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Risk Factors for Catheter Associated Urinary Tract Infections (CAUTI) in Medical Wards and Intensive Care Units (ICU)

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Abstract **Background:** Urinary tract infection (UTI) is the most common hospital acquired infection. The use of indwelling urinary catheters is the major associated cause for catheter associated urinary tract infections (CAUTI). CAUTI is defined as a UTI in a patient who had an indwelling urinary catheter in place at the time or within 48 hours prior to infection. There is a gap in the literature about the risk factors of CAUTI. **Objectives:** To assess the occurrence of CAUTI, and to determine the risk factors associated with CAUTI among patients admitted in medical wards and ICU in KFHH in KSA. **Methods:** It is a prospective surveillance study of CAUTI among patients admitted in medical wards and ICU in KFHH, in the period of May to August 2017. All patients with medical conditions other than urinary tract infection, and had been catheterized with Foley's, catheter were included in the study and data was collected from the medical records. **Results:** The total number of patients was 200, most of the patients were females (72%), 82.5% of the patients were in general medical wards and 17.5% were in ICU, past medical history of urinary tract infection was found in 10% of the patients. Most of the patients showed no symptoms of urinary tract infection. About 29.55% of patients had CAUTI, with the majority of them located in general wards than ICU. Female gender was significantly associated with CAUTI, where 81.4% females had CAUTI, P-value 0.050. Associated disease or comorbidity among patients with CAUTI had significant association with CAUTI P-value 0.001. Patients who stayed longer than 30days in hospital had significant association with CAUTI, P-value 0.001, while age, past medical history of UTI, and past history of Foley's catheter had no significance association with CAUTI. **Conclusion:** The occurrence of CAUTI was more common in patients in wards than ICU. Nearly one third of patients had CAUTI. Risk factors for CAUTI were, female gender, associated disease or comorbidity and longer duration of stay in hospital. While age, past medical history of UTI or previous history of Foley's catheter insertion had no significant association with CAUTI.

Keywords Risk factors, Urinary catheter, Urinary tract infection

1. Introduction

Urinary tract infection (UTI) is considered one of the most common bacterial infections and worldwide more than 150 million individuals are affected. UTIs account for 36% of all health-care associated infections, of these 36% infections, 80% are estimated to be catheter-associated. CAUTI is considered to be one of the most common hospital acquired infection. [1]. Around more than 30% of infections reported by acute care hospitals were due to UTI. [2]. Centres for Disease Control and Prevention (CDC), defined CAUTI as a UTI in a patient who had an indwelling urinary catheter in place at the time or within 48 h prior to infection. Catheter can be made from rubber, plastic or silicone and there are different types of catheters like, indwelling catheter which is known as Foley catheter and it resides in the bladder. Other types of catheters include external catheters and short term catheters. Beyond the initial urinary infection, CAUTIs can

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lead to complications including bacteraemia, endocarditis, osteomyelitis, septic arthritis, and meningitis and this in turns will result in prolonged hospital stays and increased morbidity and mortality. [1]. CAUTI symptoms include one or more of the following symptoms or signs, with no other recognized infection: fever (temperature ≥38°C), urinary urgency, frequency, dysuria, or suprapubic tenderness, with positive urine culture with no more than two pathogens isolated. [3]. In Europe, the mortality rate of nosocomial infections is 10%; 97% of which is related to catheters. The most common causative organisms for CAUTI are Escherichia coli in 24%, Candida in 24%, Enterococcus in 14% Pseudomonas in 10%, Klebsiella in 10% and remaining part with other organisms. The impact of CAUTI on morbidity and mortality is significant because biofilm producing organisms has high antibiotic resistant. [4] Significant risk factors for CAUTI include age, uncontrolled diabetes and long hospital stay. [5]. Female gender and impaired immunity are other risk factors in addition to the length of duration of catheterization. [1]. Another important risk factor for the development of nosocomial CAUTI, especially in the intensive care units, is the presence and care of urinary catheter and the method of catheterization. In addition to this, in many cases, catheters are placed for inappropriate indications, and health care providers are unaware that their patients have catheters, leading to prolonged, unnecessary use which in turns leads to CAUTI. [6]. The most common mechanism of UTI is transurethral ascent of microorganisms and this increase the risk of infection especially in case of bladder catheterisation. Bacteria can ascend in the lumen of the catheters by reflux of urine from the contaminated bags either intra-luminary or along the extra-luminal catheter-urethral surface. For each day of catheter insertion, the incidence of bacterial colonisation is increased by 3–8%. Biofilm formation is a universally occurring phenomena on the surface of the catheters in the urinary tract. Biofilms are structured communities of microorganisms encapsulated within a self-developed polymeric matrix adherent to a surface. These bacteria may differ from their planktonic free-floating counterparts in many aspects, such as metabolic rates or antibiotic susceptibility. The formation of biofilms on catheter surfaces is the reason why bacteriuria becomes universal in case of long-term catheterisation. [7]. The impact of a UTI varies greatly, depending on age, co-morbidities and socio-economic circumstances. CAUTIs may lead to unnecessary use of antibiotics and antimicrobial resistance and longer hospital stays [8]. CAUTI has been associated with increased morbidity, mortality, hospital cost, and length of stay. [9] However, 17% and 69% of CAUTI can be prevented through implementation of evidence-based bundle for CAUTI [10]. The aim of this study was to assess the occurrence of CAUTI, and to determine the risk factors associated with CAUTI among patients admitted in medical wards and ICU in KFHH in KSA in the period of May-August, 2017.

