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A Bacteriological study of Post-Operative Wound Infections in S.V.R.R. Government Hospital, Tirupati, Andhra Pradesh

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Abstract: Post-operative wound infection (or) Surgical site infection (SSI) is a severe problem in the surgical specialties, which can cause mortality, morbidity, delays incision healing and economic burden. In most SSI the causative pathogens originate from endogenous flora of the patients skin, mucous membranes (or) hollow viscera and prolonged hospital stay. Aims and Objects of the study are isolation and identification of the bacterial pathogens from the SSI, their clinical profile and association of risk factors. A total number of 210 clinically suspected cases of post-operative wound infections in various surgical departments during July 2009 to April 2010 were included. Standard bacteriological methods were used for bacterial isolation. Among enrolled cases the age of the patients ranged from ≤20 yrs to ≥ 60 yrs. Out of 210 wound swabs 167/210 were culture positive aerobically yielding 235 bacterial isolates, while 43 were sterile. Of these 112 out of 131 were emergency surgery patients and 55 out of 79 were elective surgery. The infection rate was high (89.47%) in dirty-infected wounds. The maximum rate of isolation of pathogens was seen in surgeries lasting >2hours (89.39%) and after EmLSCS (15.71%). Klebsiella pneumonia and Pseudomonas aeruginosae was commonest polymicrobial growth pattern followed by Eschericia coli and Klebsiella pneumoniae seen. Staphylococcus aureus, Pseudomonas aeruginosae was commonly isolated pathogens in monomicrobial and polymicrobial etiology. Of all risk factors pre-operative stay of >7 days (31.9%) was considered as the most significant factor. The present bacteriological study has determined the commonest bacteria and associated risk factors responsible for the post-operative wound infections. Active surveillance is recommended.
Keywords: Post-Operative Wound Infection Isolates Clean Wound Contaminated Wound Emergency surgeries.

INTRODUCTION

Post -operative wound infection is an infection that develops within 30 days after an operation (or) within one year if an implant was placed and infection appears to be related to the surgery [1]. Post -operative wound infection remains the major sources of illness and one of the causes of death in surgical patient [2]. Post - operative surgical site infections are associated with increased morbidity, mortality, prolonged hospital stay and increased economic costs for patient care [3].

Post – operative wound infections occur when the inoculums of contaminating microorganisms is not contained by host defenses, proliferates and produces established infection [4]. The chances of developing an establishing infection after surgery are determined by pathogenicity of the invading microorganisms and by the size of bacterial inoculums [5]. The virulence and invasive capability of the organisms have been reported to influence the risk of infection, but the physiological state of the tissue in the wound and immunological integrity of the host seem to be of equal importance in determining whether infection occurs or not [6]. Despite improved understanding of the pathophysiology and improved methods of prevention, SSI remains the most common cause of post – operative morbidity and mortality [7].

Post–operative wound infection rate has varied from a low of 2.5% to a high of 41.9% [8]. Advances in infection control practices include improved operating room ventilation, sterilization methods, barriers, surgical technique and preoperative stay. Despite these activities, SSIs remain a substantial cause of morbidity and mortality among hospitalized patients. This may partially explained the increased number of surgical patients who are elderly and/or have a wide variety immune - compromising underlying diseases. Thus, to reduce the risk of SSI, a systematic but realistic approach must be applied with the awareness that risk is influenced by characteristics of the patient, operation personnel and hospital [9].

In the present work a solemn endeavor is made and study the aerobic pathogens involved in the causation of SSI. All this has been done with a purpose to acquire some data on the pattern of SSI prevalent in our hospital and formulate guidelines in the light of present findings.

AIMS AND OBJECTIVES

1. To isolate and identify the bacterial pathogens from the infected surgical site.
2. To study the clinical profile and to identify the risk factors in the causation of surgical site infection.

MATERIAL AND METHODS

The present study was conducted on patients admitted for surgery in various surgical units of S.V.R.R. Government hospital and Government Maternity hospital, Tirupati.

