Citation: Amira, A. Omer, Huda M. El-Amin, Magda J. Abozaied, Sabha A. Al-Mogamer. Aerobic bacteria associated with Post-operative Wound Infections in Sudanese Patients. African Journal of Medical Sciences, 2016, 1(12) ajmsc.info

Aerobic bacteria associated with Post-operative Wound Infections in Sudanese Patients

Amira A. Omer, Huda M. El-Amin, Magda J. Abozaied, Sabha A. Al-Mogamer
Faculty of Medical Laboratory Sciences, Al-Neelain University, Khartoum, Sudan

Abstract

Background: Surgical wound infections comprise 12% of all hospital -acquired infections. The rate of infection varies depending on the type of surgery undertaken. Especially high frequency rates are associated with contaminated surgery. The association of pathogenic bacterial strains with postoperative wound infections has been studied by many workers worldwide; however, such scientific research is inadequate in Sudan.

Objective: To study the association of aerobic bacteria with post-operative wound infections in Sudanese patients.

Materials and methods: 83 wound swabs were investigated. Standard bacteriological techniques were employed for isolation, identification, and sensitivity of pathogenic organisms. All patients were interviewed, demographical data were collected, and medical history was taken.

Results: 73 wound swabs (88 %) were found infected. The majority (98.8 %) was discharging; some were necrotic, bloody, and with foul smell. Patients investigated were 69.9 % males and 30.1 % females. About half of them had fever. Frequency rate of infection was higher in the age group 45-59 years. *Staphylococcus aureus* was the predominant bacterial species isolated (47.4%). Most of the wound infections had developed in the wards (67 %). Abscess opening was the commonest operation performed; and the frequency rate of infection was higher in Khartoum Teaching Hospital. The organisms isolated were highly sensitive to the antibiotic amikacin.

Conclusion: Most postoperative wound infections were prevalent among males above 45 years admitted in hospital wards rather than operating theatres. *Staphylococcus aureus* was the predominant bacterial species colonizing postoperative wounds; and the drug of choice for treating aerobic wound infections was amikacin.

Key words: Aerobic bacteria, Post-operative wound infections, Sudanese patients.

Introduction

Surgical wound infection is a common post-operative complication and causes significant post-operative morbidity, mortality, prolongs hospital stay, and adds between 10% - 20% to hospital costs. In1992, the term 'surgical wound infection' was changed to include infection of organs or spaces deep in the skin and soft tissue such as peritoneum and bone. Surgical site infection is classified into superficial site infection and organ or space infection[1].

The more common aerobic pathogens in wound infections are: *Staphylococcus aureus* (17%) and entercocci (13%).The less common are: *Proteus mirabilis* (4%) and *Klebsiella pneumoniae* (3%). The predisposing factors to wound infection can be age, obesity, malnutrition, endocrine disturbances, metabolic disorders, hypoxia, anemia, malignant diseases, immunosupression, and presence of necrotic tissue, foreign bodies, ischaemia, haematoma formation, and poor surgical techniques[2].
Microbiological contamination depends on type and virulence of the organism, in addition to size of bacteriological dose and antibiotic resistance. Prevention of surgical wound infection may be performed by antibiotic prophylaxis that decreases the risk of infection in certain types of surgery. The use of antibiotics to prevent wound infections may be helpful. Treatment is needed to eradicate established sepsis. Prophylaxis is important in surgery with a high risk of post-operative infection (e.g. colony surgery), or surgery where infection would be hazardous (e.g. prosthetic valves) [3].
The aim of this study was to isolate and identify the aerobic bacteria causing postoperative wound infections, as well as determining the suitable antibiotics for treatment of infected patients. The study also aimed to determine the age and gender incidence of wound infections, in addition to assessing the frequency rate of wound infections at different hospitals.

