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PROFILE OF INFECTIONS IN INTENSIVE CARE UNIT (ICU) IN A CENTRAL NIGERIA TERTIARY HOSPITAL

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Abstract
Background: Intensive Care Units (ICUs) accommodate the most seriously ill patients in a relatively confined environment. Increased duration of stay, increased number of indwelling and invasive devices and prolonged or inappropriate use of antibiotics are common features of ICUs, with consequent or associated increase in selection of multi-resistant pathogens, morbidity and mortality.
Objectives: To determine the identity and antimicrobial resistance pattern of organisms commonly associated with infections in the ICU of the hospital.
Method: A retrospective study of Intensive Care Units (ICU) infections in NHA over a three-year period January 1st, 2010 to December 31st, 2012 was conducted through review and analysis of laboratory data.
Results: Data for 79specimens were fully analysed; 35(44%) from urine, 17 (22%) from blood, 6 (8%) from tracheal specimens and 8 (10%) from wound. Forty-one (52%)of the specimens yielded growth;16 (20%) from urine, 8 (10%) from wound, 6 (8%) from tracheal specimens,3(4%) from blood and others 8(10%). 14(34%) out of the 41 isolates were Escherichia coli, 8 (20%) Pseudomonas aeruginosa, 6 (15%) were Staphylococcus aureus and 6 (15%) Klebsiella pneumoniae. Three (4%) of the specimens yielded mixed growths while another 3 (4%) yielded Candida species. Sensitivity of E. coli to third generation cephalosporins ranged from 62-72%and 90% to imipenem. For Klebsiella pneumoniae it was 67-75% to third generation cephalosporins and 100% to imipenem. Pseudomonas aeruginosa was 71% and 83% sensitive to ceftazidime and imipenem respectively. Staphylococcus aureus was 67% and 83% sensitive to amoxicillin-clavulanate and imipenem respectively. Susceptibility of all these isolates to fluoroquinolones and aminoglycosides remained poor.
Conclusion: The isolates from the ICU were same as common in clinical specimens. There was wide variability in resistance with a tendency to increase over time. This trend needs to be monitored while antibiotic stewardship should be emphasised.

Key words: Intensive care units (ICU), nosocomial Infections, antibiotic susceptibility.

PROFILE D'INFECTIONS DANS LE SERVICE DE SOINS INTENSIFS DANS UN HOPITAL TERTIAIRE CENTRAL DU NIGERIA

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RÉSUMÉ

Contexte: Les services de soins intensifs accueillent les patients les plus gravement malades dans un environnement relativement confiné. Une durée accrue du séjour, un nombre accru de demeurants et d'appareils et une utilisation prolongée ou inappropriée d'antibiotiques sont des caractéristiques communes de soins intensifs, avec l'augmentation conséquente ou associés de la sélection des agents pathogènes multi-résistants, de la morbidité et de la mortalité.

Méthodes: Une étude rétrospective des infections de services de soins intensifs dans l'Hôpital National d'Abuja a été menée pour l'examen et l'analyse des données de laboratoire sur une période de trois ans allant du 1er Janvier 2010 au 31 Décembre 2012.

Résultats: Les données de 79 échantillons ont été entièrement analysés; 35 (44%) échantillons d'urine, 17 (22%) échantillons du sang, 6 (8%) à partir d'échantillons trachéaux et 8 (10%) à partir de la plaie. Quarante-et-un (52%) des échantillons ont produit une croissance: 16 (20%) d'urine, 8 (10%) de la plaie, 6 (8%) à partir d'échantillons trachéaux, 3 (4%) à partir du sang et 8 (10 %) à partir d'autres type d'échantillons. 14 (34%) des 41 isolats étaient

de *Escherichia coli*, 8 (20%) *Pseudomonas aeruginosa*, six (15%) étaient des *Staphylococcus aureus* et 6 (15%) *Klebsiella pneumoniae*. Trois (4%) des spécimens ont montré une croissance mixte tandis que les trois autres (4%) ont donné les espèces de Candida. La sensibilité de *E. coli* aux céphalosporines de troisième génération variait de 62 à 72% et 90% pour l'imipenème. Pour *Klebsiella pneumoniae*, 67-75% de souches étaient sensibles aux céphalosporines de troisième génération et 100% à l'imipenème. 71% et 83% de *Pseudomonas aeruginosa* ont été sensibles respectivement à la ceftazidime et à l'imipenème. 67% et 83% de *Staphylococcus aureus* étaient sensibles respectivement à l'amoxicilline+ acide clavulanique et à l'imipenème. La sensibilité de toutes ces souches aux fluoroquinolones et aux aminoglycosides est restée médiocre.

Conclusion: Les souches de services de soins intensifs étaient les mêmes que les principales souches cliniques. Il y avait une large variabilité dans la résistance tendant à augmenter avec le temps. Cette tendance doit être surveillée pendant que la gestion d'antibiotique devrait être accentuée.

