Original Article ISSN (O):2395-2822; ISSN (P):2395-2814

Study of Various Risk Factors & Antibiotic Sensitivity of the Causative Organisms in Surgical Site Infections (SSI) - A Prospective Study.

Laxminarayan Mohanty[1], Jateen Anshuman[2]

[1]Assistant Professor, Department of Surgery, S.C.B Medical College, Cuttack, Odisha, India

[2]Junior Resident, Department of Surgery, S.C.B Medical College, Cuttack, Odisha, India

Received: July 2020
Accepted: July 2020

ABSTRACT

Background: Surgical site infection (SSI) are the infections of the tissues, organ spaces exposed by the surgeons during performance of an invasive surgery. SSI occurs within 30 days of surgery or 1 year of implant. It causes a significant problem to the surgeons & contribute significantly to the post-op. Morbidity. A lot of organisms starting fromstaph. aureus, epidermidis, E.coli, klebsiella, pseudomonas, proteus, enterococci are responsible depending on various types of surgical site infections (clean/clean contaminated/ contaminated/dirty). Multiple risk factors like diabetes mellitus, obesity, malnutrition, surgical wound types, prolonged operative surgery, increased age, improper sterilization, lack of antibiotic prophylaxis etc, contribute immensely to the SSI. Aim of our study was to find out various risk factors contributing to SSI & to formulate a protocol for use antibiotic according to the sensitivity of organisms in various surgical site infections. **Methods:** This prospective study was based on study of various risk factors like diabetes mellitus, cancer, HIV, surgical wound types, prolonged operative surgery etc, & various bacteriological agents & their antibiotic sensitivity pattern in 256 patients who were admitted to our surgical unit at S.C.B Medical College Cuttack during the period of May 2016 to July 2018 considering the inclusive & exclusive criterias. Among them 34 patients developed surgical site infection (SSI). Inclusive criteria: All elective & emergency cases undergoing operative procedures. Exclusive criteria: All infected wounds needing incision & drainage and patients admitted in very low conditions. Post-op wound inspection was started on 3rd day, followed by every alternate day. Any secretion or pus if found was sent to dept. of microbiology for culture &sensitivity. Organisms isolated were recorded along with their sensitivity pattern & the risk factors associated with them were recorded. **Results:** In our study of 256 patients among which 34 developed surgical site infection. Among the most important risk factors [17,18] were types of wound ,duration of surgery, Dibetes mellitus, cancer & HIV ,types of surgery(elective / emergency), ASA grading. Staph. aureous, & epidermidis account for most of the wound infection in clean wound, E.coli, enterococci, klebsiella, Pseudomonas were responsible in clean contaminated, contaminated & dirty wounds in various proportions .Most of the organisms were sensitive to combination of piperacillin & Tazobactam and Aminoglycosides with MRSA(methicillin resistant staph. aureous) were sensitive to teicoplanin,linezolid . **Conclusion:** Surgical site infection is a very common nosocomial infection contributing to post-operative morbidity. In our study the risk factors for SSI were Diabetes mellitus, Age >75, Cancer, HIV, various wound types etc. various organisms like staph, E. colietc play major role. So proper detection of causative agents& their treatment by following their sensitivity pattern along with proper precautions like hand hygiene, prophylactic antibiotics, proper sterilization etc decrease the post-operative complication as well as reduces the incidence of antibiotic resistance.

Keywords: Surgical site infection, risk factors, types of wounds, bacteriological agents, sensitivity pattern.

INTRODUCTION

Surgical site infection are defined as infection less than 30 days after surgery or 1 year of implant.[1,2] involves skin, subcutaneous tissue (superficial incision type), fascia & muscle(deep incision),or deep organ space infection plus one of the followings that is 1). Purullentmaterial from the wound or through the drain. 2). Diagnosis by a surgeon. 3). Signs of inflammations that is pain, tenderness or culture of organism from the wound. A study by 21NNIS (national nosocomial infection survilllence) reveals that the most important factors for SSI are wound classification, ASA >3, prolonged operative time (>than 75th percentile) although a lot of other factors also responsible like increased age, immunocompromised states like diabetes, cancer, HIV, obesity, smoking, renal failure, prior radiation. Environmental factors like inadequate disinfection /sterilization also play a major role. Although treatment of infection has been an integral part of surgeons practice since the dawn of time the body of knowledge that led to the present field of surgical infectious disease was derived from evolution of germ theory (Louispasteur) & antisepsis.[2] Application of the later to clinical practice particularly after introduction of anesthesia by Morton was pivotal in allowing surgeons to expand their repertoire to encompass the complex procedures that were previously associated with extremely high rate of mortality & morbidity due to post op infections. During later part of nineteenth century Louis pasture discovered Germ theory & developed techniques of sterilisation. Joseph Lister after observing that 50 %of

