A STUDY OF SENSITIVITY PATTERN ANALYSIS OF SURGICAL WOUND ISOLATES IN A TERTIARY CARE HOSPITAL

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ABSTRACT

BACKGROUND

The common Health Care Associated Infection (HCAI) as per CDC updated 2007 is UTI (32%) followed by postoperative wound infections (22%), nosocomial pneumonia (15%) and nosocomial septicaemia (14%).^[1]

MATERIALS AND METHODS

The study was conducted in the Department of Microbiology, Govt. Medical College, Calicut for a period of one year from July 2007 to June 2008. The total number of elective and emergency surgeries done during the one-year period in the three units was 1902 which included 1074 elective (major) and 828 emergency cases. One hundred and two cases of clinically suspected postoperative wound infection (Fifty-nine elective and forty-three emergency) from the above cases was studied in detail. The study included twenty-seven 'clean', thirty-two 'clean-contaminated', thirteen 'contaminated' and thirty 'dirty' cases. Records of these cases were analysed for preoperative antibiotic prophylaxis.

RESULTS

The commonest microorganism causing wound infection in the study was Staphylococcus aureus followed by Escherichia coli, Pseudomonas aeruginosa and Enterobacter. Klebsiella, Acinetobacter and Serratia was isolated from one case each. Pseudomonas aeruginosa was isolated from 4 cases.

CONCLUSION

The study was selected to find out the sensitivity pattern of surgical site infection isolates in these patients which is responsible for much morbidity and mortality to patients. The most important isolate in the study was Staphylococcus aureus in clean surgeries. In clean-contaminated, contaminated and dirty surgery cases, multidrug resistant E. coli and Staphylococcus aureus (MRSA) were the main pathogens followed by Pseudomonas, Enterobacter, Acinetobacter and Klebsiella. Antibiotics have a definite role in the treatment of established infections. Development of a suitable antibiotic policy along with proper surveillance programme is essential for our hospital to reduce the postoperative wound infection rates.

KEYWORDS

Post-Operative Wound Infection, Antibiotic Sensitivity.

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BACKGROUND

It is important to have a clear understanding of the terms used for wound infection. Since 1985 the most commonly used terms have included wound contamination, wound colonisation, wound infection and more recently, critical colonisation. These terms can be defined as: Wound contamination: The presence of bacteria within a wound without any host reaction.^[2] Wound colonisation: The presence of bacteria within the wound which do multiply or initiate a host reaction.^[2] Critical colonisation: Multiplication of bacteria causing a delay in wound healing, usually associated with an exacerbation of pain not previously reported but still with no overt host reaction.^[3,4] Wound infection: The deposition and multiplication of bacteria in tissue with an associated host reaction.^[2]

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Recognition of wound infection: The inflammatory response is a protective mechanism that aims to neutralise and destroy any toxic agents at the site of injury and restore tissue homeostasis.^[5] There are a number of indicators of infection. These include the classical signs related to the inflammatory process and further more subtle changes as highlighted by Cutting and Harding.^[6] The classical signs of infection include: Localised erythema, Localised pain, Localised heat, Cellulitis and Oedema. Further criteria include: Abscess, Discharge which may be viscous in nature, discoloured and purulent; Delayed healing not previously anticipated, Discolouration of tissues both within and at the wound margins, Friable, bleeding granulation tissue despite gentle handling and the non-adhesive nature of wound management materials used; Unexpected pain and/or tenderness either at the time change of dressing or reported by the patient as associated specifically with the wound even when the wound dressing is in place; Abnormal smell, Wound breakdown associated with wound pocketing/bridging at base of wound, i.e., when a wound that was assessed as healing starts to develop strips of granulation tissue in the base as opposed to a uniform spread of granulation tissue across the whole of the wound bed. The above criteria should be used as discriminating factors when the 'classic' signs of wound infection do not appear to be present but the presence

of a wound infection is suspected. Surgical wounds are classified based on the presumed magnitude of the bacterial load at the time of surgery.^[7]

