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Surgical Site Infection – A Comparative Study between Elective and Emergency Abdominal Surgeries in Tertiary Care Hospital

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Abstract:
Background*: The consequences of SSIs greatly impact patients and the healthcare systems.*
Prevention of SSI requires a multifaceted approach targeting pre, intra, and postoperative factors. Surgical site infections (SSI) are serious postoperative complications with significant impact on morbidity of the patients. The aim of our study is to study the risk factors in causing surgical site infection following elective and emergency surgery and to compare and document the incidence of surgical site infection in elective and emergency surgery.
Materials and Methods*: It is a Prospective and Comparative study. A total of 100 patients who underwent elective and emergency abdominal surgeries were taken up for the study after fulfilling the selection criteria. A written informed consent was obtained from the patients before enrolment into the study. Thorough history was taken by structured proforma. Patients were followed up, post operatively until discharge for any wound related complications. Necessary investigations were done including blood investigations and pus culture and sensitivity.*
Results*: Out of 100 patients who underwent elective and emergency abdominal surgeries, the incidence of SSI in elective surgeries was 12% and that of emergency cases was 24%.Risk factors like malnutrition, anemia, diabetes, malignancy were found in relation with higher incidence of SSI. The incidence of SSI was highest among*
dirty cases in both elective and emergency cases and the highest isolated organism in both elective and emergency cases was S.aureus.
Conclusion: *Increasing age of the patient, contaminated wound, prolonged duration of surgery, use of drains , malnutrition, anemia, diabetes, malignancy are associated with increased incidence of SSI. Increased awareness among hospital staff with regard to infection control and strict adherence to the aseptic precautions is the need of the hour.*
Key Word*: Surgical site infection; Elective surgery; Emergency surgery; Laparotomy; Prophylactic antibiotics*

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I. Introduction

Every operation in surgery is an experiment in microbiology - Lord Moynihan, 1920. Development of infection in the postoperative wound continues to be one of the serious complications from time immemorial. The understanding of wound infection has come a long way from the days when pus was "laudable". Infection was accepted as an inevitable sequel of surgery a century ago[1,2]. The infection rate, which was 75%, has now dropped to less than 10%. Surgical site infections (SSI) result from colonization with a bacterial load greater than the capability of the immune system to manage. SSI can significantly increase costs, morbidity and mortality among surgical patients. The introduction of antibiotic therapy in the middle of the 20'h century fostered hope that serious surgical infections would be eliminated However, not only have post-operative wound infections continued, but widespread antibiotic therapy has also often made prevention and control of surgical infections more difficult. The modern surgeon cannot escape the responsibility to deal with infections. He must realize that knowledge of many aspects of microbiology, immunology, and pharmacology and is an essential

component to surgical skills. The surgeon must remember that the possibilities for incisional wound sepsis in modern hospital practice are numerous and ever threatening. However, it is now possible to prevent infection routinely in most of the elective operative wounds, the achievement that undoubtedly is the greatest milestone of surgery[3].

II. Material And Methods

This study is a Prospective and Comparative study, considering minimum of 100 patients with 50 elective and 50 emergency abdominal surgeries done in

Study Design: Prospective and Comparative observational study

Study Location: Bangalore medical college and research institute and Atal Bihari Vajpayee medical college and research institute

Study Duration: June 2019 to June 2021.

Sample size: 100 patients.

Sample size calculation: A total of 100 patients who underwent elective and emergency abdominal surgeries were studied.

Subjects & selection method: Patients were interviewed and demographic data such as age, presenting symptoms were noted. A total of 100 patients undergoing both elective and emergency abdominal surgeries at the Department of General Surgery, Bangalore medical college and research institute and Atal Bihari Vajpayee medical college and research institute were included.

Inclusion criteria:

All the patients who were admitted for abdominal surgeries both elective and emergency, for various causes were studied in depth.

Exclusion criteria:

Patients with pre-existing infections were excluded.

