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A clinical study to assess the incidence of catheter associated urinary tract infections (CAUTI) by leukouria and nitrite analysis using dipstick urinalysis in tertiary health facility in Jos, Nigeria

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ABSTRACT: Insertion of a catheter carries a high risk, with daily incidence of bacteriuria of 3 to 10%. Between 10 and 30% of patients who undergo short-term catheterization (i,e, 2 to 4 days) develop bacteriuria and are asymptomatic. Between 90 and 100% of patients who undergo long-term catheterization develop bacteriuria. About 80% of nosocomial UTIs are related to urethral catheterization; only 5 to 10% are related to genitourinary manipulation. The objective of this study is to assess the incidence of Catheter Associated Urinary Tract Infection by Leukouria and Nitrite analysis using dipstick urinalysis. A cross sectional study was conducted at the Plateau Specialist Hospital, Jos, Plateau State, Nigeria. It was conducted amongst 33 subjects who were on hospital admission in the medical or surgical wards within the time of this study. All subjects were on Urinary Catheter. Some of them were catheterized in the hospital, others were referred cases, brought in on urinary catheters. Samples were obtained using a 20 ml syringe from the sample ports of the catheters. Combi-11 dipstick (Cybow TM) reagent strips were used for the urine analysis. Results were recorded immediately. The results showed that 84.8% of catheterized patients had detectable Leukouria, 76.9% of surgical patients had detectable Leukouria and 85% medical patients had detectable Leukouria. 92.9% of elderly patients had detectable leukouria levels on urinalysis. Thus, more medical patients are at risk of developing UTI before surgical patients. The average time to first detectable Leukouria was 6 days. Women developed CAUTI before men. 71.4% of elderly patients had moderate to high Leukouria within 7 days. Catheter Associated Urinary Tract Infections are one of the commonest nosocomial infections occurring in our society. Appropriate urinary catheter care should be ensured and it is changed regularly. Complete avoidance of urethral catheterization possible is still the Gold standard to CAUTI prevention.

Keywords: CAUTI, northern Nigeria, nosocomial infections, urethral Catheters, UTI.

Abbreviations: CAUTI, Catheter Associated Urinary Tract Infection, **UTI,** Urinary Tract Infection, **DM,** Diabetes mellitus, **IUTC,** Indwelling Urinary Tract Catheterization, **BPH,** Benign Prostatic Hypertrophy/Hyperplasia, **SCD,** Sickle Cell Disease.

INTRODUCTION

Urinary Tract Infection (UTI) is an infection of the urinary tract; kidney, ureter, bladder and urethra (Muslim students' society of Nigeria, 2014). It is a common disorder accounting for 1 to 3% of consultations in general medical practice. It is most prevalent amongst women and also men above 60 years (Walker et al., 2014). It may be an infection of the upper or lower urinary tract, which may be complicated or uncomplicated. However, all UTIs in men, pregnant women and children are considered complicated (Muslim students' society of Nigeria, 2014). It is simply

presence of microbial pathogens within the normally sterile urinary tract (Lindsay, 2014).

Personal hygiene is a critical attribute in the prevention of UTIs, starting from limiting nephrotoxic substances intake, to regular clean underwear changing to usage of clean and properly maintained toilet facilities. In Nigeria, only 56% of Nigerian households use an improved sanitation facility. The proportion of households with no toilet facility has decreased over the last 5 years, from 29% of households in 2013 to 25% of households in 2018 (NDHS, 2013; NDHS, 2018).

Although bacteria and fungi are more likely to cause UTI, Viral UTI is uncommon but should be considered as a potential diagnosis in immunocompromised hosts (Hooton, 2003).

In patients with a urinary catheter, bacteriuria increases the risk of gram negative bacteraemia fivefold. Bacteriuria is common and almost universal during long term catheterization. Patients though may be asymptomatic; treatment is avoided in this group to prevent antibiotic resistance (Walker et al., 2014; Lindsay, 2014).

