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Incidence and Isolation of Bacteria Associated With Nosocomial Urinary Tract Infection (UTI) in Sudanese Women*

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Abstract: One hundred and sixty three 14-82 year old women hospitalized at the Departments of Surgery and Medicine, Khartoum Teaching Hospital and co-patients women, nurses and workers were investigated for urinary tract infection. The number of women who had significant bacteriuria (10^5) was 94; 53 of them were symptomatic while 41 were asymptomatic. From the total of 100 bacterial strains that were isolated from the urine samples, (85%) of them were Gram-negative rods and (15%) were Gram-positive cocci. The Gram-negative bacilli were identified as *Escherichia coli* (49.4%), *Proteus mirabilis* (14.1%), *Pseudomonas aeruginosa* (10.6%), *Klebsiella pneumoniae* (5.9%), *Citrobacter freundii* (5.9%) and the rest belonged to the family Enterobacteriaceae. The Gram positive cocci were *Staphylococcus* spp. and 6 of them were coagulase- positive. The factors that affected the incidence of bacteriuria were age, duration of hospitalization and catheterization. Poor hygiene affected the incidence of the bacteriuria and was frequently observed among workers than nurses.

Key words: Bacteria, urinary tract infection, urinary catheterization, nosocomial infection

Introduction

Urinary tract infection (UTI) in hospital, especially over the last few decades has been considered as an immune trouble due to changes in the immune system of the patients and the increased emergence of resistance to antibiotics of prevalent strains. Urinary catheterization is the most frequent predisposing factor.

Bacterial infections of the urinary tract are most commonly observed in general practice being responsible for considerable morbidity (Ledingham and Warell, 1996). According to (Foxman, 2002) acute urinary tract infection is an extremely common entity that affects almost half of women in the United States of America. Nosocomial infections are produced by infectious pathogens that develop within a hospital or other type of health care system can infect nurses, physicians, visitors, sale people, delivery personnel and persons who have contact with the hospital (Prescott *et al.*, 1999). Collier *et al.* (1998) and Shanson and Speller (1989) considered the sex, age, pregnancy, catheterization and prolonged hospital stay as risk factors that affect acquiring of the UTI and accounts to 40% of the nosocomial infections of the urinary tract. Most hospital- acquired infections of the urinary tract are associated with urethral catheterization (Kunin, 1987). Long -term catheterization (more than 30 days) increases incidence of bacteriuria (Beizer, 1996). In non-catheterized patients, clinical and microbiological diagnosis of nosocomial UTI are essentially the same as the diagnosis of community-acquired UTI, usually monomicrobial but infections may involve resistant organisms (Sharbough, 1997).

Most of nosocomial infections are associated with *E. coli* and *Serratia marcescens* (Musial *et al.*, 1988). Finegold and Baron (1986) reported that most of nosocomial infections involved

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a single pathogen and about 20% involved multiple pathogens. The organisms may occasionally be recovered from the air and dust collected near the patient, imperfectly sterilized moist objects, fluid, skin and faeces of the patients (Greenwood *et al.*, 2002).

E. coli is the most common cause of acute UTI outside hospital as well as hospital-associated UTI (Cheesbrough, 1984). The infections due to *Pseudomonas aeruginosa* may be asymptomatic but catheterization of such patients can lead to bacteriuria (Harvey *et al.*, 2001). *Pseudomonas aeruginosa* infections came into prominence with increasing number of patients rendered susceptible by illness or treatment (Speller *et al.*, 1990).

Collier *et al.* (1998) reported the isolation of *Staphylococcus* spp. from UTI patients. *Salmonella typhi* and *paratyphi* were also isolated from urine of about 25% of the patients with enteric fever from the third week of infection (Cheesbrough, 1984; Mathia *et al.*, 1995).

Materials and Methods

Hundred urine samples were examined for bacteriuria in female patients (163) and healthy women at the Department of Surgery and Medicine, Khartoum Traching Hospital, as well as nurses, workers and co-patients. All samples were taken from women aged between 14 and 82 years and were classified into three groups:

Group (1)

Included non-catheterized hospitalized patients for >72 h and their urine samples (106) were bacteriologically screened.

Group (2)

Included patients who were >72 h catheterized in hospital with indwelling urinary catheter. Fifty seven urine samples were also screened for bacteriuria.

Group (3)

Included healthy hospital staff (nurses and workers) and co- patients whose urine samples (100) were screened for bacteriuria.

