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Pattern of Microscopic Urine Examination in A Single Nigerian Centre: A Retrospective Cross-sectional Study

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ABSTRACT

Introduction: Urine microscopy is a relevant, inexpensive and non-invasive investigation. However, its usefulness depends on the availability of the appropriate equipment and expertise often lacking in low-resource countries. This study aimed to describe the pattern of urinary abnormalities, the frequency of urinary tract infections, the pattern of microorganisms causing UTI, and the antibiotic sensitivities.

Materials and Methods: A retrospective cross-sectional study conducted in a tertiary institution in southern Nigeria, using the urine microscopy results of all patients tested over a 6month period. Data were collated using Microsoft Excel and analyzed on IBM SPSS version 20.

Results: The frequency of haematuria and pyuria were 19% and 52.3% respectively. The frequency of pyuria was higher in females than males (64% vs. 42%, P=0.003 and X^2=9.09). There were 60.7% of males with haematuria and 32.4% of females with haematuria (X^2=5.16 and P= 0.023). Casts were seen in only 2.7% and crystals in 6.5% of the sample. Of the 152 patients, 47.1% had significant cultures and the most common organism grown was E. coli (40%). UTI was frequent in males compared to females (53.6% vs 41.7%, p=0.188). E.coli was most sensitive to Amoxicillin/Clavulanic acid (48.3%).

Conclusion: The frequency of haematuria and pyuria is higher compared to casts and crystalluria. Haematuria was significantly commoner in males while more females had pyuria. E.coli was the most frequent organism implicated. There is a need for phase-contrast microscopes in Nigerian hospitals to improve diagnosis of urine sediments.

Keywords: urine microscopy, haematuria, UTI

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INTRODUCTION

The urine has been one of the most readily assessed bodily fluids with diagnostic significance for centuries, but its usefulness in clinical practice depends on the availability of equipment and skill. In 400 BC Hippocrates conducted the first urine microscopy,[1,2] after that, in the 17th century following the invention of the microscope, Peirsc and Van Leeuenhoek revolutionized microscopic urine examination. Since then, it has remained one of the most relevant, inexpensive and non-invasive investigations used for centuries to diagnose medical conditions from infections to drug intoxication. Other technological advances in urine examination include the dipsticks, phase contrast microscopes, immunofluorescences, Polymerase Chain Reaction amongst others. [3,4]

The parameters assessed in the urine ranges from cells (red blood cells, white blood cells, pus cells, epithelial cells) casts, crystals, microorganisms, and the sensitivity of bacteria growth to antibiotics. Haematuria is one of the most prevalent microscopic urinary abnormalities in practice, and it is classified as glomerular and non-glomerular in origin based on the presence or absence of dysmorphic red cells [3,4] Leucocyturia usually depicts an infective process; however, leucocytes can be found in interstitial nephritis. Presence of leucocytes and erythrocytes is suspicious of Glomerulonephritis(GN)[3,4] Renal tubular epithelial cells are derived from exfoliation of the tubular epithelium, and transitional epithelial cells signify exfoliation of the uroepithelium,[5,6] that is seen in acute tubular necrosis and cystitis respectively.

Casts are cylindrical structures of variable length that form in the distal and collecting ducts of the kidney. The Tamm Horsfall glycoprotein secreted from the thick ascending loop of Henle makes up the matrix.[7,8] The commonest casts include the hyaline cast, granular cast, red cell cast and white cell cast, and each may be indicative of a specific disease process. Crystals are a sign of urine supersaturation with substances derived from metabolism, inherited diseases or drugs, [9]they are classified into four categories, namely, common, pathological, drugs, and other crystals. The commonest crystals seen on urine examination are the calcium oxalate. [10,11] Organisms isolated in urine vary according to age, sex, method of urine collection, [12] and sexual practices amongst others; however, bacteria are the most frequent organisms to be isolated with E.coli being the commonest bacteria. [13,14]

The pattern of urine abnormalities varies from region to region, based on demographic characteristics, socio-cultural/behavioural factors, health status, and pre-existing co-morbidities. However, the wrong technique of urine collection and examination may significantly mask the real epidemiological picture. Health institutions in resource-poor areas are often not equipped for reliable renal histopathologic services; therefore, microscopic urine exam is vital. This retrospective hospital-based cross-sectional study was aimed at describing the pattern of urine abnormalities seen in a single tertiary institution, specifically the frequency of urine abnormalities, culture patterns and the sensitivity.

