Pattern of pathogens from surgical wound infections in a Nigerian hospital and their antimicrobial susceptibility profiles

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Abstract:

Background: In surgical patients, infection is an important cause of morbidity and mortality. A prospective study to find the pattern of microorganisms responsible for post operative wound infections and their antibiotic susceptibility profile was therefore conducted.

Setting and Methods: Surgical wards in Obafemi Awolowo University Teaching Hospital Complex, Ile-Ife, Nigeria. Isolation, identification and antimicrobial susceptibility screening of organisms were done employing standard microbiological techniques.

Results: Bacterial pathogens were isolated from all the specimens while the yeast Candida species (spp) was isolated from 12.4%. Staphylococcus aureus was the most frequent organism isolated accounting for 23 (18.3%) of a total of 126 isolates. Other organisms were Pseudomonas aeruginosa and Bacillus spp 11.1% each; Escherichia coli 10.3%; Candida spp 8.7%; Coagulase negative staphylococci 8.7%; Pseudomonas spp 6.3%; Serratia odorifera 4.7%; Bacteroides 4.0%; Enterococcus spp 3.2%; the remaining isolates were other enterobacteria. Sensitivity of the bacterial isolates to antibiotics varied. In general, resistance to the β-lactam antibiotics was above 98%, whilst more than 70% of isolates were resistant to erythromycin, fusidic acid and tobramycin.

Conclusions: The infections were polymicrobic and multidrug resistant. The quinolones, ciprofloxacin and ofloxacin, should be used as frontline drugs in the management of surgical wound infections at the hospital.

Keywords: surgical wound infections, susceptibility, bacterial pathogens, antibiotics

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Introduction

In spite of the progress in surgery, surgical techniques and antibiotic prophylaxis[1,2,3], postoperative infections remain the commonest postoperative complications and one of the most frequently encountered nosocomial infections worldwide[4,5]. The incidence of these infections has been estimated to be 15.45% and 11.32% by the Center for Disease Control and Prevention (CDC) USA and the UK Nosocomial Infection Surveillance respectively[6]. These infections lead to increase morbidity with the attendant increase in cost of therapy[7]. The high incidence and prevalence of postoperative wound infections also result in increasing demand on the limited resources available to healthcare delivery eventually resulting in high degree of mortality[1,7]. As a result of these problems, routine surveillance for hospital acquired wound infections, including surgical wound infections, is recommended by both the CDC and the Surgical Infection Society in USA (SIS)[2,7].

Risk of wound infection varies with the type of surgery and surgical operations have been classified into, clean, clean-contaminated, contaminated and dirty[8,9]. A clean wound is an incision through un-inflamed tissue in which the wound is primarily closed. In this wound type only closed drainage systems are used and there is no breach in aseptic technique and the viscus is not opened. A clean-contaminated wound is one (that is otherwise clean) created at emergency surgery and in which the un-inflamed upper gastrointestinal tract, normal gall bladder and urinary bladder are opened but there is no spillage of contents and there is minor break in aseptic technique. Contaminated wounds are traumatic wounds less than 6 hours old and wounds in which the inflamed upper gastrointestinal tract and obstructed urinary bladder are opened or spillage of contents occurs. In these wounds there are major breaks in sterile technique. Dirty wounds are associated with presence of pus and may include intra-peritoneal abscess formation or visceral perforation and traumatic wounds more than 6 hours old[8,9].

The choice of treatment for post-surgical infections requires an understanding of the usual infectious flora, available antimicrobial agents and susceptibility patterns of the infecting organisms as these would be helpful in the selection of empiric antimicrobial therapy and also on infection control measures in the health institutions[10,11]. The investigation of the microbiologic spectrum and antibiotic susceptibility of isolates in surgical would infections is therefore of increasing importance bearing in mind the increasing antibiotic resistance by microorganisms and the high incidence of surgical infections caused by these resistant organisms[11].

Anaerobic bacteriology is expensive and requires special facilities and expertise to perform. It is not readily available in many hospitals in the developing countries. Therefore most studies from developing countries do not incorporate anaerobic bacteriology in the study of surgical wound infection despite the reported significant roles that anaerobes play in such infections[1].

In this study we report on the microbiological spectrum of post operative wound infections in a Nigerian Teaching Hospital and the antimicrobial susceptibility profiles with a view to providing guideline to the clinicians for making rational decision over the choice of antibiotics in the management of surgical site infection.

