Scholars Journal of Applied Medical Sciences (SJAMS) **ISSN 2320-6691 (Online)**
Sch. J. App. Med. Sci., 2016; 4(9D):3408-3412 **ISSN 2347-954X (Print)**

(An International Publisher for Academic and Scientific Resources)
www.saspublishers.com DOI: 10.36347/sjams.2016.v04i09.048

Original Research Article

Incidence of urinary tract infections in ureteroscopic lithotripsy patients: A single center study

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Abstract: Urinary tract infection is a major threat in health care units which increases the hospital stay and related expenses. In the present study, we compared the incidence of urinary tract infection (UTI) in patients who have undergone ureteroscopic lithotripsy (URSL), for calculus disease. Bacteria were isolated from the mid-stream urine before and after urological interventions. The isolated bacteria were identified by standard microbiological and biochemical methods. The bacterial loads of pre and post URSL subjects were statistically compared. The study results indicated that the rate of infection was significantly higher after the URSL procedure as compared to the pre-operative state. *Bacillus* sp., *Staphylococcus* sp. and *E. coli* were the most prevalent bacteria isolated from both pre and post URSL. The results showed that there is significant increase in the incidence of infection in post-operative cases ($p < 0.05$) however, without serious complications. These observations underline in the importance of extra care needed for the post-operative patients.
Keywords: Urinary tract infection, nosocomial, URSL.

INTRODUCTION

Urinary tract infections (UTIs) are infections of urinary tract caused by microbial pathogens. Among the UTIs bacterial infections are the most common in both adults and children and they account for an estimated 25-40% of the nosocomial infections [1]. UTI can be asymptomatic or symptomatic. UTIs that occur in a normal genitourinary tract with no prior instrumentation are considered uncomplicated, whereas complicated infections are diagnosed in genitourinary tracts that have structural or functional abnormalities [2].

Ureteroscopic lithotripsy (URSL) is usually performed for the management of ureteral calculi because URSL has the advantage of shorter operative times, shorter postoperative hospital stays, and fewer postoperative complications [3]. By ureteroscopy the antirefluxing barrier of the intramural ureter is breached so that pathogens of the lower urinary tract may descend into the upper tract [4].

The use of indwelling catheters post operatively increases the risk of UTI [1]. It has been estimated that the use of indwelling urethral catheter, carries a predictable and unavoidable risk of UTI averaging 5% of catheterized patients/day (range 3%–7%) [5]. Patient required additional antibiotics to prevent the risk of post-operative UTI [6]. However, there are no exclusive study reports on the incidence of UTI in post-URSL patients.

UTI is generally hospital acquired often polymicrobic and multi-drug resistant [7]. *E. coli* still accounts for major share of the UTIs, and others include *Enterococcus faecalis*, *Klebsiella* sp, *Enterobacter* sp, *Citrobacter* sp, *Serratia* sp, *Pseudomonas* sp, *Enterococcus* sp *and Staphylococcus epidermis* [8-10]. Some organisms may cause significant disease in patients who are anatomically and immunologically compromised such as the elderly and diabetic.

Study on the incidence of UTI in a hospital setting is important for developing appropriate

strategies for initiating the appropriate preventive measures. In the present study, incidence of UTI was evaluated in patients undergoing URSL pre and post operatively in a tertiary care hospital.

MATERIALS AND METHODS

This study was carried out in the Department of Urology, Yenepoya Medical College Hospital, Mangalore, Karnataka, for a period of three months between February and April 2016. After obtaining the consent, 34 patients admitted with urolithiasis were selected for the study. Patients with underlying systemic diseases, critically ill, patient those who had undergone antibiotic use for more than two weeks, immunosuppression, and post-operative patients discharged within one day were excluded. Pre-operative as well as 3rd day postoperative midstream urine samples were collected in a sterile container and cultured on nutrient agar.