2. Methods

Study design

It is a prospective surveillance study of CAUTI.

Study setting:

The study was done in the Medical ward of King Fahad Hofuf hospital (KFHH) from May to August 2017. The bed capacity of about 210 beds, 15 of these beds are in adult medical ICU. Bed occupancy rate 61.2% in medical ward and 100% in medical ICU, estimated average length of stay in medical ward about 4.9 days and medical ICU 9.8 days.

Study population:

The study included all adult patients who were admitted to medical wards or ICU during the study period with diagnosis rather than UTI and had been catheterized with Foley catheter. The exclusion criteria were patient admitted with community acquired UTI (patients admitted with UTI from the community, not acquired in hospital) Foley's catheter (inserted before hospitalisation) and those who were transferred from other hospital with indwelling urinary catheter.

Study tools and data collection:

The information of the patients was collected from the medical records of the wards and day care unit. The collected data included information on the demographic, clinical data, type and cause of admission, co-morbidities, risk factors, causes of urinary catheterization, number of patients who had any type of infection at admission, duration of devices use, number of days each Foley's catheter use, type Foley catheter (most are silicone two way catheter), date of infection, type of isolated pathogen contribute to infection, antibiogram, prescribed antibiotic, dose and duration of antibiotics, length of hospital stay and outcome of CAUTI management.

Ethical considerations:

A written approval was provided from the ethic committee in KFHH the aim of the study and research proposal.

3. Results

The total number of patients in this study was 200 patients, 56 were males (27.5%). 144 were females (72.5%). (Table 1).

Table 1. Demographic data of the patients

Gender		Frequency	Percent (%)
	Male	56	28
	Female	144	72
	Total	200	100.0

165 (82.5%) patients were in the general medical wards while 35 patients (17.5%) were in intensive care unit (ICU), as shown in table 2. The mean age of the patients was 66.83 year.

Table 2. Distribution of patients in wards and ICU

Location	Frequency	Percent (%)	Valid percent (%)	Cumulative percent (%)
ICU	35	17.5	17.5	17.5
Wards	157	82.5	82.5	82.5
Total	200	100.0	100.0	100.0

Base line urine analysis was negative for bacteria in 100%. Past medical history of urinary tract infection was found in 20 patients (10%) of patients, in 180 patients (90%) no past history of urinary tract infection. (Table 3).

Table 3. Past medical history of urinary tract infection (UTI)

Past medical history of UTI	Frequency	Percentage %
Positive	20	10%
Negative	180	90%
Total	200	100%

25 patients (12.5%) 0f patients had history of Foley s catheter insertion while 175 (87%) were not. Type of Foley's catheter was silicone in all patients (100%). Symptoms related to UTI, were as follows: fever was found in 9 patients (4.5%) and 191(95.5%) had no fever. Suprapubic pain, in only 1% of patients. Haematuria in 1% of patients. 1.5% of patients had suprapubic pain and tenderness and 1.5% of patients were confused. Past history of surgical operation in 12%. About 29.55% of patients (59) had CAUTI, with the majority of them located in general wards than ICU and significantly associated with female gender where 48 females (81.4)% had CAUTI compared to 11 males (18.6%), P-value 0.050. (Table 4)

Table 4. Distribution of CAUTI according to total number and sex of patients

	Frequency	**Percentage %**
Without CAUTI	141	70.45%
With CAUTI	59	29.55%
Total	200	100%
Female with CAUTI	48	81.40%
Male with CAUTI	11	18.60%
Total	59	100%

The most common associated comorbidities or diseases, were sepsis and pneumonia followed by hyperglycaemia, and no patient with renal stone. Most of the patients had no associated disease (35%) but 22% have diabetes with hypertension and 10% have diabetes only. Patients with associated disease among patients with CAUTI were 51 patients (86.4%), P-value 0.001 which is significant result. (Table 5).

