Original Research Article

URINARY TRACT INFECTIONS IN POST OPERATIVE PATIENTS: PREVALENCE RATE, BACTERIAL PROFILE, ANTIBIOTIC SENSITIVITY AND SPECIFIC RISK FACTORS

ABSTRACT

Background aims: Urinary tract infections (UTIs) are the most common minor complication after operations, mostly due to bladder catheterization which used routinely during operations. This investigation seeks to determine the prevalence rate, bacterial features, antibiotic sensitivity and risk factors for urinary tract infection in postoperative patients in tertiary hospitals in Sana'a, Yemen. **Methods**: This prospective analysis included 390 patients undergoing surgery between 2017 and 2018 at Al-Thawra Hospital. The study includes 258 male and 132 female ages 5 to 80 years. Clinical and demographic data and factors affecting UTIs were collected in the standard questionnaire, and the sample was obtained after catheter removal; or, in patients with a clinical indication of continuous catheterization, a sample was obtained after the replacement of a new catheter. The samples were cultured, examined for significant possible bacterial pathogens, isolated and identified by standard laboratory techniques, and microbial sensitivity testing was carried out by disc diffusion method. Also operative characteristics associated with postoperative UTI were analysis. **Results**: Postoperative UTI occurred in 144/390 (37%), and the predominant post-operative uropathogen was *Escherichia coli (34*%), followed by *Pseudomonas aeruginosa* 1(27%) and *Staphylococcus* coagulase negative (16.7%). In Gram-negative bacteria, high resistance to ampicillin (95%), nalidixic acid (63%), ceftriaxone (68%) and cotrimoxazole (55%) was recorded, while high sensitivity to amikacin (98%) and ciprofloxacin. (84%), cefotaxime (87%), gentamicin (87%) and imipenem (98%). In Gram-positive bacteria, high resistance to penicillin (90%), erythromycin (85%), and amoxicillin (78%) was recorded, while high sensitivity to aztreonam (94%), augmentin (83%), ciprofloxacin (93%), cefotaxime (86%), gentamicin (85%) and Rifampicin (100%) and vancomycin (97%). The following characteristics are independently associated with postoperative UTI: female sex (OR 2.1, 95% CI 1.3–3.2), Rubber PTFE catheter (OR 4.7, 95% CI 1.99–11.4), longer duration of catheterization >10 days (OR 4.4, 95% CI 2.3–8.3), overweight (OR 1.7, 95% CI 1.1–2.9), and emergency surgery (OR 1.9, 95% CI 1.2–3.0). **Conclusions**: POUTI remains an important problem in our hospitals and what complicates the situation is that all the causative microorganisms are MDR with few treatment options; and several risk factors were independently associated with POUTI.

KEYWORDS: Catheter associated Urinary tract infections, post operative UTI, POUTI, drug resistance, antibiotics, Sana'a City, Yemen.

INTRODUCTION

Urinary tract infection is the fourth leading cause of healthcare-related infection[1] with approximately 70% - 80% attributable to inappropriate use of indwelling urinary catheters[2]. CAUTI is associated with increased morbidity and mortality and extended the length of hospital stay[2]. Indwelling bladder catheterization is a known risk factor for developing UTIs [3]. There is no widely recognized guideline regarding catheterization in the perioperative setting, to date, with surgeon preferred largely bladder management[4,5]. Routine catheterization has been used at various surgical centers with the purpose of avoid postoperative urinary retention, something for which patients get through operation are recognized to be at increased risk, and which itself is associated with UTIs [6,7]. UTIs account for between 13-15% of all health care-related diseases worldwide, leading to long hospital stays, increased health care expenditures, and an increased mortality rate[2,8]. Postoperative UTIs incidence of has been before estimated as high as 30.26%[9]. POUTIs are described as the most common minor systemic postoperative complication after operations, exceeding pneumonia, deep venous thrombosis,, and renal insufficiency [8]. Also, POUTIs have been linked to considerable unfavorable events such as periprosthetic infection, implant failure, and subsequent revision procedures, consequential in extended and costly hospital stays[10-14]. This investigation seeks to determine prevalence rate, bacterial profile, antibiotic sensitivity and specific risk factors for UTI in post operative patients in tertiary hospitals in Sana'a, Yemen.

