International Journal of Advances in Medicine
Kochhal N et al. Int J Adv Med. 2019 Apr;6(2):324-329
http://www.ijmedicine.com
pISSN 2349-3925 | eISSN 2349-3933
DOI: http://dx.doi.org/10.18203/2349-3933.ijam20191135

Original Research Article

A study of clinico-microbiological profile of surgical site infections in a tertiary care hospital

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Received: 12 January 2019
Accepted: 12 March 2019

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ABSTRACT

Background: Surgical Site Infection (SSI) is the 3rd most commonly reported infection accounting for 14-16% of all Health care associated infections among hospitalized patients. Surgical Site Infections are responsible for an increased economic burden to healthcare systems, including additional postoperative hospital stay and costs. The present study was conducted in a tertiary care hospital to study the incidence, risk factors and associated pathogens of Surgical Site Infection.
Methods: A total of 100 patients operated of clean and clean-contaminated surgeries from Orthopaedics, Surgery and Obstetrics and Gynaecology Department of AVBRH, Sawangi were included.
Results: Overall infection rate was 6%. Patients in the age of above 71 years showed maximum rate of infection (14.28%) followed by 61 to 70 years (10%) and 51-60 years (10%). Surgical site infection rate was 4.65% (2/43) in clean operative wounds and 7.02% (4/57) in clean contaminated operative wounds. *Escherichia coli and Klebsiella pneumonia* were the most common organisms causing SSI. None of the risk factor was found significantly associated with the development of SSI.
Conclusions: This study gave a better understanding of microbial pathogens of our institute which may have epidemiological and therapeutic implications. It will act as a pilot study to conduct further such larger research.

Keywords: Clean surgery, Clean contaminated surgery, Nosocomial infection, Surgical site infection

INTRODUCTION

Surgical Site Infection (SSI) is the infection that occurs in the wound created by an invasive surgical procedure.[1]

Prior to the mid-19th century, operated patients commonly developed post-operative fever, purulent drainage from their incisions, sepsis and even death. Introduction of the principles of antisepsis by Joseph Lister in the late 19th century led to a marked decrease in wound infection rates.[2] Since then many advances have been made in asepsis and antisepsis to reduce the hazards of infection in surgical operations.

The incidence of SSI varies from study to study. Based on National Nosocomial Infections Surveillance (NNIS) system reports, SSI is the 3rd most commonly reported infection accounting for 14-16% of all Health care associated infections among hospitalized patients.[2]

Surgical Site Infections are responsible for an increased economic burden to healthcare systems, including additional postoperative hospital stay and costs.[3] *Staphylococcus aureus* is a commonly isolated organism in SSI, accounting for 15-20% of infections occurring in hospitals; other organisms regularly isolated from SSIs

include gram-negative bacilli, coagulase-negative *Staphylococci*, *Enterococcus spp*. and others.[3-5]

The risk of developing Surgical Site Infection depends on a broad range of factors including age and clinical condition of the patient at the time of the surgery, duration of preoperative stay in the hospital, the type and duration of operative procedure, type of anesthesia, preoperative skin preparation of patient, use of implant and drain and postoperative wound care. Identification of these factors is important for developing preventive measures for SSI.[6,7]

Broad spectrum empirical antibiotics are given at many institutes in surgical patients. However, inappropriate use of antibiotics may result in the emergence of multi drug resistant strains. Knowledge of common organisms causing SSI and their susceptibility pattern will help us choose most sensitive antibiotics earlier thus, preventing further life-threatening infections and adding less to the patient's suffering.

Aim and objectives

- To determine the incidence of SSI.
- To study the risk factors associated with SSI.
- To determine the prevalence of aerobic micro-organisms and their antibiotic susceptibility pattern isolated from the cases of SSI.

METHODS

A cross sectional study was conducted in AVBRH, Sawangi (Meghe) and Microbiology Department of JNMC, Sawangi (Meghe), Wardha for two months (1st June 2014 to 31stjuly 2014). A total of 100 patients operated of clean and clean-contaminated surgeries from Orthopaedics, surgery and Obstetrics and Gynaecology Department of AVBRH, Sawangi were included. Each patient was followed from the time of admission till discharge from the hospital.

Exclusion criteria[2]

- Contaminated surgeries (Class III operative wounds) and dirty surgeries (Class IV operative wounds)
- Stitch abscess
- Episiotomy and circumcision wounds

Clinical history of each patient was recorded as per the proforma. Clinical details including risk factors, antibiotics given, complete haemogram and other biochemical parameters was also recorded.