Table 5. Associated diseases with CAUTI

	Frequency	**Percentage%**
With associated disease	51	86.4%
Without associated disease	8	13.6%
Total	59	100%

Among patients with CAUTI, 3 patients (5%) stayed less than 7 days 2 patients (3.5%) between 7-14 days, 18 patients (30,5%) 14-30 days and 36 patients (61%) more than 30 days, the longer duration of stay in hospital had significant association with CAUTI, P-value 0.001. (Table 6).

Table 6. Duration of stay of patients with CAUTI in hospital

Duration of stay	Patients	Percentage
Less than a week	3	5%
7-14 days	2	3.5%
14-30 days	18	30.5%
More than 30 days	36	61%
Total number of patients	59	100%

While age, past medical history of UTI, and past history of Foley's catheter had no significance association with CAUTI, with P-value of 0.870, 0.278, and 0.580 respectively.

4. Discussion

Total population in this study was 200. Females were 144 (72%), and males were 56 (28%). Most of the patients were in the general medical wards 165 (82%) while 35 patients (18%) were in ICU. The mean age of the patients was 66.83 year. 10% of patients had past history of urinary tract (UTI) infection (were not excluded from the study). On admission almost all patients has negative urine analysis for bacteria. CAUTI was found in 29.55%, of patients, and significantly associated with female gender (P-value 0.050), may be due to large number of females in the study sample, or the increased risk among females may be probably due to anatomic structure, where, a woman's urethra is closer to anus causing an easier access of the perennial flora to the bladder along the catheter as it traverses the shorter female urethra. The presence of other associated disease or comorbidity could be a risk factor for CAUTI where P-value was 0.001. Long duration of hospital stay was associated with increased risk of CUTI in this study, where 61% of patients with CAUTI, stayed more than 30 days in hospital, this can be explained by the fact that, the presence of catheter for long time will inoculate organisms into the bladder and promote colonization by providing a surface for bacterial adhesions and causing mucosal irritation leading to CAUTI and it is well known that, for each day of catheter insertion, the incidence of bacterial colonisation is increased by 3–8% [7]. The findings in this study were similar to the findings of the study conducted by Talaat M et al, in four hospitals ICU in Alexandria in Egypt where they found that, female gender was an important risk to have CAUTI, relative risk (RR) was 1.7, as well as prolonged hospital stay which had significant higher risk to develop CAUTI. [11]. The incidence of CAUTI in this study was 29.5%, which was more compared to the study done in Abant Izzet Baysal University Hospital in Turkey were the incidence of CAUTI among 143 catheterized inpatients was 13%. [12]. In another study carried out in Japan, to check the efficacy of antimicrobial

catheter in CAUTI, the incidence of CAUTI was 8.8% and 8.3% in the control and antimicrobial catheter groups, respectively. [13]. Symptoms related to UTI, was mainly fever, found in 4.5% of patients. This is as in the literature CAUTI symptoms, are not necessarily referred to the urinary tract and fever is the most common symptom. In a study carried out by Muramatsu K et al, in Japan, they found that, significant risk factors for CAUTI were age, diabetes requiring insulin therapy and long frequent catheterization. [5]. This was similar to this study apart from age which had no significant relation with CAUTI in this study. The finding of this study were similar to a study done in USA where they found significant relation for female sex, as risk factor for CAUTIs and they found that approximately 12% of patients who had catheter (silicone catheter) inserted for 30 days developed a CAUTI. [14]. The finding in this study were also similar to the study done in India, by Sandhu, where they found that, associated comorbid diseases increase the risk for CAUTI, but unlike in this study, they found that CAUTI was more among patients with previous history of UTI and patients with previous history of urinary catheter insertion. [15]. In another study carried out by Letica-Kriegel AS, the incidence of CAUTI was 88.2% at 30 days and 71.8% at 60 days, which was similar to this study where longer duration of catheterization associated with increased risk of CAUTI. [16]. In a study done by Temiz E and his colleagues in ICU setting, they found that, female gender (P-Value = 0.043) and long duration of urinary catheterization (P-value = 0.019) were significant risk factors for the acquisition of CAUTIs. [17].

5. Conclusions

The occurrence of CAUTI was more common in patients admitted in wards than ICU. Majority of patients did not have urinary symptoms. Nearly one third of patients had CAUTI. Risk factors for CAUTI were, female gender, associated disease or comorbidity and longer duration of stay in hospital. While age, past medical history of UTI or previous history of Foley's catheter insertion had no significant association with CAUTI.

6. Recommendations

Avoidance of catheterization in patients generally and females with comorbidities specifically unless otherwise strongly indicated.

Follow up of infectious control measures during catheter placement with using of catheters with antimicrobial properties.

Aseptic insertion of catheter especially in females.

Keeping urinary catheter in situ for the shortest possible period of time to avoid CAUTI.

Based on UTI prevention guidelines, there should be protocols and checklists for catheter insertion and management

(https://www.google.com/search?q=silicone+foley+catheter&oq).

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