A total number of 210 clinically suspected cases of post-operative wound infections in various surgical units like general surgery, orthopedic and Obst & Gynaec were included in this study during the period of July 2009 to April 2010. Each patient carefully assed for the sign of SSI till the day of discharge and followed up as an outpatient basis once a week for 30 days, in case of Orthopedic implants up to one year.

SAMPLING PROCEDURE

A questionnaire was used to obtain data from the patient after obtaining an informed consent from the patient guardians. Double wound swabs were taken from each wound at a point in time to reduce the chance of contamination.

CULTURE AND IDENTIFICATION

One of the swabs collected was used for preparation of direct smear and stained by Gram's stain. Then the smears were screened under oil immersion objective. Second swab from infected wounds were inoculated into Blood agar, MacConkey agar & Nutrient agar plates were incubated at 37^{o}c overnight aerobically. After overnight incubation the plates were examined for bacterial growth. Further identification and confirmation of organisms was done by the standard identification technique which include studying the colonial morphology, Gram's stain and biochemical reactions.

ETHICAL ISSUES

The study was approved and ethically cleared by the Research and Ethical Review Committee of Sri Venkateswara Medical College, Tirupati. Written consent was obtained from each study participants and parents or care takers. All patient information was kept confidential.

RESULTS

Total 210 clinically suspected cases of post-operative wound infections were included in this study.

Table-1: Effect of type of surgery on SSI

S. No	Type of Surgery	Cases (210)	Number of Cases Positive (167)	Percentage
1.	Emergency	131	112	85.49%
2.	Elective	79	55	69.62%

The occurrence of the SSI in Emergency cases (85.49%) was found to be higher compared to Elective cases (69.62%) (Table-1).

Table-2: Age wise distribution of cases

S. No	Age Groups	Cases (210)	Number of Cases Positive (167)	Age Wise Isolation %
1.	≤20 yrs	10	5	50%
2.	21- 40 yrs	98	83	84.69%
3.	41- 60 yrs	74	59	79.72%
4.	≥ 60 yrs	28	20	71.42%

Among age wise distribution of cases the maximum rate of isolation of pathogens was from 21-40 years (84.69%) followed by 41-60 years (79.72%), >60 years (71.42%) and <20 years (50%) (Table-2).

Table-3: Effect of duration of surgery on SSI

S. No	Duration of Surgery (hrs)	Number of Cases (210)	Number of Cases Positive (167)	Percentage
1.	< 1	73	53	72.6%
2.	1 -2	71	55	77.46%
3.	> 2	66	59	89.39%

The number of SSI increased as the duration of surgery also increased showing surgeries lasting >2hours (89.39%) followed by 1-2 hours (77.46%) and < 1 hour (72.6%) (Table-3).

Table-4: Distributions of isolates in various surgeries

S. No	Surgery	Cases	Number of Positive Cases (167)	Rate of Isolation
1.	Emergency Lower Segment Caesarian Section (Em LSCS)	43	33	15.71%
2.	Hysterectomy	17	12	5.71%
3.	Family planning sterilization	11	6	2.85%
4.	Colorectal surgery	10	10	4.76%
5.	Herniorraphy	9	5	2.38%
6.	Appendicectomy	9	6	2.85%
7.	Small bowel surgery	32	26	12.38%
8.	Gastro duodenal surgery	19	15	7.14%
9.	Limb amputation	7	7	3.33%
10.	Open Reduction Internal Fixation (ORIF)	25	25	11.90%
11.	Arthroplasty	8	6	2.85%
12.	Split skin graft	10	4	1.9%
13.	I &D abscess drainage	5	5	2.38%
14.	Oncological surgeries	4	4	1.9%
15.	Tracheostomy	1	1	0.4%

Highest infection rate was observed in EmLSCS (15.71%) and lowest rate was in Tracheostomy surgeries (0.4%) (Table-4).

