

Bacteriological Spectrum of Urine Culture in Patients with Obstructive Uropathy

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Abstract Background: Obstructive uropathy and urinary tract infection increase the risk of infection and renal scarring. When there is an obstruction in the urinary tract, stasis of urine with multiplication and ascending translocation of bacteria can result in urinary tract infection. These may present as cystitis, pyelonephritis, abscess formation and urosepsis. Treatment requires appropriate antibiotic treatment following urine culture and sensitivity to prevent potentially fatal urosepsis. **Objectives:** To evaluate the bacteria isolated in the urine culture of patients with obstructive uropathy and determine the common organisms associated with upper and lower urinary tract obstruction. **Methods and Methodology:** The study was an 8year retrospective evaluation of patients presenting with obstructive uropathy from two hospitals. All patients with upper and urinary tract obstructive uropathy were included. Their laboratory request forms and results of culture and sensitivity were reviewed. The data was extracted from records, coded into Excel, and analyzed using SPSS Version 20. **Results:** 445 patients with obstructive uropathy had their urine culture reports analyzed in the study population. The ages range from 2years to 108years with a mean age of 58years and a median age of 61years. 397(89.2%) were male, and 48(10.8%) were females. The urine positive culture rate was 70.6%. Gram-negative organisms were the commonest, with Klebsiella sp. 105(23.6%) the most frequently isolated. Escherichia Coli 98(22.0%). Citrobacter sp was the least common pathogen isolated and was not observed in females. **Conclusion:** Gram-negative organisms are the commonest pathogens cultured from the urine in patients with obstructive uropathy. The positive culture rate was 70.6%. Klebsiella sp. and E. Coli were the most prevalent organisms from the urine in patients with upper and lower urinary tract obstruction.

Keywords: Gram-Negative, Obstructive Uropathy, Urine culture, UTI

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1. Introduction

Stasis of urine in the urinary tract increases the risk of infection and renal scarring [1]. Urinary tract obstruction can have long-lasting effects on the physiology of the kidney, including its ability to concentrate urine. [2] Obstructive uropathy is a functional or anatomic obstruction of urine flow at any level of the urinary tract. [2]. It is responsible for about 4% of end-stage renal disease. [3] The causes will depend on age. Common causes include posterior urethral valves, pelvic ureteric obstruction, and ureteroceles in children. The usual causes in adult young men include urethral stricture and urinary stones. The aetiological risk factors in the middle-aged and elderly are prostatic enlargement, benign and malignant lesions, bladder tumours and urinary stones. Female causes include bladder tumours, urinary stones and genital malignancies [3,4]. When there is an obstruction in the urinary tract, stasis of urine with multiplication and ascending translocation of bacteria

result in urinary tract infection. These may present as cystitis, pyelonephritis, abscess formation and urosepsis. Treatment requires appropriate antibiotic treatment following urine culture and sensitivity. [5,6,7,8]

2. Aims and Objectives

To evaluate the bacteria isolates in the urine culture of patients with obstructive uropathy and determine the common organisms associated with upper and lower urinary tract obstruction.

3. Materials and Methods

The study was an 8year retrospective evaluation of patients presenting with obstructive uropathy from two hospitals. The hospital includes the Urology Department, University of Port Harcourt Teaching Hospital, and Rosiville Clinic and Urology Centre, Port Harcourt, Nigeria, from January 2013 to December 2020. All the

patients had obstructive uropathy at some level from the renal calyces to the tip of the urethra. Included are patients diagnosed with posterior urethral valves, meatal stenosis, pelvi-ureteric obstruction, ureterocele, urinary calculi, urothelial tumours of the ureter, bladder and urethra, bladder outlet obstructions from benign and malignant obstructions, schistosomiasis, and urethral strictures. Their laboratory request forms and results of culture and sensitivity were reviewed. The data was extracted from records, coded into Excel, and analyzed using SPSS Version 20.

