Nosocomial significant bacteriuria: prevalence and pattern of bacterial pathogens among children hospitalised for non-infective urinary tract disorders.

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Summary

This study was undertaken to determine the prevalence of nosocomial significant bacteriuria (NSB) and pattern of bacterial pathogens among children hospitalised for non–infective urinary rtract disorders (NUTDs) namely, acute glomerulonephritis, nephrotic syndrome, renal failure and congenital urinary tract anormalies in our nephrology unit.

Serial midstream or suprapubic puncture urine specimens were collected into sterile plastic universal bottles from the patients for microscopy, culture and sensitivity, using the standard laboratory methods.

Seventeen of the 96 patients admitted for NUTDs were excluded from the study based on the set exclusion criteria; only 19 out of the 79 patients studied were found to have NSB giving a prevalence rate of 24.05%. The isolated pathogens included *Klebsiella spp.* (47.37%). *Staphylococcus aureus* (31.58%). *Escherichia coli* (10.53%), *Pseudomonas spp.* (5.26%) and Citobacter spp. (5.26%). While 78.95% and 69.23% of the isolates were sensitive to gentamicin and cefuroxime respectively, 57.9% were sensitive to ceftazidime and nitrofurantoin. Less than 50% of the isolates were sensitive to each of the other antibiotics tested. Five of the patients died giving a case fatality rate of 26.3%. In this study, NSB is evidently a very common health problem and a significant risk factor for mortality in patients with NUTDs. Weekly urine culture is recommended in any hospitalised child with NUTD in order to diagnose and manage NSB early before clinical deterioration sets in.

Keywords: ***Nosocomial, Bacteriuria, Children, Non-infective urinary tract disorders.***

Résumé

L'étude a été entreprise pour déterminer la prévalence des bactéuries nosocomiales significatives et types d'agents pathogènes bactériens parmi les enfants hospitalisés pour troubles urinaires non infectieux appelès glomérulonéphrite aigue, syndrome néphrotique, insuffisance rénale et anomalie congénitale rénale dans notre service de néphrologie.

Une série de prélèvements d'urine en {midstream} et paruroponction ont été effectués dans des bouteilles universelles en plastique stérilisée pour étude microscopique, culture et test de sensibilité en utilisant les méthodes standard de laboratoire.

Parmi les 96 patients hospitalisés pour troubles urinaires non infectieux, 17 ont été exclus sur la base de la sériede critéres d'exclusion. Seuls 19 des 79 patients étudies sont porteurs de bactériurie nosocomiale significative soit un taux de prévalence 24, 05%. Les espéces pathogénes isolées sont: Klebsiella spp. (47.37%), Staphylococcus aureus (31.58%), Escherichia coli (10.53%), Pseudomonas spp. (5.26%) et Citobacter spp. (5.26%).

78.95% et 69.23% des espéces bactériennes isolées ont été respectivement sensibles à la gentamicine et au cefuroxime, 57.9% étaient sensibles é la ceftazidine et à la nitofurantoine. Moins de 50% étaient sensibles aux autres antibiot ques testés.

Cinq des malades sont morts donnant un taux de mortalité de 26.3%. Cette étude montre que bactériurie nosocomiale significative est manifestement un probléme commun de santé et un facteur de mortalité significative chez les patients afffectés par les troubles urinaires non infectieux. Une culture hebdomadaire d'urine est recommandée pour chaque enfant hospitalisé pour cette maladie pour pouvoir diagnostique et gérer tôt la significative bactériurie nosocomiale avant toute détérioration clinique.