Insertion of a catheter carries a high risk, with daily incidence of bacteriuria of 3 to 10%. Between 10 and 30% of patients who undergo short-term catheterization (i.e, 2 to 4 days) develop bacteriuria and are asymptomatic. Between 90 and 100% of patients who undergo long-term catheterization develop bacteriuria. About 80% of nosocomial UTIs are related to urethral catheterization; only 5 to 10% are related to genitourinary manipulation (Brusch, 2017).

Risk factors for bacteriuria in patients who are catheterized include longer duration of catheterization, colonization of the drainage bag, diarrhea, diabetes, absence of antibiotics, female gender, renal insufficiency, errors in catheter care, catheterization late in the hospital course, and immunocompromised or debilitated state (Walker et al., 2014; Brusch, 2017).

Speaking from nosocomial perspective, catheterization should be avoided when possible and properly removed immediately a natural alternative, like bed pans, are usable. CAUTI is responsible for as high as 70 to 80% of nosocomial infections, new technologies like alloy and antimicrobial urethral catheters have not yet proved satisfactorily, if at all, a better solution on long term against CAUTI to the commonly used Foley's catheter (Muramatsu et al., 2018; Schumm and Lam, 2008; Bonfill et al., 2017).

Thus, the objective of this study is to assess the incidence of catheter associated urinary tract infection by Leukouria and nitrite analysis using dipstick urinalysis.

METHODOLOGY

A cross sectional study was conducted at the Plateau State Specialist Hospital, Jos, Plateau State, Nigeria. Sixty-seven patients were admitted within the time of this study from October, 2018 to March, 2019. It was conducted amongst 33 (49.3%) of those patients who were on urinary catheter at some point while on admission in the medical or surgical wards. 20 (60.6%) of those catheterized patients were in the medical ward, while 13 (39.4%) were surgical patients and 14 (42.4%) were above 60 years. All subjects were on Urinary Catheter. Some of them were catheterized in the hospital, others were referred cases, brought in on urinary catheters.

Detailed medical history relevant to the outcome of the study was obtained from each patient. Duration of current catheterization was requested and documented. Then, the dipstick urinalysis was carried out once on each patient and based on result, they were categorically documented.

Early morning urine was used for the urinalysis. Samples were obtained using a 20 ml syringe from the sample ports of the catheters. A Combi-11 dipstick (Cybow TM) reagent strips were used for the urine analysis. The expiration date was months away. Readings were made against the result chat on the combi-11 dipstick (Cybow TM) container at exactly 60 seconds. Results were recorded immediately.

Ethical approval

Ethical approval/clearance was obtained from the ethical committee of the Plateau State Specialist Hospital. However, verbal consent was still given by every subject after due explanation of the test procedures.

RESULTS

The results showed that 28 (84.8%) of the 33 catheterized patients had detectable Leukouria, 10 (76.92%) of the 13 surgical patients had detectable Leukouria and 17 (85%) of the 20 medical patients had detectable Leukouria. 13 (92.86%) of the elderly patients had detectable leukouria levels on urinalysis (Table 5). Thus, more surgical patients are at risk of developing CAUTI before medical patients (Tables 1, 2 and 3). The average time to first detectable Leukouria was 6 days. Women developed CAUTI before men (Table 3). 10 (71.4%) of the 14 elderly patients had moderate to high Leukouria within 7 days. This shows that elderly patients were more likely to develop CAUTI within shorter durations of insertion that was proportionally increased in predisposition by age (Tables 2 and 3). Medical patients were more likely to have CAUTI before surgical patients (Table 2). Patients with little mobility had a faster and higher rate of developing CAUTI, most at risk were those who could not clean up themselves and had fecal incontinence like diabetic morbid patients. Urethral catheterization up to 2 weeks' duration is bound to have detectable Leukouria levels and significant levels at 3 weeks and above, irrespective of aseptic procedures or regular catheter changes. As this was strictly adhered to (in patient number 12, Table 3) yet, he still developed significant Leukouria.