Mots clés: Services de Soins Intensifs, Infections nosocomiales, sensibilité d'antibiotique.

INTRODUCTION

Many tertiary hospitals in Nigeria have developed critical care facilities for the care of the critically ill patient.(1). The intensive care unit (ICU) of the National Hospital, Abuja (NHA) is an eight bed facility in a 200-beded centre. This represents 4% of the total bed space in the hospital. This percentage varies from one country to another, ranging from 1-2% in the UK, 1.7% in New Zealand to 6-11% in the USA (2-4)

Infection is often the cause of ICU admissions (5-6), and four types account for most ICU infections; namely pneumonia (usually ventilator associated),urinary tract infection (UTI) (usually catheter associated), primary bloodstream infection (BSI) (usually associated with the use of an intravascular device) and surgical site infections(SSI)(7)

The common pathogens include Staphylococcus aureus, Pseudomonas aeruginosa, Candida species, Escherichia coli and Klebsiella species, often predisposed to by invasive applications and devices, and patients' clinical conditions (8,9).These infections account substantially for the high mortality in ICUs.

Antimicrobial resistance constitutes a major challenge in the management of ICU infections, and these often emerged from selective pressure due to increased, and sometimes inappropriate antibiotic use and transmission via health workers. . Greater than 60% of ICU patients receive broad spectrum antibiotics at some time during their hospitalization, and up to 60% of antibiotic use in hospitals is inappropriate or unnecessary (10,11). Microbiological cultures and antibiotic sensitivity testing are central to rapid and accurate diagnosis and treatment, which improves outcomes and reduces resistance. It also guides empiric antibiotic therapy.

Prevention of infection in the ICU is fundamental and can be achieved through good antimicrobial use and infection control practices, including hand hygiene (12) It is therefore important that physicians strike a balance between patients' safety, and the desire to reduce mortality and antibiotics resistance. In our environment the profile of the common organisms associated with infections in the ICU is not clear. This study was therefore, designed to determine the common pathogens in our environment and their antibiotics susceptibility profiles so as to guide therapy and achieve reduction in mortality and resistance development.

METHOD

The NHA is a tertiary medical centre providing medical services to Abuja and its surrounding states of Kogi, Nasarawa, Niger, Kaduna and Benue. A retrospective study of adult Intensive Care Units (ICU) infections over three years in NHA was conducted for the period of 1st January 2010 to 31st December 2012. The record of all specimens submitted to the medical microbiology laboratory within this period were analysed including evaluation of their microbial susceptibility pattern. Those with incomplete record were excluded.

Data obtained for analysis included; age, sex, specimen type, isolated organisms and their corresponding antibiotic susceptibility pattern.

Briefly, in our laboratory clinical specimens are collected in sterile plastic containers, swabs or others as appropriate for the relevant anatomic sites and are usually processed as soon as they are received. The macroscopic appearances of the samples are noted and then inoculated onto appropriate culture media. Where necessary direct smears of specimen are made on clean glass slide, fixed and stained by Gram's standard method (13). The plates are then incubated at 37^{o}C in ambient air for 16-24hours, but chocolate agar plates are incubated in a candle light jar. Cultures are examined for growth thereafter. In some cases where there is no growth, cultures may be re-incubated for another 24 hours before they are discarded as having no growth. The colonies are identified using standard methods[13,14]. Antimicrobial drug susceptibility of the isolates are usually tested by the modified Kirby-Bauer technique and results interpreted according to the Clinical Laboratory Standards Institute-CLSI Guideline [15].

RESULTS

79 specimen were fully analysed; 35(44%) from urine, 17 (22%) from blood, 6 (8%) from tracheal specimens and 8 (10%) from wound. 41(52%) of the specimens yielded growth; 16 (20%) from urine, 8 (10%) from wound, 6 (8%) from tracheal specimens and 3(4%)

from blood. 14 (34%) out of the 41 isolates were Escherichia coli, 8 (20%) Pseudomonas aeruginosa, 6 (15%) were Staphylococcus aureus and 6 (15%) Klebsiella pneumoniae. Three (3%) of the specimens yielded mixed growths while another 3 (4%) yielded Candida species (Table 1). One of the blood isolates was Salmonella typhi. The ages of patients in this study ranged from 37-68, with a mean of 51 years. There were 44(56%) males and 34(44%) females.

