ORIGINAL ARTICLE

COMMON CAUSES OF NOSOCOMIAL INFECTIONS AND THEIR SUSCEPTIBILITY PATTERNS IN TWO HOSPITALS IN ADDIS ABABA

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ABSTRACT

Background: *Nosocomial infection is defined as an infection, which is not present or incubating on admission and is usually not manifested in the first 72 hours of hospitalization. Infectious diseases including hospital acquired infections account for 25% of mortality worldwide and 45% in low-income countries*

Objective: *To assess the susceptibility pattern of the bacterial causes of common nosocomial infections and their susceptibility pattern in surgical patients.*

Methods*: A one-year prospective survey of nosocomial infections of surgical patients admitted in 1999-2000 at Tikur Anbesa Hospital (TAH) and Saint Paul Hospital (SPH) was performed. The samples were collected and processed following standard microbiological techniques as part of the routine clinical management of the patient. Antibiotic sensitivity testing was done on pure culture isolates employing the disc-diffusion method for the commonly used antibiotics*

Results*: A total of 133 patients in Tikur Anbesa (69) and Saint Paul (64) were found to have nosocomial infection among surgical patients admitted in the study period making the prevalence 6.19% in TAH and 5.74% in SPH. Wound infection was the leading nosocomial infection 36(52.1%) in TAH and 54(79%) in SPH followed by urinary tract infection 26 (38%) in TAH and 10(15.9%0) in SPH. The most frequently isolated organisms were Escherichia coli 16(25.4%) in TAH and 29(46.0%) in SPH, followed by Klebsiella 22(34%) in TAH, 13 (25.4%) in SPH and Proteus species 5(6.8). The percentage of resistant strains to Gentamycin was found to be 56% in samples taken from Hospital acquired infection at TAH. The resistance level is even higher for the penicillin group such as, crystalline penicillin and ampicillin which is (95%) of isolates from nosocomial infection*

Conclusions*: Most isolates from hospital-acquired infection were found to be resistant to the most frequentl used antibiotics in the setting where the study was conducted.*

INTRODUCTION

Nosocomial infection is defined as an infection which is not present or incubating on admission and is usually not manifested in the first 72 hours of hospitalization (1). Infectious diseases account for 25% of mortality worldwide and 45% in low-income countries. In developing countries all over the world, especially in Africa, a large number of people die daily of preventable and curable diseases due to inadequate health care services (2). Hospital acquired infections also constitute a large proportion of this burden.

Aspiration from the oral cavity in to the lungs plays a central role in the pathogenesis of nosocomial pneumonia in about 45% of the cases. Surgical procedures, such as, prostatectomy and laparotomy performed on patients for treating their underlying diseases create situations that predispose to infections which are the leading causes of death among hospital-acquired infections (3, 4). Certain procedures are associated with a higher risk of wound contamination than others. The possibility of wound infection following procedure depends on many other factors apart from the type of procedure and the degree of contamination alone. The host's immune response is one of these (5, 6).

In the absence of a continuous surveillance of antimicrobial resistance, defining the patterns of nosocomial infection and their causative organisms has paramount importance. The difficult problem today is the development of multi-drug resistance which demands lots of financial and time resources for the treatment of infections (7, 8). Therefore, the

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importance of a continuous surveillance of the effectiveness of antimicrobials to common bacterial pathogens cannot be overemphasized. In an attempt to identify the common pathogens causing nosocomial infections and to understand their susceptibility patterns, this study was conducted.

METHODS

***Study design and area*:** This cross-sectional study was conducted at Tikur Anbessa (TAH) and Saint Paul (SPH) hospitals in Addis Ababa. Both are teaching hospitals that provide health services to millions of Ethiopians.

Subjects: All patients, both emergency and elective, who were admitted to the surgical wards of TAH and SPH from Sep 1999 to Aug. 2000, were followed in their pre and post operative period in search of nosocomial infection.

Relevant clinical data (presence of fever, wound discharge, development of clinical condition suggestive of wound infection and cough, current physical findings and the type of operation performed) were collected using a standardized format during the routine clinical examination period.

***Inclusion criteria*:** Patients who developed infections and illness 72 hours after hospital admission were included.

***Exclusion criteria*:** Patients who developed infections or illness before or in the first 72 hours of hospitalization were excluded.

***Sample collection*:** Sputum was collected from subjects who were intubated and admitted in surgical ICU. Pus was collected from the operative wound using moisturized cotton wool swab. Urine (Catheter urine) was collected from suspected patients. Blood was also collected form the subjects who were suspected to develop septicemia.

All specimens were collected aseptically following the standard microbiological procedure. The collected **s**pecimens were transferred to the bacteriology laboratory of the Ethiopian Health and Nutrition Research Institute (EHNRI) within the first 30 minutes and processed for culture and sensitivity tests following conventional procedures (1).

Decisions about the presence of nosocomial infection were made by a group of care takers including the surgeon in charge of the patient to check if the culture grew organisms.