Specimen collection

Swabs were collected and processed by standard microbiological procedure if any one of the following criteria were fulfilled.[7,8]

- Serous or non-purulent discharge from the wound
- Pus discharge from the wound
- Signs of inflammation: Oedema, redness, increased local temperature, fever >380ºC, tenderness
- Incision deliberately opened by surgeon

Two sterile cotton swabs were used to collect the sample from wound. Normal saline was used to wash the wound prior to collection of swabs to remove contaminating materials like debris, dried exudates and dressing residue. If the wound is dry, then the swab tip was moistened with sterile saline. Care was taken that the swab only came into contact with the wound and not the surrounding skin. Tip of the swab was applied to wound with gentle pressure and rotated between fingers while ziz-zagging across the entire wound. In case of a large wound at least 1 cm^2 area was sampled and material from both the wound bed and wound margin will be collected. It was then transferred to the specimen container. Transport to the laboratory and processing of the specimen was done as soon as possible.[9-11]

Processing of specimen

A smear was prepared from one swab. It was stained by Gram stain and findings were recorded. Second swab was plated on 5% sheep Blood agar (BA) and MacConkey agar (MA). The plates were incubated aerobically at 37˚C for 18 to 24 hours. Organisms were identified using Gram stain characteristics, colony characteristics and biochemical reactions as per standard guidelines.[12]

Antimicrobial susceptibility testing

The organisms isolated were subjected to antimicrobial susceptibility using the Modified Kirby-Bauer disc diffusion method on Muller Hinton agar according to Clinical and Laboratory Standards Institute (CLSI) guidelines 2016.[13]

Statistical analysis

The tabulation and cross tabulation were done. Results were expressed in percentage. Data entry and analysis was done using SPSS software for windows version 17.0 and Gratan Pad prism 6.0 version. Pearson's Chi-square test at 95% confidence limit and Fisher's exact test will be used for calculating statistical significance. The level of statistical significance was set at p value <0.05.

This research was done under the Short Term Studentship Programme of ICMR (Indian Council Of Medical Researches).

RESULTS

Out of 100 patients included in the study maximum belonged to the age group of 21 to 30 years (36%) followed by 31 to 40 years (17%). There were 48 males (48%) and 52 females (52%). Of the total 100 patients

included in this study,6 developed surgical site infection with the overall infection rate of 6%. Patients in the age of above 71 years showed maximum rate of infection (14.28%) followed by 61 to 70 years (10%) and 51-60 years (10%).

Table 1: Department wise distribution of cases.

Department	No of cases operated	No of cases with SSI	SSI rate
General surgery	40	3	7.50%
Orthopaedic surgery	30	2	6.67%
Obstetrics and gynaecology	30	1	3.33%

Surgical site infection rate was 4.65% (2/43) in clean operative wounds and 7.02% (4/57) in clean contaminated operative wounds. In clean surgeries infection was seen in two cases of open reduction from orthopaedics. In clean contaminated surgeries infection was seen in patients with surgeries for large bowel, kidney, appendix and LSCS. Patients with surgeries for hernia, hydrocele, gall bladder and breast, had no surgical site infection (Table 2).

Purulent discharge was the most common sign seen in all the infected patients (100%) followed by localized warmth (66.66%) and tenderness/pain (50%).

Table 2: Surgical site infections in different surgeries.

Surgical procedure	No of surgeries performed	No of SSI (%)
Orthopaedic procedures	30	2 (6.67%)
Bowel surgery (small bowel and gastric)	4	0 (0.0%)
Bowel surgery (colon)	2	1 (50%)
Gall bladder surgery	9	0 (0.0%)
Kidney surgery	2	1 (50%)
Hernia	4	0 (0.0%)
Hydrocele	6	0 (0.0%)
Appendix	8	1 (12.5%)
Breast	3	0 (0.0%)
LSCS	29	1 (3.4%)
Uterus and adnexa	3	0 (0.0%)
Total	100	6 (6.0%)

Various risk factors were studied for their association with occurrence of SSI. Infection rate was found to be influenced by some of the risk factors which include pre-operative stay more than 8 days, use of drains and use of implants. But none of the risk factor was found significantly associated with SSI (Table 3).

Table 3: Risk factors associated with SSI.

Risk factor	No of operated cases without SSI (%) (N=94)	No of operated cases with SSI (%) (N= 6)	Significance* P Value
Diabetes	23(24.46%)	0(0.0%)	0.167
Hypertension	10(10.64%)	0(0.0%)	0.399
Clean wound	41(43.62%)	2(33.33%)	0.243
Clean contaminated wound	53(56.38%)	4(66.67%)	0.243
Antibiotic prophylaxis	44(46.81%)	4(66.67%)	0.167
Preoperative stay			
0-2 days	37(39.36%)	1(16.67%)	
3-5 days	23(24.47%)	1(16.67%)	0.500
6-8 days	10(10.64%)	1(16.67%)	
>8days	24(25.53%)	3(50%)	
Duration of surgery			
less than 2 hrs	72(76.60%)	3(50%)	0.561
more than 2 hrs	22(23.40%)	3(50%)	
Use of implant	13(13.83%)	2(33.33%)	0.233
Use of drain	13(13.83%)	2(33.33%)	0.233
Emergency operations	36(38.30%)	2(33.33%)	0.808

One of the six infected wound was culture negative. From the remaining five infected wounds, 6 isolates were recovered. *Klebsiella pneumoniae* and *Escherichia coli* were the commonest isolate (Table 4).