TABLE 1: SPECIMENS DISTRIBUTION

Specimens	No	No of Isolates
Blood	**17 (22%)**	**3(4%)**
Urine	**35(44%)**	**16(20%)**
Wound	**8 (10%)**	**8 (10%)**
Tracheal	**6 (8%)**	**6 (8%)**
High Vaginal Swab	**4(5%)**	**2 (3%)**
Other	**9(11%)**	**6 (7%)**
Total	**79(100)**	**41(52%)**

Sensitivity of E. coli to third generation cephalosporins ranges from 62-72%and 90% to imipenem. For *Klebsiella pneumoniae* it was 67-75% to third generation cephalosporins and 100% to imipenem. *Pseudomonas aeruginosa* was 71% and 83% sensitive to ceftazidime and imipenem respectively. Staphylococcus aureus was 67% and 83% sensitive to amoxicillin-clavulanate and imipenem respectively. Sensitivity of all these isolates to fluoroquinolones and aminoglycosides were poor (Table 2).

DISCUSSION

The National Hospital Abuja has an eight bedded, well equipped ICU, which partly explains the relatively low number of samples received in the laboratory from the unit. The other prominent factor is connected with the financial inability of the majority of the patients admitted into the unit to afford the cost of investigations. The 79 samples included in the study yielded 41 isolates over a period of three years. As established in previous studies, the small numbers of isolates recovered from the ICU specimens tend to limit objective discussions due to its potential to overstate ICU resistance problems based on a small number of resistant isolates[13-15]. This appears to be the trend in most ICUs as most patients presenting to the unit would have had substantial doses of variable antibiotics.

Notwithstanding these limitations, it is worthy of note that most specimens processed in this study were urine, blood, wound and respiratory, corresponding to the to the most common infections encountered in the ICU, namely urinary tract, blood stream, wound and respiratory infections (16). Together they yielded over 80% of the isolates, dominated by organisms previously identified to be associated with nosocomial infections and invasive procedures (8,9), both of which are common in the ICU.

The two main *Enterobacteriacae, Klebsiella pneumoniae* and *Escherichia coli*, isolated in our ICU demonstrated high and moderate sensitivity to imipenem and the third generation cephalosporins/amikacin respectively, and high resistance to amoxicillin-clavulanate, fluoroquinolones, second generation cephalosporin and gentamicin. This pattern suggests high prevalence of extended spectrum β-lactamase (ESBL) production and low level carbapenemase production among the isolates. Pseudomonas aeruginosa isolates only showed moderate sensitivity to imipenem and ceftazidime, similar to similar finding in a previous study (17); the likely implication of this pattern is that while the choice for empiric therapy may be substantially limited, there may be a tendency to over-use the carbapenems, which will further compromise their use as drugs of last resort in our environment at the moment. In all, the predominance of *Pseudomonas aeruginosa, Escherichia coli, Klebsiella pneumoniae* and *Staphylococcus aureus* amongst all isolates from the ICU is similar to the profile seen in a previous study (18).

The choice of chemotherapy for staphylococcal infections may appear even more challenging as the isolated strains displayed only moderate sensitivity to amoxicillin-clavulanate and imipenem. There was also isolation of Enterococcus and Candida spp from urine, in agreement with result of a previous study[18].

Generally, the moderate to high resistance and multidrug resistance seen in the ICU isolates, subject to the limitations earlier mentioned, is in agreement with what had been observed with ICU isolates (8,19).This is due to the over-use of antibiotics, which invariably puts the organisms on selective pressure. To address this and reduce the rate of resistance development choice of antibiotics must be based on established guidelines and sound knowledge of pharmacokinetics and pharmacodynamics of the drugs. Since synchronized adherence to locally evolved guidelines within a hospital has been associated with stable antibiotic resistance patterns.[20], antibiotics stewardship should be practiced, while further studies are needed to determine the prevalence of ESBL and carbapenemase production as well as prevalence of methicillin resistant staphylococcus aureus (MRSA) in the ICU.

.TABLE 2: FOUR MOST COMMON ICU INFECTIONS ISOLATES AND ANTIBIOTICS SENSITIVITY PATTERN

Antibiotics	Isolates							
	Escherichia coli		Klebsiella pneumoniae		Pseudomonas aeruginosa		Staphylococcus aureus	
	No Tested	% Sensitive	No Tested	% Sensitive	No Tested	% Sensitive	No Tested	% Sensitive
AMC	13	31	0	0	Nil	nil	6	67
CTX	12	67	6	67	7	14	6	17
CAZ	11	72	4	75	7	71	5	0
CRO	13	69	6	67	Nil	Nil	4	0
XM	14	29	2	0	Nil	Nil	6	50
GN	14	36	5	60	6	43	6	33
AK	8	75	6	83	7	57	6	50
CIP	13	43	5	60	7	57	5	40
OFX	9	44	nil	Nil	Nil	Nil	2	50
IMP	10	90	5	100	8	86	6	83

AMC: amoxicillin-clavulanate; CTX: cefotaxime; CAZ: ceftazidime; CRO: ceftriaxone; XM: cefuroxime; GN: gentamicin; AK: amikacin; CIP: ciprofloxacin; OFX: ofloxacin; IMP: imipenem

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