All urine samples were collected aseptically in sterile containers and inoculated using calibrated loop firstly into blood agar, MacConkey agar, CLED and EMB agar. Isolation was done by the methods of Finegold and Baron (1986) and identification of the isolates was made according to that of Cheesbrough (1984).

Results

Out of 263 urine samples, 94 (35.74%) showed bacteriuria and 169 (64.26%) were non-bacteriuric. The positive bacteriuric samples were classified as 38 (40.4%) from non- catheterized patients (group 1), 41 (43.6%) from catheterized patients (group 2) and 15 (16%) from the medical staff (group 3). The non bacteriuric samples were classified as 68 (40.2%) non catheterized patients, 16 (9.5%) from catheterized patients and 85 (50.3%) from medical staff (Table 1).

Table 1 also showed that out of 106 specimens collected from non- catheterized patients, 38 (35.8%) were bacteriuric and 68 (64.2%) were non- bacteriuric. The catheterized patients showed that 41 (71.9%) were bacteriuric and 16 (28.1%) were non-bacteriuric and the medical staff group showed that 15 (15%) were bacteriuric and 85 (85%) were non-bacteriuric.

The bacteriuric non-catheterized patients (38) were classified as symptomatic, 21 (55.3%) and asymptomatic 17 (44.7%). Table 2 while the non-bacteriurics were identified at 28 (41.2%) symptomatic patients and 40 (58.8%) asymptomatic patients.

Table 1: Number and percentage of bacteriuric and non bacteriuric catheterized and non-catheterized patients

	Group 1		Group 2		Group 3		Total
	(Non-catheterized)		(Catheterized patients)		(Medical staff)		
Bacteriuric	38 (40.26%) (35.80%)		41 (43%) (71.9%)		15 (16%) (15%)		94 (35.7)
Non-Bacteriuric	68 (40.2%) (64.2%)		16 (9.5%) (28.1%)		85 (50.3%) (85%)		169 (64.3)
Total	106		57		100		263

Table 2: Number and percentage of bacteriuric patients in different departments

Department	Group 1 Non-catheterized patients		Group 2 Catheterized patients		Group 3 Medical staff	
	No.	(%)	No.	(%)	No.	(%)
Medicine	21	55.3	30	73.2	51	64.6
Surgery	17	44.7	11	26.8	28	35.4
Total	38		41		79	

Table 3: Number and percentage of bacteriuric and non- bacteriuric patients with or without symptoms

	Group 1		Group 2		Group 3		Total
	Bacteriuric	Non-Bacteriuric	Bacteriuric	Non-Bacteriuric	Bacteriuric	Non-Bacteriuric	
Symptomatic	21 (55.3%)	28 (41.2%)	19 (46.3%)	3 (18.7%)	13 (86.7%)	63 (74.1%)	147 (55.9%)
Asymptomatic	17 (44.7%)	40 (58.8%)	22 (53.7%)	13 (81.3%)	2 (13.3%)	22 (25.9%)	116 (44.1%)
Total	38 (14.4%)	68 (25.9%)	41 (15.9%)	16 (6.1%)	15 (5.7%)	85 (32.3%)	263

The bacteriuric-catheterized patients were identified at 19 (46.3%) symptomatic and 22 (53.7%) a symptomatic. 3 (18.7%) of the non-bacteriuric patients were symptomatic and 13 (81.3%) were a symptomatic. The bacteriuric medical staff were identified as 13 (86.7%) symptomatic and 2 (13.3%) asymptomatic and the non- bacteriurics were identified as 63 (74.1%) symptomatic and 22 (25.9%) asymptomatic (Table 3). It was also found that out of 263 urine samples, 147 (55.9%) had symptoms of urinary tract infection while 116 (44.1%) showed no symptoms of urinary tract infection. The majority of the positive bacteriuric samples revealed symptoms of urinary tract infection except catheterized patients who were mainly asymptomatic.

According to age of the non- catheterized patients, the high incidence of bacteriuria was observed in the age group (36-46 year old) at 11 (28.9%) followed by the age group (25-35 year old) at 10 (26.3%). The catheterized patients showed the highest incidence at age groups (36-46 and 58-69 years of age) at 9 (21.9%) and followed by age group >68 years of age. The medical staff showed the highest incidence of bacteriuria at age group (47-57 year old) at (46.6%) as shown in Table 4. It was also shown that the age group (25-35 year old) had the highest incidence of non- bacteriuria among the different groups except the catheterized patients.