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Materials and Methods

Study centre

The study was conducted at Obafemi Awolowo University Teaching Hospital Complex (OAUTHC), Ile-Ife, Nigeria for a period of 2 years from September 2005 to Sept 2007 after appropriate approval were obtained and following standard guidelines. The hospital caters for a wide variety of patients ranging from high to low income level patients. The teaching hospital provides health care services for people from over five different states in the South Western parts of Nigeria: Oyo, Osun, Ondo, Ekiti and Kwara States. During the collection of specimens for the study, hospital activities were disrupted at several points by industrial actions undertaken by several staff unions within the hospital, hence a smaller number of surgical operations than expected were carried out in the centre.

Patients

Samples were obtained from the surgical sites of 89 hospitalised patients who showed clinical evidence of post operative wound infections as diagnosed by the physicians. In such cases, a surgical wound with pus or seropurulent discharge and with signs of sepsis was considered as surgical site infection. In all the cases, the detection of infection was within thirty days of surgery. Wounds with cellulitis and no drainage and suture abscesses were not included in the study. The patients included 56 males and 14.6% of all the patients fall below the age of 15 years. The patients were diagnosed as having cellulitis, breast cancers, typhoid perforation, biliary atresia, scalp necrosis, burns, faecal fistula and abscesses. Information about patients regarding age, sex, date of admission, associated co-morbid conditions, type of surgery, type of wounds and preoperative antibiotic prophylaxis were collected in a case record.

Collection of Samples

All consenting general surgical patients with wound infection were used for the study. Specimens were collected using standard collection techniques.[12] Briefly, a sterile cotton-wool swab was used to collect a sample from the infected site. The swabs were introduced gently into the wound sites and rotating the swab tips in the wound, taking care to avoid contamination of specimen with commensals from the skin, and then immersed immediately in a MacCartney bottle containing Stuart Transport medium (Merck, Germany). Each sample bottle was labeled carefully and transported to the laboratory immediately for microbiological investigations.

Isolation of organisms

At the laboratory, the swabs were inoculated onto freshly prepared blood agar and Sabouraud Dextrose agar [SDA] (Oxoid, England) plates and incubated aerobically at 37°C for 24-48 hours for the blood agar and 25°C for 3-5 days for SDA. Anaerobic incubation was also done by culturing on fastidious anaerobic blood agar (LAB M, England) plates prepared according to the instruction of the manufacturer and incubated anaerobically in an anaerobic jar supplied with a commercial gas generating kit (BBL Cockleysville, USA) that provided an atmosphere of 1% O_2/8% CO_2 in accordance to the manufacturers instruction. Incubation was done at 37°C for 3 to 5 days. Distinct well separated colonies growing on such plates were then sub-cultured onto newly prepared blood agar plates as appropriate. Isolates were maintained by cryopreservation using the medium of Gibson and Khoury[13] and in nutrient agar stabs.

Identification of isolates

The characterization of bacterial isolates was based on standard biochemical tests[14] which were performed on the isolates and these include; gram stain, morphological and cultural characteristics of colonies on MacConkey agar, Eosine Methylene Blue agar, Brilliant Green Agar, and Mannitol Salt Agar, haemolysis, catalase production and test for oxidase. Coagulase tests were done for both free and bound coagulase to confirm pathogenic staphylococci.

Coagulase negative staphylococci were characterized as described[15]. Further tests carried out for gram negative isolates included motility test, nitrate reduction, hydrogen sulphide production, indole production, Methyl Red – Voges Proskauer tests, citrate utilization, Triple – Sugar Iron Agar tests and sugar fermentation tests using maltose, mannose, mannitol, glucose, sorbitol, raffinose and arabinose[14].

Antibiotic resistance testing

Resistance to antibiotics was determined for the staphylococci isolates using the standard disc diffusion methods as described by the Clinical Laboratory Standard Institute (CLSI)[16]. The test media was Isosensitest Agar supplemented with whole blood for aerobes and chocolate agar for anaerobes[22]. The antibiotic discs employed include ofloxaxin (Of), chloramphenicol (Chl), cephalothin (CE) all at 30μg, erythromycin (Ery) at 15μg, ciprofloxacin (Cip) and penicillin V (PV) at 10μg [Abtek, England]. Also, fusidic acid (FU) (50μg), tobramycin (TM) (30μg), trimethoprim (TR) (5μg), cefadroxil (DX) (30μg), piperacillin (PP) (30μg) [AB-Biodisk,Sweden and oxacillin (OX) (1μg) [Oxoid, England] were screened. The zones of inhibition were measured and interpretation was in accordance with manufacturers' instructions (AB, Biodisc; PDM Interpretative chart). Staphylococcus aureus NCTC 6571 and Escherichia coli NCTC 10418 were used as controls.