Microbiological studies

The freshly collected urine samples were cultured on nutrient agar media for 24 hours by incubating at 37ºC. Samples indicative of significant bacteriuria (>10^5cfu/ml) were included for the further microbiological analysis. From the positive cultures, colonies were isolated and pure cultures were stored as glycerol stocks under -80° (FORMA 900 series, Thermo Fischer, United States). Identification of the bacteria was carried out initially by Gram's staining and standard microbiological techniques, by using specific media and biochemical tests as described below.

Oxidase test

A bacterial colony from the agar plate was rubbed onto a filter paper, impregnated with tetramethyl-p-phenylenediaminedihydrochloride and the dye indophenols. The zone in the filter paper turned into blue/purple indicate the positive result, while the negative result was with no change of color.

Indole test

To an aliquot of 5 mL 48 h old grown culture, an aliquot of 0.5 mL of Kovac's reagent (p-dimethylaminobenzaldehyde, isoamyl alcohol and HCl) was added. Formation of a cherry-red or purple-red ring at the interface of the broth culture and the reagent indicated the indole production from tryptophan.

Methyl red test (MR test)

Test bacteria was inoculated and incubated for 48 h at 37 °C in 5 mL sterile MRVP broth (peptone 7 g, glucose 5 g, potassium phosphate 5 g, pH 6.9). To this culture, five drops of methyl red solution was added as an indicator and change in the color to red was considered as positive for the formation of organic acids.

Voges-Proskauer test (VP test)

A loopful of test culture was inoculated to 5 mL sterile MRVP broth, and incubated for 48 h at 37 °C. To this culture, 10 drops of VP I reagent (5% α-napthol, in absolute alcohol) and 2-3 drops of VP II reagent (40% KOH solution) were added and the mixture was allowed to stand for 15-20 min for the reaction to complete. Appearance of red color of the mixture, i.e., production of a neutral product, acetoin from the fermentation of glucose by the organism indicated the positive result, while yellow color production indicated the negative result.

Citrate test

The test culture was inoculated onto a slant of Simon Citrate Agar that was incubated for 48 h at 37 °C. The change of color of agar from green to blue indicated that organism used citrate as the sole source of carbon.

Urease test

The test organism was inoculated onto a slant of Christensen's Urea Agar (peptone 1 Gm, glucose 1 g, sodium chloride 5 g, mono-potassium phosphate 0.8 g, urea solution (40%) 50 ml, phenol red 0.012 g, distilled water 1 L, pH 6.8). The hydrolysis of urea yielding ammonia gas increased the pH that changes the color of the medium from off-white to pink/orange, the positive result.

Triple-sugar-iron test (TSI test)

Two or three drops of test broth culture were inoculated on TSI-agar slant and subsequently, a stab was made up to the butt of the slant. The tube was incubated at 37 °C for 48 h; the black color appearance indicated the H_2S production.

Nitrate test

5 mL of nitrite broth (peptone 5 g, beef-extract 3 g, KNO_3 1 g and distilled water 1000 mL) was inoculated with 1 drop of 24 h old broth culture and was incubated for 48 h at 37 °C. From the development of red colour within 30 seconds of adding a few drops of the reagent A (α-napthol 5 g in 1 000 mL of 30% acetic acid) and reagent B (sulphanilic acid 5 g in 1000 mL acetic acid), the positive result was inferred. No color change suggested the negative result.

Data analysis

Data on the incidence of culture positive urine in the pre and post URSL cohort was compared by analyzing the significance of difference using paired t test. To study the possible association between gender and incidence of infection in the study Fishers exact test was used. All the statistical tests were performed using statistical package SPSS (Version 23). Data are considered significantly different if $p < 0.05$.