Materials and methods

This was a hospital-based, cross-sectional, descriptive, qualitative, case study. It was carried out at different hospitals in Khartoum State (Sudan) during the year 2003 in patients presenting with post-operative wound infections. The collected data were analyzed using master sheets and the Statistical Package of Social Science (SPSS) program. Approval to conduct the study was given by Al Neelain University (Khartoum). Permission to collect and investigate the specimens was granted by the Administrations of the different hospital enrolled in the study. Verbal consent of the patients investigated was obtained.
Sampling technique employed in this study was a non-probability, convenience sampling type. The sample size was 83 post-operative wound infection. Data were collected using a structural questionnaire covering demographical and clinical data, e.g. age, gender, occupation, medical history, type and date of operation, wound picture, antibiotics taken, and duration of therapy.
A wound swab from the infected area was collected from each post-operative wound, using a sterile swab and inserted in Ames transport medium.. In the laboratory all specimens were examined macroscopically for colour of discharge, smell, and presence of blood. Under aseptic conditions, each swab was inoculated in a plate of blood agar and a plate of Mac Conkey agar and streaked by a wire loop. The two plates were incubated aerobically at 37° C overnight. Each swab was examined using Gram stain. Blood agar inoculated plates were morphologically examined for size, colour, and haemolysis. Mac Conkey inoculated plates were examined for colour, size, and lactose fermentation.
Gram positive cocci were identified by catalase test, coagulase test, DNAse test, bacitracin sensitivity test, and heat resistance test. Grain negative rods were identified by indole test, oxidase test, citrate utilization test, urease test, motility test, and Kligler iron agar test. The analytical profile index (API-20 E) was used for *Enterobacteriaceae* identification.
Anti-microbial sensitivity testing was performed by the Kirby-Bauer technique. The turbidity of the isolate suspension was matched to the turbidity of the Mc Farland standard; and the suspension was streaked over the surface of a Muller Hinton agar plate.

Then the plate was allowed 3-5 minutes to dry up; and using a sterile forceps the antimicrobial discs were distributed evenly on the inoculated plate. The antibiotic discs tested were: ciprofloxacin (5 mcg), cephalexin (30 mcg), carbenicillin (100 mcg), rifampicin (5 mcg), amikacin (10 mcg), co-amoxiclav (20 mcg), and ceftriaxone (30 mcg). The plate was inverted and incubated aerobically at 37°C. After overnight incubation the control and test plates were examined to ensure the confluence of the growth. Using a ruler on the underside of the plate the diameter of each zone of inhibition was measured in mm. The end - point of inhibition was that where growth starts.

A pathogen reported as sensitive implies that the infection responds to treatment when the drug was used at the recommended dose and administered via the appropriate route. A pathogen reported as resistant implies that the infection would not respond to treatment with the drug irrespective of dose or site of administration. A pathogen reported as intermediately sensitive implies that the infection was likely to respond to treatment when the drug was prescribed at larger doses or the drug was concentrated at the site of infection.

Results

A total of 83 postoperative wound swabs were investigated. 73 swabs (88%) were infected and 28 of them (33.7%) had a foul smell. Nearly 48 (57.8%) of these postoperative wounds were bloody. On the other hand, the degree of necrosis (24.1 %) was moderate; and the majority (98.8%) was discharging exudates.

58 of these swabs (69.9%) were collected from males, and 25 of them (30.1%) were collected from females. The general condition of these patients was satisfactory; however 41 of them (49.4%) were febrile. Bacterial strains were isolated from 73 wound swabs (88%) and no bacterial growth was detected in 10 swabs (12%) only.

Two organisms were isolated from each of five swabs; however *Staphylococcus* species was one of these two, i.e. total isolates were 78 bacterial species. 66 wound infections (67.0%) developed in the wards, and about 19 cases (21.6%) derived the infection from the theatre.

Furthermore, 27 surgical excisions of abscesses represented the majority (37%) of infected wounds, followed by 18 infected surgical amputations (24.7%). 10 postoperative (12%) were not infected.

Infected wounds were more frequent among patients in the age range 45-59 years and least frequent among those in the age range 1-14 years. From the 34 wound swabs collected from the patients attending Khartoum Teaching Hospital, 31 were found infected (91.1 %).

Coagulase-positive *Staph. aureus* was the predominant (47.4%) pathogen isolated, followed by *Pseudomonas aeruginosa* (15.4%) and *E.coli* (12.8%). All pathogenic organisms were isolated in heavy, pure growth (Table I).

Sensitivity tests were performed on all isolated organisms. These organisms were found to be highly sensitive to amikacin (75.6%), ciprofloxacin (52.6%), and rifampicin (44.9 %). Sensitivity to cefalexin (15.4 %) was poor (Table II).

Discussion

A large number of postoperative wound infections are encountered in hospitals. The causes of this condition are manifold and may be attributed to bacterial strains.

