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A Study on Surveillance of Surgical Site Infection in Surgical Ward of a Tertiary Care Hospital

Bhaiolina Das[1], Dipak Kr Das[2*], Partha Pratim Das[3] and Monjuri Kataki[1]

[1]*Department of Microbiology, Gauhati Medical College & Hospital, Guwahati, Assam - 781032, India*
[2]*Department of Microbiology, Diphu Medical College & Hospital, Guwahati, Assam - 781032, India*
[3]*Department of Surgery, Gauhati Medical College & Hospital, Assam - 781032, India*

**Corresponding author*

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A B S T R A C T

Surgical site infections are the most common hospital acquired infection in both developed and developing countries. In the period from June 2019 to May 2020, 300 patients admitted for surgery were assessed preoperatively, intraoperatively and postoperatively Out of 300 samples collected from post operative cases with symptomatic wound infection, 157(52.3%) samples showed positive culture. Out of 157 isolates 128(81.5%) isolates are gram negative organisms and 26(18.4%) isolates are gram positive organism, among gram negative isolates *Klebsiella pneumoniae* (32.48%) is the predominant pathogen. In the present study found that Imipenem, Meropenem, Aztreonam, Piperacillin-Tazobectam were the most effective drugs for gram negative bacteria and Linezolid, Vancomycin and Teicoplanin were the most sensitive drugs for gram positive bacteria.

Introduction

Surgical site infections are the most common hospital acquired infection in both developed and developing countries. (Mukagendaneza *et al.*, 2019) They may affect either the incision or deep tissue at the operation site. Despite the improvements of all the measures of prevention, SSIs remain a significant clinical health problem as they are associated with an increased rate of mortality and morbidity (Owens and Stoessel, 2008). Surgical site infections are associated with a considerable economic burden arising from healthcare cost, increased length of hospital stay and increased risk of readmission (De Lissovoy *et al.*, 2009; Allegranzi *et al.*, 2011 and Kirkland *et al.*, 1999). Objective of this study was to determine the prevalence and the outcome measures of surgical site infection in patients attending surgical wards of tertiary care Hospital.

Materials and Methods

The present study was conducted taking approval from the Institutional Ethics Committee vide letter no MC190/2007/Pt-11/MAR-2019/PG/127.The study duration was one year from May 2019 to June 2020.The study included patients admitted for surgery in general surgery units of Gauhati Medical College and Hospital, Gauhati. A total of 300 surgical wounds in six general surgery units were enrolled in this study. The patients were assessed preoperatively, intraoperatively and postoperatively.

Wound classification was done by wound class (CDC, 1999), clean surgeries (Class I-operative wound) / clean-contaminated surgeries (Class II-operative wound), type and duration of operation, antimicrobial prophylaxis, preoperative hospital stay and total stay. Each patient was followed up from the time of admission till discharge from the hospital and also for 30 days postoperatively.

Surgical wound was inspected at the time of first dressing and weekly thereafter for 30 days. Wound infection was diagnosed if any one of the following criteria were fulfilled:

Serous or non-purulent discharge from the wound, pus discharge from the wound

Serous or non-purulent discharge from the wound with signs of inflammation (oedema, redness, warmth, raised local temperature, fever > 38°C, tenderness, induration) and wound deliberately opened up by the surgeon due to localized collection (serous/purulent). Stitch abscesses were excluded from this study.

Swabs obtained from infected wounds were processed aerobically by standard methods and identification of organisms were done by various biochemical tests. The sensitivity of the bacterial isolates were tested for different antimicrobial agents. As per recommendation of Clinical and Laboratory standard Institute (CLSI), antimicrobial susceptibility testing were performed by using Kirby-Bauer disc diffusion method

Staphylococcus aureus strains isolated from infected surgical wounds were tested for methicillin resistance and also for D –zone test for detection of inducible clindamycin resistance. *Klebsiella pneumiae, Escherichia coli* were screened for ESBL production by Kirby Bauer disc diffusion method and also for carbapenemases production by Modified Hodge test.

Statistical Analysis

All statistical analysis were performed using SPSS 23.0 (Statistical Package for Social Sciences) software. Categorical data comparisons were done by Chi square test and a two sided programme value less than 0.05 was considered statistically significant. All the graphical representations were plotted in MS excel.

Results and Discussion

A total of 300 samples were collected from 300 patients having surgical site infections in the surgical wards of GAUHATI MEDICAL COLLEGE AND HOSPITAL out of which 100% wounds were superficial incisional (Fig 1.1).

Out of 300 patients included in this study 71.33% were dirty infected, 25% were clean contaminated,2.67% were contaminated and 1% was clean wound.(Table 1). A chi-square test was performed between the surgical site infection cases and the types of wound and a highly significant interaction was observed at $P<0.05$.

