INTRODUCTION

Urinary Tract Infections (UTI) represent about 40% of nosocomial infections and about 80% of these infections are catheter-associated, resulting in substantial morbidity and mortality.

Bacteriuria develops in catheterized patients after a variable period of time with urinary tract infection developing in 5% and associated bacteremia in 4% of patients.

The various risk factors for catheter-associated bacteriuria are the duration of catheterization, microbial colonization of the drainage bag, Diabetes mellitus, female gender and errors in catheter care. With long-term catheterization, bacteriuria develops in the majority of patients by the end of 30 days. Various complications associated with catheterization are symptomatic urinary tract infections, pyelonephritis and bacteremia, while catheter obstruction, urinary tract stones, chronic renal infection and bladder cancer are associated with long-term indwelling catheters. Additionally, the catheterized urinary tract becomes a reservoir of bacteria that can be transmitted to other patients.

Although most organisms causing urinary tract infection have previously colonized the periurethral area, the urethra itself is an effective obstacle to bladder inoculation.

With an indwelling catheter, the defense mechanisms of the urinary tract are jeopardized. The organisms may enter into the bladder at the time of insertion of catheter, during collection of urine specimen or during irrigation of the bladder. To prevent bacteriuria and associated complications, unnecessary catheterization should be avoided and once inserted, should be removed as soon as possible.

ABSTRACT

Objective: To determine the number of catheterized patients who develop bacteriuria due to the presence of organisms in their periurethral flora, which may subsequently cause Urinary Tract Infection (UTI) in these patients.

Study Design: Non-interventional, cohort study.

Place and Duration of Study: This study was conducted on patients of Medical Intensive Care, Surgical and Urology Units of Combined Military Hospital, Lahore, from February to April 2006.

Methodology: A total of 60 hospitalized patients, who were catheterized for various underlying diseases, were included in the study. Urine samples and periurethral swabs were obtained from all patients and cultured on appropriate culture media. Various tests used for the identification of microorganisms were: Gram-staining, catalase test, coagulase test and esculin hydrolysis for the identification of Gram-positive bacteria, API 20e for Gram-negative bacilli, whereas lactophenol blue preparation and germ tube test were used for the identification of yeasts.

Results: Out of 60 patients, 41 (68.3%) were males and 19 (31.7%) were females. The mean duration of catheterization was 4.5 days. In males, culture of periurethral swabs revealed coagulase negative *Staphylococcus* in 11 (40.7%) and *Enterococcus faecalis* in 3 (11.1%) patients. In females, the organisms isolated were coagulase negative *Staphylococcus* in 4 (25%), *Staphylococcus aureus* in 4 (25%), *Enterococcus faecalis* in 4 (25%), *Pseudomonas aeruginosa* in 2 (12.5%), *Escherichia coli* in 3 (18.6%) and *Candida albicans* in 3 (18.6%) patients. Twenty nine patients developed bacteriuria (p <0.05). *Escherichia coli* was the commonest organism causing bacteriuria in either gender followed by other Gram-negative organisms. Coagulase negative *Staphylococcus* was isolated in the urine of one male patient only. In males, 2 (10%) out of 20 patients with Gram-negative bacteriuria were colonized by the same organism, whereas in females, 4 (44.4%) out of 9 bacteriuric patients were colonized by the same organism.

Conclusion: Predominantly Gram-positive organisms colonized the periurethral area in males as well as in the majority of females, whereas Gram-negative bacteria were mainly responsible for the bacteriuria in both genders. There was a significant association between periurethral colonization and subsequent bacteriuria, however, prior colonization with a particular organism is not a decisive event in the initiation of bacteriuria.

Key words: Periurethral colonization. Bacteriuria. Catheterization.
as possible. This would further reduce the morbidity and mortality and the expenses incurred on the treatment of these infections. Most organisms incriminated in bacteriuria are said to have previously colonized the periurethral area from where the organisms travel along the catheter wall up into the bladder.

This study was conducted to determine the association of bacteria present in the periurethral area and subsequent bacteriuria in catheterized patients.