Results

All the specimens obtained yielded growth of bacteria. A total of 126 isolates were recovered from the 89 samples taken. There were 73.0% dirty surgical wounds which gave 74.6% of the isolates and 27.0% contaminated surgical wounds which accounted for the remaining isolates. Abdominal wounds were most frequent accounting for 44.9%, followed by leg wounds, 18.0%; chest wall, 9.0% and burns, 9.0%. Correspondingly, abdominal wounds accounted for the majority of the wound pathogens isolated (39.7%) while leg wounds, burns, and chest wall wounds accounted for 17.5%, 10.3% and 8.7% of the pathogens respectively.

The count of aerobic bacteria in the samples was high. Only 8.0% of the isolates were anaerobes and these anaerobes were isolated from 11.7% of the patients. Also, some of the infections were caused by the yeast Candida spp as 12.4% of the patients yielded this pathogen.

A single pathogen was identified in 56.2% patients, 2 agents were isolated from 33.7% while 3 agents were isolated from each of the remaining samples. Polymicrobic infections did not follow any specific pattern (Table 2).

TABLE 2. The distribution of bacterial isolates in relation to type of surgical operation and type of wound that develop infection

Wound type	Surgical Operations (no of cases)	Isolates (no of isolates)
Head / Skull (n = 4)	Dirty (1)	*S. aureus* (1), *Pseudomonas spp* (1), *Bacteroides* (1)
	Contaminated (3)	*S. aureus* (1), *E. coli* (1), *Proteus mirabilis* (1), *Ps. aeruginosa* (2), *Candida spp* (2)
Chest wall (n=8)	Dirty (8)	*S. aureus* (1), *E. coli* (1), *Enterobacter agglomerans* (1), *Proteus penneri* (1), *Pseudomonas aeruginosa* (2), *Pseudomonas spp* (3), *Anaerobic cocci* (1), *Bacteroides* (1)
Upper arm (n=1)	Contaminated (1)	*P. aeruginosa* (1), *Pseudomonas spp* (1), *Candida spp* (1)
Facial (n=1)	Contaminated (1)	*Staphylococcus spp* (1)
Trunk/Traumatic (n=1)	Contaminated (1)	*P. aeruginosa* (1), *Candida spp* (1)
Abdomen (n=40)	Dirty (30)	*S. aureus* (8), *S. epidermidis* (1), *S. saprophyticus* (1), *S. xylosus* (1), *Staphylococcus* spp (2), *Bacillus spp* (7), *Enterococcus* spp (3), *E. coli* (5), *S. odorifera* (1), *P. aeruginosa* (3), *Ps. maltophila* (1), *Pseudomonas spp* (1), *Anaerobic cocci* (2), Gram positive anaerobic rods (1), *Candida spp* (1)
	Contaminated (10)	*S. aureus* (4), *S. epidermidis* (1), *Bacillus spp* (2), *E. coli* (3), *K. pneumonia* (1), *S. odorifera* (1)
Buttock (n=3)	Dirty (3)	*S. aureus* (1), *S. epidermidis* (1), *E. agglomerans* (1), *Candida* spp (2)
Scrotal (n=4)	Dirty (4)	*S. aureus* (1), *S. epidermidis* (1), *S. saprophyticus* (1), *K. pneumonia* (1)
Leg/Limb (n=16)	Dirty (16)	*S. aureus* (3), *S. epidermidis* (1), *Bacillus* spp (2), *E. coli* (2), *P. mirabilis* (1), *Citrobacter* spp (1), *Proteus* spp (2), *S. odorifera* (3), *P. aeruginosa* (2), Anaerobic cocci (1), *Bacteroides* (2), *Candida* spp (3)
Burns (n=8)	Contaminated (8)	*S. aureus* (3), *Bacillus spp* (1), *Enterococcus spp* (1), *E. coli* (1), *E. agglomerans* (1), *Enterobacter spp* (1), *S. odorifera* (1), *Ps. aeruginosa* (2), *Ps. maltophila* (1), *Candida spp* (1)
Thigh (n=3)	Dirty (3)	*Bacillus spp* (2), *P. aeruginosa* (1), *Bacteroides* (1)
Scrotal (n=4)	Dirty (4)	*S. aureus* (1), *S. epidermidis* (1), *S. saprophyticus* (1), *K. pneumonia* (1)
Leg/Limb (n=16)	Dirty (16)	*S. aureus* (3), *S. epidermidis* (1), *Bacillus spp* (2), *E. coli* (2), *P. mirabilis* (1), Citrobacter *spp* (1), *Proteus spp* (2), *S. odorifera* (3), *P. aeruginosa* (2), *Anaerobic cocci* (1), *Bacteroides* (2), *Candida spp* (3)
Burns (n=8)	Contaminated (8)	*S. aureus* (3), *Bacillus spp* (1), *Enterococcus* spp (1), *E. coli* (1), *E. agglomerans* (1), *Enterobacter* spp (1), *S. odorifera* (1), *Ps. aeruginosa* (2), *Ps. maltophila* (1), *Candida spp* (1)
Thigh (n=3)	Dirty (3)	*Bacillus spp* (2), *P. aeruginosa* (1), *Bacteroides* (1)