In the present study there were 14(4.67%) cases of abcess drainage, 3(1%) cases of amputation, 20(6.67%) cases of appendicectomy, 1(0.33%) case of appendicectomy +PD,1 case(0.33%) of cholidocholithotomy, 2 (0.67%) cases of EEL +adhesiolysis+PL+PD,16(5.33%) cases of EEL +PD +appendicectomy, 3(1%) cases of EEL +PL+ appendicectomy, 8(2.67%) cases of EEL+ appendicectomy+PL+PD, 3(1%) cases of EEL+ PL +PD, 1 (0.33%) case of EEL+ repair of perforation,1(0.33%) case of sigmoid loop colostomy, 151 (50.33%) cases of EEL, 2 (0.67%) cases of EL, 11(3.67%) cases of hernioplasty, 18(6%) cases of illeostomy, 42(14%) cases of open cholecystectomy,1(0.33%) case of partial cholecystectomy, 2((0.67%) cases of whipple operation (Table -2).

Surgical site infection rate was more in patients who underwent emergency surgery (75%) than the patients who underwent elective surgery (25%) with a highly significant interaction P<0.05.(Fig1.2)

Infection rate was more in male (66.3%) than female (33.7%). A highly significant interaction was observed at P<0.05 between the gender of the patient and diagnosis.

In the present study alcohol intake was the most common risk factor (56.66%) followed by smoking (55%), diabetes (53.33%), obesity (2.33%), malnutrition (0.3%) and altered immune response (0%). It was seen that incidence of SSI was more in alcoholic than the non-alcoholic (170 out of 300), with a significant interaction of P <0.05 and also more in smokers than the non-smokers(165 out of 300) with a significant interaction <0.05.(Fig 1.3)

In the present study 8.67% of surgical site infection patients had duration of operation less than 2 hours and 91.33% patients had duration of more than 2 hours.

Out of 300 samples 157 were culture positive (52.3%) and 143 were culture negative (47.7%). From 157 culture positive samples 9 organisms were isolated, where *Klebsiella pneumoniae* is the most common organism followed by *Escherichia coli* (Table-3).

Klebsiella pneumoniae showed highest sensitivity to Imipenem and Meropenem (60.78%) and resistant to Ciprofloxacin. Other gram negative organisms also showed similar antibiogram pattern with highest sensitivity to Imipenem and Meropenem. Out of 51 isolates of *Klebsiella pneumoniae* 24 were ESBL producing (47%) and 10 were carbapenemase producing (24.3%).Out of 41 *Escherichia coli* 15 (36.5%) were ESBL producing (Fig1.4). Among the gram positive isolates there were 14 isolates of *Staphylococcus aureus*, all were resistant to Penicillin, where 4 were Methicillin resistant.

In this study, the surgical site infection rate was highest in the age group of 40 years and above i.e 46% followed by the age group of less than 29 years i.e.30.67%. Lowest incidence of infection was seen in the age group of 30-39 years (23.33%). Other studies with similar findings such as Negi *et al.,* (2015) reported highest incidence of surgical site infection in age group of >50 years(51.8%) in comparison to an incidence in age group of <30 years (12.4%). Mekhla *et al.,* (2019) reported SSI was significantly higher in patients >50 years of age. A study by Mukagendaneza *et al.,* (2019) reported the highest incidence of SSI (16.9%) in the age group between 26 and 45 years followed by the 10.9% in patients age group below 25 years (10.9%). A study by Sasikumari *et al.,* (2016) also reported that the patients belonging to 50-59 years were the major group affected (24.7%) (Sasikumari *et al.,* 2016).

In the present study, it was seen that out of total 300 cases, there were 199 (66.3%) males and 101(33.7%) females in the study group.

Other studies with similar findings such as Negi *et al.,* (2015) reported males (74.6%) were more commonly affected than females (25.5%) and the sex ratio male: female was 2.9:1. (Negi *et al.,* 2015) Another study by Lubega *et al.,* (2017) reported that out of 110 patients 82 (74.5%) were males and 28 (25.5%) were females. (Lubega *et al.,* 2017) A study by Sasikumari *et al.,* (2016) also reported a total of 138 males (60.8%) were infected being more than females. On the other hand a study by Alkaaki *et al.,* (2019) reported that out of 337 patients, 193 females (57.3%) and 144 males (42.7%).

In the present study, out of 300 surgical site infection patients the type of wound for all the patients were superficial incisional(100%). Other studies with similar findings such as Mukagendaneza *et al.,* (2019) reported all of the infections were superficial according to the CDC definition (Mukagendaneza *et al.,* 2019). Another study Zahran *et al.,* (2017) reported most common type of SSI as superficial (51%) followed by deep wound infection (32%) and organ/space wound infection (17%). (Zahran *et al.,* 2017). A study by Alkaaki *et al.,* (2019) reported out of 55 patients with SSI, 45% had superficial infections, 9% had deep infections and 45% had combined superficial and deep infections.