Procedure methodology

After written informed consent was obtained, a well-designed questionnaire was used to collect the data of the recruited patients retrospectively. The patients would be explained regarding the objectives as well as the method of study. After fulfilling the selection criteria, all patients were counselled about the study and informed written consent was obtained. Thorough history was taken by structured proforma. Patients were followed up, post operatively until discharge for any wound related complications. Necessary investigations were done including blood investigations and pus culture and sensitivity[4,5].

Statistical analysis

Data processing and statistical analysis would be done with the help of a staff statistician and using SPSS 17.0.1 (Statistical Package, Software for windows, Chicago: SPSS. Inc)

III. Result

This study was conducted for two years from June 2019to June 2021. A total of 100 eligible patients with 50 elective and 50 emergency abdominal surgeries done in Bangalore medical college and research institute and Atal Bihari Vajpayee medical college and research institute.The data obtained was tabulated on excel spread sheet. The data was analysed and the final results were tabulated as below

Incidence of SSI

	N0. Of cases	No. of infection	Percentage of sepsis
ELECTIVE	50	6	12%
EMERGENCY	50	12	24%

	ELECTIVE			EMERGENCY		
AGE (yrs)	No. of patients	No. of cases infected	Percentage	No. of patients	No. of cases infected	Percentage
<30	12	-	0	10	1	10
30-40	14	1	7.1	12	-	0
40-50	11	2	18.2	13	5	38.5
50-60	9	1	11.1	13	6	46.3
60-70	4	2	50.0	2	-	0

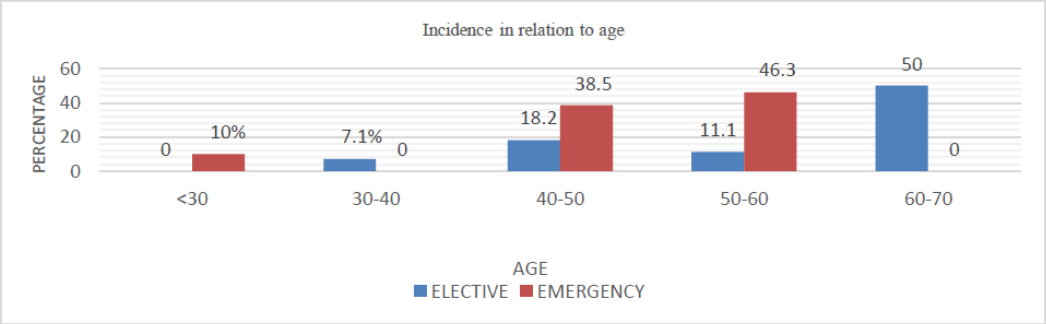

Figure 3: Incidence of SSI in relation to age

In the elective surgeries group higher incidence of infection is found in the patients aged between 60-70 years (50%) followed by 40-50 years age group (18.2%) and then followed by patients in 30-40 years age group (7.1%). SSI was not reported in patients < 30 years. In the group which underwent emergency surgery, higher incidence of SSI is found in the 50-60 years (46.3%) age followed by 40-50 (38.5%) years age group, followed by < 30 years group (10%). No SSI was found in patients between 30-40 years and 60-70 years age group[6,7].

TABLE 3- Incidence of SSI in relation to sex

	ELECTIVE			EMERGENCY		
	No. of patients	No. of cases infected	Percentage	No. of patients	No. of cases infected	Percentage
MALE	29	3	10.3	34	10	29.4
FEMALE	21	3	14.3	16	2	12.5

