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SHORT COMMUNICATION

Bacteriological Profile of Infected Surgical Sites in Jos, Nigeria

Solomon Chuwang Chollom*, Godwin Ojonugwa Agada, Jurbe Gofwan Gotep, Daniel Sudan Gbise, Simi Esther Mwankon and Ameh Joseph Okwori
Viral Research Department, National Veterinary Research Institute PMB 01 Vom-Jos, Plateau State, Nigeria
E.mail: cholloms_12@yahoo.com

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ABSTRACT

The often-high mortality and morbidity rates of surgical site infections are the concern of most health practitioners including administrators globally. The need to know the bacterial agents responsible and their treatability to common antibiotics was the main thrust of this study. Two hundred surgical site swabs were collected from two hospitals and investigated. The swabs were cultured and organisms identified according to standard procedures. A prevalence rate of 31.5 % was obtained from the surgical sites investigated. Direct gram staining gave a greater recovery rate of incriminated organisms than cultural methods. *Staphylococcus aureus* was the most encountered pathogen with 13.0 % prevalence rate followed by *Pseudomonas aeruginosa* (6.5 %), *Proteus mirabilis* (6.0 %) and *Klebsiella aerogenes* (4.0 %).The least encountered pathogens were Beta-haemolytic streptococci and *Escherichia coli* with prevalence rates of 1.0 % each. Statistically, chi square analysis showed that there was no significant difference in the number of isolates from the two health facilities at 99 % confidence limit. Susceptibility of isolates was more with the aminoglycosides than with the penicillins. This study has thus revealed that some hospitals are not doing enough to stem the tide of surgical site infections.

Keywords: Swabs, organisms, infections, hospitals

INTRODUCTION

The centre for Disease Control has defined surgical site infections (SSIs) as those infections occurring within 30 days of surgery (or within a year in the case of implants) (Horan *et al*., 1992). Wound infections including SSIs are among the leading nosocomial infections with alarming morbidity and mortality rates the world over (Hemart *et al.,* 2008). This is in spite of massive campaigns on strict adherence to standard surgical and dressing procedures. In the United Kingdom, surgical site infections alone account for seventy seven percent of deaths of surgical patients (Mangram *et al.,* 1997). The prevalence rate of nosocomial infections in the United Kingdom as at 1998 stood at 21 % with surgical wounds accounting for 5-34 % of the total (Mayon-White *et al*., 1998). By 2001, this value has dropped to 10 % (NINSS, 2002). These values will no doubt be higher in developing countries including Nigeria primarily due to absence of standard operating theatres and dressing rooms, use of obsolete tools and procedures, sub-standard training facilities, inadequate man power, inadequate funding as well as non-adherence to ethical standard by professionals amongst others.

Microorganisms invade and colonize surgical wounds, burns, bruises, cuts and open sores in the event of any breach in septic procedures (Thomson, 2007). The organisms are either of endogenous or exogenous origin: exogenous when natural pathogens from environment colonize and multiply in the wounds and endogenous when resident flora infiltrate from their natural habitats into these wounds (Heinzelman *et al*., 2002. Although microbes could contaminate surgical wounds, not all become infected; this is because innate host defenses are quite efficient in the elimination of contaminants (Hemart *et al*., 2008). A wide range of organisms are known to infect wounds, they span from gram positive cocci and bacilli, gram negative cocci and bacilli, spore-formers and non-spore formers, aerobes and anaerobes with *Staphylococcus aureus* leading the pack in frequency of occurrence (NNIS, 1996). Risk factors other than microbiological include decreased host resistance, local wound characteristics and operative characteristics have been included (Cruse and Foord, 1980). There is therefore need for assessment of bacteriological status of wounds, published report on the infections and more aggressive campaign on averting the ugly trend in this part of the world.

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MATERIALS AND METHODS

Study population and Area

Patients with surgical sites infections were targeted for this study. Two hundred swabs were collected from this population which comprised one hundred swabs each from the Jos University Teaching Hospital (JUTH) and Plateau State Specialist Hospital (PSSH) all in Jos, Plateau State of Nigeria. This was done after due ethical clearance.

Sample collection

Sterile swab sticks were used to collect pus from the surgical sites of subjects under aseptic conditions. Samples were collected from each subject in duplicate. The samples were properly labeled and immediately conveyed to the laboratory for processing.

Direct gram staining

From the pair of swab collected from each patient, one swab stick was used for direct gram staining as documented by Cheesbrough (2002).

Cultural methods

The second swab stick from each patient was cultured in duplicate using blood and chocolate agar plates. Cultured blood agar plates were incubated aerobically at 37^0 C for 18hrs while cultured chocolate agar plates were incubated anaerobically at 37^0C also for 18hrs. Organisms were identified based on standard biochemical reactions as documented by Cheesbrough (2002).

Antimicrobial susceptibility test

Kirby-Bauer disc diffusion susceptibility technique as documented by Hudzicki (2010) was adopted for the susceptibility assay. For economic reasons, only representatives of the various isolates obtained were used for this assay. In this technique, a well dried agar plate was seeded with appropriate inoculum. Filter paper discs impregnated with various antibiotics were placed at specific locations on the seeded agar plate. The plates were incubated at 37^0C for 18 h after which sensitivity to antimicrobial agents was measured as zones of inhibition, in millimeter, around the antibiotic discs.

Statement of Hypothesis

Ho= Surgical sites of patients in Jos, Nigeria are free from bacterial infections.
H_1= Surgical sites of patients in Jos, Nigeria are not free from bacterial infections.
The research is out to ascertain whether Ho or H_1 is true.