4. Results

Four hundred forty-five patients with obstructive uropathy had their urine culture reports analyzed in the study population. The ages range from 2years to 108years with a mean age of 58years and a median age of 61years. 397(89.2%) were male, and 48(10.8%) were females. The urine positive culture rate was 70.6%. Gram-negative organisms were the commonest, with *Klebsiella* sp. 105(23.6%) the most frequently isolated. *Escherichia Coli* 98(22.0%) was next, then *Proteus* sp. 62(13.9%) and *Pseudomonas* sp. 46 (10.3%), respectively. *Klebsiella* was the commonest cultured in females 24(50.0%), while *E. Coli* was the most frequent in men 89(22.4%). *Citrobacter* sp was the least common pathogen isolated and was not observed in females.

Table 1. Age and Sex distribution of patients with obstructive uropathy

| | N | % |
|--------|-----|-------|
| Age | | |
| <19 | 2 | 0.4 |
| 20-29 | 12 | 2.7 |
| 30-39 | 37 | 8.3 |
| 40-49 | 54 | 12.1 |
| 50-59 | 96 | 21.6 |
| 60-69 | 142 | 31.9 |
| 70-79 | 80 | 18.0 |
| >80 | 22 | 4.9 |
| Sex | | |
| Female | 48 | 10.8 |
| Male | 397 | 89.2 |
| Total | 445 | 100.0 |

Table 2. Bacteria isolated from urine culture in patients with obstructive uropathy

| | N | % |
|-------------------------------|-----|-------|
| No Growth | 131 | 29.4 |
| <i>Citrobacter</i> sp. | 3 | 0.7 |
| <i>E. coli</i> | 98 | 22.0 |
| <i>Klebsiella</i> spp | 105 | 23.6 |
| <i>Pseudomonas Aeruginosa</i> | 46 | 10.3 |
| <i>Proteus</i> | 62 | 13.9 |
| Total | 445 | 100.0 |