Male P= 0.173 Female P =0.192

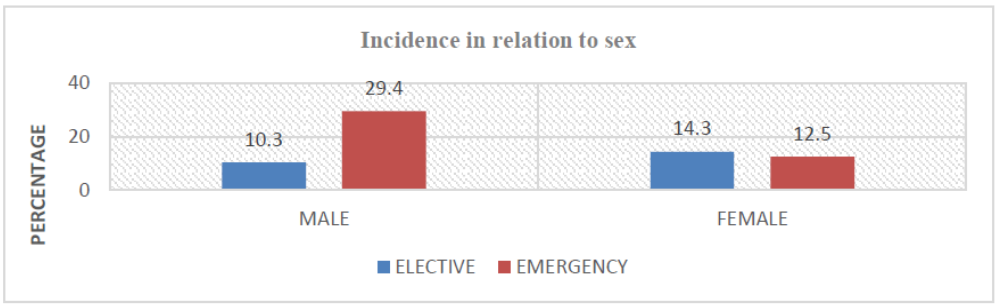

Figure 4: Incidence of SSI in relation to sex

In cases who underwent elective surgeries, females (14.3%) were found to have higher incidence of infections compared to male patients (10.3%). In case of emergency surgery patients males (29.4%) had higher incidence of infections than females (12.5%). [Table 3] [Figure 4]

TABLE 4

Incidence of SSI in relation to Malnutrition (Albumin)

ELECTIVE			EMERGENCY		
No. of patients	No. of cases infected	Percentage	No. of patients	No. of cases infected	Percentage
9	4	44.4	12	12	100

P=0.003

Out of the 9 patients with malnutrition in the Elective surgeries group, 4 patients (44%) had SSI, while in the emergency surgeries group out of 12 malnourished patients all of them (100%) had SSI.

The P value is highly significant (P=0.003) indicating relation between malnutrition and SSI.[Table 4] [Figure 4][8,9]

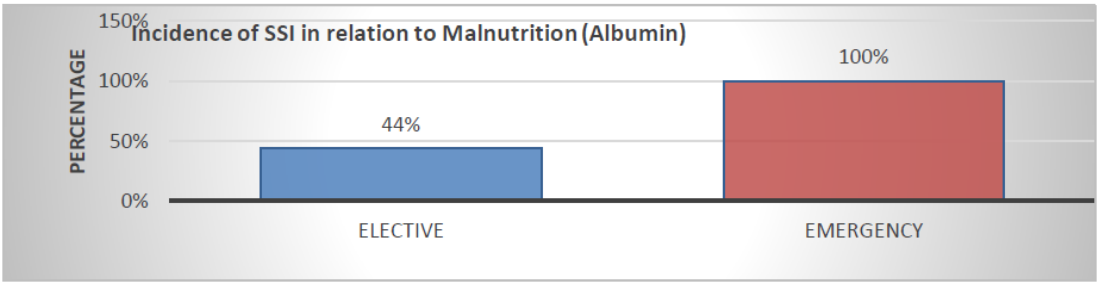

Figure 5: Incidence of SSI in relation to malnutrition

Table 5 Incidence of SSI in relation to Anemia [<10gm/dl]

ELECTIVE			EMERGENCY		
No. of Patients	No. Of case Infected	Percentage	No. Of Patients	No. of case Infected	Percentage
2	2	100	23	9	39

P= 0.096

Out of 2 patients who had anemia in the elective surgeries group, 100% of the anaemic patients had SSI while in the emergency surgeries group, out of 23 anemic patients 9 patients (39.1%) had SSI.[Table 5] [Figure 6]

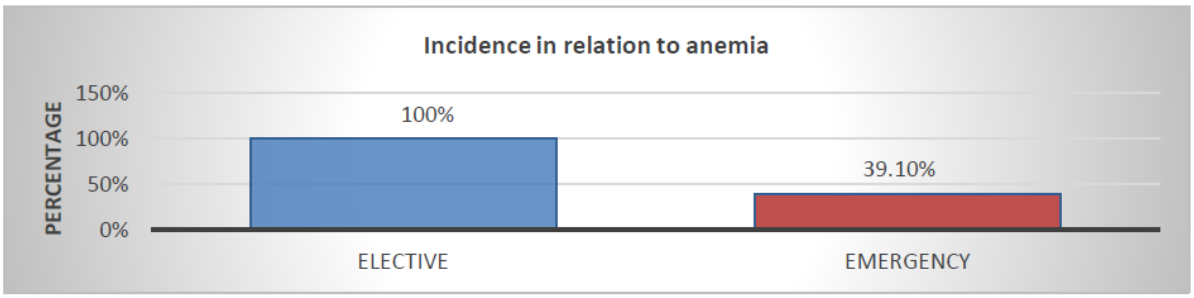

Figure 6 : Incidence of SSI in relation to anemia(>10gm/dl)