Name & Address of Corresponding Author
Dr. Laxminarayan Mohanty,
Assistant Professor,
Department of Surgery,
S.C.B Medical College,
Cuttack, Odisha, India

his patients undergoing amputation died because of infection, he started using carbolic acid solution. Hippocratis used wine &vinegar to irrigate wounds.[1] The concept of magic bullet that could kill microbes but not the host became reality after discovery of sulfonamide. Penicillin was discovered by Alexander Fleming in 1941.[3] After that A new adjunct method came to treat & prevent infection. The present generation of surgeons have seen increasing no of serious infections related to complex operations, prolonged operative time, increasing number of geriatric patients, increase use of implant, organ transplantation requiring immunosuppressive agents. Simultaneously the resistance of the organisms also increasing .so to deal with the changing nature of the organisms, modern surgeons must be well aware of the organisms that may initiate surgical site infection & their remedies as well as to know regarding how to control infection by controlling various patient, surgeon & environment related factors.

Objectives: To study various risk factors & the causative organisms along with to formulate a protocol for antibiotic use according to sensitivity report in surgical site infection wounds.

MATERIALS AND METHODS

This prospective study was conducted in the department of General surgery, S.C.B medical College, Cuttack, Odisha during the period of 2016 may to 2018 July taking 256 patients undergoing some form of surgery among whom SSI was found in 34 patients using following inclusion &exclusion criteria.

Inclusion Criteria:
All elective & emergency cases undergoing operative procedures.

Exclusion Criteria: All infective wounds needing Incision & drainage & all patients presenting in very low moribund conditions.
Various comorbid risk factors causing surgical site infection were recorded.
Surgical procedures were performed with all available aseptic conditions. Wound inspection was routinely done on 3rd day and alternate day thereafter. If any discharge or pus was found it was sent to laboratory for culture & sensitivity. SSI was clinically diagnosed if there was any serous, non-purulent or purulent discharge, signs of infection like edema, redness, local rise of temperature is there. Data obtained from study were arranged according to organisms isolated and their sensitivity reports. Before that the wounds were classified as clean, clean contaminated, contaminated, dirty.

RESULTS

The results of our study regarding the risk factors for SSI & the causative organism & the sensitivity pattern are shown in a tabulated form.
[Table 1] shows among the most important risk factors were types of wound, duration of surgery (SSI rate 9.8 % if >2 hrs),[17,18] Diabetes mellitus (15.6 %), cancer & HIV (10 & 50%), types of surgery (elective 8.09% vs emergency 24.3%), ASA grading.
Among 256 patients that had undergone surgery, [Table 1] shows 50% (128) were clean surgeries,25% (64) were clean contaminated, 14.8%(38) were contaminated, 10.1% (26) were dirty. Surgery didn't include necrotizing infections, abscess, infective lesions requiring I & D and patients admitted in very low conditions. Among 256 patients chosen for study 34 (13.28%) patients developed SSI which was comparable to other reports (2.5 to 40%).[8,9] Among those 12 cases (46.15%) were dirty surgery, 9 cases (23.6%) were contaminated, 8 cases (12.5%) were clean contaminated, 5 case (3.9%) was clean case. The biological pattern in our study were staph. Aureous, Epidermidis, 52%, pseudomonas 22%, E.coli 14%, enterococci 12% in clean wounds (class 1) [Figure 1]. In clean contaminated (class 2) [Figure 2] organisms isolated were E.coli (37%), Enterococci (30%), klebsiella (18%). Staph. Aurious (15%). In class 3 [Figure 3] (contaminated wound) were E.coli (40%). Enterococci (34%), klebsiella (21%), bacteroides (5%), staph aureus (5%). In class 4 [Figure 4] (dirty wound) organisms isolated were E.coli (33%), klebsiela (25%), enterococci (22%), staph aureus (11%), proteus mirabilis (9%). [Table 2] shows Staphylococcus was sensitive to combination of piperacillin & Tazobactam, Aminoglycosides. Methicillin resistant staphylococcous (MRSA) were sensitive to vancomycin, linezolide & teicoplanin. E.coli was found to be sensitive to piperacillin & tazobactam, Aminoglycosides but were resistant to meropenam. Pseudomonas was susceptible to ceftazidime, meropenem, piperacillin & tazobactam. In our study overall most of the organisms were sensitive to piperacillin & tazobactam, Aminoglycosides. MRSA were sensitive to teichoplanin, vancomycin, linezolide though vancomycin resistant cases were also found.[14]

