Antibiogram of nosocomial urinary tract infections in Felege Hiwot referral hospital, Ethiopia

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Abstract

Background: Nosocomial infections increase the cost of medical care, extend hospital stay and reflect on the morbidity and mortality of the admitted patients. Urinary tract infections (UTIs) are one of the most common nosocomial infections in humans.

Objectives: To determine the prevalence and antibiogram of nosocomial UITs from a referral hospital.

Methods: A cross-sectional study was conducted on 1 254 patients from April to August 2010. Antimicrobial susceptibility tests were done using disc diffusion technique as per the standard of Kirby-Bauer method.

Results: Of the 1 254 patients, 118 (9.4%) developed nosocomial UTIs. Seventy three (61.9%) and 44 (37.1%) of the bacterial isolates were gram negative and gram positive, respectively. One patient had a mixed infection. *E. coli, S.aureus* and *K. pneumonia* were the most predominant isolates. Gender, catheterization and pre-operative antimicrobial prophylaxis and underlying diseases were significantly associated with the occurrence of nosocomial UTIs (p=0.001). Most bacterial isolates showed high resistance rates (>80%) to ampicillin, amoxicillin/clavulanic acid, chloramphenicol and cloxacillin.

Conclusion: Catheterization and preoperative antibiotic prophylaxis were found to be the risk factors for nosocomial infection. Effective infection prevention measures should be in place to reduce the prevalence of nosocomial UTIs.

Key words: Antimicrobial resistance, urinary tract infection, bacteria, nosocomial

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Introduction

The quality of health care provision at any level of health facilities is affected by many factors among which nosocomial infection stands in forefront. Nosocomial infections are defined as infections that are identified between 48 and 72 hours after a patient is admitted to a hospital[1]. With the increased use of invasive procedures, at least 8% of patients acquire nosocomial infections[1,2]. Nosocomial infections increase the cost of medical care, extend the duration of hospital stay, and reflect on the morbidity and mortality of the admitted patients[3]. The health care providers are also at risk of acquiring nosocomial infections and add the functional disability to the health care system[4].

Urinary tract infections (UTIs) are one of the most common nosocomial infections in humans[5]. Worldwide, approximately 150 million people are diagnosed with urinary tract infections resulting in $6 billion health care expenditures[6]. These UTIs are the most common bacterial infections encountered by clinicians in developing countries[7]. Most urinary tract infections are caused by gram-negative bacteria like *Escherichia coli, Klebsiella* spp., *Proteus mirabilis, Pseudomonas aeruginosa, Acinetobacter* spp., and *Serratia* spp, and gram-positive bacteria such as *Enterococcus* spp, and *Staphylococcus* spp[8]. *E. coli* is responsible for most UTIs[9]. Drug resistance among bacteria causing UTI has increased since introduction to UTI chemotherapy[10]. Use of antimicrobial prophylaxis may lead to unnecessary prolonged antimicrobial dosing which can contribute to development of resistance due to selection pressure.

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The UTIs from catheterized and hospitalized patients are known to include strains which are resistant to antimicrobials[10]. The etiological agents and their susceptibility patterns of UTI vary in regions and geographical locations. Besides, the etiology and drug resistance change through time[11]. Knowledge of the local bacterial etiology and susceptibility patterns is required to trace any change that might have occurred in time so that updated recommendation for optimal empirical therapy of UTI can be made[12]. Routine antimicrobial sensitivity tests cannot be done in the hospitals of many developing countries. Therefore, empirical therapy of UTIs is based on survey of antimicrobial susceptibility test. The aim of the present study was therefore to investigate prevalence of nosocomial bacterial UTI, assess risk factors and determine the antibiogram of bacterial isolates from a Felege Hiwot referral hospital.