SUBJECTS AND METHODS

This prospective analysis included 390 patients undergoing operation between 2017 and 2018 in Al-Thawra Hospital, with indwelling urinary catheters were analyzed for UTI and antibiogram susceptibility , 258 male and 132 female, aged 5 to 80 years. Clinical and demographic data and factors effect UTIs were collected in the standard questionnaire. First , the sample was obtained after removal of the catheter; or, in patients with a clinical indication for ongoing catheterization, a sample was obtained after a new catheter has been placed. Then the samples were cultured in blood agar and MacConkey agar aerobically; cultures were then examined for significant possible bacterial pathogens of UTIs. Possible bacterial pathogens were isolated and identified by standard laboratory techniques, and microbial sensitivity testing was carried out by disc diffusion method. The antibiotics employed in this study were: Aztreonam, Amoxicillin, Amikacin, Augmentin, Ampicillin, Ciprofloxacin, Clarithromycin, Cotrimoxazole, Ceftriaxone, Cefixime, Ceftazidime, Cefotaxime, Cefepime, Gentamicin, Imipenem, Nalidixic acid, Nitrofurantoin, Norfloxacin, Penicillin, Erythromycin, Rifampicin and Vancomycin (Oxide, USA). Inhibition zone was measured after 24 h of incubation at 37°C. The experiments of each antibiotic were performed in triplicate. The results were interpreted according to Clinical and Laboratory Standards Institute (CLSI) methodology [15]. Also operative characteristics associated with postoperative UTI were analysis.

DATA ANALYSIS

The data were statistically analyzed by a software version for statistical significance (Epi Info version 6, CDC, Atlanta, USA). First rates were calculated, then from two-by-two tables, the independence odds ratios* were calculated and *P*-value was determined using the uncorrected chi square test. Fisher's exact test was used for the small expected cell sizes with a two-tailed probability value.

* Associated risk factors are generally defined independently in the statistical sense: the variable is called an independent risk factor if it has a significant contribution to the outcome in a statistical model that includes established risk factors.

RESULTS

This prospective analysis included 390 patients undergoing operation between 2017 and 2018 in Al-Thawra Hospital, with indwelling urinary catheters were analyzed for UTI and antibiogram susceptibility , 258 male and 132 female, aged 5 to 80 years (Table 1). Postoperative UTI occurs in 144/390 (37%) of patients following operations (Table 2). The predominant post-operative uropathogen was *Escherichia coli* (34%), followed by *Pseudomonas aeruginosa* (27%) and *Staphylococcus* coagulase negative (16.7%) while other bacterial cause were less frequent (Table 4).
In Gram-negative bacteria, a high resistance to ampicillin (95%), nalidixic acid (63%), ceftriaxone (68%), and cotrimoxazole (55%) was recorded, while a moderate sensitivity to amoxicillin/clavulanate (65%), ciprofloxacin (84%), cefixime (76%) etc, and high sensitivity to amikacin (98%), ciprofloxacin (84%), cefotaxime (87%), gentamicin (87%) and imipenem (98%) (Table 5). In Gram-positive bacteria, high resistance to penicillin (90%), erythromycin (85%), and amoxicillin (78%) was recorded, while moderate resistance to co-trimoxazole (45%), ceftazidime (38%) and cefepime (24%). High sensitivity to aztreonam (94%), augmentin (83%), ciprofloxacin (93%), cefotaxime (86%), gentamicin (85%) and rifampicin (100%) and vancomycin (97%) was recorded (Table 6). The following characteristics are independently associated with postoperative UTI: female sex (OR 2.1, 95% CI 1.3–3.2), Rubber PTFE catheter (OR 4.7, 95% CI 1.99–11.4), longer duration of catheterization >10 days (OR 4.4, 95% CI 2.3–8.3), overweight (OR 1.7, 95% CI 1.1–2.9), and emergency surgery (OR 1.9, 95% CI 1.2–3.0) (Table 3).