Introduction

Nosocomial infection is a serious health problem with significant morbidity and mortality in both developed and developing countries[1]. A World health Organisation (WHO) prevalence study puts its prevalence rate at 3.0–20.7%[2]. Nosocomial significant bacteriuria (NSB) or nosocomial urinary tract infecction appears to be quite common among hospitalised patients; NSB has been reported to account for 20.6 – 28.2% of all nosocomial infections in some series[2,3]. Significant bacteriuria whether nosocomial or community-acquired remains one of the principal causes of morbidity and mortality in infants and young children, especially when the kidneys are involved[4–6]. Pyelonephritis may result in severe renal scarring with serious complications such as hypertension and renal failure in later life[5,7]. From the foregoing, it is possible that severe renal damage may occur should significant bacteriuria complicate conditions like acute glomerulonephritis, nephrotic syndrome, renal failure and some congenital urinary tract anomalies; such a complication may either lead to death or chronic ill-health in survivors particularly if diagnosis and treatment are delayed. These potential dangers informed the need to determine the prevalence of NSB and pattern of bacterial pathogens among children hospitalised for non-infective urinary tract disorders (NUTDs) since such a study has not been previously undertaken in our unit.

Patients and methods

Consecutive cases of NUTDs namely: nephrotic syndrome, acute glomerunephritis, acute renal failure, chronic renal failure and congenital urinary tract anomalies admitted between September 1, 1994 and August 31, 1996 were studied.

Midstream or suprapublic puncture (where indicated) urine specimen was collected from each patient into sterile plastic universal bottle and delivered to the microbiology laboratory within 30 minutes for microscopy, culture and sensitivity.

**Correspondence*

Timing of urine collection:

(a) within 48 hours of admission
(b) weekly until discharged or urine culture was positive
(c) 72 hours before discharge from hospital if previous urine culture had been sterile.
(d) anytime there were bacteriuria symptoms in patients who had spent more than 48 hours on admission.

The exclusion criteria:

1. Clinical evidence or suspicion of bacterial infection on or within 48 hours of admission.
2. Patients in whom urine could not collected within 48 hours of admissions for whatever reason(s).
3. Growth of bacteria in urine of any patient who has spent less than 48 hours on admission; this suggests pre-admission bacteriuria.

Bacteriology

The following definitions were made:

* *Significant bacteriuria:*
  (i) 10^5 or more pure bacterial colony counts per millilitre of clean-voided urine specimen.
  (ii) any pure growth of gram negative bacteria or just a few thoudands of Gram positive cocci per millilitre of aseptically collected suprapubic urine spoecimen[8].

* *Significant pyuria:* presence of 10 or more white cells per high power field[9].

A drop of unspun clean-voided urine was placed on a clean glass slide, covered with a cover slip and then examined under the light microscope using the high power objective (X40), for white cells and bacteria. The standard sterile platinum wire loop of 4mm diameter was used to deliver 0.01ml of urine from each patient onto dry Cysteine Lactose Electrolyte Deficient (CLED) Agar. The inoculated plates were incubated for 18–24 hours at 37°C aerobically. Plates showing no growth were re-incubated for an additional 24 hours before the final readings were done. Growths that were less than 30 colony forming units on CLED were regarded as insignificant (i.e. $<10^5$ bacteria per ml) and therefore disregarded except in suprapubic specimens. Where two or more different types of bacteria were isolated, fresh urine samples were collected from the patients concerned and the test repeated. Bacterial species were identified according to standard bacteriological tests.

All pure bacterial isolates were tested using the plate diffusion method for antibiotic susceptibility on the Diagnostic sensitivity test (DST) Agar (Oxoid, UK) with commercially preparedurinary antibiotic Muloto discs. The antibiotics disc used contained the following concentrations: ampicillin 10mg, cloxacillin 5mg, erythromycin 5mg, tetracycline 10mg, streptomycin 10mg, gentamicin 10mg, nitrofurantoin 200mg, nalidixic acid 30mg, ceftazidime 30mg, cefuroxime 30mg, colistin 25mg, cotrimoxazole 25mg, and chloramphenicol 30mg. The antibiotics were those commonly used in our hospital. The sensitivity plates were incubated aerobically overnight and zone of inhibition noted.

Results

A total of 96 cases of NUTDs were admitted out of which, 17 were excluded from the study based on the exclusion criteria and the remaining 79 were investigated for evidence of NSB (Table 1).

Table 2 shows the two methods employed for urine collection and outcome of urine cultures in the 79 patients. NSB was found in 19 patients giving a prevalence rate of 24.05%.