According to WHO report 2002, prevalence rate of health care associated infection (HCAI) is 7.7% - 9% in developed countries and 10-11.8% in developing countries. The common HCAI as per CDC updated 2007 is UTI (32%) followed by postoperative wound infections (22%), nosocomial pneumonia (15%) and nosocomial septicemia (14%).^[1]

MATERIALS AND METHODS

Samples were collected from patients with suspected postoperative wound infection, using sterile cotton swabs. The wound was thoroughly irrigated with sterile normal saline until all visible debris had been washed away. Care was taken not to clean the wound with Betadine or any other antiseptic solution before swabbing the area. The area selected was the highly vascular granulation tissue rather than the yellow fibrous slough. The material was collected by pressing the swab over the clean wound surface to extract tissue fluid as this may contain the potential pathogen.^[8,9] Two swabs were collected from each site. One swab was used for direct smear examination after Gram staining. The second swab was subjected to culture and antibiotic sensitivity testing by standard microbiological techniques. The swab was plated on Blood agar and MacConkey's agar. Blood agar plates were incubated in the candle jar (CO₂) at 37°C for 24 hours. A sterile report was given only after 48 hours of incubation. From the culture plates, Gram stained smears were made from different types of colonies after noting the colony characteristics. Identification of bacteria was carried out as described by Koneman's textbook of microbiology (sixth edition).^[10] Antibiotic sensitivity testing of the isolates was done by the Stokes method for Staphylococcus and Kirby Bauer method for Gram-negative bacilli. The following antibiotic discs were used for sensitivity testing of Gram-positive cocci: Penicillin (10 units), Erythromycin (15 mcg), Gentamicin (10 mcg), Vancomycin (30 mcg), Cefazolin (30 mcg). Oxacillin screen agar was used for Staphylococci. Ampicillin (10 mcg), Gentamicin (10 mcg), Cefazolin (30 mcg), Ceftriaxone (30 mcg), Amikacin (30 mcg), Ciprofloxacin (5 mcg) were used for sensitivity testing of Gram-negative bacilli. For Pseudomonas Ceftazidime (30 mcg) (HiMedia Laboratories Pvt. Ltd. Mumbai.) was also used. In 50 cases, a repeat swab was taken and processed as there was a delay in wound healing and poor response to treatment. All cases were followed up to the date of discharge. Condition of the wound was noted at the time of discharge from the hospital.

RESULTS

Total number of surgeries done during the one year period in the three surgical units was 1902 which comprised of 1074 elective and 828 emergency cases. One hundred and two suspected postoperative wounds were studied. Twenty-seven were of the 'clean' type of surgical wounds, thirty-two of the 'clean-contaminated', thirteen of the 'contaminated' and thirty of the 'dirty' cases. The incidence of postoperative wound infection was 5.36%. Among one hundred and two clinically suspected cases studied, bacteriologically proven surgical site infection was identified in thirty-six patients. The prevalence of infection being 35% (36/102). In the 'clean'

surgical group, five patients developed infection, the prevalence was 18.5%. Prevalence of Infection in the 'clean-contaminated' group was 37.5% (12/32). In the 'contaminated' group, it was 38.5% (5/13) and in the 'dirty' group it was 47% (14/30). Lowest infection rate was seen in clean surgery followed by clean-contaminated, contaminated and dirty surgeries. Out of the thirty-six infected cases, thirty-one cases showed infection with single organism and five cases showed mixed infection.

The pathogenic organisms isolated from the thirty-six cases of wound infection are given below. (Table 1a).

Staphylococcus aureus was isolated from 18 cases, Escherichia coli from 15 cases and Enterobacter from 2 cases. Klebsiella, Acinetobacter and Serratia was isolated from one case each. Pseudomonas aeruginosa was isolated from 4 cases. Five cases showed mixed infection. One case of mixed infection was with three organisms and four cases with two organisms (Table 1c).