Discussion

CAUTI is the most common hospital infection and accounts for about 30-40% of all hospital acquired infections and is a major source of hospital sepsis and related deaths in acute care hospitals[16]. Our study examined bacterial POUTI rate in postoperative patients at Al-Thawra University Hospital along with testing for common risk factors and common pathogens associated with bacterial post operative UTI. In the current study, the bacterial POUTI rate was found to be 37% (144/390). These infections are mainly bacterial infections, and previous studies have shown that about 26% of patients who have an indwelling urinary catheter in place for 2-10 days will develop bacteriuria, and 25% of these patients will develop bacterial CAUTI. Our results are to some extent higher than published rates perhaps because all of the patients enrolled in this study had undergone operations and stayed longer in hospitals and had a number of risk factors that increase the opportunity of the development of bacterial CAUTI[17,18]. Substantial research has been done on nosocomial UTIs in general; nevertheless, research on UTIs is strictly limited in postoperative patients [19-22]. In this study, a number of potential risk factors for the development of bacterial CAUTI were evaluated. Our results revealed that 48.5% of patients suffering from bacterial CAUTI were female sex is independently associated with postoperative UTI (OR 2.1, 95% CI 1.3–3.2); this is consistent with what has been published in other studies [23,24]. The mean age of bacterial CAUTI patients in this study was 34.1 ± 19.3 years and it was noted that only 26.4% of these patients were over 45 years of age; this result differs from many studies that reported CAUTI is most common in patients above than 45 years[16].

The most important risk factor for the development of bacterial CAUTI is the duration of the catheterization[18]. In the current study, the longer catheter period> 10 days was independently associated with postoperative urinary tract infection (OR 4.4, 95% CI 2.3-8.3) (Table 3), this result is similar to the one previously reported and in which one of the important risk factors for the development of bacterial CAUTI is the duration of the catheterization as has been verified in several studies[23, 26]. This association can be explained by that increased duration most probably increases the likelihood of microbes ascending to the bladder either around the catheter or through its lumen. Also, increased duration of catheterization has been a significant factor associated with acquiring CAUTI in this study (>6 days) as has been shown in many other studies [23,26]. Also, the two mainly important factors that lead to the development of CAUTIs and have been the main focus of quality improvement areas are unnecessary urinary catheter placement and inappropriate delay in removing a catheter when it is no longer needed[27,28]. Regrettably, 38% of attending physicians are unaware that their patients have a urinary catheter in place[29]. In addition, in 20% to 50% of cases, there is no obvious indication in favor of catheter placement [1,29].

Diabetes mellitus was not significant independently associated with postoperative UTI, (OR 1.7, 95% CI 0.8–3.3,p=0.1) (Table 3). These results are disagreement with Saint *et al.* and Lobdell *et al.* studies where one of the risk factors for developing CAUTI is diabetes mellitus[30,31]. Emergency surgery was independently associated with postoperative UTI (OR 1.9, 95% CI 1.2–3.0) (Table 3). With respect to postsurgical patients in further surgical specialties, research reveals that the appreciable incidence of postoperative UTIs is not exclusive to type of surgeries[11]. One study investigating the incidence of postoperative UTIs following major surgeries in various specialties revealed that the rates are indeed similar across multiple surgical services: 30-day postoperative UTI rate for coronary artery bypass, vascular, colorectal, and TJA surgeries were 3.3, 3.4, 4.0, and 3.4%, respectively[11].

In the current study, the predominant post-operative uropathogen was *Escherichia coli* (34%), followed by *Pseudomonas aeruginosa* (27%) and *Staphylococcus* coagulase negative (16.7%) while other bacterial cause were less frequent (Table 4). The current results are different from other published nosocomial investigation studies conducted in Europe and North America consistently support *E. coli*, *Klebsiella* spp., and *Enterococci* spp. as the predominant bacterial pathogens causing CAUTI [32,33]. Also the current study results are different from findings by Rebmann and Greene study ; and Gaynes and Edwards reviews in which *Klebsiella* spp. were the most commonly identified bacteria (8/16, 50%), followed by *Enterococci* (7/16, 44%). Although *E. coli* is known to be the most predominant etiology for UTI [24,34], it was isolated from 34% of the positive bacterial culture patients enrolled in this study. This finding might suggest dissimilarity in bacterial population consistent with different locality and suggests a role of the environment in determining the bacterial population in each hospital [35].