In the present study the majority (71.33%) of wounds are dirty- infected followed by clean contaminated type of wounds (25%), contaminated wounds (2.67%) and clean wounds (1%). Other studies with similar findings such as Patel *et al.,* (2012) reported highest percentage of dirty infected wounds (40.9%) and least percentage of clean wounds (3%). On the other hand a study by Mekhla *et al.,* (2019) reported most of the wounds as clean contaminated (59/100) followed by dirty and contaminated type of wound (41/100).

In the present study, alcohol intake was the most common risk factor (56.66%) followed by smoking (55%), diabetes (53.33%), obesity (2.33%), malnutrition (0.3%) and altered immune response (0%). It was seen that incidence of SSI was more in alcoholic than the non-alcoholic (170 out of 300), more in smokers than the non-smokers(165 out of 300) and more in diabetics than the non-diabetic patients (160 out of 300).

Other studies with similar findings Mundhada *et al.,* (2015) reported that the surgical site infection was more in patients with pre existing illness such as diabetes (66%). Another study by Mukagendaneza *et al.,* (2019) reported alcohol consumption was the most common risk factor, i.e.37.1%. They reported 10 (3.4%) SSI patients as smokers. In their study the majority of patients were (71%) having healthy weight, 26.7% were overweight and only 1.6% were obese. A study by Patel *et al.*, found that the rate of SSI was 36.4% (8/22) in patients with diabetes mellitus compared to the rate of SSI in patients without diabetes mellitus, which was 13.5% (24/178). A study by Alkaaki *et al.,* (2019) reported seventy patients (20.8%) were diabetic and 41 (12.2%) were smokers. Systemic steroid therapy and other immunosuppressive medications were not common in this cohort.

In the present study 52.3% sample showed growth of different types of bacteria and 47.7% samples showed no growth. From 157 culture positive cases, 9 types of bacterial species were isolated. The most common bacteria isolated was *Klebsiella pneumoniae* (32.48%), followed by *Escherichia coli* (26.11%), *Pseudomonas aeruginosa* (9.55%), *Staphylococcus aureus* (8.92%), *Acinetobacter baumannii* (8.28%), *Coagulase negative staphylococcus* (7.64%), *Klebsiella oxytoca* (3.18%), *Proteus mirabilis* (1.91%) and *Enterococcus fecalis* (1.91%).

A study by Mukagendaneza *et al.,* (2019) also found that the most common organism was *Klebsiella sp* with an incidence of 55%, followed by Escherichia coli (15%) and Proteus sp (12%). [(1)]Other bacteria isolated were *Acinectobacter* (9%), *Staphylococcus aureus* (6%) and coagulase-negative staphylococci (3%).

Patel *et al.,* (2011) also reported *Klebsiella* spp. was the most common isolate responsible for SSI.

On the other hand a study by Alkaaki *et al.,* (2019) reported that most common organism was *Escherichia coli* (52%), followed by gram-positive bacteria (38%) and a considerable number of *Acinetobacter baumannii* and *Pseudomonas*.

Another study by Narula *et al.,* (2020) reported *Staphylococcus aureus* was the most common organism isolated (35.16%) followed by *Klebsiella pneumoniae* (23.08%) and *Pseudomonas aeruginosa* (16.48%). Other organisms isolated from postoperative wounds with their frequency of occurrence in decreasing percentage were *Escherichia coli* (12.09%), *Proteus mirabilis* (6.59%), *Coagulase-negative Staphylococcus* (5.49%) and *Enterococcus sp*. (1.10%). In the present study among 300 patients 75% patients underwent emergency procedure and 25 %patients underwent elective procedures. There were 14 (4.67%) cases of abcess drainage, 3 (1%) cases of amputation, 20 (6.67%) cases of appendicectomy, 1(0.33%) case of appendicectomy +PD,1 case(0.33%) of cholidocholithotomy, 2 (0.67%) cases of EEL+adhesiolysis+PL+PD,16(5.33%) cases of EEL+PD+ appendicectomy,3(1%) cases of EEL+PL+ appendicectomy, 8(2.67%) cases of EEL+appendicectomy+PL+PD, 3(1%) cases of EEL+PL+PD, 1 (0.33%) case of EEL+ repair of perforation,1(0.33%) case of sigmoid loop colostomy, 151 (50.33%) cases of EEL, 2 (0.67%) cases of EL, 11(3.67%) cases of hernioplasty, 18(6%) cases of illeostomy, 42(14%) cases of open cholecystectomy,1(0.33%) case of partial cholecystectomy, 2((0.67%) cases of whipple operation.

