

## Urinary imaging findings in young infants with bacteremic urinary tract infection.

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### Abstract

**Background:** The Urinary Tract Infection (UTIs) is one of the most widely acquired bacterial infections in infants. UTI sometimes accompanied by bacteremia. Bacteremia is characterising as the development of a pathogen within the blood culture. Imaging tests, such as a Renal Ultrasound (RUS) and Voiding Cystourethrogram (VCUG) use to diagnose UTIs.

**Aim:** We aimed to describe RUS and VCUG findings in young infants with bacteremic urinary tract infection and to determine the association between imaging findings and other variables at a tertiary hospital in Jeddah, Saudi Arabia.

**Methods:** We retrospectively studied the medical records of 30 infants from both genders who had diagnosed with bacteremic UTIs at a tertiary hospital in Jeddah, Saudi Arabia. Infants were excluded if they had known urologic abnormalities at the time of presentation, required intensive unite care and infants with immunocompromised diseases. Data was analyzed by SPSS program.

**Results:** Of the 30 infants, 70% were boys, 50% aged from 0-3 months while the other 50% aged >3 months, 14 (46.7%) were Saudis while 16 (53.3%) were non-Saudis, 61.1% were non-febrile, 58.62% had standard creatinine value. All infants 100% underwent RUS, 96.2% of them had RUS abnormalities (18 males and seven females) while only 3.8% (1 male) had typical RUS result. 37.9% of infants underwent VCUG, 18.2% (2 miles) of them had normal VCUG, while the majority 81.8% (7 males and two females) had abnormal findings. 17.9% presented with VUR. There was no significant association between RUS results with sex, age group, creatinine value and urine cultures. On another hand, there was a significant association between RUS abnormal result and blood culture. Also, no significant association found between VCUG results with sex, age group, creatinine, blood and urine cultures.

**Conclusion:** In conclusion, the prevalence of RUS and VCUG abnormality in our cohort found to be higher than other studies. There was a significant association between RUS finding and blood culture results; on another hand, there was no significant association between RUS and VCUG findings with other variables that could suggest bacteremic risk in UTI infants.

**Keywords:** Bacteremic Urinary Tract Infection (UTIs), Young infants, Urinary imaging.

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### Introduction

Urinary Tract Infections (UTIs) is one of the most widely acquired bacterial infections in infants [1]. UTI sometimes accompanied by bacteremia. Bacteremia is characterized as the development of a pathogen within the blood culture [2]. The signs and symptoms of UTI are nonspecific all over infancy [3]. Imaging tests, such as a Renal Ultrasound (RUS) and voiding cystourethrogram (VCUG) use to diagnose UTIs [1]. Urine White Blood Cell (WBC) thresholds have advocated for the diagnosis of probable UTI among infants [4]. About 31% of infants with UTI diagnosed with bacteremia [2]. The main parameter that was consistently found as a risk factor for bacteremia is a young age [2].

Chang PW, 2016, conducted a retrospective study to describe the findings and to specify the predictors of abnormal Renal

Ultrasound (RUS) and Voiding Cystourethrogram (VCUG) imaging in young infants with bacteremic UTI. The study involved 276 infants, 19 excluded. The other 257 infants, 254 went through a RUS, and 224 went through a VCUG. The study found that the bacteremia in bacteremic UTI had no particular findings nor special considerations in imaging. Also, not *Escherichia coli* (*E.coli*) infection was associated with both abnormal RUS and abnormal VCUG [5].

On the other hand, Honkanen, et al. prospectively studied the clinical characteristics of bacteremic urinary tract infection (UTI) in children. The study population of 134 patients with bacteremic UTI divided into three age groups: Infants from 1 week to 3 months old; infants from 3 to 11 months past; and children  $\geq$  12 months old with a comparison group of 134 age-

and sex-matched non-bacteremic UTI patients randomly selected.

The study found bacteremic children, especially those with non-*E. Coli* UTI was more often had anatomical or functional abnormalities in the urinary tract [6]. Another study conducted a retrospective review of the medical records of 130 children 12 years of age or younger admitted with a first UTI to assess the value of routine RUS in the management of children hospitalized with the first episode of UTI.

The findings showed that the RUS has a few values in the management of infants with first UTIs [7]. Averbuch D, 2014, retrospectively studied the factors correlated with bacteremia in infants with UTI. The study involved 81 infants with 82 episodes of UTI managed in Hadassah-Hebrew University Medical Center during a 1-year period in which infants with bacteremia compared with those without bacteremia.

Overmunch et al. Found ultrasound (US) abnormalities in 4/12 infants (33.3%) with bacteremic UTI while different defects found in 8/37 infants (21.6%) with non-bacteremic UTI. VCUG abnormalities found in 1/5 infants with bacteremic UTI and in 3/18 in non-bacteremic cases [2]. Megged O, et al. retrospectively studied the medical records of 527 pediatric patients, 464 were bacteremic with the majority in boys, to be younger than 90 days of age with high creatinine level. The conclusion of this study provides that high creatinine level may predict early identification of a patient with a high risk of bacteremia and other complication [8].