Table-5: SSI Rate depending on surgical wound classification

Surgical Class	Number of Cases	Number of cases Positive	Percentage
I	34	21	61.76%
II	87	68	78.16%%
III	51	44	86.27%
IV	38	34	89.47%

Out of all cases in which SSI occurred the infection rate was maximum is in Class IV wounds (89.47%) and lowest in Class I wounds (61.76%). The infection rate in different types of wounds is shown in Table- 5.

Table-6: Incidence of SSI in association with risk factors

S.No	Risk Factor	Cases	Percentage
1.	Obesity	11	5.2%
2.	Diabetis mellitus	16	7.6%
3.	H/O Alcoholism	41	19.72%
4.	Smoker	45	21.42%
5.	Any current infection	21	10%
6.	Immunosupression	4	1.9%
7.	Presence of drains	46	21.9%
8.	Pre-operative stay >7 days	67	31.9%
9.	Time of local preparation	55	26.19%

The post – operative wound infection rate was high among patients with certain risk factors such as pre – operative stay of > 7 days , time of local preparation, presence of drains, smoking, H/O alcoholism, presence of septic focus, Diabetes mellitus, obesity and immune suppression are depicted in Table-6.

Table-7: Overall results of the cases studied

Details of Isolation	Number	Percentage
Positive Cultures	167	79.52%.
Monomicrobial	101	48.09%
Polymicrobial	66	31.42%
Negative Cultures	43	20.47%
Total	210	

Of the 210 swabs 167 (79.52%) were culture positives for bacterial pathogens, while 43 (20.47%) were bacteriologically sterile. The presence of only one species isolated from each sample was the most frequent (48.09%) while, more than one species were isolated (31.42%) from the total swabs (Table-7).

Total Number of Specimens - 210

Total Number of Isolates - 235

Table-8: Aerobic bacterial pathogens isolated from SSI cases

Organisms	Monomicrobial	Polymicrobial	Number of Isolates	Percent Among the Isolates
Staphylococcus aureus	52	17	69	29.36%
Staphylococcus epidermidis	6	9	15	6.3%
Enterococcus faecalis	2	4	6	2.55%
Klebsiella pneumoniae	9	34	43	18.2%
Escherichia coli	13	21	34	14.4%
Proteus vulgaris	0	1	1	0.42%
Proteus mirabilis	0	4	4	1.7%
Citrobacter koseri	1	5	6	2.55%
Citrobacter freundii	1	7	8	3.4%
Pseudomonas spp.	14	32	46	19.75%
Providencia rettgerii	0	1	1	0.42%
Serratia marcescens	0	1	1	0.42%
Enterobacter aerogenes	0	1	1	0.42%

A total of 235 bacterial isolates were obtained, 145 (61.7%) were aerobic gram negative bacilli. While 90 (39.29%) were aerobic gram positive cocci. Staphylococcus aureus was the predominant organism isolated 69 (29.36%), followed by Pseudomonas aeruginosa (19.75%), Klebsiella pneumoniae (18.2%), Eschericia coli (!4.4%) (Table-8).

Total Number of Isolates - 134

Table-9: Distributions of organisms in polymicrobial growth

S.No	Polymicrobial Growth	Cases	Percentage
1	Klebsiella pneumonie and Pseudomonas aeruginosa	17	25.3%
2	Klebsiella pneumoniae and Escherichia coli	11	16.4%
3	Staphylococcus aureus and Pseudomonas aeruginosa	9	13.4%
4	Staphylococcus aureus and Escherichia coli	5	7.4%
5	Staphylococcus epidermidis and Citrobactar koseri	5	7.4%
6	Citrobactar freundii and Pseudomonas aeruginosa	4	5.9%
7	K.pneumoniae and Proteus mirabilis	3	4.4%
8	Escherichia coli and Klebsiella pneumoniae and Staphylococcus epidermidis	2	2.9%
9	Escherichia coli and Pseudomonas aeruginosa	2	2.9%
10	Staphylococcus epidermidis and Serratia marcescens	1	1.4%
11	Staphylococcus epidermidis and Providencia rettgerii	1	1.4%
12	Staphylococcus aureus and Proteus vulgaris	1	1.4%
13	Enterobacter aerogens and Pseudomonas aeruginosa	1	1.4%
14	Enterococcus faecalis, Staphylococcus aureus and Staphylococcus epidermidis	1	1.4%
15	Enterococcus faecalis and Citrobactar freundii	1	1.4%
16	Enterococcus faecalis and Klebsiella pneumonia	1	1.4
17	Enterococcus faecalis and Escherichia coli	1	1.4%
18	Staphylococcus aureus and Proteus mirabilis	1	1.4%

