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Localization of Urinary Tract Infection In Catheterized Adults Patients: Experience With The Bladder Washout Technique

Amisu MA, Awobusuyi J, Salako BL, Mutiu WB and Ojongbede M

Nephrology unit, Department of Medicine Lagos State University Teaching Hospital Ikeja, Lagos
Department of Microbiology, Lagos State University Teaching Hospital, Ikeja, Lagos.

ABSTRACT

Catheter-associated urinary tract infection is a nosocomial infection acquired by patients admitted into hospitals who are catheterized for various reasons. The prevalence of CAUTI varies from 10.5 to 35% in previous studies done in Europe. Although perceived to be one of the commonest nosocomial infections in our hospitals, local studies on its prevalence and site of infection are sparse in Nigeria., Catheterization is a common procedure in the hospital environment and many in-patients are routinely catheterized for a number of reasons, the general impression is that most of CAUTI are localized to the bladder as patients tend to have few classical symptoms of upper urinary tract infection.

This study aims at determining the prevalence of CAUTI in patients admitted to our Hospital and to localize the sites of infection using the Bladder Wash Out technique.

Methodology: A cross-sectional descriptive study of 226 catheterized subjects recruited over 6 months Bladder washout technique was used to localize the site of infection, and cultures of the collected urine were performed using standard laboratory techniques.

Results: A total of 226 catheterized patients were studied. There were 144 (64%) males and 80 (36%). 118 (52.2%) had CAUTI. Prevalence in males was 81.4% while it was 18.6% in females who had CAUTI. The prevalence of Upper UTI was 42.4%., this prevalence was seen more commonly in males with (88%) and (12%) in females respectively.

Conclusion

The study showed a higher prevalence of CAUTI in Hospitalized patients in LASUTH. Contrary to previously held opinion, majority of the infections were upper Urinary Tract infections. Increased duration of an indwelling catheter is a major risk factor for catheter-associated urinary tract infections.

INTRODUCTION

Catheter-associated urinary tract infections (CAUTI) is a nosocomial infection acquired by patients admitted into hospital who are catheterized for various reasons. It is one of the commonest hospital-acquired infections and accounts for about 35% of all nosocomial infections[1]. Risk factors for hospital acquired urinary tract infection (UTI) include complication arising from urological interventions and invasive radio-diagnostic procedures. Catheter-associated urinary tract infection (CAUTI) is the second most common cause of bacteraemia in hospitalized patients[2], while bacteriuria develops in at least 10 – 15% of hospitalized patients with indwelling urethral catheter[1,2].

The commonest offending uropathogen implicated is *Escherichia coli* which is isolated in 80-85% of episodes[3], Staphylococcus saprophyticus in 5-10% of episodes and other gram-negative isolates

Corresponding author: **Amisu MA**, Nephrology Unit, Department of Medicine, Lagos State University Teaching Hospital, Lagos, Ikeja.

like *Klebsiella s*pecies and *Proteus* species in 2-3% of cases[4,5]. Recently more virulent organisms than *E.coli* have been observed frequently in catheter-associated urinary tract infection. Fungal UTI has been increasing in frequency, it is primarily a nosocomial infection and it occurs in the setting of diabetes, prolong indwelling urethral catheters and intense broad spectrum antimicrobial therapy. *Candida albicans* is the organism most frequently implicated in this setting[6,7].

Other less common organisms causing hospital-acquired UTI are related to instrumentation and surgery[8], like *Klebsiella oxytoca* has been isolated in this setting. The spectrum of pathogens that causes UTI is changing, for example, microbes like *Providentia stuatti* and candida species are being isolated with increasing frequency in patients on long term urethral catheterization. Simple isolates like *E.coli* or *Proteus* is usually associated with cystitis while polymicrobial pathogens are pathognomonic of acute pyelonephritis.

Currently available methods of distinguishing renal parenchyma infection from cystitis are largely clinical. Patients with loin pain, fever, dysuria, pyuria are considered to have pyelonephritis or upper UTI, while patients with cystitis have dysuria, micturition frequency with occasional vague constitutional symptoms. These clinical features are neither reliable nor convenient and sometimes these symptoms overlap. It is also essential to note that catheter-associated UTI is rarely symptomatic and it is generally assumed that the commoner site of UTI in a catheterized patient is lower UTI. Comparatively, Fergusson et al in 1989 proffered that the upper UTI had a higher case frequency and fatality than lower UTI[8]. Also Fairly et al inferred that site of infection affects the clinical course and response to treatment[9] as recurrent upper UTI is known to be associated with scarring of the kidney with a progressive decline in renal function.