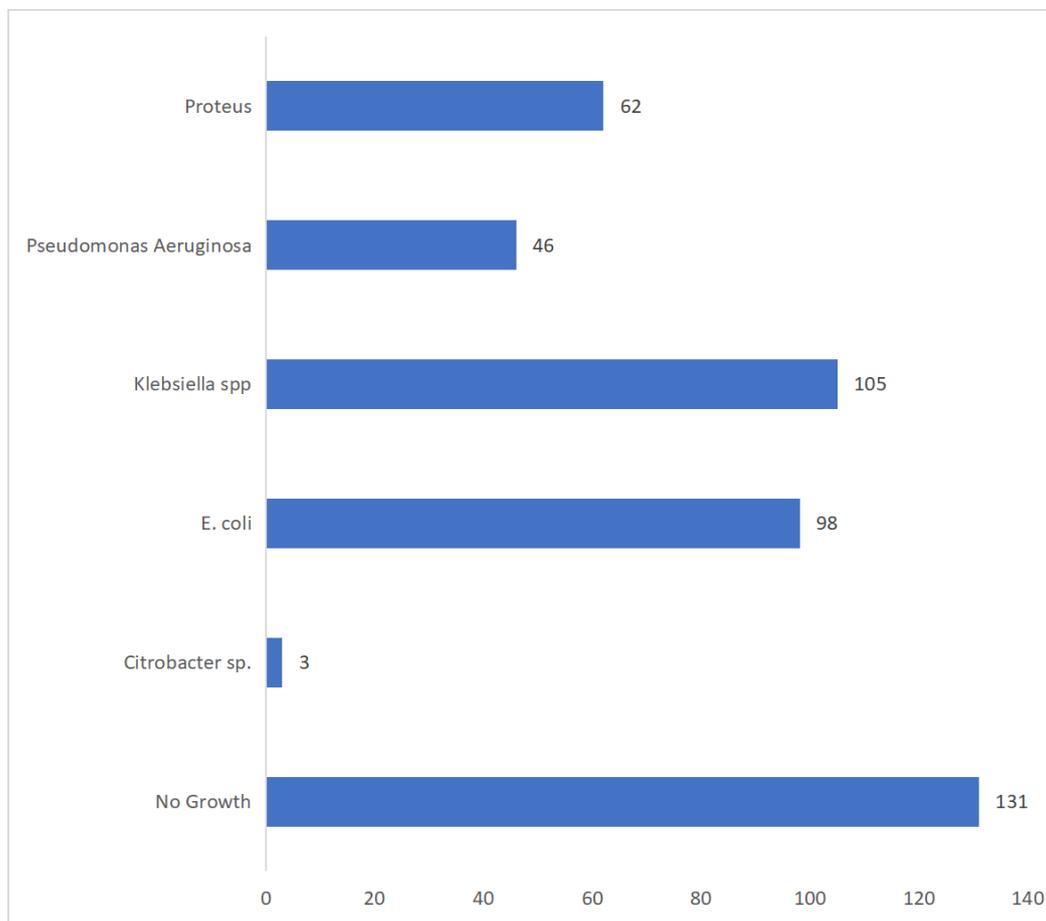
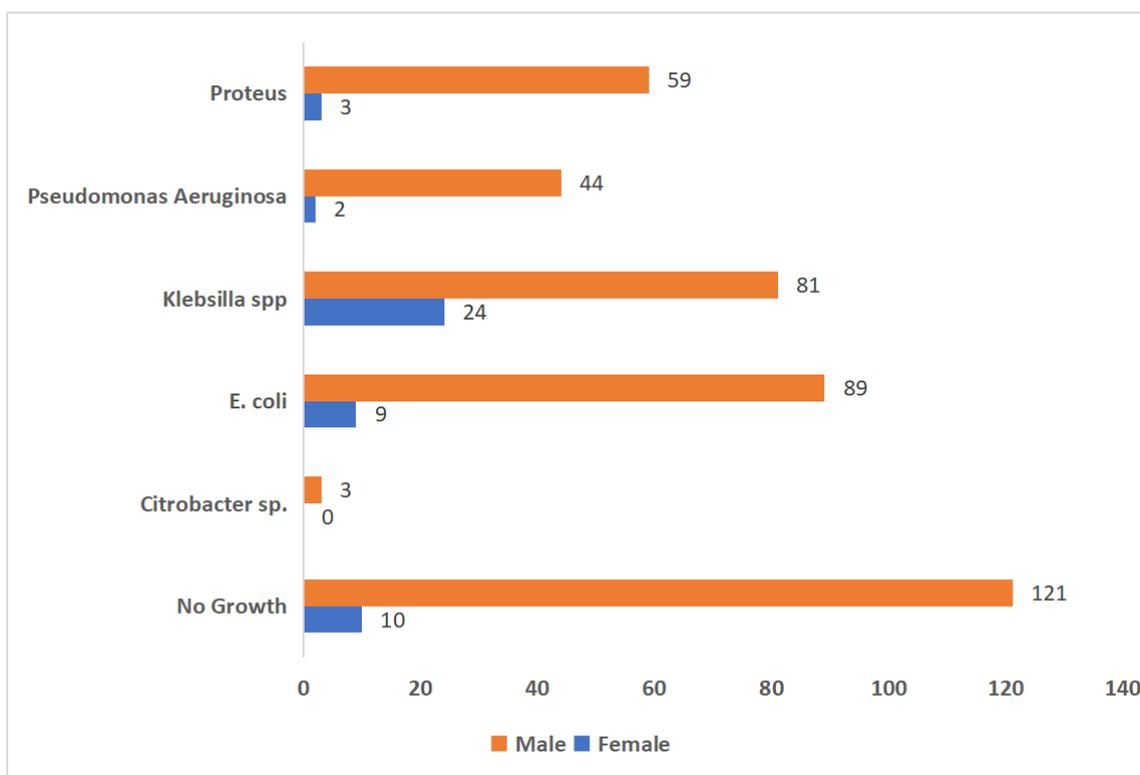


Figure 1. Distribution of bacteria isolated from urine in patients with obstructive uropathy