Most common organism isolated were *Escherichia coli* (33.33%), *Klebsiella pneumoniae* (33.33%) followed by *Staphylococcus aureus* (16.67%) and *Pseudomonas aeruginosa* (16.67%). Sensitivity pattern of Enterobacteriaceae is depicted in Table 5. Both the *Klebsiella pneumoniae* and one *Escherichia coli* were ESBL producers. Overall Enterobacteriaceae isolates were 100%sensitive to imipenem, 75% to amikacin, 50% to ciprofloxacin and cotrimixazole, 25% to ceftazidime.

Psedomonas aeruginosa isolate was sensitive to Imipenam and piperacillin - tazobactam. It was resistant to piperacillin, ceftazidime, gentamycin and ciprofloxacin. Methicillin sensitive *Staphylococcus aureus* isolate was sensitive to erythromycin, gentamycin and vancomycin. It was resistant to penicillin and ciprofloxacin.

Table 4: Organisms isolated from various surgeries.

Surgical procedure	Organisms isolated
Orthopaedic procedures	*Klebsiella pneumoniae*
Bowel surgery (colon)	*Escherichia coli* + *Staphylococcus aureus*
Kidney	*Klebsiella pneumoniae*
LSCS	*Pseudomonas aeruginosa*
Gall bladder	*Escherichia coli*

DISCUSSION

The problem of SSI continues despite introduction of new aseptic techniques. The SSI rates reported by different worker are different (3.38% to 32%).[14-17] The overall rate of 6% in the present study was comparable with studies by Shahane V et al, Singh RR et al, and Kokate SB et al.[16,18,19]

Table 5: Surgical Site Infection Rate reported by various authors.

Author/ Country/ Year	Surgical Site Infection Rate according to wound class				
	Overall	Clean	Clean contaminated	Contaminated	Dirty
Lilani SP et al[7]	8.95%	3.03%	22.41%	-	-
Suchitra JB et al[21]	12%	-	-	-	-
Shahane V et al[18]	6%	4.6%	8%	36.3%	12.5%
Singh RR et al[19]	6%	-	–	-	
More SR et al[20]	13.57%	7.73%	14.43%	23.29%	54.55%
Aniruddha S et al[14]	32%	17.65%	39.39%	-	-
Negi V et al[15]	17.8%				
Kokate SB et al[16]	5.44%	-	-	-	-
Shah KH et al[17]	3.38%	2.25%	2.2%	5.75%	37.5%

Number of studies carried out in India indicates an infection rate of 2.25% to 17.65% for clean surgeries and 2.2 to 39.39 for clean contaminated surgeries.[7,14,17,20] Finding in the present study of SSI rate 4.65% (2/43) in clean operative wounds and 7.02% (4/57) in clean contaminated operative wounds is comparable with study by Shahane V et al.[18] Infection rate was found to be influenced by some of the risk factors which include pre-operative stay more than 8 days, surgery lasting for more than two hours and use of implants.

Studies by Lilani SP et al, and Aniruddha S et al, included cases with Clean and Clean Contaminated wounds only.[7,14] More SR et al, and Shah KH et al, have shown contaminated and dirty wounds to be associated with higher rate of SSI.[16,17]

The higher rate of infection in elderly patients observed in the present study is in conformity with the findings of several researchers.[14,17,19] The present study showed higher incidence of SSI with increasing age of the patient, though, such a difference was not noted between the two sexes. Increased age is associated with various predisposing factors like diabetes, anemia which could be attributed to this trend of increasing incidence of SSI with increasing age.

Staphylococcus aureus has been reported to be the most common cause of SSI in several studies.[7,14,15,20,21] In the present study there is predominance of *Escherichia coli* (33.33%) and *Klebsiella pneumoniae* (33.33%). Few studies have reported gram negative bacilli as the commonest isolate in SSI. Shahane V et al, and Singh RR et al, reported that commonest isolate in SSI was *Escherichia coli*.[18,19] The pathogens isolated vary with the surgical procedures. For the clean surgery's organisms form the environment and skin microflora are the usual pathogens. But for clean contaminated surgeries the normal endogenous micro flora of the surgically resected organ are the most frequently isolated pathogens.

Study population was small, and we included only clean and clean contaminated wounds. A larger study population obtained over longer period and including

contaminated and dirty surgical wounds can give more accurate data on clinico-microbiological profile of surgical site infections.

CONCLUSION

Surgical Site Infection (SSI) was more with contaminated surgical wound than clean surgical wound. None of the risk factor was found significantly associated with the development of SSI. *Escherichia coli* and *Klebsiella pneumoniae* were the most common organisms causing SSI.

This study gave better understanding of microbial pathogens of our institute which may have epidemiological and therapeutic implications. It may also act as a pilot study to conduct further such larger research.

ACKNOWLEDGEMENTS

Authors would like to thank to Indian Council of Medical Research (ICMR), New Delhi, India for the award of Short-Term Studentship-2017 to this project.

Funding: Funding sources from ICMR (Indian Council of Medical Researches)
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Kochhal N, Mudey GD, Choudhari SZ. A study of clinico-microbiological profile of surgical site infections in a tertiary care hospital. Int J Adv Med 2019;6:324-9.