Culture: Samples were cultured and further processed following the standard Microbiological Techniques developed by Finegold and Martin (10). Urine was inoculated on MacConkey agar plate and incubated for 24 hours aerobically. Urine cultures with $>10^5$ colony forming units of bacteria per ml of urine were considered to indicate significant bacteriuria.

Pus was inoculated on blood agar, chocolate agar and MacConkey agar plates (Oxoid Ltd, Basingstoke, Hampshire, UK) and incubated at 35-37^{o}C aerobically. The Chocolate agar plates were incubated by putting them in a candle jar which provided 5–10% of CO_2 concentration to create a microareophilic condition for fastidious bacteria. After 18-20 hours of incubation, the plates were examined for the growth of bacterial colonies. Plates, which didn't show any growth, were further incubated for additional 24 hours.

Blood was inoculated on thyoglycollate broth and incubated aerobically for 7 days regularly subcultured to MacConkey, blood and Chochaolte agar plate every 24 hours and incubated as above.

Identification: Gram negative rods were identified with the help of a series of biochemical tests which routinely included triple sugar iron agar, indole, Simmon's citrate agar, lysine decarboxylase, urease and motility. Each culture medium was prepared as per the instruction of the manufacturer (Oxoid Limited Basingstoke, Hampshire, England). And gram positive cocci were identified based on their gram reaction, catalase and coagulase tests (10).

Sensitivity tests: A standard method of disc diffusion sensitivity testing developed by Bauer *et al* (13) was employed to determine susceptibility patterns to commonly used antibiotics: ampiciline (30µg), gentamycin (10µg), penicillin G (10IU), tetracycline (30µg), chloroamphenicol (30µg), cephalotin (5µg), streptomycin (15µg) and cotrimoxazole (25 µg). Diameters of growth inhibition around the discs were measured and interpreted as sensitive, intermediate or resistant as per the guideline of the manufacturer (Oxoid Limited Basingstoke, Hampshire, England).

Data analysis: The data were entered and analyzed using EPI Info 6 software.

Ethical issues: The study was conducted after institutional ethical clearance was obtained from EHNRI. Since the study was conducted as part of the routine clinical management of the patient, informed consent was not taken.

Operational definitions

Septicemia: if the subject develops fever and blood culture grows pathogenic organism

Wound infection: when there is Pus or infected fluid in the site of operative incision

Hospital acquired pneumonia: patient developing cough and sputum production 72 hours after hospitalization or after upper air way intubations for surgical operation reasons or ventilation purposes

Urinary tract infection: turbid or pussy urine or symptoms of urinary tract developed after admission or instrumentation of the urinary tract.

RESULTS

A total of 2,223 patients were admitted to the surgical wards of TAH and SPH. As diagnosed based on culture and sensitivity result, 69 TAH and 64 SPH patients had nosocomial infection. This makes the prevalence 6.19% in TAH and 5.74% in SPH. Wound infection was the most common type of nosocomial infection in both TAH and SPH, (52.1%) and (79.4%), respectively. Urinary tract infection accounted for 38.0% in TAH and 15.9% in SPH. Septicemia was the third commonly encountered type of infection in TAH (5.6%) while pneumonia accounted for 3.2% of the nosocomial infection (Table 1).

Table 1: Type and frequency of nosocomial infection In Tikur Anbessa and Saint Paul hospitals, Addis Ababa 1999-2000

Type of nosocomial infection	Number of cases in :	
	Tikur Anbessa N (%)	Saint Paul N (%)
Wound infection	36(52.1)	54(79.4)
Urinary tract infection	26(38)	10(15.9)
Sepsis	4(5.9)	1(1.5)
Pneumonia	3(3.5)	2(3.2)

** Three cases developed two kinds of nosocomial infections simultaneously*

The organisms frequently isolated in TAH were: Klebsiella species (32.4%), Pseudomonas (32.4%), E. coli (25.40%), and Proteus species (7.2%). However, the pattern was different in SPH where *E. coli* accounted for (45.30%), Klebsiella (20.3%), Pseudomonas (20.3%), S. aureus (10.9%), Proteus and Enterobacter 4.7% each (Table 2).

Table 2: The frequency of isolated organisms among Tikur Anbessa and Saint Paul hospitals surgical patients who had clinically developed nosocomial infections 1999-2000

Isolated organism	Prevalence in TAH	Prevalence in SPH
E.coli	16(25.4%)	29(45.3%)
Klebsiella sp.	22(32.4%)	13(20.3%)
Pseudomonas	22(32.4%)	13(20.3%)
Proteus sp.	5(7.2)	3(4.7%)
Enterobacter	6(8.7%)	3(4.7%)
S. Aureus	3(4.3%)	7(10.9%)

** There is possibility of two or more organisms being isolated in one patient*

Ninety five percent of the organisms frequently isolated were found to be resistant to commonly used parenteral antibiotics namely, the Penicillin group (ampicillin, crystalline penicillin) and 76% to Chloroamphenicol. The percentage of resistant strain to Gentamycin was 56% and to Cephalothin 75 % (Tables 3 and 4).

