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Aerobic Bacterial Isolates from Post-Surgical Wound and Their Antimicrobial Susceptibility Pattern

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Abstract: *Post-operative wound infections as well as emergence and spread of drug resistant strains have been found to pose a major problem in the field of surgery. This study investigated common aerobic bacterial isolates and their antimicrobial susceptibility patterns in patients with clinical diagnosis of post-surgical wound infections. Microbial analysis was carried on pus samples obtained from 1000 patients with clinical diagnosis of postsurgical wound infections at S.V.R.R Government General Hospital, from November 2016 to September 2017.Out of 1000 patients admitted for surgery 145 (14.5%) suffered from wound infections. Of these, 70 out of 277 (25.27%) were emergency surgery patients and 75 out of 723 (10.37%) were elective surgery. The infection rate was 32.2% in dirty wounds followed by 30% in contaminated wounds, 9.39% in clean-contaminated and 3.84% in clean wounds. Only 10.37% with pre-operative antibiotic prophylaxis developed infection as compared to 25.27% without antibiotic prophylaxis. The bacterial profile showed polymicrobial flora comprising of Staphylococcus aureus (33.93%), Pseudomonas aeruginosa (20.60%), Escherichia coli (15.75%), Klebsiella pneumoniae (9.69%),Coagulase negative Staphylococcus (7.87%), Proteus mirabilis (5.45%) Proteus vulgaris (3.03%) and Citrobacter species (3.63%). Post-operative wound infections are a serious medical problem that has to be tackled due to its increased morbidity, mortality.The high isolation rate of aerobic bacteria and their increased resistance to the commonly used antibiotics warrants the need to practice aseptic procedures and rational use of antimicrobial agents leading to minimizing infection rate and emergence of drug resistance and medical care costs. An active surveillance program is therefore recommended.Post-operative wound infections as well as emergence and spread of drug resistant strains have been found to pose a major problem in the field of surgery. This study investigated common aerobic bacterial isolates and their antimicrobial susceptibility patterns in patients with clinical diagnosis of post-surgical wound infections. Microbial analysis was carried on pus samples obtained from 1000 patients with clinical diagnosis of postsurgical wound infections at S.V.R.R Government General Hospital, from November 2016 to September 2017.*

Keywords: *Wound infections; Post-operative infections; Antimicrobial susceptibility testing*

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I. Introduction

When a patient enters the specialized environment of a modern hospital, he is exposed to both known and ill-defined hazards. Infection is encountered when the first line of host defense-the cutaneous or mucosal barrier between environmental microbes and the host's internal defence mechanism is impaired. Infections that result from operative treatment include wound infection, postoperative abscess, postoperative peritonitis, other post-operative body cavity infections, other hospital acquired infections among which are pneumonia, urinary tract infections and vascular catheter related infections [1]. The development of surgical infection depends on several factors like microbial pathogenicity, host defenses, local environmental factors and surgical techniques.Postoperative wound infection seldom causes death, yet it does prove to be an economic burden on the patient and the hospital administration because of prolonged convalescence, prolonged postoperative hospital stay, additional expenditure, nursing care and an unnecessary waste of time.For effective control of wound infections and administration of judicious therapy, the data regarding the causative organisms, their antibiotic sensitivity patterns and their special characteristic must be made available. With this point of view, the present study was undertaken to study the problem of post-operative wound infection in our hospital in reference to various factors directly or indirectly related to wound infection.

II. Materials And Methods

A total of 1000 patients admitted in two surgical units, two Gynecology and Obstetrics unit, one orthopedic unit, one Ear Nose and Throat (ENT) unit, one ophthalmology unit and one paediatric surgery unit of S.V.R.R Government General Hospital, Tirupathi were included in the study. Of the 1000 patients, 642 were male and 358 were female. Patients were specified into two groups:

1. Planned elective operative cases

2. 1 Emergency Operative Cases

The operative wound was inspected at frequent intervals for clinical evidence of infection. When infection was suspected, two swabs were taken by using sterile cotton swab sticks. The first swab was used for Gram staining and the second inoculated on plates of Nutrient agar, Blood agar and McConkey's agar respectively. The isolates Staphylococci, *Pseudomonas aeruginosa* , *Escherichia coli*, *Klebsiella*, Proteus and Citrobacter were identified using standard identification protocols [2]. Staphylococcus aureus ATCC 25923,Escherichia coli ATCC 25922Pseudomonas ATCC 27853 were used as the standard control strains for antibiotic sensitivity testing. The antibiotic sensitivity testing was done using Kirby Bauer disc diffusion technique [3]. The antibiotic discs used were according to the local prescribing pattern as per the antibiotic policy of the Hospital. For Gram positive cocci discs of Penicillin (10 units), Erythromycin (15 µgm), Cloxacillin (5 µgm), Gentamycin (10 µgm), Ampicillin (10 µgm) and Vancomycin (35 µgm) were used. For *Pseudomonas* isolates discs of Amikacin (30 µgm), Ceftriaxone (30 µgm), Cefotaxime (30 µgm), Gentamycin (10 µgm), Ciprofloxacin (5 µgm) and Norfloxacin (10 µgm). For other Gram negative isolates discs of Cefotaxime (30 µgm), Ciprofloxacin (5 µgm), Norfloxacin (10 µgm), Gentamycin (10 µgm), Ampicillin (10 µgm) and Tetracycline (30 µgm) were used.Centre for Disease control (CDC) criteria were used for defining the type of surgical wound [4].Clean: non traumatic wound, no inflammation, no break in technique. Respiratory, alimentary and genitourinary tract not entered.Clean contaminated: non traumatic wound, minor break in technique. Respiratory, alimentary or genitourinary tract entered without significant spillage.Contaminated: Fresh traumatic wound or operative traumatic wound in which there is a major break in technique, gross spillage from gastrointestinal tract, genitourinary or biliary tract.Dirty: traumatic wound from dirty source, faecal contamination, foreign body or retained devitalized tissue. Operative wound in which acute bacterial inflammation or perforated viscous encountered.