All bacterial post-operative uro-pathogens were found to be resistant to most of the tested antimicrobials (Tables 5,6). These results are consistent with previous studies that demonstrated that organisms recovered from hospitalized patients are often resistant to multiple antibiotics [36-38]. The high rate of MDR among nosocomial pathogens reflects the extensive use of antimicrobials in the hospital in addition to the huge ability of the organism to acquire resistance genes [39,40]. Amikacin and imipenem were the most active drugs against Gram negative bacteria (98% sensitivity). Rifampicin and vancomycin were the most active drugs against Gram positive bacteria (100% and 99%

sensitivity, respectively). The current findings are similar to that reported by Daef *et al.* (2009) study and Daef *et al*. (2012) in which Gram negative bacteria *Klebsiella* spp. were highly sensitive to amikacin and imipenem (100% sensitive in 2008, 94.4% in 2010,87.5% in 2013) [41,42]. On the other hand, other antibiotics were found to have high and moderate resistance to all bacterial post-operative uro-pathogens, and this constant increase in antibiotic resistance over time is frightening and creates a risk for patients with it being the only antimicrobial option to isolate MDR.

CONCLUSION

Our study has identified multiple characteristics independently associated with postoperative UTIs following surgery, which may be helpful to clinicians in categorizing at-risk patients. While this information alone may have the potential to improve the quality of patient care, at this time, the clinical utility of these risk factors is unproven. Further research such as a prospective study stratifying patients into risk groups to guide postoperative management or perioperative catheterization may be employed to establish practical utility.

RECOMMENDATIONS

CAUTI remains a huge problem in our hospitals and what makes it worse is that all causative microorganisms are MDR with few treatment options. According to our results, amikacin, and imipenem can be used for empirical treatment. The Comprehensive Unit-based Safety national program, must be applied in our hospitals that aim to reduce catheter-associated urinary tract infections (CAUTIusts) by focusing on proper technical skills, behavioral changes, education, and feedback. Implementation of the CUSP recommendations to reducing catheter use and CAUTIs in post-operative patients. The program will be likely successful because it included both socio-adaptive and technical changes and allowed the individual hospitals to customize interventions based on their own needs.

ACKNOWLEDGMENT

The authors would like to acknowledge Sana'a University, Sana'a, Yemen which supported this work.

CONFLICT OF INTEREST

No conflict of interest associated with this work.

REFRANCESES

1-Magill SS, Edwards JR, Bamberg W, et al. Multistate point prevalence survey of health care-associated infections. N Engl J Med 2014;370:1198–208.

2-Nicolle LE. Catheter associated urinary tract infections. Antimicrob Resist Infect Control 2014;3:23.

3-Platt R., Polk B. F., Murdock B., Rosner B. Risk factors for nosocomial urinary tract infection. *American Journal of Epidemiology*. 1986;124(6):977–985.

4-Hälleberg Nyman M., Gustafsson M., Langius-Eklöf A., Johansson J.-E., Norlin R., Hagberg L. Intermittent versus indwelling urinary catheterisation in hip surgery patients: a randomised controlled trial with cost-effectiveness analysis. *International Journal of Nursing Studies*. 2013;50(12):1589–1598. doi: 10.1016/j.ijnurstu.2013.05.007.

5-Huang Z., Ma J., Shen B., Pei F. General anesthesia: to catheterize or not? A prospective randomized controlled study of patients undergoing total knee arthroplasty. *Journal of Arthroplasty*. 2015;30(3):502–506. doi: 10.1016/j.arth.2014.09.028.

6-Darrah D. M., Griebling T. L., Silverstein J. H. Postoperative urinary retention. *Anesthesiology Clinics*. 2009;27(3):465–484. doi: 10.1016/j.anclin.2009.07.010.

7-Hansen B. S., Søreide E., Warland A. M., Nilsen O. B. Risk factors of post-operative urinary retention in hospitalised patients. *Acta Anaesthesiologica Scandinavica*. 2011;55(5):545–548. doi: 10.1111/j.1399-6576.2011.02416.x.

8-Thakker A, Briggs N, Maeda A, et al. Reducing the rate of post-surgical urinary tract infections in orthopedic patients.BMJ Open Quality 2018;7:e000177. doi:10.1136/ bmjoq-2017-000177

9-Alvarez AP, Demzik AL, Alvi HM, *et al*. Risk Factors for Postoperative Urinary Tract Infections in Patients Undergoing Total Joint Arthroplasty. Adv Orthop. 2016; 2016: 7268985.

10-Berbari E. F., Hanssen A. D., Duffy M. C., et al. Risk factors for prosthetic joint infection: case-control study. *Clinical Infectious Diseases*. 1998;27(5):1247–1254. doi: 10.1086/514991.