Table 6- Incidence of SSI in relation to Diabetes

ELECTIVE			EMERGENCY		
No. of Patients	No. Of case Infected	Percentage	No. Of Patients	No. of case Infected	Percentage
5	3	60	6	4	66.7

X^2=0.052, P=0.819

Out of 5 diabetic patients in the elective surgeries group, incidence of SSI in diabetic patients was 60% (3 patients) while out of 6 diabetic patients in emergency surgeries incidence of SSI was 66.7% (4 patients).[Table 6] [Figure 7][10,11]

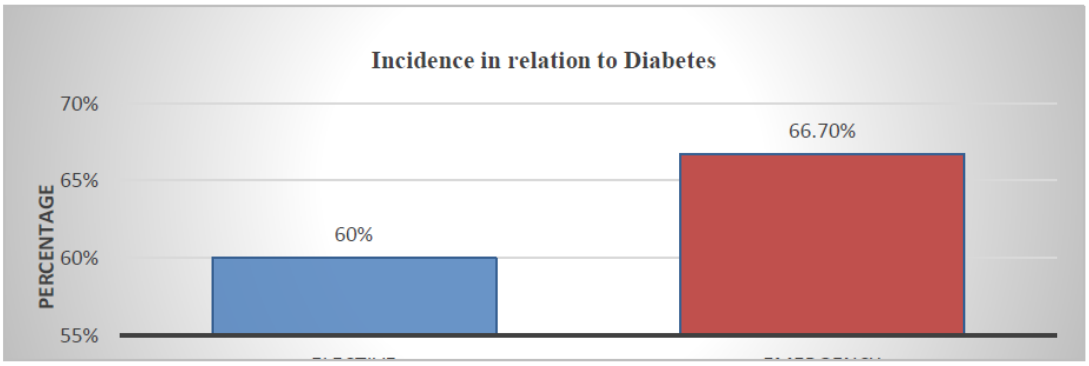

Figure 7: Incidence of SSI in relation to diabetes

Table 7-Incidence of SSI in Jaundice

ELECTIVE			EMERGENCY		
No. of Patients	No. Of case Infected	Percentage	No. Of Patients	No. of case Infected	Percentage
5	1	20	1	Nil	O

P=0.624

In elective surgeries group, out of 5 patients with jaundice, incidence of SSI in these patients was 20% (1 patient) while in emergency surgery group out of 1 patient with jaundice, there was no incidence of SSI.[Table7] [Figure8]

Table 8-Incidence of SSI in Malignancy

ELECTIVE			EMERGENCY		
No. of Patients	No. Of case Infected	Percentage	No. Of Patients	No. of case Infected	Percentage
10	4	40	2	1	50

X^2=0.068 P=0.793

Out of 10 patients with malignancy in the elective surgery group, incidence of SSI was 40% (4 patients) while in the emergency surgery group, out of 2 patients with malignancy incidence of SSI was 50% (1 patient).[Table 8] [Figure 9]

Table 9-Incidence of SSI in relation to alcohol consumption

ELECTIVE			EMERGENCY		
No. of Patients	No. Of case Infected	Percentage	No. Of Patients	No. of case Infected	Percentage
11	2	18.2	24	8	33.3

X^2=0.848 P=0.357

Out of 11 alcoholic patients in the elective surgery group, incidence of SSI was 18.20% (2 patients) while in the emergency surgery group, out of 24 alcoholic patients the incidence of SSI was 33.30%(8 patients). [Figure 10]

Table 10

Incidence of SSI in relation to nature of Surgery

	ELECTIVE			EMERGENCY			
	No. of Patients	No. of case Infected	Percentage	No. of Patients	No. of case infected	Percentage	P Value
CLEAN	21	1	4.8	7	Nil	0	0.557
CLEAN CONTAMINATED	19	2	10.5	26	1	3.8	0.375
CONTAMINATED	9	2	22.2	9	4	44.4	0.317
DIRTY	1	1	100	8	7	87.5	0.708

In elective surgeries, out of 21 clean surgery cases, 1 patient (4.8%) had SSI.