RESULTS

In the present study urine samples were collected from subjects (n = 34) pre and post URSL procedures for observing the incidence of UTI after intervention. Among the study group, five patients were culture positive in pre-operative period and others were culture negative. A single dose of injection ceftriaxone sodium was given preoperatively to all patients. Follow-up of the patients were done in order to study the incidence of UTI after surgical procedure. On second day of URSL 12 (35.2%) patients had positive urine culture, however, they were culture negative preoperatively (Fig 1). Interestingly, none of the pre-operative culture positive subjects were reported culture positive post-operatively. Majority of members (n=26) of the study were males and only seven (27%) presented with post-operative infection whereas, five (63%) out of eight female subjects showed pre-operatively culture negative became culture positive after urological interventions (Fig. 2, A & B). Fisher's exact test showed no significant relation between the male and female study groups (*p= 0.177).

The most common organisms associated with UTI were *Bacillus* sp. followed by *Staphylococcus* sp, *E. coli, Enterococcus* sp. and *Streptococcus* sp. Others included *Corynebacterium* sp, *Neisseria* sp, *Kurthia* sp. and *Pediococcus* sp as indicated by the conventional biochemical tests (Fig 3, A-D).

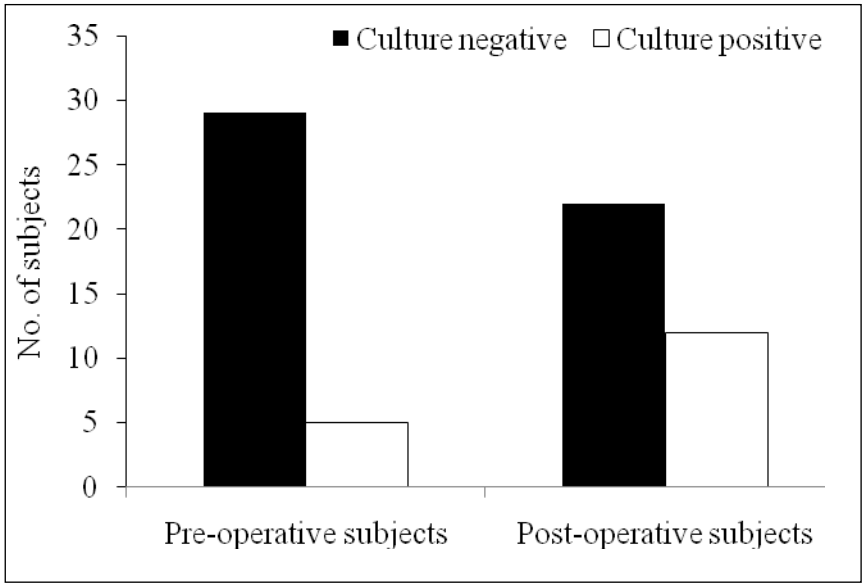

Fig-1: Incidence of UTI in pre-operative subjects and post-operative subjects. * Indicate the significance of difference between the respective pre and post URSL culture positive and negative incidence.

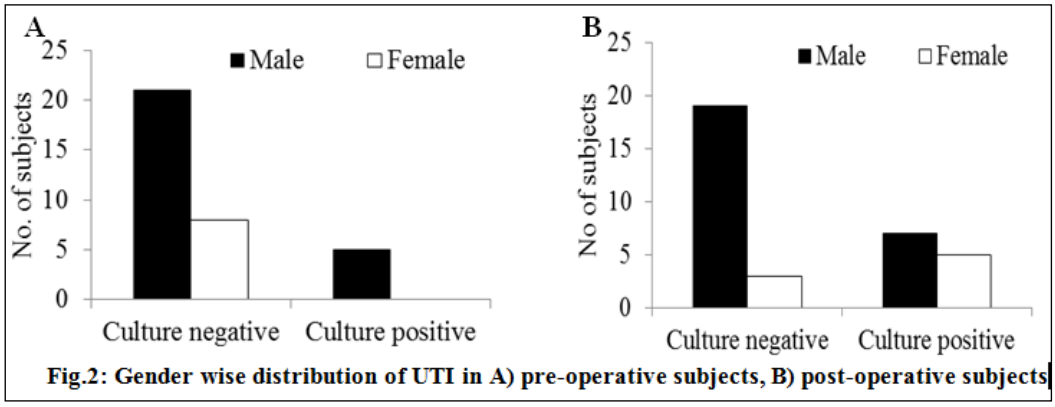

Fig-2: Gender wise distribution of UTI in A) pre-operative subjects, B) post-operative subjects