A study by Sasikumari *et al.*, (2016) reported maximum surgical site infection in emergency laparotomy wounds which is similar to the present study. Another study by Alkaki *et al.*, (2019) also reported highest SSI rate in laparotomy wounds. Other studies with similar findings Mundhada *et al.*, (2015) reported that rate of infection was higher in emergency cases (45%) than elective cases (21%). Another study by Mekhla *et al.*, (2019) also found the SSI rate in elective surgery cases was 28% and in emergency surgery cases was 50%. A study by Patel *et al.*, (2012) also reported that in patients with emergency surgery the infection rate was 24.14% (14/58) while in patients operated electively, the rate was 12.68% (18/142).

In the present study 8.67% of surgical site patients had duration of operation less than 2 hours and 91.33% patients had duration of more than 2 hours.

A study by Mundhada *et al.*, (2015) reported that Infection rate varied with duration of operation with rate of 10.75% in surgeries which lasted for >1 h, which is higher than the rate in surgeries which lasted between 30 min to 1 h (2.04%). Another study by Narula *et al.*, (2020) also found that SSI incidence was highest (55.56%) among 18 cases that took more than 120 min per operation to complete and lowest (9.12%) in 340 operations that took less than 60 min per case. Shahane (2012) also reported increased number of SSI cases i.e.13.1% cases, where surgery has been prolonged more than 2 hours.

Klebsiella pneumoniae showed 60.78% sensitivity to Imipenem and Meropenem, 43.14% sensitivity to Aztreonam, 41.17% sensitivity to Piperacillin and Tazobactam, 33.33% sensitivity to Ceftriaxone, 31.37% sensitivity to Amikacin, 9.80 % sensitivity to Cefepime, 7.84% sensitivity to Amoxyclave followed by Cefotaxime (5.88%), Gentamicin (1.96%) and Ciprofoxacin (0%).

A study by Narula *et al.*, (2020) found *Klebsiella pneumoniae* 95% sensitive to Amoxyclave which is not similar to the present study but the sensitivity pattern of Piperacillin- Tezobectam was almost similar to the present study. Another study by Mundhada *et al.*, (2015) also found almost similar sensitivity pattern of Amikacin to the present study.

Klebsiella oxytoca showed 100% sensitivity to Imipenem and lowest sensitivity to Amoxyclave, Ceftriaxone, Cefotaxime and Ceftazidime, Gentamicin and Amikacin.

A study by Njoku *et al.*, (2019) is almost similar to the present study showing 100% sensitivity to Imipenem and 0% sensitivity to Amoxyclav, Ceftriaxon and Ceftazidime.

Table.1

Types of wound	Numbers	Percentage
Clean	3	1%
Clean contaminated	75	25%
Contaminated	8	2.67%
Dirty- infected	214	71.33%

Table.2

		Abcess drainage	*Amputation*	*Appendicectomy*	*Appendicectomy+PD*	*Cholidocholithotomy*	*EEL+Adhesiolysis+PL+PD*	*EEL+PD+Appendicecto*	*EEL+PL+Appendicecto*	*EEL+PL+Appendicecto+PD*	*EEL+PL+PD*	*EEL+repair of*	*EEL+sigmoid loop*	*Emergency exploratory Laparotomy*	*Exploratory Laparotomy*	*Hernioplasty*	*Illeostomy*	*Open cholecystectomy*	*Paertial cholecystectomy*	*Whipples operation*	*Total*
Diagnosis	Abcess over left cervical region	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
	Acute appendicitis	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**20**
	Acute intestinal obstruction	0	0	0	0	0	1	0	0	0	1	0	0	5	0	0	0	0	0	0	**7**
	Appendicular abcess	0	0	0	1	0	1	16	0	0	0	0	0	0	0	0	0	0	0	0	**18**
	Appendicular perforation	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	**3**
	Appendicular perforation with abcess	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	**8**
	Breast abcess	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**12**
	Carcinoma ascending colon	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	**1**
	Cecal perforation	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	**1**
	Cholecystitis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	0	0	**27**
	Chronic Calculous Cholecystitis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	**15**
	Duodanal perforation	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	**2**
	Haemoperitoneum	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	**2**
	Hepatic abcess	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	**2**
	Hollow viscus perforation	0	0	0	0	0	0	0	0	0	0	0	0	77	0	0	0	0	0	0	**77**
	Illeal perforation	0	0	0	0	0	0	0	0	0	0	1	0	4	0	0	18	0	0	0	**23**
	Illeo jejunal perforation	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	**1**
	Impacted CBD stone	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
	Inguinal hernia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	**9**
	Intestinal obstruction	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**1**
	Intraabdominal abcess	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	**2**