**METHODOLOGY**

The study was conducted on the patients admitted to the medical intensive care unit, surgical and urology wards with various underlying diseases. Gender, age, date of admission, diagnosis, underlying medical problem, date and indication for indwelling catheterization were recorded. Patients with confirmed UTI or a history of catheterization in the previous 3-4 weeks were excluded from the study. A total of 60 hospitalized patients who were catheterized for various underlying diseases from February to April 2006 were included in the study. The periurethral area was cleansed with povidone iodine and catheters were inserted by trained nurses with aseptic precautions. Closed drainage system was employed in all the patients and periurethral area was cleansed with soap and water 6-8 hours after catheterization. The catheters used were made of Teflon-latex obtained from different manufacturers. Five to 10 ml of specimen was collected from each patient by aspirating urine from the rubber catheter with 70% alcohol 48 hours after disinfecting the rubber catheter with 70% alcohol 48 hours after catheterization. All the urine specimens were cultured on blood agar plates. A periurethral swab was also collected from each patient and cultured on blood agar and Mac Conkey agar. All cultures were incubated aerobically at 37°C for 48 hours. Gram-positive cocci were identified on the basis of colony morphology, Gram-staining, catalase test, slide and tube coagulase test and esculin hydrolysis. The Gram negative bacilli were identified by Api 20e. The yeast colonies were identified as *Candida albicans* when budding yeast cells were obtained on lactophenol blue preparation and germ tube test.

Data collected was coded, computed and analyzed on SPSS version 15. Frequencies were run and Chi-square test was used as a test of significance.

**RESULTS**

Table I shows the underlying diseases in the catheterized patients. The age of the patients ranged from 17-95 years with mean age of 56 years.

Out of 60 patients, 41 (68.3%) were males and 19 (31.7%) females. Eighty percent of the patients were 21-80 years old. The mean duration of catheterization was 4.5 days. In 14 patients, catheterization was continued for more than 7 days but less than 14 days. Irrespective of the age and gender of the patient, bacteriuria occurred as early as 2 days after catheterization.

Various organisms isolated in the periurethral area of the males and females at the time of bacteriuria are shown in Table II. Out of 41 male patients, coagulase negative staphylococci were isolated in 11 (40.7%) patients, *Staphylococcus aureus* was isolated in 10 (37%) patients and *Enterococcus fecalis* in 3 (11.1%) patients. Other organisms, less frequently colonizing the periurethral area, were *Proteus mirabilis*, *Escherichia coli*, *Klebsiella pneumoniae*, *Candida albicans* etc. Only 2 patients were colonized by more than one organism. No organism was grown in the periurethral area in 14 patients.

In female patients, the organisms isolated in the periurethral area were coagulase negative staphylococci in 4 (25%) patients, *Staphylococcus aureus* in 4 (25%) patients, *Enterococcus fecalis* in 4 (25%) patients, *Pseudomonas aeruginosa* in 2 (12.5%) patients, *Escherichia coli*...
in 3 (18.7%) patients and Candida albicans also in 3 (18.7%) patients. Nine patients were colonized by more than one organism. There was no periurethral colonization in 3 patients.

In males, 20 patients had bacteriuria whereas the urine was sterile in 21 patients. In 90% patients with bacteriuria, Gram-negative organisms were isolated in urine. Coagulase negative Staphylococcus was isolated in only one patient along with a Gram-negative organism and Candida albicans was isolated in 2 patients.

Only 2 (4.9%) patients with Gram-negative bacteriuria were colonized by the same organism in the periurethral area. Other patients were colonized by Gram-positive cocci in 10 patients, Candida albicans in one patient and by another Gram negative organism in one patient. There was no periurethral colonization in 6 bacteriuric patients.

Out of 19 female patients, only 9 patients had bacteriuria. Seven patients had Gram-negative organisms in urine and 2 had Candida albicans. Four patients (21.1%) with Gram-negative bacteriuria were colonized by the same organism in the periurethral area, 3 were colonized by Gram-positive organisms. Only one patient who had candiduria was not colonized. No Gram-positive organism was isolated in the urine in females. Only one patient who had candiduria was not colonized by any organism. The urine was sterile in 10 patients.

In males, Escherichia coli was the commonest organism causing bacteriuria followed by Citrobacter freundii, Klebsiella pneumoniae and Candida albicans.

In females, Escherichia coli and Candida albicans were the most commonly isolated organisms in urine. Other organisms isolated in the urine were Pseudomonas aeruginosa, Enterobacter cloacae and Citrobacter diversus.