Among distribution of organisms in polymicrobial growth total number of isolates were 134 while Klebsiella pneumonia (25.3%) was commonest polymicrobial growth pattern seen followed by Eschericia coli and Klebsiella pneumonia (16.4%) (Table - 9)

DISCUSSION

The present study was undertaken to describe the spectrum of bacterial isolates in causation of SSI and association of considerable risk factors in the causation of SSI.

Out of 210 clinically suspected cases of SSI, the highest incidence of SSI was observed in 21-40 years (84.69%), followed by 41-60years (79.72%) group. This finding correlated with the work published by others, Kiran Ruhil, Bharti Arora, Himanshu *et al*., [11] reported an increased incidence of SSI in 16-40 (47.2%) years age group, followed by those of 41-60 years (41.6%) and of >60 years (6.9%) [10].

The maximum rate of isolation of the pathogens was seen in emergency (85.49%) surgeries compared to elective surgeries (69.62%). This finding was well correlated with the work of Renvall *et al*., [11] and Gil Egea *et al*., [12] who reported a higher incidence in patients requiring emergency operations.

SSI was also directly related to duration of surgeries. The maximum rate of isolation of the pathogens was seen in surgeries lasting for > 2 hours (89.39%), followed by 1-2hours (77.46%).This finding was in accordance with the study of Miftari *et al*., [13] who reported an increased incidence of infection in surgeries lasting >1 hour(50%) when compared to surgeries lasting <1 hour (10%). Lilani *et al.*, [9] also observed the same finding, reporting an SSI rate of 1.47% and 38.46% in surgeries lasting <1 hour and >2 hours respectively.

SSI was classified into four classes according to the degree of contamination of the surgical site by CDC. According to this classification maximum rate of isolation of the pathogens were from class IV (89.47%), followed by class III (86.27%), class II (78.16%) and class I (61.76%).This finding was correlated well with studies carried out by Renvall *et al*., [11], Abu *Hanifah et al.*, [14], Twum- Danso *et al*., [15], Narotam *et al*., [16], Lilani *et al*., [9] and Sangrasi *et al*., [17].

The association of risk factors in the causation of SSI was also studied. A higher incidence of SSI was seen in surgeries with pre-operative stay >7days (31.9%), followed by the time of local preparation of >12 hours (26.19%), the presence of drains (21.9%), smoking (21.42%), H/O alcoholism (19.72%), presence of septic focus(10%) and diabetes mellitus (7.6%). This finding was correlated with the work carried out by others. Kowli *et al*., [18] reported an infection rate of 17.4% and 71.4% with a pre-operative stay of 0-7 days and >21 days respectively. Suchitra and Lakshmidevi *et al*., [19] also reported an increased incidence of SSI in patients with pre-operative stay of >7days and in diabetic patients. Lilani *et al*., [9] reported an SSI rate of 22.41% in cases where drain was used than in non-drained wounds (3.03%). Nagachinta *et al*., [20], De SA LA, Sathe LJ, Bapat RD *et al.*, [21] reported an infection of 36.6% in patients with septic focus.