Aerobic gram positive organisms accounted for 41.3% of the total number of organisms. S. aureus constituted 44.2% of the gram positive pathogens, coagulase negative staphylococci (CoNS), Bacillus spp and Enterococcus species accounted for 21.2%, 26.9% and 5.8% respectively. The CoNS isolated included S. epidermidis, S. saprophyticus and S. xylosus. Overall, S. aureus, CoNS, Bacillus spp and Enterococcus spp accounted for 18.3%, 8.7%, 11.1% and 2.4% of the total isolates respectively. Aerobic gram negative organisms accounted for 42.1% of the total isolates and Pseudomonas aeruginosa and Escherichia coli constituted 26.4% and 24.5% of the gram negative pathogens respectively. The remaining aerobic gram negative isolates are of the family Enterobacteriaceae (Table 1).

TABLE 1. Bacteria and Fungal Isolates Recovered From Surgical Wound Infections

Serial No	Organism	No (%)
1.	*Staphylococcus aureus*	23 (18.2)
2	*S. epidermidis*	5 (4.0)
3	*S. saprophyticus*	2 (1.6)
4	*S. xylosus*	1 (0.8)
5	*Staphylococcus spp*	3 (2.4)
6	*Bacillus spp*	14 (11.1)
7	*Enterococcus spp*	4 (3.2)
8	*Escherichia coli*	13 (10.3)
9	*Enterobacter agglomerans*	3 (2.4)
10	*Enterobacter spp*	1 (0.8)
11	*Klebsiella pneumonia*	2 (1.6)
12	*Proteus mirabilis*	2 (1.6)
13	*Proteus penneri*	1 (0.8)
14	*Citrobacter spp*	1 (0.8)
15	*Proteus spp*	2 (1.6)
16	*Serratia odorifera*	6 (4.7)
17	*Pseudomonas aeruginosa*	14 (11.1)
18	*Ps. maltophila*	2 (1.6)
19	*Pseudomonas spp*	6 (4.7)
20	*Anaerobic cocci*	4(3.2)
21	*Bacteroides*	5 (4.0)
22	Gram. Positive anaerobic rods	1 (0.8)
23	*Candida spp*	11 (8.7)

Pure cultures of pathogens most commonly yielded S. aureus, 22.0%; Bacillus, 12.0%; Ps. aeruginosa, 8.0% and CoNS, 8.0%.

The susceptibility pattern of all the bacterial strains is summarized in Table 3.

TABLE 3. Sensitivity profile of bacterial isolates from Surgical Wound infections