Another study retrospectively reviewed 122 medical charts of infants with first febrile UTI to investigate if the presence of *E. coli* versus non-*E.coli* bacteria and routine or abnormal renal Ultrasound (US) could avoid the use of VCUG. The study concluded to advice performing VCUG only in infants with UTI secondary to non-*E.coli* bacteria and in the presence of abnormal US [9].

The conflict in the literature and the shortage in such studies about imaging findings in a young infant with bacteremic urinary tract infection in Saudi Arabia, Jeddah is considerable. In this study, we aimed to describe the imaging findings in young infants with bacteremic UTI in Saudi Arabia, Jeddah.

## Methodology

A retrospective study was conducted at a tertiary hospital in Jeddah Saudi Arabia by using medical records from 2012-2019. Our sample was 30 infants from both genders who had diagnosed with bacteremic UTI and had at least one imaging study of RUS and VCUG. The exclusion criteria were infants with known urologic abnormalities at the time of presentation, infants required intensive unit care, and infants had the immunocompromised disease. The primary endpoint was a description of RUS and VCUG findings.

The secondary endpoint was the association between imaging study and other variables. The following data were obtained from each patient: age, sex, nationality, creatinine, presence of pyuria, blood and urine culture results, number of UTI recurrences, a pathogen of first UTI and recurrence, rate of

mortality, temperature, US and VCUG results, presence of Vesicoureteral Reflux (VUR). Data entry was performed by using Microsoft Excel. Data were statistically analysed by SPSS program. Univariate analysis was applied on following variable (age, sex, creatinine category, temperature category, RUS, VCUG, RUS result, VCUG result, pyuria, UTI recurrence). Chi-square test is done for RUS and VCUG results with the previous variable.

## Results

A total of 30 infants with bacteremic UTI were identified. Of which, 70% were males, and the other 30% were females, 46.7% were Saudis, and 53.3% were non-Saudi, 15 (50%) aged from 0-3 months while the additional 15 (50%) were >3 months with a median of 2.4 ( $\pm$  5) months. Additionally, the median age of females was 1.5 ( $\pm$  3.0) months and the mean age of males was 3.7 ( $\pm$  3.23) months. The median value of the number of UTI recurrences was 5 ( $\pm$  6) around 4.93 ( $\pm$  4.09) times were in males and 8.57 ( $\pm$  7.80) times were in females. 61.1% of infants were non-febrile while 38.9% of them were febrile and estimated as  $\geq$  38C. On the other hand, pyuria was positive in 50 % of cases. The blood culture pathogen was *E. coli* in 3.3% of patients and non-*E. coli* in 86.7%.

Urine culture results showed 40% *E. coli* infections and 46.7% non- *E. coli* infections. The mortality rate was 31% among those bacteremic UTI infants. All patients that included in our study underwent renal ultrasound imaging; it was normal in 3.8% (1 male) and abnormal in 96.2% (18 males and seven females). 37.9% (11) of the infants underwent VCUG, 18.2% (2 males) were reasonable, and 81.8% (7 males and two females) were abnormal. 17.9% presented with VUR. There was no significant association between RUS result and age interval, sex, creatinine category and urine culture, but there is a subculture result, the P-values.

## Discussion

In this study, we aimed to describe RUS and VCUG imaging findings in patients with bacteremic UTI and to study the association between imaging results and other variables.

In our study, 96.2% of infants that underwent RUS have abnormal findings. In a previous study, 134 patients with bacteremic UTI divided into three age groups: infants from 1 week to 3 months old; infants from 3 to 11 months past; and children  $\geq$  12 months old with a comparison group of 134 age- and sex-matched non-bacteremic UTI patients randomly selected. Patients with bacteremic UTI founded to have RUS abnormalities by 51% more than non-bacteremic ones [6]. Another study involved 257 infants younger than three months found similar results with  $\geq$  1 RUS abnormalities in 55% of infants [5]. This comparison between our study and the previous two studies pay our attention to an essential common finding, which is the prevalence of RUS abnormalities is high in bacteremic UTI cases.

The prevalence of VCUG abnormalities in our cohort is 81.8% while in Ismaili et al. Study of 43 infants <3 months with UTI

(with and without bacteremia) found VCUG abnormalities in 21% of cases. This dissimilarity in results may be due to delayed VCUG imaging in Ismaili's study which performed after at least one month of the diagnosis also could be due to inclusion of both bacteremic and non-bacteremic UTI in his research while only bacteremic UTI involved in our study [10].

Our study found that UTI rate was 70% among males and 30% among females, the median age in females was 1.5 ( $\pm$  3.0) months, and the mean age in males was 3.7 ( $\pm$  3.23). A similar study in the United States was concluded on bacteremic UTI infants showed that bacteremic UTI was more likely to happen in males [2].

