

Urinary Tract Infection: Causative Agents, the Relation Between Bacteriuria and Pyuria

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Abstract: 388 urine samples were studied for bacteriuria and pyuria. Samples have been collected from children aged 3-12 years attending Tobruk medical center. Bacterial strains were isolated from 65.97% of urine samples. The pathogens isolates were as follows: *Escherichia coli* 33.98%, *Proteus* spp. 21.48% *Enterobacter* spp. 15.23%, *Klebsiella pneumonia* 10.3 and *Staphylococcus* 10.54%. The presence of puss cells in urine precipitate considered as important sign of infection. The clinical feature of the children were recorded.

Key words: Urinary tract infection • Bacteriuria • Pyuria

INTRODUCTION

Urinary tract infections (UTIs) are among the most common bacterial infectious diseases encountered in clinical practice and account for significant morbidity and high medical costs. A urinary tract infection (UTI) is a bacterial infection that affects part of the urinary tract. When it affects the lower urinary tract it is known as a simple cystitis (a bladder infection). Alternatively, it may involve the upper urinary tract, in which case it is known as pyelonephritis. If the urine contains significant bacteria but there are no symptoms, the condition is known as asymptomatic bacteriuria [1]. In children when a urinary tract infection is associated with a fever, it is deemed to be an upper urinary tract infection [2]. Urine may contain pus (a condition known as pyuria) as seen from a person with sepsis due to a urinary tract infection. The most common symptoms are burning with urination and having to urinate frequently and significant pain [3]. These symptoms may vary from mild to severe. People experiencing an upper urinary tract infection, or pyelonephritis, may experience flank pain, fever, or nausea and vomiting in addition to the classic symptoms of a lower urinary tract infection [1]. Rarely the urine may appear bloody [4] or contain visible pyuria (pus cells in the urine) [5].

In young children, the only symptom of a urinary tract infection (UTI) may be a fever. Because of the lack of

more obvious symptoms, when females under the age of two or uncircumcised males less than a year exhibit a fever, a culture of the urine is recommended by many medical associations. Infants may feed poorly, vomit, sleep more, or show signs of jaundice. In older children, new onset urinary incontinence (loss of bladder control) may occur [2]. *E. coli* is the cause of 80-85% of urinary tract infections, with *Staphylococcus saprophyticus* being the cause in 5-10%. Rarely they may be due to viral or fungal infections [6]. Other bacterial causes include: *Klebsiella*, *Proteus*, *Pseudomonas* and *Enterobacter*. These are uncommon and typically related to abnormalities of the urinary system or urinary catheterization [4]. Urinary tract infections due to *Staphylococcus aureus* typically occurs secondary to blood born infections [1]. Urinary tract infections may affect 10% of people during childhood [4]. Among children urinary tract infections are the most common in uncircumcised males less than three months of age, followed by females less than one year [2]. Estimates of frequency among children however vary widely. There are important age and sex differences in incidence and that some widely accepted views about bacterial counts and the presence or absence of pyuria should be questioned. To quantify these impressions and consider their implications we conducted this study of all urine specimens from children received in the laboratory of Tobruk medical center during one year.

MATERIALS AND METHODS

Urine specimens from children aged 3-12 years of both sexes have been collected by the midstream or clean catch methods. Hospital specimens were collected by these two methods or suprapubic aspiration.

The specimens were examined by the inverted microscope method. Pyuria was defined as the presence of ≥ 5 white blood cells/ml [7]. For suprapubic aspirates, however, in which extraneous contamination is extremely unlikely, the presence of any white cells was recorded as pyuria [8].

Specimens were cultured by inoculation on general, enriched and selective agar and incubated in an atmosphere containing 5% carbon dioxide. Cultures were classified according to the criteria in standard use in the laboratory:

Positive (infection)-Any count of a Gram negative pathogen or; of a Gram positive pathogen in pure growth a count of $\geq 10^5$ /l.

Doubtful (possibly contaminated)-Mixed growths, in any count, of more than two organisms including a Gram negative pathogen; or of a Gram positive pathogen.

