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Original article

Nosocomial infection in surgical site wounds caused by staphylococcus aureus and pseudomonas aeruginosa: case study of four major hospitals in Benue State

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ABSTRACT

Surgical sites wound swab specimens were collected from four major hospitals in Benue State Nigeria namely; Federal Medical Centre Makurdi, General hospital Gboko, General hospital Otukpo and General hospital North bank, Makurdi over a period of seven months and were examined bacteriologically.. Out of a total of 300 samples examined, 170 had bacterial isolates and of these 61(35.9%) were Pseudomonas aeruginosa, 39(22.9%) Staphylococcus aureus and 25(14.7%) co-infection of Pseudomonas aeruginosa and Staphylococcus aureus. Other bacterial isolates were Klebsiella species 12(7.1%), Escherichia coli 10(5.9%), atypical coliform 8(4.7%), Proteus species 7(4.1%), Enterococcus faecalis 4(2.4%) and Streptococcus pyogenes 4(2.4%). The incidence of Pseudomonas aeruginosa was higher at Federal Medical Centre Makurdi (33; 25.3%) than at other hospitals namely General Hospital Gboko (24; 34.3%), General Hospital Otukpo (14; 20.6%) and General Hospital North Bank Makurdi (15; 23.8%). Staphylococcus aureus occurred also more at the Federal Medical Centre Makurdi (24; 24.2%) than at General Hospital Gboko (16; 22.9%), General Hospital Otukpo (12; 17.6%) and General Hospital North Bank Makurdi (12; 19.0%). There were no significant differences between the hospital facilities and the microbial infections at significance level of ($p>0.05$). The findings in this study suggest that patients, patient's caregivers and health workers should adhere strictly to guidelines and policies on

nosocomial infection preventions and control.

1. Introduction

Nosocomial infection is an infection that occurs within 48 hours of hospital admission, 3 days after discharge or 30 days after a surgical procedure (Inweregbu et al., 2005). They affect 1 in 10 patients admitted to hospital. Nosocomial infection (hospital-acquired infection) is an infection acquired in a hospital by a patient who was admitted for a disease condition other than that infection (Ducel et al., 2002) .The term for infections associated with surgical procedures was changed from surgical wound infection to Surgical Site Infection in 1992 by the Center for Disease Control and Prevention (CDC) (Horan et al ., 1992) . These infections are classified into incisional, organ, or other organs and spaces manipulated during an operation; incisional infections are further divided into superficial (skin and subcutaneous tissue) and deep (deep soft tissue-muscle and fascia). Detailed criteria for these definitions have been described (Horan et al ., 1992). These definitions should be followed universally for surveillance, prevention, and control of Surgical Site Infections. Surgical site infections incidence rates (0.5-15%) vary dependent on the type of operation and underlying patient status (Cruse et al.,1980; Horan et al.,1993).. The impact on hospital costs and postoperative length of stay (between 3 and 20 additional days) (Brachman et al.,1980; Fabry et al.,1982; Prabhakar et al.,1983;Kirkland et al.,1999) is considerable. Nosocomial infections is global health problem occurring both in the resource-rich and poor countries. They are a significant burden to patients and public health. They are a major cause of mortality and increased morbidity among in-patients. This may result in increased functional disability and emotional stress and may lead to conditions that reduce quality of life. There is effect of financial burden, apart from the general health. Increased stays contributes greatly to the cost that patients with nosocomial infections require.

Most infections acquired in hospital today are caused by microorganisms which are common in the general population. Pathogenic bacteria such as Gram-positive bacteria: Staphylococcus aureus (cutaneous bacteria that colonize the skin and nose of both hospital staff and patients. Pseudomonas spp. are often isolated in water and damp areas could colonize the gut cause digestive tract infections. Nosocomial infections affect more than 2 million patients each year -- or about 5% to 10% of hospitalized patients -- leading to approximately 90,000 deaths per year (Bearman et al., 2006). On this bases, the research study was designed to ascertain the aetiological agents of surgical site infections from patients who had undergone different types of surgery and their susceptibility to antimicrobial agents.

2. Materials and methods

2.1. Ethical consideration

Approval for this study was obtained from ethical clearance committees and the Chief Medical Director of each hospital. Confidentiality was maintained in accordance with standard Medical practice.

2.2. Sample collection

Specimens were aseptically collected using a commercial sterile swab sticks from post- operative wounds of patients who had developed pus or discharge following surgical operations. Samples were collected over a period of 7 months from Federal Medical Centre Makurdi, General hospital Otukpo, General hospital Gboko and General hospital North Bank Makurdi (September 2008-March 2009), 300 from patients who had undergone surgical operations in surgical, paediatric, orthopaedic, obstetrics and gynaecology wards of these hospitals. Sites of collection were Mastectomy, Leparatomy, Appendicetomy, Colostomy, Prostatectomy, Thyroidectomy, Gastrectomy, Caeserean section (C/S), Herniotomy, Amputation, Cystostomy and Osteotomy wounds.