RESULTS

From the 200 swabs processed, 63 (31.5 %) cultures yielded one bacterial isolate or the other. The remaining 137 swabs did not yield any bacterial growth. Direct gram stain recovered 86 organisms from the swabs in the form of bacilli, rods or a mixture of the two (**Tables 1 and 2**). The spectrum of the isolates obtained cut across gram positive cocci and gram negative bacilli. Among the gram positive cocci, *Staphylococcus aureus* took the lead with 13.0 % prevalence while beta-haemolytic streptococci occurred in as little as 1.0 % of the sample population. The gram negative bacilli obtained included *Pseudomonas aeruginosa* (6.5 %), *Proteus mirabilis* (6.0 %), *Klebsiella aerogenes* (4.0 %) and *Escherichia coli* (1.0 %) (**Table 3**).

Table 1: Pattern of Direct Gram Stain Results from the Two Hospitals

	PSSH	JUTH	Total
Cocci	16	21	27
Bacilli	17	24	41
Cocci/Bacilli	5	3	8
Organism-free	62	52	114
Total	**100**	**100**	**200**

Table 2: Percentage Prevalence of Infected and Non-Infected Swabs from Cultures

	PSSH	JUTH	Total	Prevalence (%)
Infected Swabs	30	33	63	31.5
Non-Infected Swabs	70	67	137	68.5
Total	**100**	**100**	**200**	**100**

χ^2 = 0.208; DF= 1; P≤ 0.05

Table 3: Percentage Prevalence of Individual Organisms from the Two Hospitals

	PSSH	JUTH	Total	Prevalence (%)
Staphylococcus aureus	10	16	26	13.0
Pseudomonas aeruginos	3	10	13	6.5
Proteus mirabilis	8	4	12	6.0
Klebsiella aerogenes	5	3	8	4.0
Escherichia coli	2	-	2	1.0
Beta-haemolytic streptococci	2	-	2	1.0

These findings therefore imply that the Null Hypothesis (Ho) is not true as a result; the Alternative Hypothesis (H_1) is confirmed since bacterial pathogens have been implicated in the infected surgical sites. Chi square showed that there was no significant difference in the number of isolates obtained from the two health facilities at 99 % confidence limit. Except for *Pseudomonas*

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aeruginosa, antibacterial susceptibility testing showed greater promise with aminoglycosides than with the penicillins (**Table 4**).

DISCUSSION

The outcome of this research shows that surgical sites in Jos, Nigeria are infected with bacterial agents. This implies that Null Hypothesis (Ho) cannot stand. Therefore, it is rejected and the Alternative Hypothesis (H_1) is hereby confirmed given the 31.5 % prevalence rate of infected surgical sites and the spectrum of bacterial pathogens implicated with SSIs in the area. The prevalence rate of 31.5 % SSIs obtained from this part of the world is outrageously high when compared with 10 % prevalence rate obtained in the United Kingdom (NINSS, 2002), 1.0 % obtained in the United States of America (de Lissovoy *et al*., 2009) and 12.5 % obtained in Vietnam (Thu *et al*., 2005). The reasons are not far-fetched as the standard of medical practice is lower in most third world countries, Nigeria inclusive. Sources of these infections are either endogenous or exogenous. This is primarily due to absence of standard operating theatres and dressing rooms, use of obsolete tools and procedures, sub-standard training facilities, inadequate man power, inadequate funding as well as non-adherence to ethical standard by professionals amongst others.

Table 4: Antibiogram Pattern of Selected Isolates

	Gentamycin 10 µg	Streptomycin 10 µg	Erythromycin 15 µg	Ampicillin 10 µg	Cloxacillin 10 µg	Vancomycin 30 µg
Staphylococcus aureus	+++	++	++	+	-	+
Proteus mirabilis	++	++	++	++	+	+
Pseudomonas aeruginosa	-	+	+	-	+	-
Klebsiella aerogenes	+++	+++	++	+++	++	+
Beta Haemolytic Streptococci	++	+	++	+	+++	++
Escherichia coli	++	++	+++	++	+	++

The fact that some swabs yielded more than one bacterial isolate suggests that the source of the contamination is external, either due to exposure to dust from surrounding environment or because of the use of non-septic materials in the dressing of surgical sites (Horan *et al*., 1992). The spectrum of bacteria incriminated is the same globally (Hemart *et al*., 2008). These authors established that *Staphylococcus aureus* is the most encountered pathogen in wounds either as primary or secondary pathogen. These findings have further corroborated this fact. The 6.5 % prevalence rate of *Pseudomonas aeruginosa* in this study is of great concern. This is because the organism has a resistant gene (R-factor) to most antibiotics, disinfectants and antiseptics. As such, it is able to frustrate the antibacterial activity of these agents once the organism has colonized wounds. In addition, the transfer of these R-factor by plasmids among the hospital bacteria population via non-septic wound dressing and surgical techniques is rapid (Bratzler and Houck, 2004).

There was a greater rate of recovery of pathogens from direct gram stain (43.0 %) than it was from cultures (31.5 %). This is likely due to the fact that some very delicate pathogens get destroyed before they are cultured or the appropriate cultural conditions (physical and nutritional) are never met. Chi square analysis at 99 % confidence limit did not show any significant difference in the number of organisms isolated from the two hospitals inferring that the two facilities which are about 25km apart have about the same standard of medical practice. Interestingly, the antimicrobial assay of selected isolates shows that most of the isolates are treatable with common antibiotics, especially the aminoglycosides.

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