Table 1 Spectrum of non-infective urinary tract disorders (NUTDs) admitted and studied

NUTDs	Number Admitted	Number studied
Nephrotic syndrome	36	33
Renal failure (RF)		
• Acute RF	23	18
• Acute-on-chronic RF	12	7
Acute glomerulonephritis	22	18
Congenital Anomalies		
• Posterior urethral valves	1	1
• Multicystic renal dysplasia with an atretic ureter	1	1
• Infantile polycystic kidney	1	1
Total	96	79

There were 9 males and 10 females; their ages ranged from 20 days to 14 years (median age, 7 years). They were admitted for between 12 and 81 days (median, 20 days).

Organisms were cultured in the urine of the 19 patients between days 7 and 29 of admission; 12 of the patients (63.16%)

Table 2 Methods of urine collection and outcome of urine culture

Methods	No	Outcome of urine cultures		
		Significant Bacteriuria	Insignificant Bacteriuria	No growth
Suprapubic urine	13	5	–	8
Mid-stream urine	66	14	10	42
Total	79	19	10	50

had significant urine cultures between days 10 and 21 of admission. The urinalysis findings with regard to pus cells and bacteria are shown in Table 3. The isolated bacterial pathogens included *Klebsiella spp.* 9(47.37%), *Staphylococcus aureus* 6(31.58%), *Escherichia coli* 2(10.53%), *Pseudomonas spp*, 1(5.26%) and *Citrobacter spp* 1(5.26%). Table 4 shows the relationship between NUTDs and isolated pathogens. The antibiotic susceptibility pattern of the isolated bacteria is shown in Table 5. While 78.95% and 69.23% of the isolates were sensitive to gentamycin and cefuroxime respectively, 57.9% were sensitive to ceftazidime and nitrofurantoin. Less than 50% of the isolates were sensitive to each of the other antibiotics tested.

Seven of the 19 patients (36.84%) were symptomatic and 5 of them died, giving a case fatality rate of 26.3%; the

Table 3 Some results of microscopic examinations of urine specimens

Microscopic findings	Significant bacteriuria n = 19	Insignificant bacteriuria n = 10
Pyuria		
• Significant	8(42.1%)	3(30%)
• Insignificant	11(57.9%)	7(70%)
Bacteria		
• Present	2(10.53%)	2(20%)
• Absent	17(89.47%)	8(80%)

• *Significant pyuria is not absolutely diagnostic of significant bacteriuria (SB) and its absence dose not exclude SB.*
• *Absence of bacteriuria on microscopic examination of a urine specimen does not exclude SB.*

Table 4 Relationship between urinary tract disorders (NUTDs) and isolated pathogens

NUTDs	Isolated bacterial pathogens					
	Citrobacter spp	*Staphylococcus aureus*	*Klebsiella spp*	*Pseudomonas spp*	*Escherichia coli*	Total
Acute glomerulonephritis (n = 18)	1	3	3	0	0	7(38.89%)
Acute renal failure (n = 18)	0	1	3	0	1	5(27.78%)
Acute-on-chronic renal failure (n=7)	0	1	0	1	1	3(42.86%)
Nephrotic syndrome (n = 33)	0	0	1	0	0	1(100%)
Posterior urethral valves (n = 1)	0	0	1	0	0	1(100%)
Multicystic renal dysplasia with an atretic ureter (n = 1)	0	1	0	0	0	1(100%)
Infantile polycystic kidney disease (n = 1)	0	0	1	0	0	1(100%)

Acute glomerulonephritis and renal failure patients are the most prone to urinary tract infections.

deaths occurred in 2 patients with acute renal failure and 1 each of patients with chronic renal failure, acute *glomerulonephritis* and posterior urethral valves. *Klebsiella spp* was associated with 3 deaths while *E. coli* and *pseudomonas spp* were associated with 1 death each.

those of Pryles and Lustik[16].