Table 1: (Risk Factors for SSI)

Wound Classification	Total No. of Case	No. of Cases of SSI	SSI Percentage
Clean	128	5	3.9
Clean Contaminated	64	8	12.5
Contaminated	38	9	23.6
Dirty	26	12	46.15

Operative Duration • > 2 hrs • < 2 hrs	 154 102	 24 10	 15.57 9.8
Diabetes Mellitus	64	10	15.6
Cancer / HIV	50 / 2	5 / 1	10 / 50
Age • > 75 yrs • < 75 yrs	 17 239	 3	 17.6
ASA Grade • I • II • III • IV • V	 87 130 32 4 3	 3 20 8 26 1	 3.4 15.3 25 50 33
Types Of Surgery • Elective • Emergency	 174 82	 14 20	 8.04 24.3
Pre-Op Hospital Stay • > 7 days • < 7 days	 152 104	 23 11	 15.1 10.57
Intra-Op Drain	120	9	7.5

Table 2: (Organisms & There Sensitivity towards Various Antibiotics)

Antibiotic Class	S. Aureus	Mrsa	S. Epidermidis	Eneterococcus	E.Coli	Pseudomonas
Cephalosporin 1st gen (cefazolin) 2nd gen (cefuroxime) 3rd gen (ceftriaxone) (ceftazidime)	 + + + +	 _ _ _	 +/_ +/_ +/_ +/_	 _ _ _	 _ + + +	 _ _ _ +
Carbapenem Meropenem Imipenem + cilastatin	+ +	_ _	+ +	_ +/_	+ +	+ +
Penicillin Piperacillin + Tazobactam	_ +	_ _	_ +	+/_ +/_	_ +	_ +
Floroquinolone Ciprofloxacin	 +	_	 +	_	 +	_
Glycopeptides Vancomycin Linezolid Teicoplanin	 + + +	 + + +	 + + +	 + + +	 _ _ _	 _ _ _
Aminoglycosides Gentamycin Amikacin	 + +	 _ _	 +/_ +/_	 + _	 + +	 + +

MRSA: Methicilline resistant S. Aureus

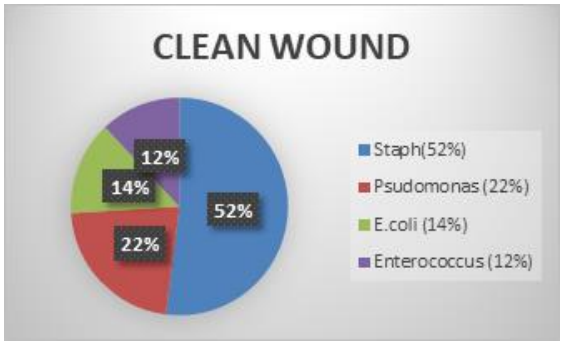
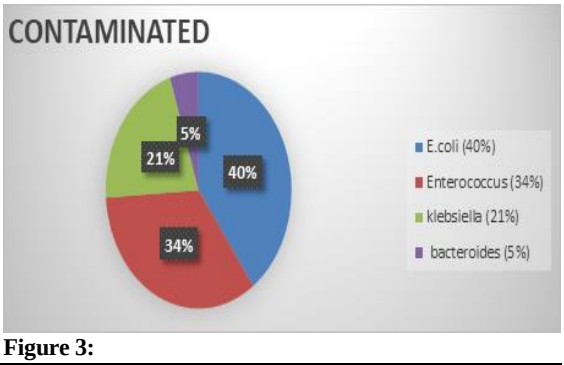


Figure 1: ?



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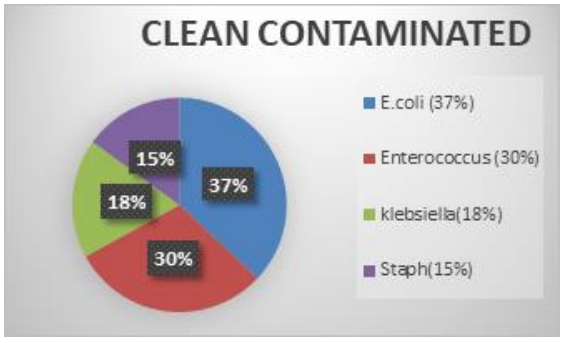

Figure 2:

