

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 infection¹ with approximately 70% - 80% attributable to inappropriate use of indwelling urinary catheters². CAUTI is associated with increased morbidity and mortality and extended the length of hospital stay². 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 stays¹⁰⁻¹⁴. 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, Ciprofloxacin, Clarithromycin, Cotrimoxazole, Ceftriaxone, Cefixime, Ceftazidime, Cefotaxime, 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 catheterization¹⁸. 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 place²⁹. 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 surgeries¹¹. 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%, respectively¹¹.

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

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.

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CONFLICT OF INTEREST

No conflict of interest associated with this work.

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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		OR	CI	X ²	p
	N=144					
	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%, X2=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		OR	CI	X ²	p
	N=144					
	No	%				
Type of catheter						
Silicon catheter	6	12.5	0.2	0.08-0.5	14	< 0.001
N=48						
Rubber PTFE catheter	138	40.4	4.7	1.99-11.4	14	< 0.001
N=342						
Duration of catheterization	1					
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	80.0
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.

st 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.

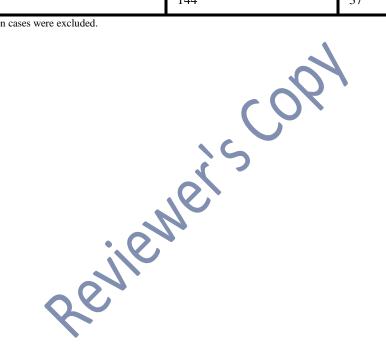


Table 5: Antibiotic pattern of 101 Gram negative bacteria isolated from post operative patients.

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