MATERIALS AND METHODS

Study design and Area

This study was a retrospective cross-sectional study conducted in the Delta State University Teaching Hospital Oghara, Ethiope west local government area Delta State, Nigeria. A 180-bed capacity hospital with five major wards: they are A/E, internal medicine, surgery, paediatrics, obstetrics and gynaecology. The hospital is equipped with a modern laboratory manned by pathologists, laboratory technologist and technicians.

STUDY POPULATION

Inclusion criteria

Results of urine microscopy/culture and sensitivity tests performed on patients over a 6 month period were obtained from the laboratory register.

Exclusion criteria: However, the results of pregnant women and children under 10years of age were excluded.

Variables
Variables collected included age and sex of patients; presence or not of urinary abnormalities such as haematuria, pyuria, crystals, casts, cultured micro-organism and antibiotic sensitivity profile.

Data source/measurement
All data were retrieved from the hospital microbiology laboratory registers. Urine microscopy is performed in the hospital laboratory using a light microscope and urine cultured on usual culture media.

Bias
Results of tests carried in the laboratory are usually checked and reported by at least laboratory scientist, and counter-signed by a clinical microbiologist. Information was collected using a data sheet and transferred to an electronic spreadsheet; both authors checked data for errors, double entries and missing information.

Study size
Results of all (n=153) urine microscopy culture and sensitivity tests done during the 6 months were collated.

Quantitative variables
Haematuria was regarded as evidence > three red cells/high power field, pyuria as having ≥three white cells/high power field of unspun urine or ≥ ten white cells per cubic millimetre in a urine specimen.[15,16] Urinary tract infection (UTI) was defined as having a cultured organism on media.

Statistical analysis
Data was entered into Excel spread sheet and cross checked by both authors. Data was analyzed using IBM SPSS version *22*. Categorical variables were presented as frequencies and percentages, while continuous variables were presented as mean and standard deviation. The Chi-square or Fisher's exact test was used to determine any association between demographic factors (age, sex) and urinary abnormalities (haematuria, pyuria and UTI). Level of significance was set as <0.05.

RESULTS
A hundred and fifty-three patient results were assessed. The mean age of patients was 49±17 years, and the majority were males (54%).

The frequency of haematuria and pyuria was 19% and 52.3% respectively. Haematuria was frequent in males compared to females (24% vs 14.3%, X^2=5.16, P= 0.023); while 64% of females compared to 42% males had pyuria (X^2=9.09, P= 0.003), see table 1 and 2. Casts were seen in only 2.7%, out of which 1.4% and 1.3% had hyaline and granular casts respectively. Crystals were seen in 6.5%, commonest being calcium oxalate (3.9%).

The prevalence of UTI was 47.1%, with the highest frequencies in the >70yrs age groups (78%). More males (24.7%) compared to females (22.9%) had UTI (X^2=3.35, P= 0.188), see table 3. The organisms isolated were E.coli (40.2%), Klebsiella (19.4%), Candida (9.7%), and Pseudomonas was grown in 5.6%. (Fig 1). Of the 29 cases with E.coli growth, 14 were sensitive to Amoxicillin/Clavulanic acid (Augmentin), and 11 were sensitive to Ceftriaxone (See table 4)

Table 1: Relationship Between Age, Sex and Haematuria

VARIABLES	Haematuria	No Haematuria	Total	P-value
Age (years)	n (%)	n (%)	n (%)	0.438*
10-19	1(20.0)	4 (80.0)	5 (100.0)	
20-29	2 (11.7)	15 (88.3)	17 (100.0)	
30-39	5 (15.6)	32 (84.4)	37 (100.0)	
40-49	4 (25.0)	16 (75.0)	20 (100.0)	
50-59	2 (16.7)	10 (83.3)	12 (100.0)	
60-69	10 (25.6)	29 (74.4)	39 (100.0)	
70-79	5 (27.8)	13 (72.2)	18 (100.0)	
80-89	0 (0.0)	4 (100.0)	4 (100.0)	
90-99	0 (0.0)	1 (100.0)	1 (100.0)	
Total	29 (19.0)	124 (81.0)	153 (100.0)	
SEX				0.023
Male	17 (24.6)	52 (76.4)	69 (100.0)	
Female	12 (14.3)	72 (85.7)	84 (100.0)	
Total	29 (19.0)	124 (81.0)	153 (100.0)	