According to duration of hospitalization, the high incidence was noticed between days 3 and 10 in catheterized and non- catheterized patients (13 and 20 patients), respectively. Between 11-20 days, 10 patients from each catheterized and non - catheterized were recorded (Table 5). The susceptibility of patients to bacteriuria was increased with the intervals of hospitalization especially exceeding one month. It was also noticed that susceptibility to acquiring bacteriuria was higher in catheterized patients when the period of hospitalization was extended.

Hundred bacterial isolates were obtained and identified as 85 (85%) Gram-negative and 15 (15%) Gram -positive organisms. The Gram-negative organisms were further identified as *E. coli*, 42 (49.4%), *Proteus mirabilis* 12 (14.1%), *Pseudomonas aeruginosa*, 9 (10.6%), *Klebsiella pneumoniae*, 5 (5.9%),

Table 4: Number and percentage of bacteriuric and non-bacteriuric patients in different age groups

Age (years)	Group 1		Group 2		Group 3	
	Bacteriuric	Non-Bacteriuric	Bacteriuric	Non-Bacteriuric	Bacteriuric	Non-Bacteriuric
14-24	8 21.0%	12 17.5%	6 14.6%	1 2.4%	1 6.7%	14 16.5%
25-35	10 26.3%	26 38.2%	4 9.7%	2 4.9%	4 26.6%	33 38.8%
36-46	11 28.9%	15 22.0%	9 21.9%	5 12.2%	2 13.3%	23 27%
47-57	2 5.2%	11 16.1%	5 12.1%	3 7.3%	7 46.6%	13 15.3%
58-68	6 16.0%	2 2.9%	9 21.9%	1 2.4%	-	2 2.4%
> 68	1 2.6%	2 2.9%	8 19.5%	4 9.8%	1 6.7%	-

- = No available patients

Table 5: Number and percentage of bacteriuric patients during different hospitalization period in non-catheterized and catheterized patients

Duration of hospitalization (Days)	Group 1 Non-catheterized patients			Group 2 Catheterized patients		
	No. of patients	No. of Bacteriuric patients	(%)	No. of patients	No. of Bacteriuric patients	(%)
3-10	47	13	27.7	34	20	58.8
11-20	26	10	38.5	11	10	90
21-34	24	7	29	7	7	100
35-50	5	4	80	-	-	-
50	4	4	100	5	4	80
Total	106	38		57	41	

- = No available patients

Table 6: Number and percentage of common bacteria isolated from different groups

Bacteria	Number and Percentage		
	Group (1)	Group (2)	Group (3)
<i>E. coli</i>	14 (36.84%)	24 (51.0%)	4 (26.66%)
<i>Proteus mirabilis</i>	5 (13.15%)	5 (10.63%)	2 (13.33%)
<i>Pseudomonas aeruginosa</i>	2 (5.26%)	4 (8.51%)	3 (20.0%)
<i>Klebsiella pneumoniae</i>	2 (5.26%)	3 (6.38%)	0
<i>Citrobacter freundii</i>	1 (2.63%)	4 (8.51%)	0
<i>Salmonella</i> spp.	2 (5.26%)	0	2 (13.33%)
<i>Alcaligenes</i> spp.	1 (2.63%)	0	0
<i>Serratia marcescens</i>	1 (2.63%)	0	0
<i>Staphylococcus saprophyticus</i>	5 (13.15%)	0	2 (13.33%)
<i>Staphylococcus aureus</i>	3 (7.9%)	1 (2.12%)	2 (13.33%)
<i>Staphylococcus epidermidis</i>	2 (5.26%)	0	0
<i>Enterobacter</i> spp.	0	4 (8.51%)	0
<i>Providencia rettgeri</i>	0	2 (4.25%)	0
Total No.	38	47	15

0 = Not isolated

Citrobacter freundii, 5 (5.9%), *Enterobacter* spp., 4 (4.7%), *Salmonella* spp. 4 (4.7%), *Providencia rettgeri* 2, (2.4%), *Alcaligenes* spp. 1 (1.2%) and *Serratia marcescens* 1 (1.2%). The Gram-positive bacteria were identified as *Staphylococcus aureus* 6 (40%), *Staphylococcus epidermidis* 2 (13.3%), an *Staphylococcus saprophyticus* 7(46.7%).

In Group (1), *E. coli* was the most frequently isolated organism (36.84%), followed by *Proteus mirabilis* and *Staphylococcus saprophyticus* which were isolated at (13.15%), *Staphylococcus aureus* at (7.9%), *Pseudomonas aeruginosa*, *Klebsiella pneumoniae* and *Staphylococcus epidermidis* at (5.26%) while *Citrobacter freundii*, *Alcaligenes* spp. and *Serratia marcescens* were isolated at (2.6%) (Table 6).