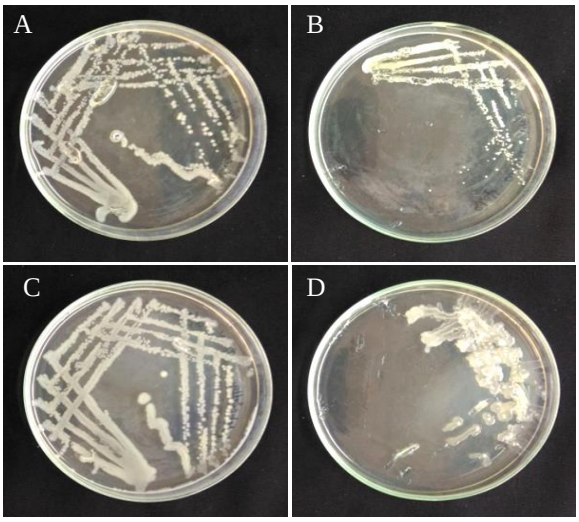

Fig-3: Uropathogen on agar plates A) *E. coli* B) *Staphylococcus*sp, C) *Klebsiella*sp and D) *Bacillus*sp colonies on nutrient agar plate

DISCUSSION

Urinary tract infections have been a major concern, as it this can extend the hospital stay and cost of treatment [11]. Patients with urinary catheter *in-situ* for more than 3 days are significant in the formation of UTI in post-operative cases [12].

The pathogens that typically cause UTIs are considered to be opportunistic pathogens that are mostly of enteric origin, suggesting that these infections occur only because of a breakdown in one or more of the immune defenses of the urinary tract [13]. The post-operative subjects are more prone to urinary tract infection due to the decreased immunity in response to surgical procedure and drug intake. The compromised immune system may open the door to recurrent urinary tract infections by overdoing its response to an initial infection [14].

In the present study, only 14.7% were culture positive before urological intervention but on second day of URSL 35.2% patients reported having UTI. Interestingly, none of the pre-operatively culture positive subjects became culture positive after surgery. This may be due to the use of effective antibiotics initially to reduce the infection prior to URSL. This indicates that almost 50% of the culture negative patients got infected in the hospital post URSL. However, all these incidences were regarded as non-complicated UTI that could be managed effectively with antibiotics such as levofloxacin and ceftriaxone.

In the present study *Bacillus* sp and *Staphylococcus* sp along with *E. coli* were also present in the post-operative urine. A study conducted by Lo *et al*., also reported the high incidence of *Staphylococcus* sp. in urinary tract infection [15]. UTIs that progress to the kidneys can lead to the production of antibodies specific for the infecting agent, but patients with infections limited to the bladder inexplicably fail to induce an antibody response [16]. This apparent defect in the antibody response of the bladder could be a major reason for the remarkable occurrence of UTIs. In spite of stringent measures, it has been difficult to manage UTIs in hospitalized catheterized patients and such incidents warrant overuse of antibiotics and lead to increased risk of antibiotic resistance.

CONCLUSION

In this study we observed that there is a higher chance for UTI in URSL patients. Based on preoperative clinical results and laboratory tests alone, a preselection of patients with regard to their risk of postoperative urinary tract infections is not possible Pre-operative culture positive subjects became culture negative and vice versa which indicates that the incidence of UTI in pre-operative and post-operative subjects does not correlate. Post-operative patients with indwelling catheter are preferable to use selective antibiotics than broad spectrum antibiotics.. Continued care and monitoring of patient is needed to control the UTI in patients who have undergone urological interventions such as URSL.

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