Table 3. Age and Sex distribution with urine culture in patients with obstructive uropathy

| | SEX | | | | | |
|------------------------|--------|--------|------|--------|-------|--------|
| | Female | | Male | | Total | |
| | N | % | N | % | N | % |
| No Growth | 10 | (20.8) | 121 | (30.5) | 131 | (29.4) |
| Citrobacter sp. | 0 | (.0) | 3 | (.8) | 3 | (.7) |
| E. coli | 9 | (18.8) | 89 | (22.4) | 98 | (22.0) |
| Klebsiella spp | 24 | (50.0) | 81 | (20.4) | 105 | (23.6) |
| Pseudomonas aeruginosa | 2 | (4.2) | 44 | (11.1) | 46 | (10.3) |
| Proteus | 3 | (6.3) | 59 | (14.9) | 62 | (13.9) |

**Figure 2.** Age and Sex distribution with urine culture in patients with obstructive uropathy

5. Discussion

Obstructive uropathy is a functional or anatomic obstruction of urine flow at any level of the urinary tract. UTI in patients with lower urinary tract symptoms (LUTS) is classified as complicated because stasis is a risk factor for bacteria colonization and mitigates treatment. [9,10,11] The combination of sepsis and obstruction have profound effects on the physiological function of the kidney, including its ability to concentrate urine. Obstructive uropathy accounts for up to 4% of end-stage renal diseases. [2] The aetiology depends on the age and sex of the patient.

The age at presentation of the patients with UTI shows a bimodal distribution during childhood and in the sixties [3,4]. In our study, the youngest patient was a two-year-old child with posterior urethral valve, while the oldest was a 108years old with prostate cancer with obstructive LUTS from BPH. Common aetiological factors in the pediatric age group include posterior urethral valves, pelvic ureteric obstruction, and ureterocele. [12] In adult young men, urinary calculi and benign urethral strictures are common causes. In contrast, in the elderly,

enlargement of the prostate, both benign and malignant, are often the observed risk factor. [1]

The modal age group was the 60-69 gear group with a median age of 61years in our study. (Table 1) The prevalence of bacteriuria among all the patients was 70.6% (Table 1). Considering that majority of the patients were men (89.2%) and that the mean age of the patients was 58.6%, bladder outlet obstruction is expected to be prevalent among these patients.

Oromia Gauguin et al. [13] conducted a prospective study evaluating UTI with BPH aged between 53-80years. They found a positive urine culture rate of 44.7% out of the 94 patients evaluated and observed that E. Coli was the commonest isolated. Akebi et al. [14] in Bida, Nigeria, found the incidence of urinary tract infections in their study population was 62.5%. E. coli 247(67.7%) was also observed to be the most prevalent uropathies followed by Staphylococcus aureus 34 (9.3%), Pseudomonas species 29(7.9%), Klebsiella species 10(2.7%), Proteus species 10(2.7%)

In another West African study, Asafo-Adjei K et al. [15] investigated bladder outlet obstruction at Korle, Accra, Ghana and found a prevalence of UTI of 76.6%. The main

risk factor observed in their study was urethral catheterization. Enterobacteriaceae were the most common organisms, and *E. coli* (62.2%) was the most often seen, followed by *Klebsiella sp.* (27.0%), *Citrobacter sp.* (8.1%) and *Aerobacter spp.* (2.7%). In their study, Khan R et al. [16] found significant bacteriuria was detected in 19.3% and 55.4% of asymptomatic and symptomatic patients, respectively. The significant risk factors were female sex, diabetes, obstructive uropathy, previous instrumentation, and chronic kidney disease. The most common isolated pathogens were *Escherichia coli* (52.4%), followed by *Klebsiella pneumonia* (12.3%) and *Citrobacter spp.* (9.1%), *Enterococcus* (6.9%), *Proteus spp.* (5.3%), *Coagulase-negative staphylococcus* (5.3%) and *staph. aureus* (4.0%).

