Evaluation of the Antibacterial Susceptibility Patterns in Patients with Indwelling Urinary Catheters in Federal Medical Centre, Umuahia, Abia State.

Nwankwo, I. U.,Godwin, C. T.

Department of Microbiology, College of Natural and Applied Sciences, Michael Okpara University of Agriculture P.M.B. 7267, Umuahia, Abia State

Abstract: *This study aimed at evaluating the sensitivity patterns of bacterial isolates from patients with indwelling urinary catheter. The disc diffusion method was adopted for the sensitivity testing while spread plate method was adopted for the isolation of the organisms from the urine samples. Organisms isolated includes Escherichia coli, Klebsiella pneumoniae, Proteus mirabilis, Pseudomonas aeruginosa and Staphylococcus aureus and streptococcus varidans. The gram negative bacteria showed high resistance to ampicillin (100%), chloramphenicol (100%), Penicillin (100%), Cloxacillin (100%), Nalidixic acid (100%) and Tetracycline (100%). The gram positive - Staphylococcus aureus and Streptococcus varidans isolates showed 100% resistance with those drugs as with the gram negative. Collistin was effective against all the isolates (100% susceptibility). The use of antibiotics should be kept under supervision, should be given in appropriate doses for an appropriate period of time and control programmes for hospital-infections should be carried out in order to prevent or decrease resistance to antibiotics.*
Keywords: *Bacterial isolates, Antibacterial susceptibility, indwelling urinary catheter.*

I. Introduction

Urinary catheterization is generally indicated to relieve urinary tract obstruction, to permit urinary drainage in patients with neurogenic bladder dysfunction and urinary retention, to aid urologic surgery and to obtain accurate measurement of urinary output in clinically ill patients (Oni et al, 2003).

Bacterial may enter the bladder through contamination of the tip during insertion with the flora of the distal urethra or from bacteria ascending the outside or the inside of the catheter (Moges, 2008). During the process of infection, bacteria need first to adhere to the epithelial cells of the urinary tract and/or the surface of the catheter. Colonization of a urinary catheter is perpetuated by microorganism producing biofilm, following insertion of a standard urinary catheter, a conditioning film made up of proteins, electrolytes and other components of urine is deposited on the surfaces of the catheter (Master ad Joshi, 2003). Microbes attach to conditioning film and begin recreating polysaccharides that form the architectural structure of biofilm. A biofilm on an indwelling urinary catheter consists of adherent microorganisms, their extracellular products, and host components deposited on the catheter. The biofilm mode of life conveys a survival advantage to the microorganisms associated with it and, thus biofilm on urinary catheters results in persistent infections that are resistant to antimicrobial therapy (Dumitri and James, 2008). Biofilm on indwelling medical devises may be composed of gram-positive or gram-negative bacteria or yeasts (Foxman, 2002). Biofilm, which covers and secures bacteria against a catheter or mucosal surface, has been demonstrated on drainage bags, catheters and the uroepithelium (Killgore and March, 2004). Organisms contained within the biofilm appear to be well-protected from the mechanical flow of urine, host defenses, and even antibiotics. The biofilm may allow the contained sessile organisms to establish a microenviron (McIssac and Glazier, 2002).

In Nigeria, Taiwo and Aderonomu (2006) reported a high incidence of resistance to the commonly prescribed antimicrobial agents. Likewise a study conducted in Gonder indicated that above 68% of the isolated pathogens showed resistance from two to nine antimicrobials and 15.7% were resistant to one antibiotic (Tambyah, 2004).

Catheterization predisposes patients to the development of urinary tract infection and hence resistance. In general, because of the continuous evolution of antibiotic resistance, regular monitoring of this phenomenon appears to be necessary to improve guidelines for empirical antibiotic therapy, which must consider the most probable microorganisms, their susceptibility according to the characteristics of the popular concerned, without forgetting side effects, and ecological and economic consequences. This study therefore aims to determine the susceptibility pattern of the isolates to the commonly use antimicrobial agents.

II.   Materials and Methods

Collection of Sample

The sex, age, date of admission, diagnosis, underlying medical problems, concomitant medication, date and indication for indwelling catheterization were recorded with patient from the obstetrics, genecology and medical intensive care units at the Federal Medical Center. Patients with confirmed UTI before catheterization were excluded. Samples of urine after insertion of catheters were collected aseptically within 2 hours from the time of insertion for baseline urine cultures and microscopic examination. Thereafter daily urine cultures and analysis were done until the catheters were removed or until a significant bacteriuria occurred on 2 consecutive cultures. These subsequent urine samples were collected by aspirating urine from the rubber catheter with a sterile syringe with guage 26 needle.