	Jejunal perforation	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	**2**
	Nerve sheath tumour of leg	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**3**
	Peianal abcess	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
	Penetrating injury abdomen	0	0	0	0	0	0	0	0	0	0	0	0	32	0	0	0	0	0	0	**32**
	Perforated Gallbladder	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
	Periampullary carcinoma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**1**
	Post op right hemicolectomy	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	**1**
	Pyloric perforation	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0	0	0	0	0	**16**
	Right sided inguinal hernia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	**1**
	Splenic laceration	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	**6**
	Traumatic hemoperitoneum	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	**1**
	Tumour head of pancrease	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	**1**
	Umbilical hernia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	**1**
	Total	**14**	**3**	**20**	**1**	**1**	**2**	**16**	**3**	**8**	**3**	**1**	**1**	**151**	**2**	**11**	**18**	**42**	**1**	**2**	**300**

Table.3

Bacterial isolates	**Numbers**	**Percentage (%)**
Klebsiella pneumoniae	51	32.48%
Escherichia Coli	41	26.11%
Pseudomonas aeruginosa	15	9.55%
Staphylococcus aureus	14	8.92%
Acinetobacter baumannii	13	8.28%
Coagulase negative staphylococcus	12	7.64%
Klebsiella oxytoca	5	3.18%
Proteus mirabilis	3	1.91%
Enterococcus fecalis	3	1.91%

Table.4

Study	Patients enrolled in the study	Age group with peak incidence of SSI	Rate of SSI at this age group
Negi *et al*(2015)	768	>50 years	51.8%
Mekhla *et al*(2019)	100	>50 years	23%
Mukagendaneza *et al* (2019)	294	26-44 years	56.5%
Sasikumari *et al*(2016)	227	50-59 years	24.7%
Present study (2019-2020)	300	≥ 40 years	46%

Table.5

Study	Patients enrolled in the study	Gender with peak incidence of SSI	Rate of SSI
Negi *et al* (2015)	768	Males	74.6%
Lubega *et al* (2017)	110	Males	74.5%
Sasikumari *et al* (2016)	227	Males	60.8%
Alkaaki *et al* (2019)	337	Females	57.3%
Present study (2019-2020)	300	Males	66.3%

Table.6

Study	Patients enrolled in the study	Most common type of SSI	Rate of SSI
Mukagendaneza *et al* (2019)	294	Superficial incisional	100%
Zahran *et al*(2017)	148	Superficial incisional	51%
Alkaaki *et al*(2019)	337	Superficial incisional	45%
Present study(2019-2020)	300	Superficial incisional	100%

Table.7

Study	Patients enrolled in the study	Types of wound
Patel *et al*(2012)	200	Dirty wound-40.9%, contaminated wound-20%,clean-contaminated wound -11.4%, clean wound-3%
Mekhla *et al* (2019)	100	Out of 100 patients 59 were clean contaminated and 41 were contaminated and dirty wound.
Present study(2019-2020)	300	Dirty wound-71.33%,contaminated wound-2.67%,clean-contaminated wound -25%, clean wound-1%

Table.8

Study	Patients enrolled in the study	Most common risk factors
Mundhada *et al*(2015)	100	Diabetes(66%)
Mukagendaneza *et al* (2019)	294	Alcohol(37.1%)
Alkaaki *et al*(2019)	337	Diabetes(20.8%)
Present study(2019-2020)	300	Alcohol(56.66%)

Table.9

Study	Most common bacterial isolates
Mukagendaneza *et al* (2019)	*Klebsiella spp*
Patel *et al*(2011)	*Klebsiella spp*
Alkaaki *et al*(2019)	*Escherichia coli*
Narula *et al* (2020)	*Staphylococcus aureus*
Present study(2019-2020)	*Klebsiella pneumoniae*

Table.10

Study	Patients enrolled in the study	Most common type of operative procedure causing SSI
Sasikumari *et al* (2016)	227	Emergency laparotomy wounds
Alkaki *et al* (2019)	337	Laparotomy wounds
Mundhada *et al* (2015)	100	Emergency cases (45%)
Mekhla *et al* (2019)	100	Emegency cases(50%)
Patel *et al* (2012)	200	Emergency cases(24.14%
Present study (2019-2020)	300	Emergency cases(75%)and most commonly emergency exploratory laparotomy wounds(51%)

Table.11

Study	Patients enrolled in the study	Duration of operation and rate of SSI
Mundhada *et al* (2015)	100	>1hr- 10.75% 30 min- 1 hr- 2.04%
Narula *et al* (2020)	609	>120 min-55.56% <60 min-9.12%
Shahane (2012)	300	>2 hrs-13.1%
Present study (2019-2020)	300	>2 hrs-91.33% < 2 hrs-8.67%