In group 2, 6 out of 41 urine samples, showed mixed growths of two specific organisms. The *E. coli* was identified at (51%) followed by *Proteus mirabilis* at (10.63%), *Pseudomonas aeruginosa*, *Citrobacter freundii* and *Enterobacter* spp. at (8.5%) and *Klebsiella pneumoniae* at (6.38%) while *Providencia rettgeri* at (4.25%) and *Staphylococcus aureus* at (2.12%) compared with group (1). In this group, isolation of *Salmonella* spp., *Staphylococcus epidermidis*, *Staphylococcus saprophyticus* and *Serratia marcescens* was negative and that both *Enterobacter* spp. and *Providencia rettgeri* were not recorded in this group.

In group 3, *E. coli* was isolated at (26.66%), followed by *Pseudomonas aeruginosa* at (20%), while *Providencia rettgeri*, *Salmonella* spp. *Staphylococcus saprophyticus* and *Staphylococcus aureus* were isolated at (13.33%). In this group, *Klebsiella pneumoniae*, *Citrobacter freundii*, *Enterobacter* spp. *Proteus mirabilis*, *Alcaligenes* spp. *Serratia marcescens* and *Staphylococcus epidermidis* were not isolated when compared with groups (1) and (2).

Discussion

The present study indicated that incidence of bacteriuria among hospitalized patients (immunocompromised) was higher (38.85%) than in healthy women (15%). This finding may reflect variation of bacteriuria between two groups of patients who has been admitted to hospital with illness or other medical problem, hence they became more susceptible to diseases than healthy persons, Our results seem to agree with the findings of Sharbough (1997). The incidence of bacteriuria increased with the duration of hospitalization, this was strongly confirmed by the increase in the possibility of patients to acquire bacterial infection at hospital due to poor hygiene or increase susceptibility of the individuals to acquire infection. The incidence of bacteriuria among catheterized patients was (72%) and was found to agree with Esen *et al.* (2003) and Perl and Dard (2003). The highest incidence of bacteriuria occurred in the aged patients (58-68) and age group (36-46). This finding is in agreement with that of Bryan and Reynolds (1984) and Beizer (1996) who reported that elders risk for bacteriuria and UTI was due to age -related changes in the genitourinary tract and changes in the immune system. These authors mentioned that in post menopausal women increased vaginal pH may alter endogenous flora. In addition, perineal hygiene may be compromised by decreased mobility leading to urethral contamination. According to duration of catheterization, the incidence of infection increased from (58.82 %) in the first week to 90 and 100% after the 2nd and 3rd week, respectively. This might be due to the increase in infection hazards associated with the usage of catheter.

E. coli was the most frequent organisms isolated from all groups. In non-catheterized patients, *E. coli* isolated at (36.84%) and similar results were reported by Grunneberg (1984) and Hooton *et al.* (2002) who isolated *E. coli* as predominant organism from catheterized patients. On the other hand, Collier *et al.* (1998) reported high incidence of *E. coli* in nosocomial infections. In this study, *Proteus mirabilis* was second infectious agent in non-catheterized and catheterized patients. Platt *et al.* (1982) reported that *Pseudomonas aeruginosa* was second infectious agent after *E. coli*, however, it was least common in this study in non-catheterized and catheterized patients. *Salmonella* spp. were isolated at (5.26%) and (13.33%) from non-catheterized and catheterized patients, respectively, being a faecal pathogen its source may be hospital food. In this study, *Enterococcus* spp. was not isolated although it was reported to be a common contaminant of urine (Cheesbrough, 1984; Finegold and Baron, 1986; Collier *et al.*, 1998; Hardy, 2002). All Gram-negative isolates belonged to Enterobacteriaceae that are present predominantly in the hospital environment. *Providencia* spp. was isolated at (4.25%) in catheterized patients, infection with this organism is often hospital-acquired. *Staphylococcus saprophyticus* was isolated at (13.15%) in non-catheterized patients, it is a primary uropathogen and is responsible for about 20% of UTI in females. *Staphylococcus aureus* was also isolated from the three groups and the pathogenicity of this organism is well known. *Staphylococcus epidermidis* was isolated at 5.26% in non-catheterized patients, infection with this organism may be due to its presence in normal skin flora and as contaminant in urine.

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