Table 1. Patients with low Leukouria

S/N	Ward	Sex/age	Duration of catheter	Leukouria	Nitrite	Flank tenderness
1.	Surgical	M/43	1 days	Negative	Negative	Absent
2.	Surgical	M/40	1 days	Negative	Negative	Absent
3.	Medical	F/30	2 days	Negative	Negative	Absent
4.	Surgical	F/62	3 days	Negative	Trace	Absent
5.	Medical	F/24	3 days	Negative	Negative	Absent
6.	Medical	M/40	4 days	+25 uL	Trace	Present

Table 2. Patients with moderate Leukouria

S/N	Ward	Sex/age	Duration of catheter	Leukouria	Nitrite	Flank tenderness
1.	Medical	M/62	2 days	++75 uL	Negative	Absent
2.	Medical	M/72	2 days	++75 uL	Negative	Absent
3.	Medical	M/92	2 days	++75 uL	Negative	Absent
4.	Medical	F/30	2 days	++75 uL	Trace	Absent
5.	Surgical	F/30	3 days	++75 uL	Negative	Absent
6.	Medical	F/40	3 days	++75 uL	Trace	Absent
7.	Medical	F/69	3 days	++75 uL	Negative	Absent
8.	Surgical	F/39	4 days	++75 uL	Trace	Absent
9.	Medical	M/90	5 days	++75 uL	Positive	Present
10	Medical	M/75	6 days	++75 uL	Positive	Present
11.	Medical	F/83	7 days	++75 uL	Positive	Present
12.	Surgical	M/45	7 days	++75 uL	Trace	Absent
13.	Surgical	M/60	7 days	++75 uL	Trace	Absent
14.	Surgical	M/37	10 days	++75 uL	Absent	Absent

Table 3. Patients with high leukouria

S/N	Ward	Sex/age	Duration of catheter	Leukouria	Nitrite	Flank tenderness
1.	Medical	M/70	7 days	+++500 uL	Trace	Absent
2,	Surgical	M/55	7 days	+++500 uL	Trace	Present
3.	Medical	F/55	8 days	+++500 uL	Trace	Absent
4.	Medical	F/18	8 days	+++500 uL	Positive	Present
5.	Medical	F/80	5 days	+++500 uL	Positive	Present
6.	Medical	M/85	2 weeks	+++500 uL	Positive	Absent
7.	Surgical	F/45	2 weeks	+++500 uL	Positive	Present
8.	Medical	M/53	2 weeks	+++500 uL	Positive	Present
9.	Surgical	M/41	3 weeks	+++500 uL	Positive	Present
10.	Surgical	M/37	3 weeks	+++500 uL	Positive	Present
11.	Medical	M/88	3 weeks	+++500 uL	Positive	Present
12.	Surgical	M/45	1 month	+++500 uL	Positive	Present
13.	Medical	M/90	7 months	+++500 uL	Positive	Present

DISCUSSION

Urinary infection is the most common bacterial infection in humans, and can be either symptomatic or asymptomatic. When a urinary catheter is inserted, it takes superficial bacteria colony further into the urinary tract and shields away the urethra urothelium from the acidic purifying actions urine (Lindsay, 2014).

Table 4. Result analysis summary on detectable Leukouria.

Duration	No. of patients catheterized within time	No. of patients with detectable Leukouria	% with detectable Leukouria
1 Week	22	17	77.2
2 Weeks	6	6	100%
3 Weeks	3	3	100%
1 Month and above	2	2	100%

NB: Urethral catheterization up to 2 weeks' duration is bound to have detectable Leukouria levels and significant levels at 3 weeks and above, irrespective of aseptic procedures or regular catheter changes. As this was strictly adhered to (in patients no. 12 Table 3) yet, he still developed significant Leukouria.

Table 5. Analysis of the elderly patients. Medical and surgical wards.