Fig.1 Bar diagram showing distribution of patients according to the type of SSI

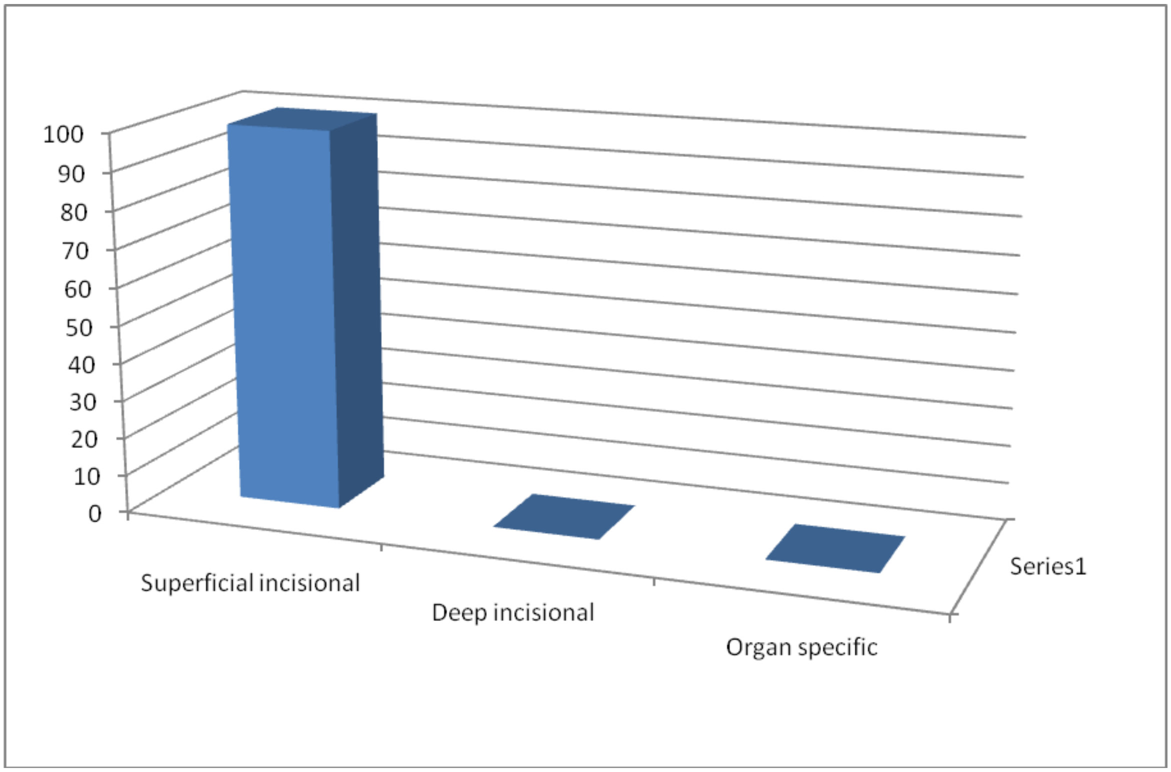


Fig.2 Distribution of patients according to the procedure

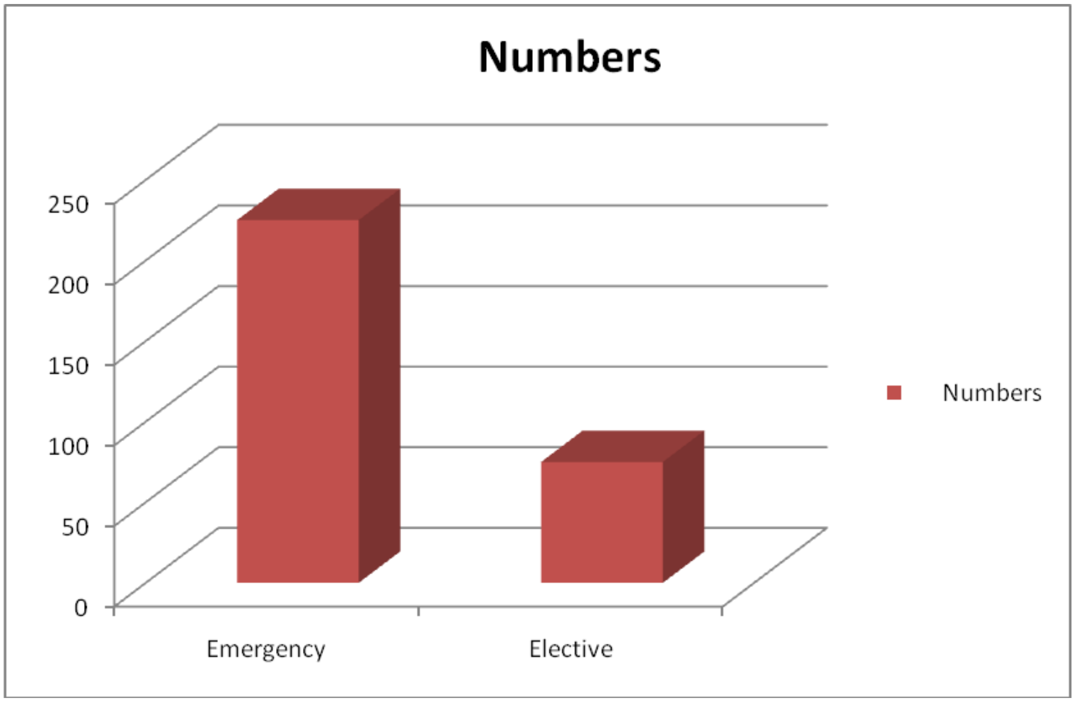


Fig.3 Bar diagram showing distribution of patients according to the presence of risk factors