11-Peersman G., Laskin R., Davis J., Peterson M. Infection in total knee replacement: a retrospective review of 6489 total knee replacements. *Clinical Orthopaedics and Related Research*. 2001;(392):15–23.

12-Phillips J. E., Crane T. P., Noy M., Elliott T. S. J., Grimer R. J. The incidence of deep prosthetic infections in a specialist orthopaedic hospital: a 15-year prospective survey. *The Journal of Bone & Joint Surgery—British Volume*. 2006;88(7):943–948. doi: 10.1302/0301-620x.88b7.17150.

13-Poss R., Thornhill T. S., Ewald F. C., Thomas W. H., Batte N. J., Sledge C. B. Factors influencing the incidence and outcome of infection following total joint arthroplasty. *Clinical Orthopaedics and Related Research*. 1984;182:117–126.

14-Pulido L., Ghanem E., Joshi A., Purtill J. J., Parvizi J. Periprosthetic joint infection: the incidence, timing, and predisposing factors. *Clinical Orthopaedics and Related Research*. 2008;466(7):1710–1715. doi: 10.1007/s11999-008-0209-4.

15-Clinical and Laboratory Standards Institute [CLSI). Performance Standards for Antimicrobial Disc Susceptibility Tests. (11th edn.), Approved standard M02-A11– Publication of Clinical and Laboratory Standards Institute [CLSI), 2012; USA, 32.

16-Burke JP, Yeo TW. Nosocomial urinary tract infections. In: Mayhall CG editor. *Hospital epidemiology infection control*. 3rd ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2004:267–286.

17-Erikson H, Iverson B, Aavitsland P. Prevalence of nosocomial infections in hospitals in Norway, 2002 and 2003. J Hosp Infect 2005; 60:40–45.

18-Bagshaw SM, Laupland KB. Epidemiology of intensive care unit-acquired urinary tract infections. Curr Opin Infect Dis 2006; 19:67–71.

19-Platt R., Polk B. F., Murdock B., Rosner B. Risk factors for nosocomial urinary tract infection. *American Journal of Epidemiology*. 1986;124(6):977–985.

20- Darrah D. M., Griebling T. L., Silverstein J. H. Postoperative urinary retention. *Anesthesiology Clinics*. 2009;27(3):465–484. doi: 10.1016/j.anclin.2009.07.010.

21- Hansen B. S., Søreide E., Warland A. M., Nilsen O. B. Risk factors of post-operative urinary retention in hospitalised patients. *Acta Anaesthesiologica Scandinavica*. 2011;55(5):545–548. doi: 10.1111/j.1399-6576.2011.02416.x.

22- Wald H. L., Ma A., Bratzler D. W., Kramer A. M. Indwelling urinary catheter use in the postoperative period: analysis of the national surgical infection prevention project data. *Archives of Surgery*. 2008;143(6):551–557. doi: 10.1001/archsurg.143.6.551.

23-Rebmann T, Greene LR. Preventing catheter-associated urinary tract infections: an executive summary of the Association for Professionals in Infection Control and Epidemiology, Inc, Elimination Guide. Am J Infect Control 2010; 38:644–646

24-Talaat M, Hafez S, Saied T, Elfeky R, El-Shoubary W, Pimentel G. Surveillance of catheter-associated urinary tract infection in 4 intensive care units at Alexandria University Hospitals in Egypt. Am J Infect Control 2010; 38:222–228.

25-Parlak E, Erol S, Kizilkaya M, Altoparlak U, Parlak M. Nosocomial urinary tract infections in the intensive care unit patients. Mikrobiyol Bul 2007; 41:39–49

26-Foxman B. Epidemiology of urinary tract infections: incidence, morbidity, and economic costs. Am J Med 2002; 113:S5–S13.

27- Tambyah PA, Oon J. Catheter-associated urinary tract infection. Curr Opin Infect Dis. 2012;25(4):365-370. https://doi.org/10.1097/QCO.0b013e32835565cc

28- Fakih MG, Watson SR, Greene T, et al. Reducing inappropriate urinary catheter use. Arch Intern Med. 2012;172(3):255-260. https://doi.org/10.1001/ archinternmed.2011.627.

29- Saint S, Wiese J, Amory JK, Bernstein ML, et al. Are physicians aware of which of their patients have an indwelling urinary catheters? Am J Med. 2000;109(6):476-480. https://doi.org/10.1016/s0002-9343(00)00531-3.