III. Results

Of the total 1000 patients 145 (14.5%) suffered from wound infections. The infection rate in routine and emergency surgery was calculated and it was observed that the infection rate was high in emergency surgery i.e.70 cases out of 277 got infected (25.27%) while in routine elective surgery the infection rate was found to be 10.37% (70 cases out of 723) Out of 1000 cases, 416 (41.6%) were classified as having clean wounds. Of these, 16 developed wound infection with an infection rate of 3.84%. Out of the 266 (26.6%) clean-contaminated wounds, 25 developed wound infection with an infection rate of 9.39%. Out of the 200 (20%) contaminated wounds, 60 developed wound infection with an infection rate of 30%. The infection rate was highest among dirty wounds, which were 44 out of 118 wounds (32.20%). The infection rate in different types of wounds is shown in **Table 1**. The effect of the pre-operative antibiotic therapy and infection rate showed 94 out of 348 (34.83%) patients without pre-operative antibiotic prophylaxis developed infection that was more as compared to 51 (10.37%) out of 642 patients under antibiotic coverage

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Type of wound	**No.**	**No. of Infections (%)**
Clean	416	16 (3.84)
Clean contaminated	266	25 (9.39)
Contaminated	200	60 (30.0)
Dirty	118	44 (32.2)
Total	**1000**	**145 (14.5)**

Table 1: Infection rates related to wound types.

Table 2 shows the infection rates in various surgeries including bowel surgeries 38.46% and orthopedic surgeries 25%. The postoperative infection rate was high among patients with certain medical illnesses such as malignancy, diabetes mellitus and others that are depicted in **Table 3**. A large number of different bacteria were isolated. The type of bacteria and their frequency of isolation are shown in **Table 4**.

Surgery	**Total no. of cases**	**No. of cases infected**	**Percentage**	**Percentage**
Lower segment caesarean section	255	26	10.19	7.09
Hysterectomy	100	12	12	13.33

ENT surgeries	100	11	11	11
Paediatric Surgeries	60	9	5.4	14
Orthopedic surgeries (including open reduction, prosthesis, amputation)	200	50	**25**	29
Bowel surgeries	52	20	**38.46**	38.46
Appendicectomy	22	4	18.18	18.18
Cholecystectomy	19	4	21.05	21.05
Hernia surgeries	32	1	3.12	4.54
Hydrocele surgeries	30	-		-
Cataract surgeries	100	-		
Others	30	8	26.66	
Total	**1000**	**145**	14.5	

Table 2: Infection rates in various surgeries.

Predisposing factors	**Total no. of cases**	**No. of cases Infected**	**Percentage**	**Percentage**
Anemia	74	32	43.24	40.74
Malignancy	50	30	60.	61.70
Diabetes	25	14	56	60.86
Chronic illness	19	11	57.89	52.63
Immunodeficiency state	5	3	60	60.00
Others	20	13	65	61.90

(Others include Hypertension, dehydration, UTI and obesity)

Table 3: Correlation of predisposing factors with infection rate.

Organism	**No. Isolated (%)**
Staphylococcus aureus	56(33.93)
Coagulase neg. Staphylococcus	13 (7.87)
Pseudomonas aeruginosa	34 (20.60)
Escherichia coli	26 (15.75)
Klebsiella pneumonia	16 (9.69)
Proteus mirabilis	9 (5.45)
Proteus vulgaris	5 (3.03)
Citrobacter species	6 (3.63)
TOTAL	**165**

Table 4: Incidence of various microorganisms.

Out of 56 *S. aureus* isolates 13 (23.21%) were resistant to Erythromycin, 26 (46.42%) to Gentamycin, 41 (73.21%) to Ampicillin and 52 (92.85%) to Penicillin. The common Gram negative bacillary isolates viz. *E. coli* , *Klebsiella* and *Proteus* species were also multi drug resistant. Of the 56 Gram negative isolates 10 (17.85%) were resistant to Cefotaxime, 16 (28.5%) to Ciprofloxacin, 19 (33.9%) to Norfloxacin, 21 (37.5%) to Gentamycin, 44 (78.57%) to Ampicillin and as many as 48 (85.71%) to Tetracycline. The resistance profile of 34 isolates of *Pseudomonas aeruginosa* showed resistance to Amikacin by 8 (23.5%) strains while 9 (26.47%) were resistant to Ceftriaxone, 12 (35.29%) to Cefotaxime, 16 (47.05%) each to Ciprofloxacin and Gentamycin and 25 (73.52%) to Norfloxacin.