The wound swabs were sent to the Medical Microbiology Laboratory from September 2008-March 2009 for bacteriological investigation. Each specimen was innoculated on Blood, Chocolate and MacConkey agars, and then incubated at 370C overnight. All specimens were Gram stained. The culture plates were incubated at 37 0 C for

24hrs. Incubation period was extended to 48 hours if there was no bacterial growth within 24 hours. Isolated pure colonies were characterized culturally, microscopically and biochemically as described by Cheesbrough (2004).

2.3. Susceptibility test

Antibiotic sensitivity tests were carried out on isolates (target organisms) using commercially available antibiotic sensitivity discs. The disc diffusion method of Kirby- Bauer was used.

3. Results

Out of the 300 surgical sites infection samples examined, 170(56.7%) showed bacterial growth. Table 1 showed the occurrence of bacterial isolates in surgical site wounds. The bacteria isolated were Pseudomonas aeruginosa 61(35.9%), Staphylococcus aureus 39(22.9%), Klebsiella species 12(7.1%), Escherichia coli 10(5.9%), atypical coliform 8(4.7%), Proteus species 7(4.1%), Enterococcus faecalis 4(2.4%) and Streptococcus pyogenes 4(2.4%). Pseudomonas aeruginosa and Staphylococcus aureus occurred as mixed growth in 25(14.7%) cases.

Table 1
Occurrence of bacterial isolates in 300 post- operative wounds examined in benue state.

Organism	Total Number isolated	% isolate
Pseudomonas aeruginosa	61	35.9
Staphylococcus aureus	39	22.9
Klebsiella species	12	7.1
Escherichia coli	10	5.9
Atypical coliform	8	4.7
Proteus species	7	4.1
Enterococcus faecalis	4	2.4
Streptococcus pyogenes	4	2.4
Co-infection (S. (aureus and P. aeruginosa)	25	14.7
Total	170	100

Table 2
Occurrence of pseudomonas aeruginosa and staphylococcus aureus in wounds according to type of surgical operation.

Types of operation	Number examined	Number (%) P. aeruginosa	S. aureus
Appendicetomy	122	36(29.5)	24(19.7)
Caesaren section(c/s)	69	19(27.0)	15(21.7)
Herniotomy	63	17(27.0)	12(19.0)
Amputation	14	6(42.9)	5(35.0)
Cystostomy	11	4(36.4)	2(18.2)
Leparatomy	7	2(28.6)	3(42.9)
Mastectomy	6	1(16.7)	2(33.3)
Prostatectomy	3	1(33.3)	1(33.3)
Osteotomy	2	0(0)	0(0)
Colostomy	1	0(0)	0(0)
Gastrectomy	1	0(0)	0(0)
Thyroidectomy	1	0(0)	0(0)
Total	300	86(28.7)	64(21.3)

Table 2 shows the percentage occurrence of Pseudomonas aeruginosa and Staphylococcus aureus according to type of surgical operation. Amputation gave the highest occurrence rate of Pseudomonas aeruginosa infection (42.9%). The next highest was cystostomy (36.4%). Thyroidectomy, Gastrectomy and Osteotomy had no bacterial

contamination. However, in Staphylococcus aureus infection, Leparatomy had the highest number (42.9%). This was followed by amputation (35%). There was no bacterial growth in Thyroidectomy, Gastrectomy and Osteotomy respectively.

Table 3 shows the co-infection of Pseudomonas aeruginosa and Staphylococcus aureus in different types of surgical operations. The highest number of mixed infections was observed in Prostatectomy (33.3%) and the next highest was Leparatomy (28.6). Colostomy, Thyroidectomy, Gastrectomy, Cystostomy and Osteotomy showed no mixed infections.

Table 3
Co-infections of pseudomonas aeruginosa and staphylococcus aureus in different types of surgical operation.

Types of operation	Number examined	Number (%) Co-infection
Appendicetomy	122	11(9.0)
Caesaren section (c/s)	69	5(7.2)
Herniotomy	63	4(6.3)
Amputation	14	1(7.1)
Cystostomy	11	0(0)
Leparatomy	7	2(28.6)
Mastectomy	6	1(16.7)
Prostatectomy	3	1(33.3)
Osteotomy	2	0(0)
Colostomy	1	0(0)
Gastrectomy	1	0(0)
Thyroidectomy	1	0(0)
Total	300	25(8.3)

Table 4 shows the occurrence of Pseudomonas aeruginosa and Staphylococcus aureus in relation to health facility. Federal Medical Centre, Makurdi has the highest frequency (33;25.3%) of Pseudomonas aeruginosa isolates compared to General Hospital Gboko (24; 34.3%), Otukpo General Hospital (14;20.6%), and General hospital North Bank, Makurdi (15;23.8%). There was no significant difference (χ 2 = 5.028; p>0.05) in Pseudomonas aeruginosa isolates between the hospitals.