Organisms	No. of Isolates	% of Isolation
Staphylococcus aureus	18	43
Escherichia Coli	15	36
Pseudomonas aeruginosa	4	9.5
Klebsiella oxytoca	1	2.3
Enterobacter kobei	1	2.3
Enterobacter intermedius	1	2.3
Acinetobacter baumannii	1	2.3
Serratia marcescens	1	2.3
Total	42	100

Table 1a. Organisms Isolated from Infected Wounds

The commonest microorganism causing wound infection in the study was Staphylococcus aureus. Staphylococcus aureus was isolated from cases of laparotomy (6), mastectomy (4), gastrectomy (1), abscess incision and drainage (1), APR for Ca rectum (2), paraumbilical hernia with appendicular abscess (1), Trendelenburg operation (1), appendicectomy (2). Fifteen out of the eighteen isolates of Staphylococcus aureus were MRSA. The three Methicillin sensitive Staphylococcus aureus were from the 'clean' surgical group. Seven MRSA were from the 'clean-contaminated', two from the 'contaminated' and six from the 'dirty' group.

Multidrug resistant Gram-negative bacilli were the predominant organisms isolated from the 'clean-contaminated', 'contaminated' and 'dirty' type of surgery.

Escherichia coli was isolated from cases of laparotomy (9), tracheal resection (2), APR for Ca rectum (3), cholecystectomy (1). There was a total of four isolates of Pseudomonas aeruginosa, from cases of laparotomy (3) and Trendelenburg operation (1). Enterobacter was isolated from cases of triple anastomosis (1), hernia repair (1). Klebsiella oxytoca (1) was isolated from a case of laparotomy. Acinetobacter baumannii was isolated from one case of Trendelenburg operation and Serratia marcescens from one 'clean' case of lipoma excision (Table 1b). Repeat swabs were collected after 3-4 days in all culture-positive cases. Same results were obtained except in one case of paraumbilical hernia with appendicular abscess where first swab grew Coagulase-negative staphylococci and repeat swab yielded growth of Staphylococcus aureus (MRSA).

Type of Surgery	Infected No. of Cases	Organisms Isolated	No. of Isolates
Laparotomy	17	Escherichia Coli	7
		Staphylococcus aureus	6
		Pseudomonas aeruginosa	2
		Klebsiella oxytoca	1
		Enterobacter intermedius	1
Hernia repair	1	Enterobacter kobei	1
Mastectomy	4	Staphylococcus aureus	4
Appendicectomy	2	Staphylococcus aureus	2
APR for Ca rectum	2	Staphylococcus aureus,	1
		Escherichia Coli	1
Abscess I & D	1	Staphylococcus aureus	1
Cholecystectomy	1	Escherichia Coli	1
Tracheal resection	2	Escherichia Coli	2
Lipoma excision	1	Serratia marcescens	1
Table 1b. Relationship between the Type of Surgery and Organisms in 31 cases which were Infected with Single Organism			

Mixed bacterial infection was observed in five cases. These were three cases of laparotomy, one case of APR for Ca rectum and one case of Trendelenburg operation. Infection with Escherichia coli and Staphylococcus aureus occurred in

Antibiotic	S. aureus 18	E. Coli 15	Enterobacter 2	Pyo 4	Kleb 1	Serratia 1	Acineto 1
Penicillin	Nil	NT	NT	NT	NT	NT	NT
Erythromycin	Nil	NT	NT	NT	NT	NT	NT
Gentamicin	22.2	13.3	Nil	25	100	Nil	100
Ampicillin	NT	Nil	Nil	NT	Nil	Nil	Nil
Vancomycin	100	NT	NT	NT	NT	NT	NT
Cefazolin	22.2	Nil	Nil	Nil	Nil	Nil	100
Ceftazidime	NT	NT	NT	25	NT	NT	NT
Oxacillin	27.7	NT	NT	NT	NT	NT	NT
Piperacillin	NT	NT	NT	25	NT	NT	NT
Amikacin	NT	73.3	100	25	100	Nil	100
Ciprofloxacin	NT	Nil	50	25	Nil	Nil	100
Ceftriaxone	NT	Nil	Nil	NT	Nil	Nil	100

Table 2. ABST Pattern of the Isolates in (%)