Methods

Patients

A prospective cross-sectional study was conducted to determine the prevalence and antimicrobial susceptibility of urinary tract infections at Felege Hiwot referral hospital from April to August, 2010. Patients aged 18 years and above who were admitted to surgical, gynecology and obstetrics wards were subjected to diagnosis for nosocomial UTIs. Patients with at least one of the following signs or symptoms with (no other recognized cause): fever (>38° C), urgency, frequency, dysuria, or suprapubic tenderness and patient who had positive urine culture i.e. ≥, 10^5 cfu/ml of urine with no more than two species of microorganisms were considered in the study.
A total of 1 254 adult patients consecutively admitted to surgical, gynecology and obstetrics wards were monitored by the surgeons and gynecologists in the respective wards developing UTI during their hospital stay during the study period. Age and sex of the patients, and risk factor of the patients such as history of catheterization, use of prophylaxis and underlying diseases were assessed by practicing nurses.

Data and specimen collection

Data on socio-demographic characteristics of patients, associated risk factors, and clinical status on admission of each patient were collected with a questionnaire. Patients were followed during their admission/postoperative period for the development of UTI, which is noted until the day of their discharge. Clinically suggestive nosocomial infections were identified based on CDC criteria[13].

Midstream urine samples were collected aseptically before and after catheterization using a sterilized container for bacteriological examination. The samples were directly inoculated on blood agar, Chromo agar orientation (biomerieux, France) and Cystine-Lactose-Electrolyte Deficient media (Oxoid). Significant bacteriuria was defined as urine culture which grewe $\geq 10^5$ colony forming unit (CFU)/ml[14]. Cultures were incubated in aerobic atmosphere at 37^0C for 24-48 hours. Positive cultures were identified based on their colony characteristics on their respective media and followed by the pattern of biochemical profiles. All gram negative bacteria were identified using API 20E strip (Biomerieux, France). Reference strains *S. aureus* ATCC 25923, *E.coli* ATCC 25922, and *P. aeruginosa* ATCC 27853(BBL) were used as controls.

Antimicrobial susceptibility testing

Antimicrobial susceptibility tests were done on Mueller-Hinton agar (Oxoid, England), using Kirby-Bauer disk diffusion method[15]. The antimicrobial agents tested were: ampicillin (10μg), sulphamethoxazole (25μg), amoxycillin (30μg), augmentin (Amoxycillin/clavulanic acid) (30μg), ceftriaxone (30μg), ciprofloxacin (5μg), chloramphenicol (30 μg), cloxacillin (1μg), tetracycline (30μg), gentamicin (10μg) , and norfloxacillin (10μg).

Morphologically identical 4-6 bacterial colonies from overnight culture were suspended in 5ml nutrient broth and incubated for 4 hours at 37°C. Turbidity of the broth culture was equilibrated to match 0.5 McFarland standards. Using sterile swab, the suspension was inoculated onto Mueller Hinton agar and antimicrobial discs were added within 5 minutes of inoculation. After 18-24 hours of incubation, the diameter of growth inhibition around the discs were measured and interpreted as sensitive, intermediate or resistant according to Clinical and Laboratory Standards Institute, formerly known as National Committee for Clinical Laboratory Standards[16]. Reference Strains such as *S. aureus* ATCC 25923, *E. coli* ATCC 25922, and *P. aeruginosa* ATCC 27853 (BBL) were used as quality controls for antimicrobial susceptibility tests.

Data analysis

Data were analyzed using SPSS- Version-15.2 to assess differences between variables. Prevalence was calculated for the sum of the numbers of positive

cases of examined patients. Chi-square test was done to check the presence of associations. Bivariant logistic regression model analysis was applied to assess the risk factors. P-values <0.05 were considered statistically significant.

Ethical Consideration

Ethical approval was secured from the Institutional Review Board (IRB) of the medical faculty of Addis Ababa University. A written consent from the medical director and manager of the hospital was obtained for conducting the study.

Results

Among the 1 254 observed patients, 633 (50.5%) were females and 621 (49.5%) were males. The age of the patients ranged from 18 to 87 years, with mean age of 33.6 (SD=14.5) years. The prevalence of confirmed nosocomial urinary tract infections was 9.4%. Among these, 80 (6.4%) were females and 38 (3.0 %) were males (table 1).