Table (I): Organisms isolated from postoperative wounds

Enterobacteriaceae	Other isolates
E. coil 10 (12.8%)	*Staph. aureus* 37 (47.4%)
K. pneumoniae 3 (3.8%)	*Ps. aeruginosa* 12 (15.4%)
Proteus mirabilis 4 (5.2%)	*Enterococcus faecalis* 3 (3.8%)
Citrobacter spp. 1 (1.3%)	*Coagulase negative staph.* 3 (3.8%)
Providencia spp. 1 (1.3%)	*Strep. pyogenes* 2 (2.6%)
Enterobacter cloacae 1 (1.3%)	No bacterial growth 10 (12%)
Serratia marscens 1 (1.3%)	Total 83 (100%)

In this context only aerobic bacteria had been studied since facilities for anaerobic culture were not feasible. Risk of wound infections varies with type of surgery. In clean surgeries, the infection frequency rate is 1-2 % and dirty operations may give an infection frequency rate up to 40%[4]. In the present study, the infection frequency rate in drainage operations of abscesses was 37 %, and in clean surgeries of renal stones and prostatectomy were 2 %.

Many workers found *Staph.aureus* to be the commonest organism isolated from postoperative wound infections. The incidence rate may reach 17 %. *E.coli* comes in the second place, and *K. pneumoniae* (3 %) was the least isolated[5].

In the present context, *S. aureus* was the predominant (47.4%); this frequency rate was higher than reported by other workers (17%) [6].

Regarding *E. coli* (12.8 %) and *K. pneumoniae* (3.8 %), the infection rates are quite similar.

There is no single organism to blame for causation of wound infections; since bacterial cultures of infected wounds yield usually different isolates and there is hardly any pathogenic organism which has not been isolated from such specimens.

From the 73 infected wound swabs investigated in this study, five swabs were found to contain two organisms, and staphylococci were the common bacterium in each of them. Nine of the organisms isolated in the present study were bacterial strains usually considered to be normal flora of the alimentary tract (Table 1). Two organisms whose habitat is outside the alimentary tract (*S. pyogenes* and staphylococci) were isolated in culture. The routes by which these organisms were able to contaminate surgical wounds may be endogenous or exogenous.

Some surgeons used to put their patients on conventional antibiotic prophylaxis. This procedure is not advocated in clean surgeries to avoid the emergence of resistance and failure of treatment. The isolation of bacteria strains in pure, heavy growth from infected wounds as shown in our study, is really needed to determine the best treatment of infection.

Incidence of wound infection was reported to be highest among neonates and elderly[7].

In this study the majority of wound infections were encountered in the age range 45-59 years, and least in the age range 1-14 years.

Table (II): Sensitivity pattern of isolated pathogens

Bacteria isolated	Number of organisms sensitive to:						
	CIP	CN	CB	AMC	RA	AN	CRO
S. aureus	17	6	9	9	21	25	9
Ps. aeruginosa	7	1	1	3	4	8	2
E. coli	6	2	2	5	2	9	4
Enterococcus faecalis	1	0	0	2	2	2	0
K. pneumoniae	0	0	0	1	1	3	0
Streptococcus pyogenes	2	1	2	2	2	1	2
Coagulase negative *Staph*	2	0	0	1	1	3	1
Proteus mirabilis	2	1	1	3	2	4	2
Citrobacter spp	1	1	0	0	0	1	1
Providencia spp	1	0	0	0	0	1	1
Enterobacter cloacae	1	0	0	0	0	1	1
Serratia marscens	1	0	0	0	0	1	0
Total	41	12	15	0	35	59	23
% Sensitive	52.6	15.4	19.2	33.3	44.9	75.6	29.5

CIP = Ciprofloxacin CN = Cefalexin CB = Carbenicillin AMC = Co-amoxiclav
RA = Rifampicin AN = Amikacin CRO = Ceftriaxone

Surgical operations on the gastrointestinal tract usually carry a potentially high risk of sepsis. Sepsis is one of the most important causes of postoperative morbidity[8].

Among males, infection of wounds was more prevalent (69.9 %) than among females (30.1%). This may be explained by the higher number of males attending hospitals for surgical operations. The presence of blood in 48 wound swabs, and the foul smell in 28 wound swabs (33.7 %), together with the high frequency rate of discharge (98.8%) and necrosis (24.1%), indicates the great degree of infection and distortion of the specimens investigated.

On the other hand, almost half of the infected patients (49.4%) developed fever. This may point out to the possibility of bacteraemia associated with wound infections in the patients studied. The source of wound infection was mainly from the wards (67 %) and about 21.6% of infections were derived from the surgical theatre. Comparing these figures with that reported internationally[9].