The pattern of bacterial pathogens in this study contrasts sharply with commonly reported pattern. While *E.coli* remains the commonly reported principal pathogen in signif cant bacteriuria[10,15,17,18], *Klebsiella spp.* (47.37%) and *staph. aureus*

Table 5 Sensitivity pattern of bacterial species isolated from patients with significant bacteriuria (n = 19)

Bacteria tested	Number of bacterial strains sensitive to:												
	GM	CXM	CZD	NI	NA	CO	CXA	ETM	CP	CTZ	SM	TC	AMP
Klebsiella spp	5	9	6	7	6	5	0	0	0	0	0	0	1
Staph.aureus	6	1	2	1	0	0	5	4	2	1	0	1	0
E.coli	2	2	2	2	2	0	0	0	0	0	0	1	0
Pseudomonas spp	1	1	1	0	0	1	0	0	0	0	0	0	0
Citrobacter spp	1	0	0	1	1	1	0	0	0	0	0	0	0
Total	15	13	11	11	9	7	5	4	2	1	1	1	1
%	78.95	69.23	57.9	57.9	47.37	36.84	26.32	21.05	10.53	5.26	5.26	5.26	5.26

GM = gentamycin *NI = nitrofurantoin* *CXA = cloxacillin* *CTZ = co-trimoxazole* *AMP = Ampicillin*
CXM = cefuroxime *NA = nalidixic acid* *ETM = erythromycin* *SM = streptomycin*
CZD = ceftazidime *CO = colistin* *CP = chloramphenicol* *TC = tetracycline*

Discussion

The 24.05% prevalence rate found in this study is quite similar to the 20.6% and 28.2% reported by WHO[2], and Ogunbi and Anyiwo[3], respectively. The prevalence rate isd rather high and may partly be due to prolonged hospital stay; the latter has been recognised as one of the factors responsible for the ease with which hospitalised patients acquire nosocomial infections[1].

Majority (63.16%) of the significant cultures occurred between days 10 and 21 of admission indicating the most likely period urine culture may be requested with the highest probability of positive yield in hospitalised patients with NUTDs. While some workers had found significant pyuria a reliable index of significant bacteriuria[10,11,12], others had not [8,13–15]. Our findings are similar to the latter observations; these contrasting observations imply that correlation between significant pyuria and significant bacteriuria is not a constant finding and therefore, significant pyuria is not a reliable index of urinary tract infection. Similarly, this study has revealed that microscopic finding of bacteria in uncentrifuged clean-voided urine is not a useful index of significant bacteriuria; this is in consonance with the findings of Okafor and Okoro[10] but in disagreement with

(31.58%) were found to be leading pathogens in this study.

This remarkable difference may be due to the fact that the infections in this study were hospital-acquired. *Klebsiella spp. Pseudomonas spp. Proteus spp. E. coli* and *staph. aureus* are common causes of nosocomial infections[1,19,20] in most teaching hospitals in South Western Nigeria.

Emergence of resistant bacterial strains owing to indiscriminate use of antibiotics in our environment may be responsible for the poor sensitivity (<50%) shown by the bacterial isolates to most of the antibiotics tested; however, the good sensitivity of the isolates to gentamicin (78.95%), cefuroxime (69.23%), ceftazidime (57.9%) and nitrofurantoin (57.9%) could be due to the following reasons: (i) Gentamicin is available only in parenteral form and therefore not commonly abused. (ii) Cefuroxime and ceftazidime are very expensive and not popular outside the hospital environment. (iii) Nitrofurantoin though cheap and available in oral form, it is not commonly prescribed, unpopular and therefore not commonly abused.

Since NSB may not be symptomatic in all cases as this study has shown, routine screening of all patients who have been admitted for more than a week for evidence of urinary tract

infection seems justified. The case fatality rate of 26.3% recorded in this study clearly shows NSB to be an important risk factor for mortality in NUTDs especially, renal failure, acute glomerulonephritis and posterior urethral valves. The death recorded in the latter further strengthens earlier observation that posterior urethral valves could end fatally when complicated by urinary tract infection[21].

It is concluded that: One, nosocomial significant bacteriuria is highly prevalent and a significant risk factor for mortality in NUTDs. Two, Klebsiella spp. and Staphylococcus aureus are the principal pathogens causing NSB but with high sensitivity to gentamicin and cefuroxime. Weekly urine cultures are recommended in all hospitalised patients with NUTDs in order to diagnose and manage NSB early before clinical deterioration occurs.

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