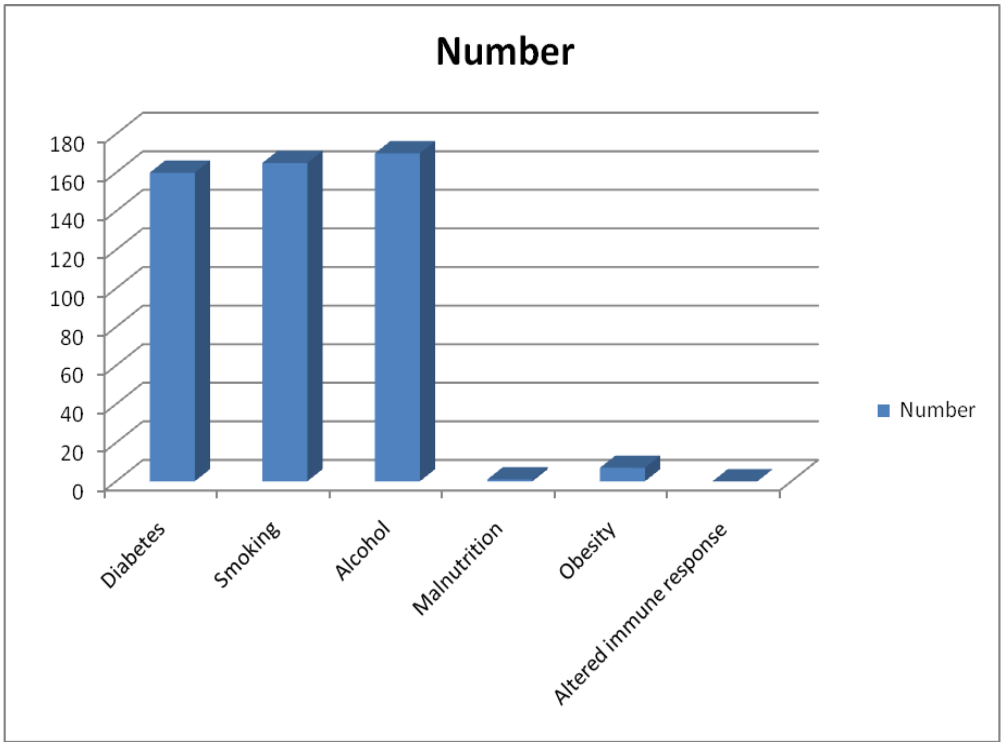
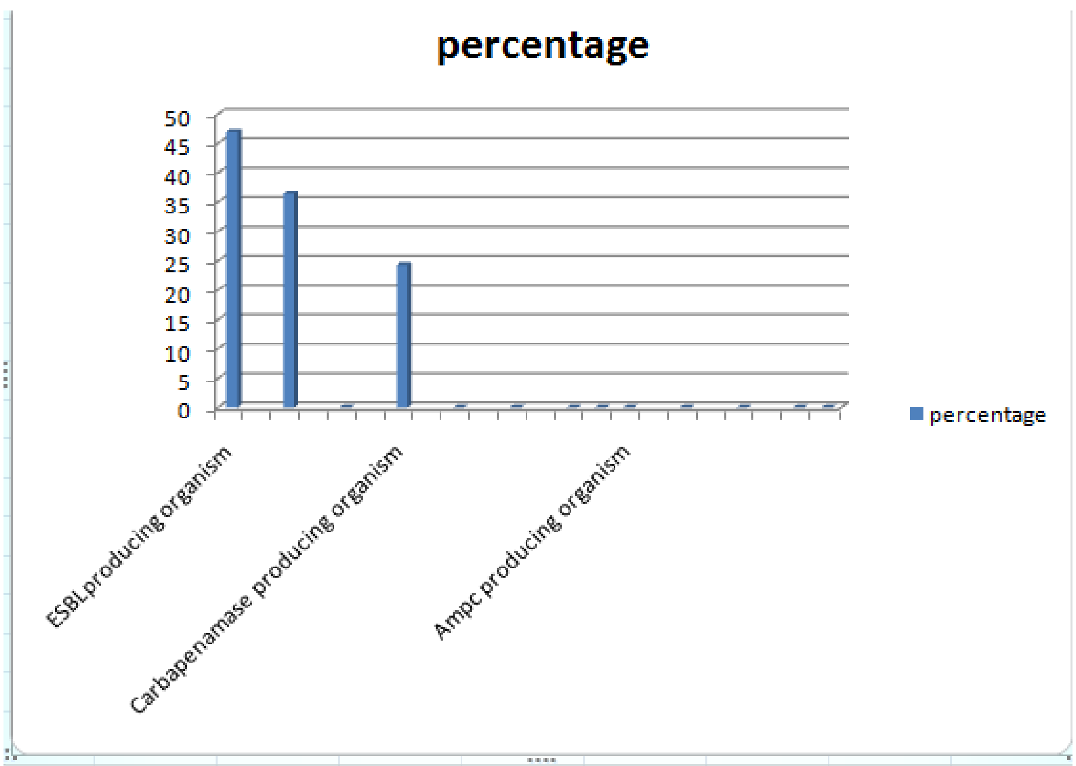