The frequency of postoperative wound infections was higher in Khartoum Teaching Hospital (91.1%). Although no hospital in Khartoum was free from wound infections, yet the high load of patients attending Khartoum Teaching Hospital explains this frequency rate of infectivity.

The overall sensitivity pattern of all pathogenic organisms (Table II) showed a high sensitivity rate of amikacin (75.6%). This was followed by ciprofloxacin (52.6%), and rifampicin (44.9%). Treatment of wound infections must be based on the isolation and identification of the causative organism and its sensitivity pattern. In some hospitals in Khartoum this may not be available in every case because of lack of facilities. In such circumstances and when bacterial infection is suspected, it is recommended to put the patient on amikacin (the drug of choice), provided that the patient is not allergic to this antibiotic. Ciprofloxacin comes next in priority; however, it is contraindicated for children and pregnant or lactating ladies. The drug of choice may be started (if needed) before the laboratory report is back.

Ludlan and his colleagues[10] reported that the choice of antimicrobial agents depends upon the organisms that are likely to colonize the operation site. Hence the determination of bacterial species related to postoperative wound infections is the first step for prevention of pre-operative sepsis. The final choice of an antibiotic will be the one capable of providing predictable inhibition of bacterial growth with lowest risk of side effects.
The rationale behind antimicrobial administration is that a sufficient dose of antibiotic should be present in the tissues and the circulation at the time when bacteria are released into the surgical field[11].

The antibiotic next sensitive (alternative choice) may be of value when the patient is allergic to the drug of first choice. The high prevalence of resistance to the antibiotics employed in this study such as cefalexin and carbenicillin (Table II) had raised considerable alarm. The factors favoring antibiotic resistance may be due to previous use of antibiotics by the patient or widespread misuse of antibiotics in the community, resulting in a shift of the bacterial species[12].
Conclusion: Most postoperative wound infections were prevalent among males above 45 years admitted in hospital wards rather than operating theatres. *Staphylococcus aureus* was the predominant bacterial species colonizing postoperative wounds; and the drug of choice for treating aerobic wound infections was amikacin.

References

1. Broderick A, Mori M, Ncttleman M.D, Streed S.A, Wenel, R.P. Nosocomial: validation of surveillance and computer modeling to identify patients at risk. *Am J Epidemiol.* 1990; 131:734-742.
2-Bross J, Talbot Gil, Maislin G, Hurwit, S, Strom, B. L. Risk factors for nosocomial candidemia: a case control study in adults without leukemia. *Am J Med.* 1989; 87: 614-620.
3. Cruse PJ, Foord, R. The epidemiology of wound infection: a 10 year prospective study of 62, 939 wounds. *Surg Clin north Am* 1980; 60: 27-40.
4. Wenel, R.P. The mortality of hospital-acquired blood-stream infection. Any need for a new vital statistics? *Inter. J. Epidcmiol.*1988; 17:225-227.
5. Hunter, P.R. Reproducibility and indices of discriminatory power of microbial typing methods *J. CIin. Microbiol.* 1990; 28:1903-1906.
6- Emori, T.G, Haley, R.W, Garner, J.S. Technique and use of nosocomial infections surveillance in U.S .hospitals. *Am J Med.* 1981; 70:933-940.
7. Goldmann, D.A. New microbiologic techniques for hospital epidemiology. Eur. *J. CIin..Microbiol.*1987; 6:344-348.
8. Maki, D.G, Weisc, C.D. and Sarafin, H.W. A semiquantitative culture method for identifying intravenous-catheter infection N. Engl. J. Med. 1977; 269:1305-1309.
9. Wey, S.B, Mori M, Pfallcr, M A, Woolson R.F, Wenel R.P. Hospital-acquired candidemia: attributable mortality and excess length of stay. *Arch Intern Med* 1988; 148: 2642-2645.
10. Ludlan, H.A., Noble, WC, Marples, R.R, and Phillips, I. The evaluation of typing scheme for coagulasc- negative staphylococci suitable for epidemiological studies. *J. Med .Microbiol.* 1989; 30:161-164.
11, Miller, J.M. Molecular technology for hospital epidemiology. *Microbiol.Infect.Dis.*1993; 16:153-158
12. Omer, El Fadhil E, El-Haj, A.I. Urinary tract infections in school children. *Medicine Digest*, 1992; 18 (6): 3-8.