Negative-No growth or counts of $<10^5$ /l of a Gram negative pathogen or; of a Gram positive pathogen.

Sterile pyuria- ≥ 5 white cells/ml with no growth.

Haematuria-Any red cells in absence of white cells or infection. Currently, bacteria from urine are identified by biochemical testing using API systems for *Enterobacteracia* and *Staphylococcus* of the bacterial colonies that are able to grow on agar plates.

RESULTS AND DISCUSSION

The result of this study revealed that positive specimens which showed positive bacterial growth were 65.97%. However, 34% showed negative growth, but the patients had urinary tract infection symptoms. This is may be due to other causative agents not detected by this study, either anaerobic bacteria [9]or fungi and viruses [10]. Sometimes, symptoms similar to urinary tract infection symptoms appear such as burning with urination and having to urinate frequently (or an urge to urinate) which may be due to prepuce infection [11] or vaginal infection [12]. There are many bacterial genera that cause urinary tract infection. The bacteria that cause urinary tract infections typically enter the bladder via the urethra. However, infection may also occur via the blood or lymph.

Table 1: The distribution of positive and negative urine samples

No of samples	Positive samples	%	Negative samples	%
388	291	75	97	25

Table 2: The distribution of positive and negative bacteriuria

No of samples	Positive growth	%	Negative growth	%
388	256	65.97	132	34.02

Table 3: Distribution of urinary tract infections causative agents

Bacterial strains	No	%
<i>E. coli</i>	87	33.98
<i>Proteus mirabilis</i>	42	16.41
<i>Proteus vulgaris</i>	13	5.08
<i>Entrebacter cloacae</i>	26	10.16
<i>Entrebacter aerogens</i>	13	5.08
<i>Klebsiella pneumonia</i>	28	10.95
<i>Staphylococcus aureus</i>	16	6.25
<i>Coagulase negative Staphylococcus</i>	11	4.29
<i>Pseudomonas aeroginusa</i>	7	2.73
<i>Streptococcus faecalis</i>	5	1.95
<i>Acinetobacter calcoacticus</i>	3	1.17
<i>Citrobacter freundii</i>	3	1.17
<i>Mixed infection</i>	2	0.78
Total	256	100.00

Table 4: The distribution of bacteriuria and pyuria

Cases	No	%
Bacteriuria with pyuria	197	50.78
Bacteriuria without pyuria	59	15.20
Sterile pyuria	35	9.02
Absence of Bacteriuria and pyuria	97	25.00
Total	388	100.00

Table 5: The relation between bacterial strains and puss cells

Bacterial strains	Less than 5 puss cells		More than 5 puss cells	
	No	%	No	%
<i>E. coli</i>	8	13.55	79	40.10
<i>Proteus spp.</i>	31	52.54	24	12.18
<i>Entrebacter spp.</i>	7	11.16	32	16.24
<i>Klebsiella pneumonia</i>	4	6.77	24	12.18
<i>Staphylococcus aureus</i>	3	5.08	13	6.59
<i>Staphylococcus (CNS)</i>	2	3.38	9	4.56
<i>Pseudomonas aeroginusa</i>	1	1.69	6	3.04
<i>Streptococcus faecalis</i>	2	3.38	3	1.52
<i>Acinetobacter calcoacticus</i>	0	0.00	3	1.52
<i>Citrobacter freundii</i>	1	1.69	2	1.01
<i>Mixed infection</i>	0	0.00	2	1.01
Total	59	23.04	197	76.95

CNS = Coagulase negative Staphylococcus

It is believed that the bacteria are usually transmitted to the urethra from the bowel, with females at greater risk due to their anatomy [13]. The findings of this study showed