Out of 19 clean contaminated cases, 2 patients (10.5%) had SSI. Out of 9 contaminated cases, 2 patients (22.2%) had SSI. Only one was dirty case and SSI occurred in that patient (100%). The incidence of SSI was highest among dirty cases (100%) followed by contaminated (22.2%) followed by clean contaminated (10.5%) and clean cases (4.8%).

In emergency cases, out of 7 clean surgeries, none of the patients had SSI. Out of 26 clean contaminated cases, 1 patient (3.8%) had SSI. Out of 9 contaminated cases, 4 patients (44.4%) had SSI. Among 8 dirty cases 7 (87.5%) had SSI.[Table 11] .the incidence was highest among dirty cases(87.5%) followed by contaminated(44.4%) followed by clean contaminated(3.8%) and clean cases(0%). However no group had significant p value.

Table 11-Incidence of SSI in relation to Drain used

ELECTIVE			EMERGENCY		
No. of Patients	No. Of case Infected	Percentage	No. Of Patients	No. of case Infected	Percentage
16	4	25	21	11	52.3

X^2=2.82 P=0.093

In the elective cases, drain was used for 16 patients , amongst them 4 patients (25%) had SSI. In the emergency cases, drain was used for 21 patients ,amongst them 11 patients (52.3%) had SSI. [Figure 11]

Table 12-Incidence of SSI in relation to surgery performed by Consultant and Postgraduate

	ELECTIVE			EMERGENCY		
	No. of Patients	No. of case Infected	Percentage	No. of Patients	No. of case infected	Percentage
CONSULTANT	23	4	17.4	25	9	36
POSTGRADUATE	27	2	7.4	25	3	12

Consultant X^2=1.17 P=0.279
Postgraduate X^2=3.95 P=0.047
In the elective cases, out of 23 cases performed by consultant, 4 patients (17.4%) had SSI and out of 27 cases performed by post graduates 2 patients (7.4%) had SSI.
In the emergency cases, out of 25 cases performed by consultants 9 (36%) patients had SSI and out of 25 cases performed by post graduates 3 patients (12%) had SSI. [Table 12]

Figure 12: Incidence of SSI in relation to surgery performed by consultant and PG

Table 13-Incidence of SSI in relation to Nature of wound infection

	ELECTIVE	PERCENTAGE	EMERGENCY	PERCENTAGE
SUPERFICIAL	4	66.7%	7	58.3%
DEEP	2	33.3%	3	25%
ORGAN/SPACE	Nil	0%	2	16.7%

X^2=1.15 P=0.564
Among the 50 elective cases, out of 6 patients who had SSI, 4 patients (66.7%) had superficial incisional infection followed by 2 patients (33.3%) had deep incisional infection. None of them had organ/space infection.
Among the 50 emergency cases, out of 12 patients who had SSI, 7 patients (58.3%) had superficial incisional infection followed by 3 patients (25%) had deep incisional infection. 2 patients (16.7%) had organ/space infection. [table 13] [Figure 13]

Figure 13: Incidence in relation to nature of wound infection

Table 14-Incidence of SSI in relation to Duration of Surgery

Duration in Hrs	ELECTIVE			EMERGENCY		
	No. of Patients	No. of case Infected	Percentage	No. of Patients	No. of case Infected	Percentage
0 – 1	5	_	0	5	_	0
1 – 2	20	_	0	31	6	19.4
2 – 3	14	1	7.1	14	6	42.8
3 – 4	7	3	42.9	_	_	_
>4	4	2	50	_	_	_