Parameters	Total patients present	Elderly patients > 60 years old	Medical ward	Surgical ward
Total number present	33	14	20	13
No. with detectable Leukouria	28	13	17	10
% with detective Leukouria (%)	84.84	92.86	85.00	76.92

This study has shown how common it is to develop bacteriuria when on urethral catheter, however asymptomatic it may be. Even at high Leukouria, some patients still showed no signs of fever, nausea, vomiting, abdomino-pelvic discomforts nor flank tenderness. The asymptomatology of CAUTI thus makes it hard to diagnose. Similar observations were made by Tambyah and Maki (2000).

The average time-to-CAUTI observed was 6 days. Perrin et al. (2020) obtained similar results in their study. Although, prolonged use, old age, female gender, previous history of UTI, immobilizing morbidities, diabetes and old age were major risk factors for faster development of CAUTI.

The risk associated with the elderly developing CAUTI was similarly noticed in this study. It was also assessed that this risk was proportional to increase in age. This may be attributed to the fact that most of the elderly admitted where in the medical ward and had non-pyrexic but, immobilizing pathologies limiting antibiotics use, such as; diabetes, hypertension and stroke. In such patients, antimicrobial catheters may come in handy (Retelski et al., 2017; Muramatsu et al., 2018).

In comparison between the medical and surgical ward predisposition to CAUTI, the medical ward had more of its patients on urethral catheters. They also developed CAUTI faster than surgical patients. This may be due to the prevalence of more immobilizing morbidities and aged patients on admission in the medical wards, other predisposing factors are diarrhea and immunocompromised states. May be as a result of the lack of generally accepted guidelines for the indication of IUTC placement in medical patients (Bhatia et al., 2010). It may also be attributed to the broad spectrum cocktail of antibiotics often utilized in care of surgical patients. Further studies are needed to clarify this.

Women are more likely to come down with CAUTI before men presenting with the same pathology. This may be because of the absence of bactericidal prostatic secretion, proximity of the female external urethral orifice to the vagina introitus and anal canal creates a larger lower urethral bacterial colony than in males (Otobo et al., 2020; Walker et al., 2014; Impey and Child, 2012). Hence, when a urethral catheter is inserted, it inoculates larger colonies of microorganisms into the sterile urethral in females than in males. Similar results were reported by Perrin et al. (2020).

Although flank tenderness was majorly observed amongst the elderly and comorbid patients, a classic case of an 18-year-old SCD female was observed. She was admitted for severe diarrhea and was being managed for acute hypovolemic shock with superimposed sickle cell crisis, however had a history of sickle cell nephropathy. She was immobile as she was weak. She had multiple risk factors, such as; female sex, diarrhea and history of nephropathy. More research needs to be done on the relationship between SCD patients and CAUTI.

CAUTI was rare in maternity wards because they seldom used one, and when they did, it was for very short periods of time; 12 to 36 hours. It was commonly used in women who delivered via caesarean section.

Finally, the most important steps in preventing CAUTI is complete avoidance of urethral catheter insertion if possible, education of health workers on CAUTI risks and prevention, and lastly, the meticulous need for a septic insertion cannot be over emphasized (Barbadoro et al., 2015).

Conclusion

There is a 100% occurrence of Leukouria on urinalysis at

2 weeks and above of urethral catheterization (Table 4). Female sex and immobilizing pathologies are risk of developing CAUTI. Catheterized elderly patients have a 71% chance of developing detectable moderate to high Leukouria levels in the first 7 days of catheterization. CAUTI may remain clinically asymptomatic even at very high Leukouria levels. Patients in the medical wards were 0.9 times more likely to develop CAUTI than surgical wards. Average time-to-CAUTI is 6 days. There should be complete avoidance of urethral catheterization when possible. Health workers' education/awareness and aseptic techniques play a vital role. On same note, proper evaluation should be carried out on every medical patient and the actual requirement for catherization should be well established before the procedure is implemented. Patients centered care should be improved upon in all hospitals.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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