Some researchers have used some methods to identify the sites of UTI in patients on urinary tract infection and their commonest pathogens.

Bladder washout technique has been used to localize the site of UTI in catheterized patients. This is based on the principle that significant bactereuria can be temporarily be eliminated by means of irrigating the bladder with a solution of an antimicrobial agent which is washed out subsequently with sterile water. Later timed urine samples are collected and sent for further microbiological and culture analysis. It is expected that all post washed out urine samples culture will be sterile in cystitis while significant bacteriuria in post washed out urine samples suggests upper UTI. It is thus possible to distinguish acute pyelonephritis (upper UTI) from cystitis lower (UTI) depending on existence or absence of pathogens following microbiologic analysis of the post irrigation samples. In 1965 Stammy et al[10] using bladder washout method noted that 50% of patients with asymptomatic bacteriuria had upper UTI, and small proportion with symptoms primarily related to the bladder also had upper UTI. Local studies using this method of bladder washout technique in localizing UTIs in patients with an indwelling urinary catheter is sparse, thus this study attempts to employ this technique to identify risk factors, prevalence and sites of CAUTI. Asides bladder washed out technique, other less common methods that can be used to localize UTI includes; fluorescence antibody coated bacteria[11] technique, using lactate dehydrogenase- isoenzyme, using N-acetyl-beta-Glutaminase (NAG), B2-microglobulin[12] and radioisotope imaging of[13] Gallium-67.

The aims of the study are (1) to determine the prevalence of catheter-associated urinary tract infection in catheterized patients. (2) To identify causative organisms of urinary tract infections in the patients and (3) To localize the site of urinary tract infections in the patients using bladder washout technique.

MATERIALS AND METHOD

This was a cross sectional hospital-based study, conducted over a 6-month period. All adult patients on admission in the medical and surgical wards of the Lagos State University Teaching Hospital, (LASUTH), Ikeja, Lagos, Nigeria, who were catheterized during their hospital stay were recruited into the study.

Demographic data, diagnosis, duration of hospital admission, duration of catheterization and other relevant information were obtained from the patients' case notes.

Localization of the site of urinary tract infection was done using bladder Wash-Out Technique[18]

The data collected were analyzed using the statistical package for social sciences - 16. A

descriptive analysis of the data obtained was performed using appropriate statistics. Association between risk factors and urinary tract infection was analyzed using Odd Ratio. A p-value of less than 0.005 was considered to be statistically significant. The confidence level was set at 95%.

RESULTS

A total of 226 patients were recruited into the study. Among this number, 118 had UTI. The overall prevalence of CAUTI was 52.2%. The upper UTI prevalence was 42.4%, while lower UTI accounted for 9.8%