We founded that creatinine level estimated as (58.6%) normal and (41.4%) abnormal, which support Orli Megged et al. They found that bacteremic UTI is associated with high blood creatinine in which 95% of their potions have abnormal creatinine level; therefore, creatinine was founded as an independent risk factor for bacteremia in general. A possible explanation for their finding that could be the presence of hypotension along with bacteremia causing decreased renal blood flow with subsequent increase in creatinine value [8].

61.1% of our sample were non-febrile. This opposes a previous study on infants diagnosed with UTI (with and without bacteremia) that reported 77 (22%) non-febrile infants out of 350 patients. This low prevalence of non-febrile infants in the previous study may be due to the involvement of both bacteremic and non-bacteremic UTI cases in the research [11]. The most common organism isolated in blood culture result are non-*E. coli* by (86.7%), comparing with other study conducted on bacteremic UTI infants in which blood cultures obtained in 14 out of 81 patients shows that *E. coli* was cultured from the blood by (17.3%) [2].

On another hand, the most common organisms in urine cultures were non *E. coli* pathogens in 46.7% of infants, which is opposite to what has been found in a previous study that conducted on infants and neonates with first UTI which reported *E. coli* was the predominant pathogen and grew in 72.6% of urine cultures, both in neonates, infants and young children [12]. We believed that the difference between tow results was due to the difference in the sample size in which 296 included in their study while only 30 infants in ours. Additionally, in our study, the mortality rate was 31% among all infants diagnosed with bacteremic UTI. To the best of our knowledge, no previous study in the literature estimate the mortality rate among bacteremic UTI infants.

Furthermore, in our study, RUS and VCUG results are not associated with the patient's age, sex, and creatinine value and urine culture results. But there was a significant association between RUS abnormal results and blood culture. In Chang's study, male sex and age <1 month was associated with an abnormal RUS. However, they were not significantly associated with an abnormal VCUG. In the same study, non-*E. coli* UTI was associated with an abnormal RUS of which 82.6% and VCUG compared with *E. coli* UTI. These associations in Chang's study may refer to his large sample that involved 257 infants [5]. To the best of our knowledge, no

paper in the literature studied the relationship between RUS and VCUG results with the creatinine value. Our study has numbers of limitations; the review was retrospective. Also, it was a single center study. In addition, the number of patients included was not high enough.

## Conclusion

In our research, we aimed to describe the findings of the RUS and VCUG and determine the association between imaging and other variables. The prevalence of RUS and VCUG in our cohort found to be higher than other studies. Our results demonstrate that there was a significant association between RUS finding and blood culture, on another hand, there was no significant association between RUS and VSUG outcome with other variables such as age interval, sex, and creatinine category and urine cultures. More extensive studies needed to confirm our finding.

## References

1. Herz AM, Greenhow TL, Alcantara J, et al. Changing epidemiology of outpatient bacteremia in 3- to 36-month-old children after the introduction of the heptavalent-conjugated pneumococcal vaccine. *Pediatr Infect Dis J.* 2006; 25: 293-300.
2. Averbuch D, Nir-Paz R, Tenenbaum A, et al. Factors associated with bacteremia in young infants with urinary tract infection. *Pediatr Infect Dis J.* 2014; 33: 571-5.
3. Leung AKC, Wong AHC, Leung AAM, et al. Urinary Tract Infection in Children. *Recent Pat Inflamm Allergy Drug Discov.* 2018.
4. Chaudhari PP, Monuteaux MC, Bachur RG. Urine concentration and pyuria for identifying uti in infants. *J Pediatr.* 2016; 138.
5. Chang PW, Abidari JM, Shen MW, et al. Urinary imaging findings in young infants with bacteremic urinary tract infection. *Hosp Pediatr.* 2016; 6: 647-52.
6. Honkinen O, Jahnukainen T, Mertsola J, et al. Bacteremic urinary tract infection in children. *Pediatr Infect Dis J.* 2000; 19: 630-4.
7. Alshamsam L, Al Harbi A, Fakeeh K, et al. The value of renal ultrasound in children with a first episode of urinary tract infection. *Ann Saudi Med.* 2009; 29: 46-9.
8. Megged O. Bacteremic vs. nonbacteremic urinary tract infection in children. *Am J Emerg Med.* 2017; 35: 36-8.
9. Pauchard JY, Chehade H, Kies CZ, et al. Avoidance of voiding cystourethrography in infants younger than 3 months with *Escherichia coli* urinary tract infection and normal renal ultrasound. *Arch Dis Child.* 2017; 102: 804-8.
10. Ismaili K, Lolin K, Damry N, et al. Febrile urinary tract infections in 0- to 3-month-old infants: a prospective follow-up study. *J Pediatr.* 2011; 158: 91-4.
11. Hernandez-Bou S, Trenchs V, Alarcon M, Luaces C. Afebrile very young infants with urinary tract infection and the risk for bacteremia. *Pediatr Infect Dis J.* 2014; 33: 244-7.

12. Kanellopoulos TA, Salakos C, Spiliopoulou I, et al. First urinary tract infection in neonates, infants and young children: a comparative study. *Pediatr Nephrol.* 2006; 21: 1131-7.

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