NT – Not tested

Enterobacter isolates showed 50% sensitivity towards ciprofloxacin. Only one out of the four isolates of Pseudomonas was sensitive to cephalosporins & aminoglycosides. The single isolate of Acinetobacter baumannii showed 100% sensitivity towards amikacin, gentamicin, ciprofloxacin and ceftriaxone. The single isolate of Serratia marcescens was resistant towards the first line antibiotics (ampicillin, gentamicin) and second line antibiotics (amikacin, 3rd generation cephalosporins and ciprofloxacin) that are routinely used for Gram-negative

one case of APR for Ca rectum, and in two cases of laparotomy. Pseudomonas aeruginosa and E. coli mixed infection was seen in one case of laparotomy. Infection with Acinetobacter baumannii, Pseudomonas aeruginosa and Staphylococcus aureus occurred in one case of Trendelenburg operation. (Table 1c).

Type of Surgery	No.	Organisms Isolated
APR for Ca rectum	1	Escherichia coli, Staphylococcus aureus
Laparotomy	2	Escherichia Coli, Staphylococcus aureus
	1	Pseudomonas aeruginosa, Escherichia Coli
Trendelenburg operation	1	Acinetobacter baumannii, Pseudomonas aeruginosa, Staphylococcus aureus

Table 1c. Infection with Multiple Organisms

Analysis of the antibiotic sensitivity pattern of the isolates: There were eighteen isolates of Staphylococcus aureus. None of the isolates were sensitive to penicillin and erythromycin. 100% sensitivity was shown towards vancomycin. There were fifteen isolates of MRSA (Methicillin-resistant Staphylococcus aureus). Cloxacillin had 28% sensitivity. Only three isolates of staphylococcus aureus were Cloxacillin sensitive. 22% of the isolates were sensitive to gentamicin. Among the isolates of Gram-negative bacilli, none were sensitive to Ampicillin. There were total twenty-four Gram-negative bacterial isolates, twenty-two were multidrug resistant (92%). Of the Gram-negative isolates, fifteen were Escherichia coli. All the strains were resistant to ampicillin, cefazolin, ceftriaxone, ciprofloxacin. Amikacin had a sensitivity of 73.3%. Ten isolates of E. coli were sensitive only to amikacin, two isolates were sensitive to both gentamicin and amikacin.

bacilli. All Gram-negative isolates were sensitive to imipenem (100%). ESBL was not detected due to limited resources.

DISCUSSION

The incidence and pattern of wound infection varies from centre to centre. In the present study, the incidence of postoperative wound infection is 5.36% of the one hundred and two clinically suspected cases of post-operative wound infection studied. Prevalence of infection in the study group is 35%.

The prevalence of postoperative wound infection among 'clean' cases was 18.5%, 'clean-contaminated' 37.5%, 'contaminated' 38.5% and 'dirty' 47%.

While the global estimates of SSI have varied from 0.5–15%, studies in India have consistently shown higher rates ranging from 23–38%.^{11,12} In a prospective study of surgical site infections in a teaching hospital in Goa, the overall SSI rate was estimated to be 30.7%. 5.4% for clean, 35.5% clean-contaminated and 78.8% for contaminated operations.¹³ Antibiotic sensitivity pattern of the isolates: Penicillin resistance was seen in eighteen of the isolates of *Staphylococcus aureus* in this study. Erythromycin resistance was also eighteen. Fifteen of the isolates were resistant to Cloxacillin.

None of the Gram-negative bacilli isolated in this study was sensitive to Ampicillin. All the *Escherichia coli* isolated from wound infection showed multiple resistance. Amikacin sensitivity was 73.3% for *E. coli*. One isolate of *Escherichia coli*, was resistant to all routine antibiotics & was sensitive to imipenem only. Table 2 explains the ABST of the isolates. In a prospective study of surgical site infections in a teaching hospital in Goa, 79% of isolates were Gram-negative and almost 64% demonstrated polyantimicrobial resistance.¹³ Data from the NNIS CDC 2007 shows that multidrug resistant *Klebsiella*, *E. coli*, *Acinetobacter*, *Pseudomonas*, etc. are now the major hospital pathogen.^{1,14}

Escherichia coli were the most resistant organisms causing wound infection among the Gram-negative bacilli in the present study. Patients in this study belonged to 18 to 83 years of age group. Maximum number of cases were between 15-25 years of age (20 cases) and 46-55 years of age (20 cases). Maximum infection rate was observed in old age, particularly between 76-85 years of age (67%). Four out of the six cases in this group got infected.