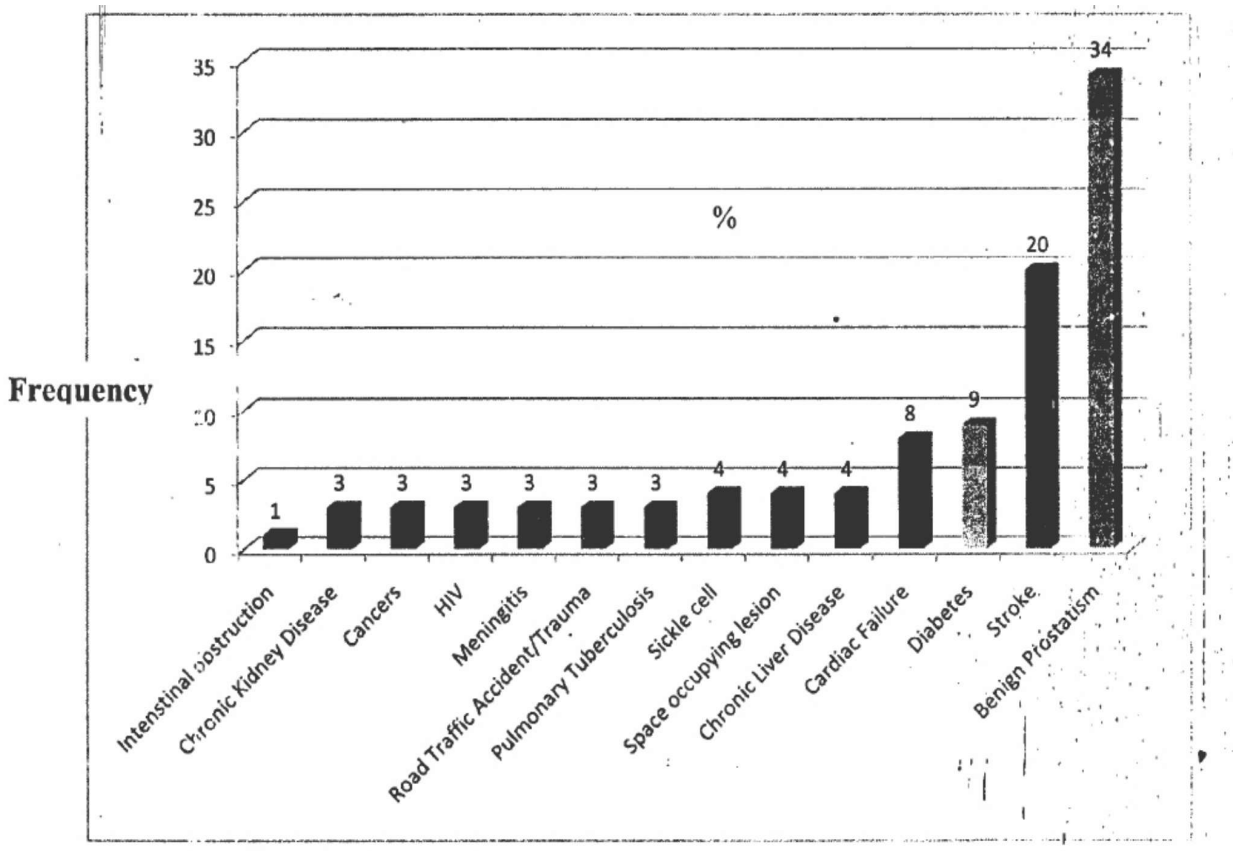

Figure 1: Admission Diagnoses of the studied subjects

Table 1: Distribution of Patients according to Gender and Age Group

	≤ 39yrs	40 – 59yrs	≥ 60	Total
Male	28(19.1%)	51(34.9%)	67(45.9%)	146
Female	20(25%)	35(42.5%)	26(32.4%)	80
Total	48	85	93	226

Table 2: Age and gender distribution of catheterized patients without Urinary tract infection

	Male	13 (27.0%)	25 (52%)	12 (22.8%)	50
NO UTI	Female	15 (15.6%)	30 (51.7%)	13 (22.4%)	58
	Total	28	55	25	108

X2= 2,252, P = 0,152

Table 3: Age and gender distribution of catheterized patients with Urinary tract infection

		≤ 39	40 – 59	≥ 60	Total
	Male	15 (15.6%)	26 (27.1%)	55 (57.3%)	96
UTI	Female	5 (22.7%)	4 (18.2%)	13 (59.1%)	22
	Total	20	30	68	118

X2= 0.686, P = 0.710

Table 4: Uropathogens and their Frequencies in Cauti Sites

NAME OF ORGANISMS	**LOWER UTI N (%)**	**UPPER UTIN (%)**
E. coli	51 (43.2%)	18 (36.7%)
P. aerugenosa	26 (22.0%)	14 (28.6%)
K. pneumonia	20 (16.9%)	9 (18.4%)
S.aureus	7 (5.9%)	1 (2.0%)
S.epidermidis	3 (2.5%)	2 (4..0%)
K.otoxica	8 (6.8%)	4 (2.9%)
P.mirabilis	3 (2.5%)	1 (2.0%)
	118 (100%)	

10 isolates of Candida albican coexisted with other bacterial pathogens.