** Fishers Exact Test*

Table 2: Relationship Between Age, Sex and Pyuria

VARIABLES	Pyuria	No Pyuria	Total	P-value
Age (years)	n (%)	n (%)	n (%)	< 0.001*
10-19	3 (60.0)	2 (40.0)	5 (100.0)	
20-29	5 (29.4)	12 (70.6)	17 (100.0)	
30-39	16 (43.2)	21 (56.8)	37 (100.0)	
40-49	8 (40.0)	12 (60.0)	20 (100.0)	
50-59	12 (100.0)	0 (0.0)	12 (100.0)	
60-69	20 (51.3)	19 (48.7)	39 (100.0)	
70-79	14 (77.8)	4 (22.2)	18 (100.0)	
80-89	1 (25.0)	3 (75.0)	4 (100.0)	
90-99	1 (100.0)	0 (0.0)	1 (100.0)	
Total	80 (52.3)	73 (47.7)	153 (100.0)	
SEX				0.003
Male	33 (41.8)	46 (58.2)	79 (100.0)	
Female	47 (63.5)	27 (36.5)	74 (100.0)	
Total	80 (52.3)	73 (47.7)	153 (100.0)	

** Fishers Exact Test*

Table 3:Relationship Between Age, Sex and UTI

VARIABLES	UTI	No UTI	Total	P-value
Age (years)	**n (%)**	**n (%)**	**n (%)**	0.016*
10-19	2 (40.0)	3 (60.0)	5 (100.0)	
20-29	3 (17.7)	14 (82.4)	17 (100.0)	
30-39	14 (37.8)	23 (62.1)	37 (100.0)	
40-49	12 (60.0)	8 (40.0)	20 (100.0)	
50-59	4 (33.3)	8 (66.7)	12 (100.0)	
60-69	20 (51.3)	19 (48.7)	39 (100.0)	
70-79	14 (77.8)	4 (22.2)	18 (100.0)	
80-89	3 (75.0)	1 (25.0)	4 (100.0)	
90-99	0 (0.0)	1 (100.0)	1 (100.0)	
Total	72 (47.1)	81 (52.9)	153 (100.0)	
SEX				0.188
Male	37 (53.6)	32 (46.4)	69 (100.0)	

Table 4: Sensitivity Pattern of Organisms to Antibiotics

ORGANISM	TOTAL n(%)	AMOX/CLAV n(%)	OFL n(%)	GENT n(%)	IMP n(%)	NITRO n(%)	CAZ n(%)	CRX n(%)
E.COLI	29 (100.0)	14(48.3)	5(17.2)	5(17.2)	3(10.3)	3(10.0)	9(31.0)	11(37.9)
KLEBSIELLA	14 (100.0)	2(14.3)	1(7.1)	0(0.0)	3(21.4)	1(7.1)	0(0.0)	3(21.4)
P. MIRABILIS	7(100.0)	0(0.0)	0(0.0)	0(0.0)	2(100.0)	0(0.0)	0(0.0)	0(0.0)
STAPH. AUREUS	4(100.0)	3(75.0)	1(25.0)	1(25.0)	0(0.0)	0(0.0)	0(0.0)	4(100.0)
ENTEROBACTER	5(100.0)	4(80.0)	0(0.0)	0(0.0)	2(40.0)	0(0.0)	0(0.0)	1(20.0)
AEROMONAS	1(100.0)	1(100.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
PSEUDOMONAS	4(100.0)	0(0.0)	1(25.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
CITROBACTER	4(100.0)	3(75.0)	1(25.0)	0(0.0)	1(25.0)	0(0.0)	0(0.0)	0(0.0)
CANDIDA	7(100.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
ACTINOBACTER	2(100.0)	0(0.0)	1(50.0)	1(50.0)	0(0.0)	0(0.0)	1(50.0)	2(100.0)

KEY: AMOX/CLAV – Amoxycillin/Clavulanic acid, OFL – Ofloxacin, GENT – Genticin, IMP – Imipenem, NITRO – Nitrfurantoin, CAZ-Ceftazidime, CRX – Ceftriaxone.