Microbiological analysis: 5 to 10ml of urine were aspirated from the catheter and placed in a sterile tube. Urine and catheter specimens were immediately placed in a refrigerator. Specimens for gram stain and culture were generally processed within 1 hour of collection. Urine culture was prepared by inoculating 0.01ml or urine onto MacConkey agar (oxoid cm 7B) and CLED agar (micro master), incubated at 35^oC and examined at 24 and 48h. Significant bacteriuria was considered when a patient had a colony count $>10^3$cfu/ml in any one sample of urine. Lower counts were accepted in catheter specimens if the organism(s) persisted and were isolated from successive specimens. Repeat urine cultures were performed at 1 week intervals (Chessbrough, 2000). The organisms isolated were subjected to different microscopic and biochemical examinations for proper identification (Chessbrough, 2000).

Antimicrobial susceptibility testing: The disc diffusion method was adopted using Mueller-Hinton agar (oxoid, England) and antibiotic discs (Ablek Biological Ltd) according to the guideline of the National committee for clinical laboratory standard (NCCLS, 2001).

Assay for β lactamase production: A strip of Whatman No. 1 filter paper was placed in the bottom of petri dish. A few drops of buffered crystalline penicillin bromocresol purple solution were dropped until the paper is almost saturated. The test organisms were transferred to the filter paper to cover an area of 5mm in diameter. The petri dishes were incubated at 37 minutes. A yellow color indicates the production of penicilloic acid from the break down of penicillin by the β lactamase producing organism.

III.   Results

Distribution of study subject by gender and age is shown in Table 1. 60% of the catheterized patients were females and 40% were male. Age ranged from <20 to >80 years. The age group >40 years old predominated and represents 75% of the study subject.

One hundred and twenty-one (121) bacterial isolates were recovered from the various urine samples of which 87.5% were gram negative organisms and12.5% were gram positive. Staphyloccocus aureus and Streptococcus varidans were the only gram positive bacteria isolated while the gram negative organisms belonged to the general Escherichia coli, Klebsiella pneumoniae, Proteus mirabilis and Pseudomonas aeruginosa. Overall, Pseudomonas aeruginosa (37.5%) was the most prevalent isolates followed by Escherichia coli (22.5%). The gram positive isolate-Streptococcus varidans was the least and accounted for 5.0% of the isolates. This is shown in Table 2.

The resistance pattern of the bacterial isolates against 11 antimicrobial drugs is shown in Table 3. The isolates (both gram positive and gram negative) showed a high level (100%) of resistance to ampicillin, chloramphenicol, penicillin, nalidixic acid, tetracycline. Variable sensitivities were observed with streptomycin and nitrofuratoin (22.5% and 22% respectively) and cotrimoxazole (30%) while lower sensitivities was observed for Cloxacillin (6%). However, 100% susceptibility was observed in all the isolates for colistin. Multiple resistance to chloramphenicol, penicillin, nalidixic acid, tetracycline and ampicillin were observed for all the isolates.

All the E. coli isolated were sensitive to cotrimoxazole and collistin and 12 were sensitive to nitrofuration. There was no activity observed with the rest of the drugs. 6 out of the 9 isolates of S. aureus were sensitive to streptomycin and gentamycin respectively. Of the 15 isolates of K. pneumoniae, 6 were sensitive to streptomycin and cotrimoxazole while 9 of the isolates were sensitive to gentamycin. 9 of the 47 isolates of Pseudomonas aeruginosa were sensitive to streptomycin and nitrofuration. Proteus mirabilis was resistant to all the drugs except collistin and nitrofuration. All the isolates of Streptococcus varidans were sensitive to streptomycin and collistin. 4 out of the 6 isolates were sensitive to cloxacillin and 3 and 2 isolates were sensitive to cotrimixazole and gentamycin respectively.

Table 4 shows the result of β lactamase production activity of the isolates. Among the organism isolated only K. pneumoniae did not show the production of β lactamase.

Table 1: Age and gender distribution of the patients with catheter

Age range	No (%) of patients	
Years	Male	Female
<20	6(4)	3(2)
21-40	12(8)	17(11.3)
41-60	6(4)	54(36)
61-80	31(20.7)	9(6)
>80	5(3.3)	7(4.7)
Total	**60(40)**	**90(60)**

Table 2: **Isolated organisms**

Gram negative	Number (%)
Escherichia coli	27(22.5)
Klebsiella pneumoniae	15(12.5)
Proteus mirabilis	18(15.5)
Pseudomonas aeruginosa	47(37.5)
Total	106(87.5)
Gram positive	
Staphylococcus aureus	9(7.5)
Streptococcus varidans	6(5.0)
Total	**15(12.5)**