30- Lobdell KW, Stamou S, Sanchez JA. Hospital-acquired infections. Surg Clin N Am. 2012;92(1):65-77. https://doi.org/10.1016/j.suc.2011.11.003

31- Gray M. Reducing catheter-associated urinary tract infection in the critical care unit. AACN Adv Crit Care. 2010;21(3):247-257.

32-Laupland KB, Zygun DA, Davies HD, Church DL, Louie TG, Doig CJ. Incidence and risk factors for acquiring nosocomial urinary tract infection in the critically ill. J Crit Care 2002; 17:50–57.
33-Gaynes R, Edwards JR. Overview of nosocomial infections caused by gram-negative bacilli. Clin Infect Dis 2005; 41:848–854.
34-Al-Hasan MN, Eckel-Passow JE, Baddour LM. Bacteremia complicating Gram-negative urinary tract infections: a population-based study. J Infect 2010; 60:278–285.
35-Rashid T, Ebringer A. Ankylosing spondylitis is linked to *Klebsiella* – the evidence. Clin Rheumatol 2007; 26:858–864.
36-Sader HS, Jones RN, Dowzicky MJ, Fritsche TR. Antimicrobial activity of tigecycline tested against nosocomial bacterial pathogens from patients hospitalized in the intensive care unit. Diagn Microbiol Infect Dis 2005; 52:203–208.
37-Zhanel GG, DeCorby M, Laing N, Weshnoweski B, Vashisht R, Tailor F *et al.* Canadian Antimicrobial Resistance Alliance (CARA). Antimicrobial-resistant pathogens in intensive care units in Canada: results of the Canadian National Intensive Care Unit (CAN-ICU) study, 2005–2006. Antimicrob Agents Chemother2008; 52:1430–1437.
38-AlySA, Tawfeek RA, Mohamed IS. Bacterial catheter-associated UTI in ICU of Assiut Univ Hospital. Al-Azhar Assiut Med J 2016; 14:52-8.
39-Hsueh PR, Chen WH, Luh KT. Relationships between antimicrobial use and antimicrobial resistance in Gram-negative bacteria causing nosocomial infections from 1991–2003 at a university in Taiwan. Int J Antimicrob Agents 2005; 26:463–472.
40-Beceiro A, Tomás M, Bou G. Antimicrobial resistance and virulence: a successful or deleterious association in the bacterial world? Clin Microbiol Rev 2013; 26:185–230.
41-Daef EA, Aly SA, El-Din S, El Sherbiny , El Gendy SM. Phenotypic and genotypic detection of extended spectrum beta lactamase *Klebsiella pneumoniae* isolated from intensive care units in Assiut University Hospital. Egypt J Med Microbiol 2009; 18:29–40.
42-Daef E, Elsherbiny N. Clinical and Microbiological Profile of Nosocomial Infections in Adult Intensive Care Units at Assiut University Hospitals, Egypt. J Am Sci 2012; 8:12–17.

Table 1: The age and gender distribution of catheterized patients: Characters

Age groups	**Male (n= 258)**		**female (n= 132)**		**Total n = 390**	
	No.	**%**	**No.**	**%**	**No.**	**%**
< 15 years	46	17.8	26	19.7	72	18.5
15 – 24 years	30	11.6	20	15.2	50	13
25 – 34 years	76	29.4	32	24.2	108	27.8
35 – 44 years	38	14.7	12	9.1	50	12.9
≥ 45 years	68	26.4	42	31.8	110	28.2
Total	258	66.2	132	33.8	390	100
Mean age	34.3 years		32 years		34.1 years	
S D	20 years		18.5 years		19.3 years	
Min	5 years		1 years		1 years	
Max	80 years		70 years		80 years	
Median	30 years		29 years		30 years	
Mode	60 years		40 years		60 years	

Table 2: The prevalence and association of postoperative UTI among different sex and age groups

Factors	**Positive for POUTI N=144**		***OR***	***CI***	***X*²**	***p***
	No	%				
Male n=258	80	31	0.47	0.3-0.7	11.4	<0.001
Female n=132	64	48.5	2.1	1.3-3.2	11.4	<0.001