Table 3: Sensitivity of the commonly isolated organisms from surgical patients of TAH and SPH against frequently used antibiotics

Antimicrobials	*E. coli*		*Klebsiella Pneumonia*		*Pseudomonas aeriginosa*		*Staphylococcus aureus*	
	TAH	**SPH**	**TAH**	**SPH**	**TAH**	**SPH**	**TAH**	**SPH**
Ampicillin	1/22	4/30	0/24	0/16	0/20	0/3	0/2	0/7
Chloroamphenicol	6/22	14/30	1/24	4/16	2/20	0/3	0/2	4/7
Cephalothin	6/22	12/30	2/24	3/16	0/20	0/3	1/2	5/7
Gentamycin	13/22	26/30	3/24	7/16	1/20	2/3	0/2	5/7
Streptomycin	1/22	2/30	1/24	3/16	0/20	0/3	0/2	5/7
Tetracycline	1/22	2/30	2/24	5/16	2/20	0/3	0/2	2/7

Table 4: Overall antibacterial activity of the most commonly used antibiotics against frequently isolated bacteria causing nosocomial infection in surgical patients of two hospitals in Addis Ababa

ANTIMICROBIALS	EFFICACY	
Ampicillin	5/124	4%
Chloroamphenicol	31/124	25.0%
Cephalcothin	29/124	23.4%
Gentamycin	57/124	46%
Streptomycin	12/124	9.7%
Tetracyclin	14/124	11.3%
Penicilline	2/124	1.6%
Bactrim	24/124	19.3%

DISCUSSIONS

In a year round surveillance of nosocomial infection in the surgical wards of two referral hospitals namely, Tikur Anbesa (69patients) and Saint Paul (64 patients) have been found to develop nosocomial infections at the rate of 6.19% in TAH and 5.7% in SPH. When compared to results reported over two decades ago, for example, 16.4% from TAH, the present result appears to be low. However, the result is not different from that of other studies done elsewhere (1). Among the types of nosocomial infections developed, wound infection is the commonest and accounted for 52.1% in TAH and 79.4% of nosocomial infections in SPH. A similar result was observed in other hospitals (2). The proportion of septicemia evident from the presence of high fever in the absence of other sources of infection and positive blood culture, has shown a significant rise in TAH contrary to previous results (2)in the same hospital.

The rate of sepsis, as a manifestation of nosocomial infection in SPH, has remained low (1.6%). This significant discrepancy is due to the presence of Surgical ICU in TAH where ICU patients are usually most susceptible because of having additional portals of entries of organisms, such as central venous catheters, multiple peripheral venous lines, and other tubes into the blood.

Urinary tract infection (UTI) is a cause of nosocomial infections in one third of the cases in TAH, but in only 15% in SPH. UTI, however, is the leading cause of nosocomial infection in many studies (3,4). The difference between the results of these two hospitals can be explained with the presence of a urology unit in TAH. Urinary catheterization and instrumentation procedures which are often done in TAH are known to produce about 80% of nosocomial infection being UTI (4).

Escherichia coli, the number one organism incriminated and isolated in many of the nosocomial infections all over the world (5), is also the most frequently isolated organism in SPH, and only second to the Klebsiella species in TAH. Despite the high rate of wound infection documented in both hospitals staphylococcus aureus,, accounted for only 4.2% in TAH and 1.6% in SPH of all the isolates. The results are in agreement with most international studies (9,11,12).

The study has also shown that most of the isolates are resistant to antibiotics routinely used in this hospital for treating non-hospital acquired infections. It is now evident that only less than 35% of these isolates from nosocomial infection are sensitive to chloroamphenicol, and 5% to ampicillin. The sensitivity of these organisms causing nosocomial infection to gentamycin has also dropped from 80% to 50% in the last two decades (6, 14).

It is a strong opinion of the investigators that nosocomial infection is not addressed to the degree it deserves. One of the reasons is shortage of relevant data that supports the emergence of multi-drug resistant strains. Hospital acquired infections are difficult to treat and consume a great deal of resources (4,11,).

Prevention of the emergence of the multi-drug resistant strains is the strategy currently employed all over the world (13, 15, 16). The results, we believe, can create awareness among the health personnel at the particular hospital or at policy makers' level enabling them to design further infection control programs as an integral part of the health service delivery.

Most antibiotics tested for efficacy are those on common clinical use in both hospitals. The lumping of some of the findings such as ampicillin and other penicillin groups is made due to the fact that it is clear both are not active against pseudomonas and Klebsiella naturally.

The study was designed to see how effective the drugs routinely used in these hospitals for treating nosocomial infections were, and the results have proved to be most useful to these hospitals. But they cannot be used with confidence to assess the whole nosocomial susceptibility pattern of organisms any where else.

In conclusion, the isolates from the nosocomial infection in these hospitals are resistant to the above mentioned commonly used antibacterials. We recommend that whenever the diagnosis of nosocomial infection is made, a more effective antibiotic treatment be instituted until the susceptibility of the strain is identified.

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