X^2=14.1 P=0.003
In terms of duration, amongst the elective cases, highest incidence of SSI was seen in cases in whom duration of surgery was more than 4 hours (50%), followed by duration extending from 3-4 hours (42.9%), followed by 2-3 hours (7.1%). No SSI was encountered in patients whose surgeries were about 0-2 hours.
Amongst the emergency cases, highest incidence of SSI was seen in cases whose duration of surgery was 2-3 hours (42.8%), followed by 1-2 hours (19.4%). No SSI was encountered in patients with surgery duration of less than 1 hour. There were no patients who underwent surgery for more than 3 hours[12]. [Table 14]

Table 15-Organisms causing SSI

Organisms	Elective	Emergency
S.aureus	5	9
E.coli	1	1
Enterococcus	1	3
Acinectobacter	1	0
Pseudomonas	0	1

Amongst the elective cases,out of the 6 patients who had SSI, the highest isolated organism was S. aureus found in 5 patients (83.3%), followed by E. coli, Enterococcus, Acinetobacter seen in 1 patient each (16.7%).
Amongst the emergency cases, out of 12 patients who had SSI, the highest isolated organism was S. aureus found in 9 patients (75%), followed by Enterococcus found in 3 patients (25%),and E. coli, Pseudomonas seen in 1 patient each (8.3%). In some surgeries, patients had mixed bacterial infections.

IV. Discussion

Nosocomial infections constitute a major public health problem worldwide. They result in high morbidity and mortality, prolonged hospital stays, greater use of antibiotics, and increased costs . Surgical-site infections (SSI) along with pneumonia, urinary tract infections, and bloodstream infections are the most common nosocomial infections. Although SSIs are not associated with a high mortality rate, they are a significant source of morbidity among surgical patients. In our study, the overall incidence of surgical site infections is 18%. Several studies from India have shown rates ranging from 6.09% to 38.7%, with the majority of studies having a rate of 14-17%. In our study, incidence of surgical site infections in elective cases was 12% and that of emergency cases was 24%[13].

Studies done by Raka et al and Razavi et al showed incidence of SSI in elective and emergency surgeries as 13.9%,10% and 18.1%, 14.9% respectively. A study done by Latika et al showed incidence of SSI in elective and emergency abdominal surgeries as 16.6% and 28.57% respectively.

In our study, the most common age group developing SSI among the elective surgery patients was 60-70 years (50%) followed by 40-50 years age group(18.2%) and that of emergency surgery, higher incidence of SSI is found in the 50-60 years (46.3%) age followed by 40-50 (38.5%) years age group . most studies show an increase in the incidence of SSI with increase in the age probably reflecting the deteriorating immune status and development of co morbidities as age advances[14].

In our study, cases who underwent elective surgeries, females (14.3%) were found to have higher incidence of infections compared to male patients (10.3%). In case of emergency surgery patients males (29.4%) had higher incidence of infections than females (12.5%). Malnutrition is an important predisposing factor for SSI. In this study we considered albumin level less than 3 as malnutrition. 44% of patients with malnutrition who underwent elective surgeries had SSI and 100% of malnourished patients who underwent emergency surgeries had SSI. The P value is highly significant (P=0.003) indicating relation between malnutrition and SSI.

In our study, in the elective surgeries group, 100% of the anaemic patients had SSI while in the emergency surgeries group, 39.1% of the anaemic patients had SSI. In a study done by Waqar et al, anaemia was showed as a significant risk factor for developing SSI.

In our study, in the elective surgeries group, incidence of SSI in diabetic patients was 60% while in emergency surgeries incidence of SSI was 66.7%. Diabetes remains a significant risk factor for SSI. National academy of science also reported higher rate of SSI in patients with diabetes mellitus which is similar to our study. In our study, in elective surgeries group, incidence of SSI in patients with malignancy was 20% while in emergency surgery group, there was no incidence of SSI.