Table 5: Comparison of Clinical characteristics of Patients with Lower Urinary Tract Infections with those with Upper Urinary Tract Infections

Total	**Days**	Lower UTI N %	Upper UTI N %	
Duration of catheter use	1 – 3 days	18 (52.9%)	16 (47.1%)	34%
	4 – 6 days	27 (65.9%)	14 (34.1%)	41%
	> 6 days	23 (53.5%)	20 (46.5%)	43%
	Total	**68%**	**50%**	**118**
		X^2 1.744, P = 0.418		
Age (years)	≤ 39	10 (50.0%)	10 (50.0%)	20%
	40 – 59	17 (56.7%)	13 (43.3%)	30%
	≥ 60	41 (60.3%)	27 (39.7%)	68%
	Total	**68%**	**50%**	**118**
		$X^2(2)=0.686$, p = 0.710		
Gender	Male	52 (54.2%)	88 (45.8%)	96%
	Female	16 (72.7%)	12 (27.3%)	22%
	Total	**68%**	**50%**	**118**
		X^2 (1) = 2.525, p = 0.152		
Immune status	Immunosuppressed	17(14.4%)	7(5.9%)	7%9
	Immunocompetent	51(43.2%)	43 (36.4%)	4%
	Total	**68%**	**50%**	**118**
		X^2 (2) = 2.918, p = 0.209		

Table 6: Antibiotic sensitivity pattern

	Antibiotics (%)					
Organism	**AMC**	**LFX-5**	**AK**	**CIP**	**SXT**	**CXM**
E. coli	7 (17.1)	26 (63.4)	16 (39.0)	27 (65.9)	1 (2.4)	0
Pseudomonas aeruginosa	2 (8.0)	14 (56.0)	7 (28.0)	13 (52.0)	0 (0.0)	0
Klebsiella pneumoniae	2 (10.0)	11 (55.0)	7 (35.0)	11 (55.0)	0 (0.0)	0
Staphylococcus aureus	1 (12.5)	4 (50.0)	4 (50.0)	2 (25.0)	0 (0.0)	0
Klebsiella Oxytoca	1 (12.5)	2 (10.0)	1 (12.5)	1 (12.5)	0 (0.0)	0

AMC … Ampiclox, LFX-5…Levofloxacin, AK …. Amikacin, CIP ….Ciprofloxacin SZT …. Cotrimoxazole, CXM …. Cefuroxime

DISCUSSION

The overall prevalence in the study was 52.2%, compared with 15% reported by Tamiyah et al[15] in a prospective study in a local facility in Eastern Europe hospital. Bryan C et al[16]. Also submitted a lower prevalence compared to the study, up to 30% of catheterized patients with genitourinary symptoms in isolated primary health-care centres were documented, correspondingly, much less prevalence of 8.5% was also recorded by Kathrine et all[17] in retrospective survey of patients with CAUTI in primary home care settings.

The observed increase in the overall prevalence of 52.2s% in the study may be associated with a high population of elderly admitted with symptoms of prostatism, unconscious patients due to stroke, diabetic coma, uremic coma an head injury. This overall prevalence of 52.2% represented the total prevalence of both upper and lower UTI in the study. However, the prevalence of upper UTI was 42.4% from the study while the prevalence of the lower UTI was 9.8%. This study thus established that upper UTI was commoner in catheterized patients than lower UTI. To lay credence to these findings, Nicolle et al also reported a higher prevalence in upper UTI over lower UTI in a related study, although the population studied was 51 subjects. However, Henry et al[18] had earlier in his landmark work using bladder washout technique and antibody-coated bacteria, interpreted that, lower UTI was more prevalent in CAUTI, this pioneering work was in contrast to this study which showed the prevalence of upper UTI over lower UTI. To corroborate this work and commonality of upper UTI over cystitis, a blinded autopsy study of 75 elderly women in a nursing home who had chronic urethral catheter, revealed that acute inflammation of renal parenchyma was present in 38% of patients with urinary catheters in place at death versus 5% of non-catheterized patients. It was concluded that chronic urethral catheterization was significantly related to acute pyelonephritis. These were observations of John and Warren et al[19] 1998.