The maximum rate of isolation of pathogens was seen in EmLSCS (15.71%) and small bowel surgery (12.38%). Among gastrointestinal surgeries highest incidence of SSI was seen in small bowel surgeries (12.38%), followed by gastro duodenal surgeries (7.14%).This finding corresponded with the study of Suchitra and Lakshmidevi *et al*., [19] who reported an increased incidence in EmLSCS, hysterectomy, gastrointestinal surgeries.

Out of 210 specimens, 183 (87.14%) were positive for bacteria by direct Gram stain of the sample and 167 (79.52%) were positive for bacteria by culture. Only 27(12.85%) samples were sterile by both direct smear and culture. Thus 43 (20.47%) samples were negative by culture. The cause for culture negative but direct smear positive samples was explained by Giacometti *et al*., [22] who said that Atypical Mycobacteria, Mycoplasma hominis, Ureaplasma urealyticum, small colony variant Staphylococcus aureus, Nocardia, Actinomycetes, Legionella, Anaerobes, Coxiella burnetti, etc as some of the causes for culture negative SSI.

Out of 167 positive cultures, 101 were positive for monomicrobial growth (48.09%) and 66 for polymicrobial growth (31.42%). This finding correlated with the study of Giacometti *et al.*, [22] who reported 76% of mono microbial growth and 25% of polymicrobial growth.

The bacteriological study of SSI revealed the isolation of a variety of organisms. Of the isolates, Gram positive cocci accounted for 38.29%, the most common pathogen being Staphylococcus aureus (29.36%), followed by Staphylococcus epidermidis (6.3%). This study result was correlated well with the study conducted by Stone *et al*., [23], Renvall *et al*., [11], Abu Hanifah *et al*., [14], Twum-Danso *et al*., [15], Santos *et al*., [24], R. Murthy *et al*., [25], Giacometti *et al*., [22], Banjara *et al*., [26], Onche *et al*., [27], Lilani *et al.*, [9], Isibor *et al*., [28], Hayath Kownhar *et al.*, [29] and Suchitra *et al*., [19]. Among Gram negative aerobic pathogens, Pseudomonas aeruginosa (21.9%) was the predominant pathogen followed by Klebsiella species (20.4%), Escherichia coli (16.1%), Citrobacter species (6.6%) and Proteus species (2.37%). This finding was correlated well the study of Anvikar *et al*., [30], Hayath, Kownhar *et al*., [31], Umesh S Kamat *et al*., [32] and Jyoti Sonawane *et al*., [33]. Anvikar *et al*., [30] suggested the emergence of Klebsiella pneumoniae as a hospital acquired pathogen. In polymicrobial etiology, Klebsiella pneumoniae and Pseudomonas aeruginosa (25.3%) was the common isolate combination, followed by Escherichia coli and K.pneumoniae (16.4%) and Staphylococcus aureus and Pseudomonas aeroginosa (13.4%) [34].

SSI remains one of the most important causes of morbidity and mortality in surgically treated patients. Wound type, longer preoperative stay, type of operation, wound class and ward type showed statistically significant association with post operative wound infection. The present study represents that the most common organisms was staphylococcus aureus followed by Pseudomonas aeruginosa. So it becomes a necessity for hospitals to recognize the growing threat of hospital infections and take immediate measures to control them. The steps taken to reduce SSI are still not adequate. Surveillance of SSI with feedback of appropriate data to surgeons would be desirable to reduce the SSI rate. Proper infection control measures should reduce SSI in the future.

LIMITATION

The study did not isolate strict anaerobic bacteria and fungi, which could have increased the number of bacterial isolates reported as negative cultures.

CONCLUSION

The high rate of isolation of pathogens in patients with pre-operative stay >7 days and with pre-operative shaving >12 hours is primarily due to colonization of patients with hospital acquired micro-organisms. Local preparation of the operating site ideally done on the day of surgery, just prior to surgery minimizes colonization of hospital acquired pathogens. Thus it is of utmost importance that surgeons and other medical personnel involved in patient care need to minimize these risk factors in order to prevent post-operative wound infections to a minimum.

COMPETING INTERESTS

The author(s) declare that they have no competing interests.

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