< 15 years n=72	20	27.8	0.6	0.3-1.0	3.2	0.07
15 – 24 years n=50	16	32	0.77	0.4-1.4	0.59	0.43
25 – 34 years n=108	39	36.1	0.9	0.6-1.5	0.04	0.83
35 – 44 years n=50	18	36	0.9	0.5-1.7	0.02	0.88
≥ 45 years n=110	52	47.3	1.4	0.95-2.2	3.0	0.08
Total n=390	144	37				

OR=odds ratio, *CI*=confidence interval 95%, X^2 =Chi squire, *p=p value*

Table 3: The relationship between positive urine culture and types of catheters and it's duration, etc among post operative patients

***Independent risk factors**	**Positive for POUTI N=144**		***OR***	***CI***	***X^2***	***p***
	No	%				
Type of catheter						
Silicon catheter N=48	6	12.5	0.2	0.08-0.5	14	<0.001
Rubber PTFE catheter N=342	138	40.4	4.7	1.99-11.4	14	<0.001
Duration of catheterization						
1-3days N=182	30	16.5	0.16	0.1-0.2	61	<0.001
4-6days N=90	41	46.7	1.6	1.0-2.5	3.7	0.05
7-9days N=68	38	55.9	2.5	1.5-4.3	12.7	<0.001
>10 days N=50	34	68	4.4	2.3-8.3	23.7	<0.001
BMI						
Underweight n=77	35	45.5	1.5	0.9-2.5	2.9	0.08
Normal n=231	70	30.3	0.49	0.3-0.7	10.6	0.001
Overweight n= 82	39	47.6	1.7	1.1-2.9	5.0	0.02
Diabetes mellitus n=39	19	48.7	1.7	0.8-3.3	2.5	0.1
Hypertension n=36	14	38.9	1.1	0.5-2.2	0.06	0.79
Type of Surgery						
*Elective surgery n=273	87	32	0.49	0.3-0.7	9.0	0.001
*Emergency surgery n=117	56	48	1.9	1.2-3.0	8.5	0.003
Amputation n=32	15	47	1.5	0.7-3.2	1.4	0.22
Excision n=65	29	44.6	1.5	0.8-2.5	1.9	0.1
*Others n=293	100	34.1	0.62	0.3-0.9	3.9	0.04

OR=odds ratio, *CI*=confidence interval 95%, X^2 =Chi squire, *p=p value*

*independence is generally defined in a statistical sense: a variable is called an independent risk factor if it has a significant contribution to an outcome in a statistical model that includes established risk factors.

*Elective surgery is done to correct a non-life-threatening condition, and is carried out at the person's request.

* Emergency surgery is surgery which must be done promptly to save life, limb, or functional capacity.

Table 4: The frequency of bacterial causative agents of CAUTI in post operative patients

Bacteria	**Number**	**Percentage %**
Escherichia coli	49	34
Klebsiella pneumoniae	7	4.9
Pseudomonas aeruginosa	39	27
Proteus mirabilis	6	4.2
Coagulase negative *Staphylococci*	24	16.7
Enterobacter spp.	5	3.5
Staphylococcus aureus	11	7.6
Enterococcus faecalis	3	2.1
Total	144	37

Note: Mixed infection cases were excluded.

Table 5: Antibiotic pattern of 101 Gram negative bacteria isolated from post operative patients.

Antimicrobial agents	**Sensitive%**	**Resistance%**
Amikacin	98	2
Amoxicillin/ clavulanic acid Augmentin	65	35
Ampicillin	5	95
Ciprofloxacin	84	16
Clarithromycin	47	53
Cotrimoxazole	45	55
Ceftriaxone	32	68
Cefixime	76	24
Ceftazidime	73	27
Cefotaxime	87	13
Cefepime	74	26
Gentamicin	87	13
Imipenem	98	2
Nalidixic acid	37	63
Nitrofurantoin	71	29
Norfloxacin	93	7

Table 6: Antibiotic resistance pattern of 43 Gram positive bacteria.

Antimicrobial agents	**Sensitive%**	**Resistant%**
Amoxicillin	22	78
Aztreonam	94	6
Augmentin	83	17
Gentamycin	85	15
Ciprofloxacin	93	7
Cefixime	75	25
Ceftazidime	72	28
Cefotaxime	86	14
Cefepime	76	24
Co-trimoxazole	55	45
Penicillin	10	90
Erythromycin	15	85
Norfloxacin	60	40
Rifampicin	100	0
Vancomycin	97	3