Overall in 24 out of 27 male patients, who were colonized in the periurethral area, Gram-positive organisms were grown, whereas the organisms present in the urine were Gram-negative in 20 out of 21 patients with bacteriuria. In the 9 colonized female patients, Gram-positive organisms were present in the periurethral area whereas Gram-negative organisms were causing bacteriuria in all patients.

In males with bacteriuria, only 2 patients (10%) were colonized with an organism present in the urine. In females with bacteriuria, 4 (44.4%) out of 9 patients had the same organism in the periurethral area as that present in urine.

There was an association between periurethral colonization and subsequent bacteriuria $X^2 (9) = 62.93$, p< 0.01.

**DISCUSSION**

Nearly 80% of nosocomial urinary tract infections occur in patients with indwelling urinary catheters. Studies have indicated that microorganisms can migrate to the bladder along the outside of the catheter in the periurethral mucosal sheath (between the catheter and the urethral mucosa), the transurethral route, or along the internal lumen of the catheter after the collection bag or catheter drainage tube junction has been contaminated (intra-luminal). Bacteriuria may also occur as a result of entry of microorganisms into the collecting system and ascend through the lumen of the urinary catheter into the bladder. Retrograde spread of organisms from the collecting bag to the bladder occurs within 24-48 hours in nearly all such patients.

The results of this study show that the predominant microbial flora in the periurethral area in the males consist of Gram-positive bacteria. The periurethral area in females is also colonized with Gram-positive bacteria frequently but the periurethral area in the males tends to be colonized less often in females. The results of this study are in accordance with those of Kuin and Steele who reported the same observation in males and females. Despite the fact that Gram-positive bacteria colonized the periurethral area in males and females frequently, they produce catheter-associated bacteriuria much less often. This is consistent with the observation of Stamey and Mihara who experimentally confirmed the observation that coagulase negative staphylococci grow slowly in urine. This may be the reason for the lower rate of bacteriuria due to coagulase negative staphylococci despite their high frequency of isolation in periurethral area. The percentage of Candida albicans isolated in the urine was much less as compared to studies carried out in other hospitals. This may be so because Candida albicans and other Candida species usually cause candiduria when indwelling urinary catheters are used for extended periods during which patient remains in ICU. In 82% of the presently studied patients, however, the duration of catheterization was for one week only.

In various reports, age is considered to be a significant risk factor for bacteriuria with older age being associated with bacteriuria more often than the younger age. In this study group, however, there was no association between the age and the development of bacteriuria. Studies have indicated that the risk factor for bacteriuria with older age being associated with bacteriuria more often than the younger age. In this study group, however, there was no association between the age and the development of bacteriuria.

In young patients also. Same was the observation of Henry et al. who also found no association between the age of the patient and bacteriuria.

The microorganisms most frequently causing bacteriuria in this study were Escherichia coli, Citrobacter freundii, Klebsiella pneumoniae, Pseudomonas aeruginosa and Candida albicans. Gram-negative organisms and especially those mentioned above are also found to be most frequently
implicated in catheter associated bacteriuria in various other studies as well.17,18

After a series of studies carried out, it is a common belief that bacteriuria in catheterized patients is preceded by periurethral colonization with the same organism, an observation that is more frequently seen in females as compared to males.19-22 This observation, however, is completely contradicted by Cooper et al.,23 who carried out a study in 2 groups of females. One group of patients had Gram-negative bacteriuria, while the other was without bacteriuria, both groups, however, were colonized by Gram-positive cocci. In this study, 2 male patients out of 19 had the same Gram-negative organism in the periurethral area as that present in the urine, all others were colonized by Gram-positive organisms, _Candida albicans_ or a Gram-negative organism other than the one present in urine. In females, on the other hand, 4 out of 9 were colonized by the same Gram-negative organism, which were also present in the urine. Moreover, there were 3 patients who were colonized by Gram-negative organisms but their urine was sterile.

Hence, Gram-negative organisms were primarily responsible for causing bacteriuria in all patients whereas the colonizing organisms in the periurethral area were Gram-positive in 45% of patients.

**CONCLUSION**

There was an association between periurethral colonization and subsequent bacteriuria and a significant number of patients develop bacteriuria due to organisms present in their periurethral area, however, prior colonization with a particular organism is not a decisive event in the initiation of bacteriuria.

Also the mere presence of a pathogen on the periurethral area is not by itself a risk factor for subsequent bacteriuria.

**REFERENCES**