Table 1: Age and sex distribution of patients with suspected urinary tract infection at Felege Hiwot Referral Hospital (April to August 2010)

Demographic characteristics	Positive No (%)	Negative No (%)	Total (%)	p value
Age (years)				
15-19	11 (0.9)	127 (10.1)	138 (11.0)	0.45
20-24	24 (1.9)	210 (16.7)	234 (18.7)	
25-29	19 (1.5)	213 (17.0)	232 (18.5)	
30-34	22 (1.8)	138 (11.0)	160 (12.8)	
35-40	12 (1.0)	122 (9.7)	134 (10.7)	
41-45	10 (0.8)	82 (6.5)	92 (7.3)	
>45	20 (1.6)	244 (19.5)	264 (21.1)	
Gender				
Male	38 (3.0)	583 (46.5)	621 (49.5)	0.001
Female	80 (6.4)	553 (44.1	633 (50.5)	
Total	118 (9.4)	1136 (90.6)	1254 (100)	

As shown in table 2, the risk of developing urinary tract infection among catheterized patients is about 2.6 times greater than those who did not have catheter insertion (OR: 18.9, 95% CI., p=0.001). The risk of developing nosocomial UTI among patients who received prophylaxis was 1.2 times higher than those who did not receive prophylaxis (OR: 1.796, 95% CI: 1.326-2.433, p=0.001). Of the 87 patients who had underlying diseases, 16 (18.4%) had confirmed UTI (OR: 4.3, 95% CI: 2.731-6.690, p=0.002).

Table 2: History of catheterization and prophylaxis and culture status among UTI patients at Felege Hiwot Referral hospital (April to August, 2010)

Category	Culture status		Total (%)	X^2	Statistic	
	Positive (%)	Negative (%)			p-value	OR
Catheterized	85 (38.5)	136 (61.5)	221 (100)	265.9	0.001	18.9
Non- Catheterized	33 (3.2)	1001 (96.8)	1033 (100)			
Prophylaxis used	54 (18.6)	237 (81.4)	291 (100)	37.3	0.001	3.2
Prophylaxis not used	64 (6.6)	900 (93.4)	963 (100)			
With underlying diseases	16 (18.4)	71 (81.6)	87 (100)	8.85	0.02	4.3
Without underlying diseases	102 (8.7)	1065 (91.3)	1167 (100)			

Gram negative bacteria accounted for 73 (61.9%) of the bacteria isolated from the patients. *E. coli and S. aureus* were the most predominant pathogens isolated from urine samples, each with prevalence of 33 (28.0%), followed by *Klebsiella pneumonia*, *Enterococcus* spp. and *Proteus mirabilis.* Coagulate negative staphylococci (CNS), and *Enterobacter* spp. and other species constituted 10.2 % of the isolates (table 3).

Table 3: Prevalence of bacteria among UTI patents with history of catheterization and prophylaxis use at Felege Hiwot Referral hospital (April to August, 2010) n = 118

Bacterial Isolates	No. bacterial	Category			
	Isolates (%)	Catheterized (85)	Non-catheterized (33)	Prophylaxis used (54)	No prophylaxis used (64)
Gram- negative					
E. coli	33 (28.0)	28	5	16	17
K. pneumonia	24 (20.3)	18	6	12	12
Proteus mirabilis	7 (5.9)	6	1	1	6
Enterobacter spp.	3 (2.5)	2	1	1	2
Proteus vulgaris	2 (1.7)	0	2	1	1
P. aeruginosa	2 (1.7)	2	0	0	2
S. marcescens	2 (1.7)	2	0	0	2
Gram- positive					
S. aureus	33 (28.0)	23	10	17	16
*Enterococcu*s spp.	8 (6.8)	7	1	3	5
CNS	3 (2.5)	0	3	2	1
Mixed Infection	1 (0.8)	1	0	0	1

CNS= Coagulase negative staphylococci

Assessment of antimicrobial susceptibility patterns indicated that most isolates revealed a high rate of resistance (>80%) to ampicillin, amoxycillin, chloramphenicol, cloxacillin and amoxycillin/ clavulanic acid. Gram positive bacterial isolates showed high a level of resistance to ampicillin, cloxacillin (92.4), chloramphenicol, and amoxycillin (84.8 - 97.4%) (Data not shown). Gram negative bacteria were highly resistant to ampicillin and amoxycillin (90.9 - 99.2 %). *E. coli* showed high level of resistance against ampicillin, 49 (100%), amoxycillin, 42 (85.7), chloramphenicol, 41 (83.7%), and tetracycline 40 (81.6%).

