supra pubic aspiration has been noted as the standard test for diagnosis of UTI, it was not performed in our study. Second, we do not have information regarding actual maternal UTI treatment and compliance.

Conclusion

In conclusion, the results of this study showed that the presence of maternal urinary tract infection may contribute to increased urinary tract infection frequency in the neonatal period. It is important to diagnose a UTI in neonates in the perinatal period. Neonates at risk for a UTI should be regularly monitored due to nonspecific clinical presentation. A prospective randomized controlled trial with more cases and well-controlled confounding factors may be needed to confirm our results.

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