The mean age was 57.24 ± 16.97 (SD) years while the age range was 15-94 years. (68.6%) 155 of the participants were elderly, with more male preponderance; male: female ratio (5:1). This could be explained by the fact that there were more male wards than female wards. It was also noted that catheter associated urinary tract infection was commoner in elderly who were admitted for stroke, type 2 diabetes mellitus complications, and obstructive uropathy. This observation corroborated the work of Nicolle et al[14] in which 51 elderly institutionalized women with asymptomatic bacteria were studied and noted to higher prevalence of CAUTI [41] However it was observed that gender had no statistical significance in patients with CAUTI unlike in community-acquired UTI in which female gender had significant association with urinary tract infection, usually adduced to short urethra of the females and also due to massage of female urethral during coital practice.

Duration of Urethral Catheter and UTI**:** While analyzing the duration of catheters inserted in all the patient, most patient's had catheters in situ for short time duration (1-6 days). This may be explained with the fact that the patients had catheters inserted during acute episodes and the catheters were removed as soon as the conditions of the patients improved on admissions. Majority of the patients were greater than 60yrs who had their catheter on for more than 6days had chronic diseases like stroke, diabetic foot syndrome and obstructive uropathy, hence the need for continuous urine output monitoring. Generally, the proportion of patients that developed upper urinary tract infection increased as the duration of catheter use increased.

The observed increase in CAUTI in the elderly may be related to decrease immunity which is usually associated with ageing. This trend showed that upper UTI is commoner with longer catheter stay and although not statistically significant with P-value greater than 0.05, while among patients who were catheterized for more than 6 days the distribution of lower to upper UTI was nearly equal.

Notably, it was shown that duration of indwelling urethral Catheter significantly correlated with an upsurge of CAUTI. The longer the duration of urethral catheter stay, the more the appearance of polymicrobial bacterial in the upper UT1. This observed increase in prevalence in upper UTI with an increase in urethral catheter stay should be approached with a need for urgent and proper catheter care, prompt catheter change, urine microscopy culture and sensitivity check with possible precise antibiotic use.

The co-morbid risk factors associated with CAUTI evaluated from this study were systemic diseases like chronic kidney disease, human immune-deficiency virus, prostatism, cancers, Diabetes

Mellitus. These risks have been known to modify or increase the chances of CAUTI, majorly due to decrease chemotactic effect of neutrophil, cytokines and other factors in the pathogenesis of UTI. It is therefore not uncommon to witness an increase in the prevalence of UTI in this group of patients. Mixed organisms like yeast, *Candida albican* and atypical bacteria have also been implicated in this group of immune-suppressed patients.

Microbiological Spectrum and Sensitivity: The microbial pattern and their frequency showed that E. coli ranked the commonest pathogen both in upper and lower UTI, but more prevalent in the upper UTI, giving credence to previous studies which affirm the predominance of this. Gram-negative bacilli in UTI[20,21]. Klebsiella pneumonia and *Pseudomonas aerugenosa* ranked the next common in that succession, although not statistically significant. Pseudomonas occurred in moderate proportion in patients with upper UTI, this supports the view that pseudomonas is commonly associated with upper UTI. However, *Klebsiella oxytoca, Proteus mirabilis* and *Staphylococcus aureus* were highly negligible as casual organisms in CAUTI, in the study. Conversely, Onipede[22] et al in his work where they looked into urinary pathogens and their microbial susceptibility in 88 CAUTI patients found out that Klebsiella oxytoca was the commonest pathogen followed by *Proteus vulgaris* and subsequently *Staphylococcus aureus*. This departure from this study was corroborated by Habte[23,24] et al in South Africa and, locally by Iregbu[23] et al in Abuja, Nigeria, where he observed an increased prevalence of Actinobacter species.

CONCLUSION

The prevalence of catheter-associated urinary tract infection (CAUTI) was higher than the previous studies and upper UTI was more prevalent than lower UTI. The longer the duration of an indwelling urethral catheter, the more likely a patient is prone to developing UTI. In addition, the risk of developing CAUTI increases with advancing age and presence of immunosuppression.

The increased prevalence of CAUTI in the study especially upper UTI needs to be given due attention in terms of management because it is more sinister and more likely to lead to complication of recurrent scarring of the renal parenchyma with eventual CKD/ESRD. There is a need for more studies preferably multicentre studies to evaluate the burden of hospital-acquired UTI. Education of health care providers in the management and cure of urethral catheters, especially those patients on a prolonged hospital stay is important. There is need to canvass or draw a protocol and a guideline for passage or use of a urethral catheter in our health-care centres as obtained in other institutions.

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