DISCUSSION

This retrospective study of urine microscopic findings in a tertiary hospital located in a low-resource country revealed that the diagnosis of haematuria and pyuria are commoner compared to crystalluria or urinary casts. UTI were found in almost half of the participants' results reviewed, with E.coli being the commonest organism cultured.

The prevalence of haematuria in our study was 19%; Aminu et al. in a hospital-based study in the northern part of Nigeria reported a prevalence of 11% among HIV positive patients, while Braimoh et al. reported a prevalence of 1.7% amongst asymptomatic adults.[17,18] Prevalence of pyuria in our study was 52.3%, and researchers in the eastern part of Nigeria reported a similar prevalence of 52%. [19] Prevalence of casts was 2.7% in this study, hyaline and granular cast were the only casts observed. The prevalence of crystalluria was 3.9% in this study, but Verdesca et al. reported a prevalence of 8.2% using a Fourier transform infrared microspectroscopy.[20] Prevalence of UTI reported in this study (47.1%) is similar to earlier reports from Nigeria. A hospital-based study in southern Nigeria reported a UTI prevalence of 48%, while Bankole et al. reported a prevalence of 39.69% from a community-based study.[21,22] Orrett et al. in Trinidad reported a prevalence of 49%.[23]

Haematuria was commoner in older males compared to females. A possible reason could be that older males are more prone to benign prostatic hypertrophy, UTI, and other urological

abnormalities.[24] Pyuria was more frequent in patients over 50 years than younger patients, possibly because older patients are not as immunocompetent as the young. Furthermore older patients are more likely to be hospitalised and often require an indwelling catheter, which increases the risk for infections. Pyuria was significantly commoner in females compared to males, and Shipman et al. similarly observed this.[25]

This study showed UTI was commoner in adults aged > 70years. A study by Mattina, Deflorio et al. in Italy also reported a higher prevalence in patients age > 60years, [26] however Sekharan et al. studied females in Tanzania and reported a higher prevalence in younger age groups 18-29 years.[27] Surprisingly, UTI was commoner in males in this study, although it did not reach statistical significance. Older males with obstructive uropathy are predisposed to recurrent UTI, males predominated in this study and two-thirds of the patients studied were over the age of 40years. Other authors have reported a higher prevalence in females,[26,28] and the reasons are due to the short urethras in females, the proximity of the urethra opening to the vaginal orifice and hygiene to name a few. Expectedly, the most common organism isolated was the E.coli and was most sensitive to Amoxycillin/Clavulanic acid. Proteus had 100% sensitivity to Imipenem and Staph. Aureus was 100% sensitive to ceftriaxone. The reduced sensitivity of E.coli to Ofloxacin and Genticin may be partly explained by self-medication amongst patients, particularly with less expensive medication before presenting to tertiary hospitals; the use of antibiotics in hospitals before adequate investigations as well as incomplete treatment due to non-adherence are other factors that encourage antibiotic resistance.

The most typical crystal isolated in this study was the calcium oxalate which is in keeping with previous literature,[8,11] Urinary casts and crystals were rarely seen in this study, possibly because of urine examination was performed using a light microscope without phase-contrast enhancement.

This study was retrospective and hospital based, and so findings may not be generalisable to the population. Being a hospital-based study, finding may overestimate the true frequency of urinary abnormalities, particularly UTI, haematuria; however overall, our results are comparable to previously reported estimates and are a meaningful contribution to knowledge in the field.

CONCLUSION

Haematuria and pyuria are more frequent abnormalities compared to casts and crystalluria. Haematuria was significantly commoner in males while more females had pyuria. E.coli was the most common organism implicated with fair sensitivity to amoxicillin/clavulanic acid and cephalosporins. Although microscopic urine examination is an indispensable tool in nephrology care, to benefit from the wealth of information obtainable, it has to be appropriately executed by trained personnel with the right protocols and equipment. There is need for phase-contrast microscopes in Nigerian institutions to improve diagnosis of urine sediments. Future local studies on microscopic urine examination using phase-contrast microscopes are required.

Competing Interest

Authors declare no competing interests.

Authors' Contributions

Roy Aghwana developed the research protocol, collected data, and wrote the first draft of the manuscript.

Oritseweyinmi Edema reviewed the introduction and methodology of the manuscript.
Ogochukwu Okoye conceptualized the research, and critically reviewed and edited the manuscript draft.

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