In our study, out of 11 alcoholic patients in the elective surgery group, incidence of SSI was 18.20% while in the emergency surgery group, the incidence of SSI was 33.30%. In our study, amongst the elective cases, The incidence of SSI was highest among dirty cases (100%) followed by contaminated (22.2%) followed by clean contaminated(10.5%) and clean cases(4.8%). In emergency cases, the incidence was highest among dirty cases(87.5%) followed by contaminated(44.4%) followed by clean contaminated(3.8%) . similarly a study done by Kumar A et al, showed that Clean (8.6%) Clean contaminated (17.5%) Contaminated (29.2%) with clean contaminated cases more prone for SSI.

In a study done by Razavi et al, they found incidence of SSIs predominantly in contaminated wounds (45.8%), followed by clean contaminated wounds (26.7%), dirty cases (14%) and clean wounds (13.6%). A study done by Raka et al, incidence rate of SSI was highest in dirty cases (100%) followed by contaminated cases (46.1%), clean contaminated (9.8%) and clean cases (3.1%)

In our study, In the elective cases, 25% of patients with drain had SSI and in the emergency cases, 52.3% of the patients with drain had SSI. It is found that use of drains and them being in-situ for longer duration is associated with more incidence of infection and they not only aid in draining the wound but also act as conduit for entry of organisms into the wound. These results are comparable to the studies done by Kumar A et al and Raka et al with incidence of SSIs 25.3% and 28.1% respectively In our study among the elective cases, 66.7% had superficial incisional infection followed by 33.3% had deep incisional infection. None of them had organ/space infection. Among the 50 emergency cases, 58.3% had superficial incisional infection followed by 25% had deep incisional infection, 16.7% had organ/space infection.

A study done by Raka et al reported that Superficial incisional SSIs were most common, followed by deep incisional, and then organ–space. In our study, amongst the elective cases, highest incidence of SSI was seen in cases in whom duration of surgery was more than 4 hours (50%), followed by duration extending from 3-4 hours (42.9%), followed by 2-3 hours (7.1%). No SSI was encountered in patients whose surgeries were about 0-2 hours and amongst the emergency cases, highest incidence of SSI was seen in cases whose duration of surgery was 2-3 hours (42.8%), followed by 1-2 hours (19.4%). No SSI was encountered in patients with surgery duration of less than 1 hour. There were no patients who underwent surgery for more than 3 hours. This is comparable to study done by Kumar A et al. they reported an increase in SSI incidence was observed when the duration of surgery was >2 hours (19.4%). Prolonged duration of operation results in increased exposure of operation site to air, prolonged trauma, stress of prolonged anaesthesia and sometimes blood loss. In our study, amongst the elective cases, the highest isolated organism was S. aureus (83.3%), followed by E. coli, Enterococcus, Acinetobacter. And amongst the emergency cases, the highest isolated organism was S. aureus (75%), followed by Enterococcus (25%),and E. coli, (8.3%). In some surgeries, patients had mixed bacterial infections.

In a study done by Kumar A et al,the most common pathogen associated with SSI were A beta hemolytic streptococci and staphylococcus aureus. Staphylococcus aureus (SA) is, and has always been, the most important pathogen in SSI around the world[15,16].

Another study done by Raka et al reported that the most frequently isolated microorganisms were Escherichia coli (36.4%) and Staphylococcus aureus (14.6%). A study done by Naveen et al reporte S.aureus to me the highest isolated organism.[17]

V. Conclusion

Incidence of SSI was observed to be high in elective surgeries which went on beyond 4 hours and about 2-3 hours in emergency surgeries[18]. Our study provided information on risk factors for SSI occurring in tertiary hospital. In particular it was observed that, increasing age of the patient, contaminated wound, prolonged duration of surgery, use of drains , malnutrition, anemia, diabetes, malignancy are associated with increased incidence of SSI. Also, Increased awareness among hospital staff with regard to infection control and strict adherence to the aseptic precautions is the need of the hour**.**

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