Sex

Out of the one hundred and two cases, thirty-two patients were female and seventy patients were male. A slightly higher infection rate of 36% (25/70) was observed in the males compared to 34.3% (11/32) in females. Diabetes, hypertension and anaemia were not observed in majority of the cases. So its influence on wound infection could not be studied in detail.

CONCLUSION

Postoperative wound infection (surgical site infection) is an important aspect of nosocomial infections which is a serious problem in hospital practice. The study was selected to find

out the pattern of postoperative wound infection and the role of antibiotics in these patients which is responsible for much morbidity and mortality to patients. One hundred and two cases of postoperative wounds were studied in detail during the one year period from July 2007 to June 2008 at Calicut medical college. The prevalence rate of post-operative wound infection among study group was 35%. The most important isolate in the study was *Staphylococcus aureus* in clean surgeries. In clean-contaminated, contaminated and dirty surgery cases, multidrug resistant *E. coli* and *Staphylococcus aureus* (MRSA) were the main pathogens followed by *Pseudomonas*, *Enterobacter*, *Acinetobacter* and *Klebsiella*. The incidence of post-operative wound infection was 5.36%. Even the clean category surgery patients received antibiotic prophylaxis which may be the reason for the low incidence of post-operative wound infection. Antibiotics have a definite role in the treatment of established infections. Development of a suitable antibiotic policy along with proper surveillance programme is essential for our hospital to reduce the postoperative wound infection rates.

REFERENCES

- [1] Bai RJT. Hospital infection-present scenario. Proceedings of the fourth triennial conference of the academy of clinical Microbiologists and pre-conference seminar on changing trends in hospital infections 2008;18-23.
- [2] Ayton M. Wound care: wounds that won't heal. *Nurs Times* 1985;81(46):16-9.
- [3] Falanga V, Grinnell F, Gilchrist B, et al. Workshop on the pathogenesis of chronic wounds. *J Invest Dermatol* 1994;102(1):125-7.
- [4] Kingsley A. A proactive approach to wound infection. *Nurs stand* 2001;15(30):50-4, 56, 58.
- [5] Collier M. Understanding wound inflammation. *Nurs Times* 2003;99(25):63-4.
- [6] Cutting KF, Harding KG. Criteria for identifying wound infection. *J wound care* 1994;3(4):198-201.
- [7] Martone WJ, Nichols RL. Recognition, prevention, surveillance, and management of surgical site infections: introduction to the problem and symposium overview. *Clin Infect Dis* 2001;33(Suppl 2):S67-8.
- [8] Howe CW. Postoperative wound infections due to *staphylococcus aureus*. *N Engl J Med* 1954;251(11):411-7.
- [9] Pulaski EJ. Discriminate antibiotic prophylaxis in elective surgery. *Surg Gynecol Obstet* 1959;108(4):385-8.
- [10] McKittrick LS, Wheelock FC. The routine use of antibiotics in elective abdominal surgery. *Surg Gyn Obstet* 1954;99(3):376-7.
- [11] Ganguly PS, Khan Y, Malik A. Nosocomial infections & hospital procedures. *Indian J Commun Med* 2000;25:990-1014.
- [12] Subramanian KA, Prakash A, Shrinivas, et al. Post-operative wound infection. *Ind J Surg* 1973:57-64.
- [13] Kamat US, Fereirra AMA, Kulkarni MS, et al. A prospective study of surgical site infections in a teaching hospital in Goa. *Indian J Surg* 2008;70(3):120-4.
- [14] National nosocomial infections surveillance system. Centers for disease control and prevention (CDC). Health care associated infection (HCAI) updated 2007.