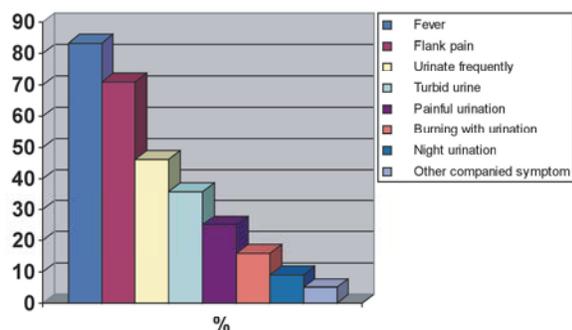


Fig. 1: Clinical features of urinary tract infection

that *E. coli* was the causes of 33.98% (Table 2) which was much lower than the result of Nicolle [3]. The reason of high ratio for *E. coli* is the presence of this bacteria in the feces, thus it cause autoinfection [14]. In addition, after gaining entry to the bladder, *E. coli* are able to attach to the bladder wall and form a biofilm that resists the body's immune response [4]. *Proteus* spp. came in second place and caused 21.84% followed by *Enterobacter* spp. which was the causative agents of 15.23%, thus they play important role in urinary tract infection. However, Salvatore *et al.* [4] claimed that this bacteria together with *Klebsiella*, *Proteus* and *Pseudomonas* are uncommon and typically related to abnormalities of the urinary system or urinary catheterization. However, the ratio of *Klebsiella* in this study was 10% which was much lower than the that reported by Akram *et al.* [15] which was (22%).

Staphylococcus aureus was the causative agents of 6.25% with coagulase negative *Staphylococcus* 4.29%. This result was in agreement with the results of Nicolle [3] which was 5-10%. Urinary tract infections due to *Staphylococcus aureus* typically occurs secondary to blood born infections [1].

The Relation Between Bacteriuria and Pyuria: Table 3 shows the relation between bacteriuria (The presence of significant bacterial growth in urine samples) and Pyuria (The presence of significant puss cells in urine samples) accompanied urinary tract infection symptoms. The presence of 5/ H.P.F puss cells considered significantly as sign of infection [7]. The findings of this study showed the presence of bacteriuria with pyuria was (50.77%). However the ratio of bacteriuria without pyuria was (15.2%) which was lower than that reported by Ginsburg and Mackarep [16] and Maskell [8] which were 21% and 44% respectively. The ratio of sterile pyuria in this study

was 9% which was much lower than the result of Maskell [8] who reported 45%. However, Kucukbayrak *et al.* [17] reported that the ratio of leukocyturia in urine samples of heart failure patients was 16.56 +/- 13.63. The presence of sterile pyuria may be due to the presence of foreign material calculi or other pathogenic agents not detected by this study.

Table 4 shows the distribution of urinary tract infection according to causative agents and the presence of puss cells. From a total of 256 positive specimens there were 59 (23%) bacteriuria without pyuria (or the presence of puss cells less than 5). The ratio of bacteriuria with significant pyuria was (76.3%). This result is similar to that reported by Saed [18] which was (71.3%). The result of this study showed that the highest ratio of bacteriuria with significant pyuria (40%) was due to *E. coli* which represents the common causative agents of urinary tract infection.

The Distribution of Clinical Feature: The clinical feature for the patients were recorded (Figure 1). The result of this study showed that the main symptom in positive cases was fever (83.2%) followed by flank pain with (71%) and frequently urinating (46%). In addition to other symptom with (5%) which included vomiting and malnutrition. These results were in agreement with the results of Bhat *et al.* [2]. However, there were other infections recorded together with urinary tract infections such as tonsillitis, pneumonia, otitis media, gastroenteritis, renal failure and one case with diabetes mellitus. The presences of calculi in urine samples of some children. However, negative cases showed fever with 86% and flank pain with 81% and vomiting 45%. Other infections recorded with these cases were gastroenteritis, pneumonia and the presence of stones in the urine, with two cases had hepatitis.

CONCLUSION

Out of 388 urine samples, 291 (75%) were positive for both bacteriuria and pyuria and 97 (25%) were negative. Bacterial strains were isolated from 256 (65.97%) while 132 (34.03) showed negative bacterial growth. *E. coli* represents the highest ratio (33.98) followed by *Proteus* spp. Bacteriuria and pyuria were present in 197 (50.77%) while sterile pyuria were present in 35 (9%). However bacteriuria alone were present in 59 (15.2%) urine samples.

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