Organism	No of Isolates	No of isolates resistant (%)										
		Chl	Cip	Of	Ery.	PV.	PP.	CE	DX	TR	FU	TM
S. aureus	20	7(35.0)	0	0	14(70.0)	20(100)	20(100)	19(95.0)	18 (90.0)	18 (90.0)	9 (45.0)	9(45.0)
CoNS	11	6(54.5)	1(9.1)	0	10(90.9)	11(100)	11(100)	11(100)	11(100)	11(100)	9 (81.8)	9(81.8)
Bacillus spp	14	5(35.7)	5(35.7)	4(28.6)	14(100)	14(100)	14(100)	14(100)	14(100)	8(57.1)	11(78.6)	7(50.0)
Enterococcus spp	3	1(33.3)	1(33.3)	1(33.3)	1(33.3)	2(66.7)	2(66.7)	2(66.7)	2(66.7)	2(66.7)	2(66.7)	1(33.3)
Enterobacter	4	1(25.0)	1(25.0)	2(50.0)	3(75.0)	4(100)	4(100)	4(100)	4(100)	4(100)	4(100)	2(50.0)
E. coli	13	5(38.5)	2(15.4)	6(46.2)	10(76.9)	13(100)	13(100)	13(100)	13(100)	13(100)	8(61.5)	4(30.8)
K. pneumonia	2	1(50.0)	1(50.0)	2(100)	1(50.0)	2(100)	2(100)	2(100)	2(100)	2(100)	2(100)	1(50)
Proteus spp	5	4(80.0)	2(40.0)	4(80.0)	4(80.0)	5(100)	5(100)	5(100)	4(80.0)	4(80.0)	4(80.0)	4(80.0)
Citrobacter spp	1	0	0	0	0	0	0	0	0	0	0	0
Serratia odorifera	6	4(66.7)	2(33.3)	4(66.7)	4(66.7)	6(100)	6(100)	6(100)	6(100)	4(66.7)	4(66.7)	3(50.0)
Ps. aeruginosa	14	4(28.6)	5(35.7)	8(57.1)	10(71.4)	14(100)	14(100)	14(100)	11(78.6)	8(57.1)	10(71.4)	4(28.6)
Pseudomonas spp	8	4(50.0)	3(37.5)	4(50.0)	6(75.0)	8(100)	8(100)	8(100)	6(75.0)	3(37.5)	6(75.0)	4(50.0)
Bacteroides	5	3(60.0)	3(60.0)	3(60.0)	5(100)	5(100)	5(100)	5(100)	5(100)	3(60.0)	5(100)	3(60.0)
TOTAL	106	46(43.4)	27 (25.5)	39(36.8)	83(78.3)	105(99.1)	105(99.1)	104(98.1)	97(91.5)	81(76.4)	75(70.8)	52(49.1)

Ofloxaxin (Of), chloramphenicol (Chl), cephalothin (CE), erythromycin (Ery), ciprofloxacin (Cip), penicillin V (PV), Fusidic acid (FU), tobramycin (TM), Trimethoprim (TR), cefadroxil (DX), Piperacillin (PP).

Sensitivity of the isolates to different antibiotics varied and most isolates were multidrug resistant. In general, resistance to the β-lactam antibiotics was above 98% except for cephadroxil which showed a resistance of 91.5%. More than 70% of isolates were resistant to erythromycin, fusidic acid and trimethoprim. Only two of the five Bacteriode spp tested was sensitive to metronidazole (result not shown).

The staphylococcal pathogens were 100% sensitive to all the fluoroquinolones tested but the CoNS had a susceptibility of 89.9% to ciprofloxacin. The resistance of S. aureus to chloramphenicol and erythromycin was 35.0% and 70.0% respectively.

Discussion

The study gives an insight to the causative pathogens of post operative wound infections in this hospital and their sensitivity profiles. It is concluded that surgical wound infections in this health institution were polymicrobic in nature and, in most cases, associated with S. aureus, Pseudomonas aeruginosa, E. coli and other pathogens. Results also showed that there is a high rate of antibiotic resistance in all pathogens isolated. Of all the antibiotics tested, ciprofloxacin was shown to be the one most likely to be effective in treating infections as, in contrast to other antimicrobial agents tested in this study, less than 30% of the bacterial isolates were found to be resistant to its activity.

Bacterial pathogens were isolated from all the specimens while the yeast Candida species(spp) was isolated from 12.4% of them. A high prevalence of aerobic bacterial pathogen was obtained. This is in accordance to other similar findings and confirms the importance of aerobes in surgical wound infections[11,17]. In addition to this, the bacteria species isolated in this study are among pathogens reported to be involved in wound infections at other centers in Nigeria[10,18]. Further more, similar organisms have been reported isolated from other wound types in earlier studies carried out at the same hospital[19]. S. aureus was the organism isolated most frequently accounting for 18.2% of the total isolates and this agrees with the findings of another study reported earlier at another major teaching hospital in South Western Nigeria[18]. Our study also agrees with the Nosocomial in-

fection national surveillance service (NINSS) survey of (1997–2001) which reported Staphylococcus (47%) including S. aureus and S. epidermidis as the most common organisms causing surgical site infections[20]. Similar reports have been documented in an Indian Hospitals[21]. The prevalence of S. aureus in surgical wound infections has been attributed to the high rate of nasal carriage of this organism in patients and health care workers involved in the treatment of the patients[22]. The environment of operating suite has also been incriminated as an important source of bacterial colonizing surgical wound at the centre[23]. This is supported by the high rate of isolation of Bacillus spp in this study. These observations suggest the need for an improved infection control programme in the centre.