Fig.4 Bar diagram showing resistance pattern for the antibiotics



Escherichia coli showed 85.36% sensitivity to Meropenem and least sensitivity to Ciprofloxacin.

On the other hand a study by Njoku *et al.,* (2019) reported the least sensitivity pattern to Meropenem.

Acinetobacter baumannii showed 100% sensitivity to Imipenem and Meropenem and least sensitivity to Ciprofloxacin.

The present study is in concordance with a study by Sasikumari *et al.,* (2016) where *Acinetobacter Baumannii* showed maximum sensitivity to Imipenem least sensitivity to Ciprofloxacin.

Pseudomonas aeruginosa showed 100% sensitivity to Imipenem. A study by Shahane (2012) *et al.,* is almost similar to the present study showing 100% sensitivity to Imipenem.

Proteus Mirabilis showed 100% sensitivity to Amikacin, Aztreonam, Piperacillin-Tazobectam, Imipenem and Meropenem, and least sensitivity to Amoxyclav and Ceftriaxone. A study by Zahran *et al.,* (2017) is not similar to the present study but the sensitivity pattern of Amikacin is almost similar showing the maximum sensitivity. *Staphylococcus aureus* showed 100% sensitivity to Linezolid and Vancomycin. The present study is in concordance with a study by Sasikumari *et al.,* (2016) where *Staphylococcus aureus* showed 100% sensitivity to Linezolid and Vancomycin.

Coagulase negative Staphylococcus showed 100% sensitivity to Linezolid and Vancomycin and least (0%) sensitivity to Penicilllin.

A study by Narula *et al.,* (2020) is almost similar to the present study showing 100% sensitivity to Linezolid and Vancomycin. A study by Zahran *et al.,* is similar to the present study showing highest percentage of resistance (100%) to Penicillin, but contrary to the present study Linezolid and Vancomycin not found 100% sensitive. *Enterococcus Faecalis* showed 100% sensitivity to Vancomycin, Linezolid and high level Gentamicin and least(0%) sensitivity to Penicillin. The present study is in concordance with a study by Sasikumari *et al.,* (2016) showing 100% sensitivity to Vancomycin and 0% sensitivity to Penicillin.

This study showed 47% ESBL producing *Klebsiella pneumoniae*,36.5% ESBL producing *Escherichia* coli, 24.3% carbapenamase producing *Klebsiella pneumoniae*, 28.57% methicillin resistant staphylococci, 16.66% methicillin resistant coagulase negative staphylococci and 0% inducible clindamycin resistant staphylococci and ampc producing organism. A study by Singh *et al.,*(2018) reported 19% carbapenem resistant which is similar to the present study.

On the other hand a study by Rajput *et al.,* (2019) reported 22.72% ESBL producing *Escherichia* coli, 15.9% ESBL producing *Klebsiella pneumonia*. A study by Zahran *et al.,* reported 88.2% MRSA,62.5% MRCONS, 65.1% ESBL producing Enterobacteriace and 73% carbapenem resistant which is not similar to the present study.[11] Another study by Sarma *et al.,* (2011) reported majority of Enterobacteriace are amp-C producers.

Surgical site infections continue to be a major source of morbidity and mortality in spite of the advances in operative techniques. Both Gram positive cocci and Gram negative bacilli caused surgical site infection and this study showed a predominance of Gram negative bacilli with multiple drug resistance.

Appropriate use of antimicrobials based on antibiogram pattern can certainly help the clinician in reducing the burden of surgical site infection. Prolonged use of antibiotics should be avoided as this can lead to the development of resistant micro organisms which are even more difficult to get rid of.

The practice of aseptic technique during and after surgery should be the primary support rather than over dependence on antibiotics to reduce emergence and spread of resistant pathogens.

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