IV. Discussion

Despite the introduction of meticulous antiseptic regimen in surgical practice, post-operative wound infections do occur in the patients and a number of exogenous and endogenous factors play an important role in the occurrence of these infections. In the present study, out of 1000 patients 145 got infected post operatively giving the post-operative infection rate of 14.5%. Several workers have quoted the percentage of post-operative wound infections in range of 10% to 76.9% [5-9]. The present rate of post-operative wound infections in the study could be attributed to the progressive trend towards operating the older patients and performing more complicated procedures including operations on contaminated and dirty surgical sites.The infection rate in different wound types was statistically significant (**Table 1**). The difference in infection rates in clean and contaminated wounds is self-explanatory. Contaminated and dirty wounds reflect the number of bacteria present at the operation site at the time of surgery. Similarly, there was statistically high infection rate in emergency surgeries as compared to the elective ones. Similar observations have been made by others [6,8,10]. In emergency surgeries, a combination of various factors like physical condition of the patient, operations on the potentially contaminated sites i.e., intestinal perforations, obstructions, strangulated hernia, short time interval for preparing the case for operation and lacking of rigorous aseptic measures due to urgency may predispose the individual to the infection.The preoperative prophylactic antibiotic significantly prevents the post-operative wound infections. However, the use of antibiotics in the preoperative period may destroy susceptible organisms and permit colonization with resistant virulent organisms [6]. To be more effective a manner that ensures

substantial tissue level at the time of incision and should target the pathogens commonly associated with the specific operation undertaken [11].The overall infection rate in different kinds of surgeries was higher when compared to that of Yalcin et al. [12] and Anvilkar et al. [8]. This is due to the low general resistance of the patients of lower socioeconomic strata, complicated cases referred from rural areas, more number of emergency surgeries performed on contaminated wounds and unhealthy living conditions as another contributory factor.
Amongst different kinds of surgery, higher infection rates were noted after bowel surgeries (38.46%), Orthopaedic surgeries (25%), Cholecystectomy (21.05%) & appendectomy (18.18%), which was expected and the reasons are well known [14]The associated medical illness in patients undergoing surgery was seen in 40-62% patients developing post-operative wound infections. This is due to impaired host defenses in these patients and longer hospitalization for correction of underlying disease leads to increased risk of colonization by hospital strains of bacteria.The bacterial isolates obtained in the study indicate a polymicrobial flora. Similar observations are also made by others [6,8,12]. The prevalence of pathogens varies from place to place and hospital to hospital. A large number of infections are caused by Gram-negative bacilli; however the single most common bacterial isolate was *Staphylococcus aureus*. The different bacterial isolates commonly found were Pseudomonas aeruginosa, *E. coli* and *Klebsiella* species, all known to be hospital pathogens. The antibiotic sensitivity profile of isolates revealed that a large number of multidrug resistant strains were prevalent in the hospital environment. Thus, it may be mentioned that post-operative wound infection occur with more frequency than ideally they should occur. A plethora of predisposing and risk factors are responsible for these infections. A large number of different types of bacteria are responsible for these infections. Hence, more stringent steps are needed to reduce the incidence. More importantly, whenever the infection occurs, proper laboratory identification of the pathogen along with its sensitivity profile must be obtained to treat the patient with proper antibiotics as well as to keep a watch whether it is causing crossinfection or resulting in spread as a hospital infection.The incidence of incisional surgical site infection in patients undergoing elective colorectal resection was substantially higher than generally reported in the literature [14]. In a study that was undertaken to determine the infection rate of wound following emergency caesarean section showed that the use of fusidic acid reduced the infection rate by six times. The relation of fusidic acid to wound infection was statistically significant (p=0.0460) [15]. It was reported that laparoscopic hysterectomies were associated with a significantly lower risk of surgical site infection and shorter hospital stays [16]. Of the 7630 laparoscopic and robotic hysterectomies identified, 399 patients (5.2%) had complications including urinary tract infection (2.1%) and superficial surgical site infection (1.0%). Operative time ≥ 240 minutes was associated with increased overall complications [17]. Post-operatory infections in orthopedic surgeries pose a significant risk and the use of antibiotics increases the population of pathogens exhibiting resistance against them. Silver nanoparticles appear to be a new therapeutic avenue for their safety and their antimicrobial activity. They can be embedded in bone cement for the prevention of infections [18].The authors concluded that these infections are infrequent complication following laparoscopic surgery and mostly associated with prolonged operative time and increasing body mass index [20].

V. Conclusion

Post-operative wound infections are a serious medical problem that has to be tackled due to its increased morbidity, mortality and medical care costs. An active surveillance program is recommended.

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