Table 3: Antibiotic susceptibility testing of the bacterial isolates

Drug		Conc.(μg)	1	2	3	4	5	6	Total
			No(%)	No(%)	No(%)	No(%)	No(%)	No(%)	No(%)
Ampicillin	(AMP)	10	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Streptomycin	(STR)	10	0(0)	6(66)	6(40)	9(20)	0(0)	6(100)	27(22.5)
Cotrimoxazole	(COT)	30	27(100)	0(0)	6(40)	0(0)	0(0)	03(50)	36(30)
Chloramphenicol	(CHL)	10	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Penicillin	(PEN)	30	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Cloxacillin	(CXC)	30	2(7)	1(11)	0(0)	0(0)	0(0)	04(66)	7(6)
Nitrofurantion	(NIT)	30	12(44)	0(0)	1(7)	9(20)	4(22)	0(0)	26(22)
Gentamycin	(GEN)	10	7(26)	6(66)	9(60)	0(0)	0(0)	2(33)	24(20)
Nalidixic acid	(NIL)	30	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Colistrin	(COL)	25	27(100)	9(100)	15(100)	45(100)	18(100	6(100)	120(100)
Tetracycline	TET)	30	0(0)	0(0)	0(0) 0(0)	0(0)	0(0)	0(0)	0(0)

Key: 1 = Escherichia coli; 2 = Staphylococcus aureus; 3 = Klebsiella pneumoniae 4 = Pseudomonas aeruginosa; 5 = Proteus mirabilis

Table 4: β lactamase activity testing

Organism	β lactamase activity
Staphylococcus aureus	+
Escherichia coli	+
Pseudomonas aeruginosa	+
Proteus mirabilis	+
Klebsiella pneumoniae	-

Key: + = production of β lactamase
- = do not produce β-lactamase

IV. Discussion

Numerous studies have documented a high prevalence of resistant pathogens in CAUTI and the association between nosocomial CAUTI and surgical site infections has been made. Therefore the present study was undertaken in order to investigate the resistance pattern of CAUTI in comparison with non-catheterized UTIs in the Federal Medical Centre, Umuahia.

The enteric gram negative organisms found in the catheterized urinary tract are those that are commonly associated with multiple resistances (Maki and Tambyah, 2000). Urine of residents with chronic indwelling

catheters has been identified repeatedly as a reservoir for resistant organisms in the long term care setting (Gessier and Woods, 2003).

Many types of implanted medical devices in contact with body fluids are susceptible to biofilm colonization and it is clear that cells in these biofilms are resistant to phagocytes, antibiotics and antibiotics (Selden, 2004). These pathogens are responsible for the characteristic failure of the host defense systems and antimicrobial chemotherapy to clear device-associated infections. The antimicrobial susceptibility pattern confirms that most of the urinary isolates in our environment are resistance to the commonly used antibiotics including the chloramphenicol and penicillins. This high resistant pattern could have resulted from poorly guided antibiotic prophylaxis after catheterization and empiric therapy of gram negative isolates to the penicillin is worrisome as these are common drugs for treating infections. There is a trend towards more resistant isolates in all groups of patients. Prolonged or repeated exposure to antimicrobial agents and the consequent antibiotic pressure increase the risk of colonization and infection with multi resistant bacteria (Master and Joshi, 2003).

Most of the gram negative isolates showed high level of resistance to the antibiotics. This in line with the findings of the studies carried out by Lagerlov and Loeb, (2000) which shows that the rate of resistance to widely used antibiotics was high for gram negative bacteria. The most effective antibiotics against gram negative bacteria were collistin and cotrimoxazole. Tetracycline, cloxacillin, chloramphenicol, ampicillin and gentamycin which are most frequently used for the treatment of community-based infections were the least sensitive antibiotics for the gram negative microorganisms.

The most important reason for resistance to antibiotics is the wide spread use of antibiotics in hospitals, particularly the use of beta-lactern antibiotics, new generation cephalosporins and fluorequinolones may cause multi-drug resistant microorganisms.

The microorganisms and their resistance pattern vary from hospital to hospital and clinic to clinic in the same hospital (Vogel and Rochette, 2004).

It is obvious that collistin remains effective against all the isolates in this study (Table 3). This could be as a result of unavailability of collistin in the market which made clinicians to stop prescribing the drug. Since the drug is not commonly prescribed, development of resistant by the uropathogens are impaired. This study has been able to evaluate the antimicrobial pattern of which all the isolates were sensitive to collistin and resistant to ampicillin, chloramphenicol, penicillin, cloxacillin, Nalidixic acid and tetracycline. In order to prevent or decrease resistance to antibiotics, the use of antibiotics should be kept under supervision, should be given in appropriate doses for an appropriate period of time and control programmes for hospital-infections should be carried out.

In conclusion, there is need to review antibiotic therapy in patients with urinary catheter in Federal Medical Center Umuahia.

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