Discussion

Urinary tract infections are one of the most common hospital-acquired infections diagnosed worldwide. Availability of new antimicrobials has improved the management of UTIs. However, the management of UTI infections has been jeopardized by increase in emergence of antimicrobial drug resistance.

A statistically significant difference was observed between genders as majority of the pathogens were isolated from females ($p< 0.001$). Studies conducted all over the world have reported differences in the prevalence between females and males[9,17]. Physiological and anatomical differences have accounted for the differences in males and females. This is because compared to females the drier environment in the urethra prevents the optimal growth of bacteria. The antimicrobial activity of prostate secretions and longer distance between the anus and urethra meatus in males are among the factors responsible for the differences in prevalence of pathogens between the two genders[18].

In this study, the presence of underlying diseases and catheterization were the risk factors for odds of developing nosocomial UTI which was reported previously[19,20]. In this study the association between antibiotic prophylaxis and occurrence of nosocomial UTI agreed with other reports[21].

E. coli and *S. aureus* were the most predominant bacteria isolated from nosocomial urinary tract infections. The isolation rates of *E. coli* and other pathogens in this study were comparable to the rates documented previously[9,11]. However, the rates were generally lower than those from other reports[17,22] and higher than the results of other studies[10]. Gram negative bacteria were more responsible for UTI than gram positive bacteria and this finding is in agreement with the findings of previous studies[5,10]. Differences in identification methods are known to influence the relative

prevalence of bacteria which makes comparison difficult[12]. Bacterial etiologies of UTI can show geographic variations and may even vary over time within a population[9,23]. This result concurred with the results of studies conducted in Ethiopia and other countries[9,24].

The frequency of bacterial etiologies of this study differ from the other reports in which the most frequently isolated causative agents in catheter infections were *Pseudomonas* spp. (17%), *Klebsiella* spp. (16%), *E. coli* (13%), *Acinetobacter* spp. (12%), Coagulase negative staphylococci (11%) and methicillin-resistant *S. aureus* (MRSA*)* (9%)[25]. The results of this study are similar to the results of a study conducted in Taipei, Taiwan[19]. Clinically significant bacterial isolates such as *E. coli, S. aureus* and *K. pneumonia* were common in catheterized patients. Similar results have been reported from previous studies[11]. Catheters support the colonization of biofilm infection where the pathogens adhere to urinary tract, to the foreign material or necrotic tissue and are embedded in exopolysacharide matrix[26].

The antibiotic resistance patterns reported in this study for ampcillin, chloramphenicol, gentamicin, and trimethoprim-sulphomethoxazol were higher than previous reports done in Ethiopia[27,28]. Overall, statistically significant resistance rates were demonstrated to amoxycillin, erythromycin and tetracycline ($p<0.001$). These rates are higher than those reported from Ethiopia[10] and other countries[22, 28]. Increasing drug resistance to these and other antimicrobials has been documented from previous studies[22]. Ciprofloxacin was effective against most bacterial isolates. High rates of sensitivity to ciprofloxacin have been documented from earlier studies[17,29].

In this study, the gram negative enteric bacilli were highly resistant to beta lactam antibiotics ampicillin and amoxycillin. Staphylococci in this study showed 76.9% resistance to tetracycline, 74.8% resistance to cotrimoxazole and 74.8% resistance to gentamicin where as in other reports resistance of 100% to tetracycline, 80% to cotrimoxazole and 60% to gentamicin[30] were shown.

Limitation of the study

This study did not consider etiology of UTIs other than bacteria and anaerobic bacteria due to lack of facility.

Conclusion

This study shows high incidence of nosocomial urinary tract infection in the hospital. The most predominant bacteria isolated were gram negative bacteria. Catheterization and preoperative antibiotic prophylaxis were found to be the risk factors for nosocomial infection. Most bacteria were resistant to cloxacillin and amoxycillin clavulanic acid. Ciprofloxacin is considered as appropriate antimicrobial for empirical treatment of UTI in the area. Effective infection prevention measures should be in place to reduce the prevalence of nosocomial UTIs.

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