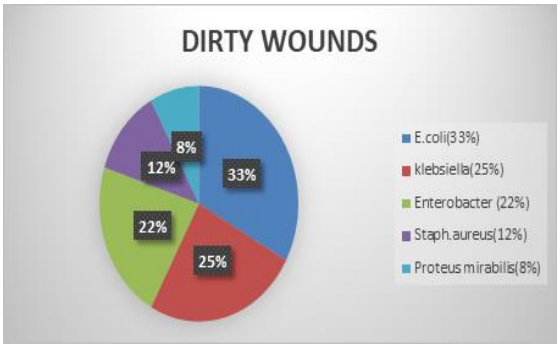

Figure 4:

DISCUSSION

Surgical site infection (SSI) are the infections of the tissues, organ spaces exposed by the surgeons during performance of an incisive surgery. SSI occurs within 30 days of surgery or 1 year of implant. It can affect skin, subcutaneous tissue (superficial incision type), fascia or muscle (deep incision type), or organ space infection. One of the followings like, diagnosed by a surgeon, purullent discharge from the wound, discharge from the drain site, localised signs of inflammation like pain, tenderness, or culture of organism from the operative site wound must bepresent for SSI to be diagnosed.[21] Surgical wounds can be clean (hernia, breast biopsy) clean contaminated (cholecystectomy, elective GI surgery), contaminated (penetrating abdominal trauma, intestinal obstruction & enterotomy) & dirty surgery (peptic ulcer perforation, diverticular perforation). The overall infection rate is 2%-40%. In our study this infection rate is 13.28%. In our study the infection rate in clean, clean contaminated, contaminated & dirty wounds were 3.9%, 12.5%, 23.6%, 46.15% respectively. According to National research council USA this rate was 1-3%, 6-9%, 20-25%, 30-40% respectivey.[9,10] The work of Cruse & Ford acts as a benchmark for these infection rate.[9,10] Factors affecting the SSI wereduration of surgery, types of wound, ASA clssification. Prolonged hospital stay was also seen to influence & increase the SSI rate may be because of hospital environment, various diagnostic procedures. Kowli & al,[7] found that the infection rate was 17.4% when preoperative stay was within 7 days &it was above 70% when the stay was 21 days. Anviker et al,[8] showed the infection rate was increased to 5% when the stay was more than 7 days. In the bacteriological pattern among the clean wounds staph aureous was found to be (50%), the most common. E.coli in 14% cases. In clean contaminated wounds they were E. coli (35%) followed by Enterococci group (32%). In contaminated it was same like clean contaminated group. In dirty group E.coli was the most common pathogen followed by klebsiella. This pattern is also consistent with other studies. The common organisms among gram positive were staph. aurius, enterococus. Gram negative organisms were E.coli, pseudomonas aerogenosa, klebsiella (Rao &Harsh).[13] In the study conducted by Nicholas 1998, Schaberg 1994 staphylococcus was the main organism followed by E. faecalis. Among the gram negatives E.coli, pseudomonas were the main pathogens. Staphylococus was sensitive to combination of piperacillin & Tazobactam, Aminoglycosides but resistant to penicillin alone. Methicillin resistant staphylococcous (MRSA) were sensitive to vancomycin, linezolide & teicoplanin. E.coli was found to be sensitive to piperacillin & tazobactam, Aminoglycosides but were resistant to meropenam. Pseudomonas was susceptible to ceftazidime, meropenem, piperacillin & tazobactam. In our study overall most of the organisms were sensitive to piperacillin & tazobactam, Aminoglycosides. MRSA were sensitive to teichoplanin, vancomycin, linezolide though vancomycin resistant cases were also found.[14]

CONCLUSION

Surgical site infection is one of the most common nosocomial infections and one of the common causes of post-operative morbidities. Though multiple factors contribute to this & to be taken care, the causative agent determination & its treatment is very important for the patient's better outcome, to avoid complications & to avoid antibiotic resistance. A microbiologist is very much essential in this respect. So effort must be given to understand the pathogens responsible for these infections and their treatment by proper selection of the antibiotics in various forms of SSI. In our study in our institution we have tried to throw some light in these areas. Measures like proper hand hygiene, antibioticprophylaxis, proper sterilization technique, glycemic control, pre op nutritional development, stopping cigarette smoking & maintaining proper surgical technique help to reduce the rate of SSI.

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How to cite this article: Mohanty L, Anshuman J. Study of Various Risk Factors & Antibiotic Sensitivity of the Causative Organisms in Surgical Site Infections (SSI) - A Prospective Study. Ann. Int. Med. Den. Res. 2020; 6(4):SG25-SG29.

Source of Support: Nil, **Conflict of Interest:** None declared