The organisms causing nosocomial infections have changed in medical practice over the years[24]. Whereas gram positive organisms were the predominant organisms involved in these infections, gram negative organisms are now being isolated at an increasing rate[25]. This shift may result from the greater complexity of the structure of the gram negative bacteria cell wall that made it to have intrinsic resistance to most antibacterial agents in use in the hospitals. This is shown in the high prevalence of Pseudomonas aeruginosa, and Escherichia coli, Klebsiella, Proteus, Enterobacter and other enterobacteria isolated in our study. Increasing isolation rate of Serratia odorifera as a pathogen in surgical wound infections as reported by other researchers[11,17] was also observed in our study.

It has been documented that the type of organisms infecting surgical wound is a reflection of the body system involved in the surgical operation[26]. According to the reports, these organisms which are normal inhabitants of the body system usually become opportunistic pathogens when their niche is violated. For example, if the gastro intestinal tract is violated then E. coli and Bacteroides are common isolates[26]. Similarly, if urinary tract is involved, S. saprophyticus, other CoNS, Pseudomonas and Proteus are the pathogens that would be most common[26]. The results of this study is actually in line with this position as there was a high rate of isolation of the enterobacteria and Bacteroides from operations that involve the head, chest wall, legs and abdomen. The organisms isolated from other part of the body were also good reflections of the microflora associated with those parts e.g S. saprophyticus from the scrotal sacs.

P. aeruginosa is an epitome of opportunistic nosocomial pathogens which is responsible for a wide range of infections and leads to substantial morbidity and mortality[27]. The incidence of postoperative wound infections due to Pseudomonas is high in this study. This corroborates the earlier studies[10] and it actually calls for a need to control the increasing relaxation of general hygienic measures in the community and increasing availability and usages of low quality antimicrobials.

Antibiotics were screened based on their chemical groups which reflect their modes of action, activities and mechanisms of resistance. These groups include; the β-lactams (penicillin and cephalosporin [β-lactamase susceptible or stable]), the macrolides (e.g. erythromycin, tobramycin), the fluoroquinolones (e.g. ofloxacin, ciprofloxacin), chloramphenicol and fusidic acid. The choices depends on their availability and use at the hospital.

Ciprofloxacin has been identified as the most potent drug available for the treatment of P. aeruginosa infection[27]. Our results showed that about 40% of the Pseudomonas species and 20% of the enterobacteria already demonstrated resistance to ciprofloxacin. However, in comparison with other antibiotics screened, our results showed that P. aeruginosa and other Pseudomonas spp isolated in this study demonstrated the lowest rate of resistance to ciprofloxacin. Similarly, although at a lower rate, reduced resistance of P. aeruginosa to ciprofloxacin has been reported in Jamaica in Latin America (19.6%), in Ilorin in Nigeria (24.7%), in India (26.22%) and in Kualar Lumpur (11.3%)[27].

It is to be noted however that, these observations under score the need for urgent steps to arrest the increasing incidence of resistance to the fluoroquinolones in this environment.

The results of this study indicated that Bacteroides isolates demonstrated high sensitivity to chloramphenicol, tobramycin, trimethoprim, metronidazole and the quinolones (ciprofloxacin and ofloxacin) being about 60% sensitive, whereas resistance to the β-lactam antibiotics (Penicillin V, Piperacillin, cephalothin and cephadroxil) were very high. These results are contrary to that obtained for anaerobes isolated from orofacial infections in an earlier study which reported good activities of the later agents against the anaerobes[2].

The reduced antibiotic susceptibility profile of all these pathogens suggested their importance for hospital acquired infections. In addition to this observation, although peri- operative prophylaxis has been shown to decrease the incidence of wound infection[1], the susceptibility data obtained in this study also suggested that most of the antibiotics used in this study would have very limited usefulness for the prophylaxis or the empirical treatment of these infections[3,29,30]. Our findings support the reported increasing trends of antibiotic resistance worldwide.

A regular surveillance should be carried out to monitor the susceptibility of these pathogens and chose appropriate regimens both for prophylaxis and treatment of surgical wound infections. There is a need to develop a viable antibiotic policy and draft guidelines to prevent or reduce indiscriminate use of antibiotics, and preserve their effectiveness for better patient management.

Continuous dialogue between the microbiology department and the surgeons is strongly advised in keeping with preventing and controlling surgical wound infections at minimal cost. This will encourage rational use of antimicrobial agents and help in curbing the menace of resistance to these agents.

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