The commonest isolated microbe in urinary tract infection is *Escherichia Coli*, both in simple, complicated and nosocomial UTIs. The organism is a normal constituent of humans and animals. [17,18] The distinctive *E. coli* strains that cause most UTIs have been designated Uropathogenic *E. coli*. They possess diverse virulence-associated factors that assist them in attaching to, invading, and injuring the host. These include adhesins, toxins, siderophores, protective polysaccharide coatings, invasions, and serum resistance-associated proteins. The presence and numbers of such virulence factors predict in vivo virulence. [19,20,21] In our study, *E. Coli* (22.0%) was the second commonest cultured isolate from the urine of the patients with obstructive uropathy, slightly less prevalent than *Klebsiella spp.* (23.6%).

Klebsiella spp. was the commonest isolated from urine culture in our study. It is closely associated with nosocomial infection and multidrug resistance. This finding is not surprising since most of the patients were referred from other hospitals, and many of them had a history of admission at previous medical facilities. [22,23]

In our study, after *Klebsiella sp.* and *E. Coli*, *Proteus spp.* (13.9%), was the next most commonly cultured organism. *Proteus sp.* is capable of causing symptomatic infections of the urinary tract, including cystitis and pyelonephritis. It is present in many cases of asymptomatic bacteriuria, particularly in the elderly and among patients with type 2 diabetes. These infections can also cause bacteremia and progress to potentially life-threatening urosepsis. Additionally, *Proteus mirabilis* infections can cause the formation of urinary urolithiasis. [24,25,26]

Pseudomonas spp. is the fourth most common pathogen in our study and is associated with hospital-acquired catheter-associated UTIs. [27] The virulence of *Pseudomonas sp.* is multifactorial. It has been attributed to cell-associated factors like alginate, lipopolysaccharide, flagellum, pilus and non-pilus adhesins, and exoenzymes or secretory virulence factors like protease elastase, phospholipase, pyocyanin, exotoxin A, exoenzyme S, hemolysins (rhamnolipids) and siderophores. [28,29,30,31]

Finally, *Citrobacter spp.* are infrequently isolated from urine cultures, and only 3(0.7%) was observed in our study. They are, however, emerging as a common nosocomial multidrug-resistant pathogen, especially in developing countries. UTI caused by *Citrobacter spp.* have been seen in 12% of patients in 1961, and since then, its prevalence has been increasing. [32] Invasive

procedures like catheterization or genitourinary instrumentation seem to assist the organism in colonization and infection of the urinary tract. [33,34]

Irrespective of the causative organisms, obstruction to urine flow leads to stasis and predisposes to infection. The continuous hydrostatic flow of slightly acidic urine is necessary to inhibit ascending colonization of the urinary tract by organisms. [9,35] This is impaired in obstructive uropathy leading to colonization and urinary tract infection. The virulence of the bacteria is also essential in the ability of microbes to invade the bladder urothelium and establish active infection. [21,36]

All gram-negative organisms can cause urosepsis, with *E. Coli* most often incriminated, in up to 50.0% of fatal endotoxemia. It is followed by *Proteus* (15%), *Enterobacter* (15%), *Klebsiella* (15%), *Pseudomonas aeruginosa* (5%), and other gram-positive bacteria (15%). [37,38] urosepsis is a deadly clinical syndrome characterized by physiologic, biologic, and biochemical abnormalities resulting from dysregulated host response to infection originating from the urinary tract. The associated exaggerated inflammatory response can potentially result in multiple organ dysfunction syndrome and death. [39,40] The fatality associated with gram-negative endotoxemia underscore the importance of isolation by urine culture, identifying and characterizing the risk by each organism, and effectively treating infections when present, especially before surgical intervention.

6. Conclusion

Gram-negative organisms are the commonest pathogens cultured from the urine in patients with obstructive uropathy. The positive culture rate was 70.6%. *Klebsiella sp.* and *E. Coli* were the most prevalent organisms from the urine in patients with upper and lower urinary tract obstruction.

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