Table 4
Occurrence of pseudomonas aeruginosa and staphylococcus aureus in relation to health facilities.

Organism	Federal Medical Centre, Makurdi	General Hospital, Gboko Frequency	General Hospital, Otukpo (%)	General Hospital, North Bank, Makurdi	Total
P. aeruginosa*	33(25.3)	24(34.3)	14(20.6)	15(23.8)	86(28.7)
S. aureus**	24(24.2)	16(22.9)	12(17.6)	12(19.0)	64(21.3)

* χ2 = 5.028(p>0.05).
**χ2 = 1.344(p>0.05).

Staphylococcus aureus occurred more frequently in Federal Medical Centre Makurdi (24; 24.2%) than in General Hospital Gboko (16; 22.9%), General hospital Otukpo (12; 17.6%) and General Hospital North Bank, Makurdi (12; 19.0%). There was no significant (χ 2 =1.344; p>0.05) difference of the microbial infection in these hospitals. The occurrence of Pseudomonas aeruginosa and Staphylococcus aureus showed no significant difference in the studied area. For instance, 28.7% of infected patients had Pseudomonas aeruginosa whereas the percentage of Staphylococcus aureus was 21.3%.

4. Discussion

In this study, the result showed the aetiologic agents that are most frequently isolated in surgical sites infection in this area. The bacteria isolated were Pseudomonas aeruginosa 61(35.9%), Staphylococcus aureus 39(22.9%), Klebsiella species 12(7.1%), Escherichia coli 10(5.9%), atypical coliform 8(4 .7%), Proteus species 7(4.1%), Enterococcus faecalis 4(2.4%) and Streptococcus pyogenes 4(2.4%). This list of bacterial isolates is in conformity with the list of pathogens as mentioned in the CDC guideline for the prevention of surgical sites infections (Mangram et al., 1999). This finding agrees with those of Oni et al. (2006) UCH Ibadan where the same aetiologic agents were isolated. Though the rate of infection obtained in this study were however higher than those reported by Joshi et al. (1984) (22.5%) in Benin City and Bertrand et al. (2002) (21.6%) in south west Nigeria. The disparity in infection rate could be attributed to differences in geographical location, possible differences in sanitary practices in the health care facilities and microbial population of the pathogens at the different places.

According to Nichols (1998), clean surgery carries a 1-5% risk of postoperative wound infection, and in dirty procedures that are significantly more susceptible to endogenous contamination, 27% risk of infection has been estimated.

They have been an increased incidence of Pseudomonas aeruginosa and Staphylococcus aureus in surgical wound infections in recent times. It is thus clear that the prevalence of Pseudomonas aeruginosa and Staphylococcus aureus obtained in this study is in agreement with what is obtained in other hospitals in Nigeria.

The microbial analysis revealed that Pseudomonas aeruginosa and Staphylococcus aureus were the leading etiologic agents of the surgical site infection in this study. Similar results were obtained by Basak et al. (1992) in Bombay town of India, Mashita et al. (2000) and Akinjogunla et al. (2009). According to Sangrasi et al. (2008) the pathogenic factor of the organism may be responsible for the high incidence rates of infections.

The rate of Pseudomonas aeruginosa and Staphylococcus aureus were higher at Federal Medical Centre Makurdi than in other hospitals. Overcrowded wards, long stay in hospitals resulting in cross infection could be attributed to the high incidence of the pathogens in Federal Medical Centre Makurdi.

Pseudomonas aeruginosa occurred more frequently than Staphylococcus aureus in all the hospitals and this finding agrees with the reports of Joshi et al. (1984), Oguntibeju et al. (2004), Akinjogunla et al. (2009) and Hani et al. (2009). This could be as a result of its ability to grow in disinfectants, sinks, water and damp materials in the hospitals. It is also possible that patients may have developed immunity against Staphylococcus aureus infection.

On the other hand several studies have shown Staphylococcus aureus as the most prevalent pathogen and common cause of the hospital acquired surgical infections. Previous studies have shown that Staphylococcus aureus constituted the major isolates in surgical sites infection with figures; 30.3% and 31% respectively Ibadan (Oni et al., 1997 ; Saudi Arabia Tayfour et al. (2005). This indicates that surgeons, hospitals staffs and patients may be heavy carriers of Staphylococcus aureus which is a microbial flora of the skin and nose and could transfer this pathogen during surgical procedures and stay in the hospital.

There are many ways hospital acquired wound infection could be minimized and prevented via periodic screening of hospital staffs and patients relatives to check nasal carriers of Staphylococcus aureus. Continuous and compulsory medical seminars and trainings for health workers in areas inclusively: general sanitations, aseptic techniques, precautionary measure and procedures in surgery rooms and procedures, water supply in hospitals. Also the stay of the patient should as much as possible be shortened. Patient should be instructed on general hygienic practices while in the hospital.

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