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RESEARCH ARTICLE

A RETROSPECTIVE STUDY ON INCIDENCE OF SURGICAL SITE INFECTION, BACTERIOLOGICAL PROFILE AND PRESCRIBING PATTERN OF ANTIBIOTIC IN A TERTIARY CARE HOSPITAL

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Abstract

Background and objective: Surgical site infection is a hospital acquired infection occurs at surgical site during the post operative periods. It is ranked as the third commonest healthcare associated infection. The aim of the study is to evaluate the incidence rate of infection in post operative patients, bacteriological profile and the prescribing pattern of antibiotics and also to determine the most common type of surgical procedures done in surgery ward. **Methodology:** A Retrospective longitudinal descriptive study was carried out for a period of 6 months in a tertiary care teaching hospital. During the study period, case files of all patients who underwent surgery were reviewed, and collected based on the selection criteria. Data was analyzed using SPSS and Microsoft excel 2013. Results: Out of 264 study subjects, 11 patients were affected with surgical site infection and the infection rate was 4.17%. Escherichia coli were found to be the predominantly isolated causative organism. Prescribing pattern of antibiotics was analyzed and found that cefuroxime + sulbactam followed by ceftriaxone and metronidazole were the commonly prescribed antibiotics during the operative period. **Conclusion:** It is important to employ a strict infection control committee in all the hospitals, if it is lacking so as to monitor and provide recommendations at all level of prevention of infection. And the overall management of surgical wounds can be improved by sharing of clinical knowledge and providing enhanced education to the healthcare workers, patients and care givers.

Introduction:-

Surgical site infection (SSI) is a hospital acquired infection occurs at surgical site during the post operative periods.[1] It is ranked as the third most commonest healthcare associated infections .[2] These infections have a major impact on both morbidity and mortality as it doubled the risk of patient's death after surgery.[1] Infection is defined as 'invasion and colonization of microorganisms in the body tissues, which may be clinically unobvious which occurs due to competitive metabolisms, intracellular replication, toxins or antigen-antibody responses in body. It is difficult to predict which wounds will become infected.[3]

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World Health Organization (WHO) described hospital acquired infections as one of the important infectious diseases having huge monetary impact due to extra bed occupancy about 7-10 days.About 25-36% of SSIs are preventable by sticking to strict guidelines by health care providers while treating patients.[4]

In an international survey arranged by the WHO in 1988, the SSI rates varied between 5.2% and 34.4%.[5] and later studies show that the rate of incidence of SSIs was found within a range of 2.6-35.6%.[6]

Most of the SSIs occurs during the surgery is due to the contamination of an wound with microorganisms from the patient's own body and surroundings.[6] The organisms commonly isolated from SSI in an international survey were Escherichia coli, Staphylococcus aureus and Pseudomonas aeruginosa. Approximately 90% of the organisms were gram-negative, of which 84% was Enterobacteriaceae.[7]

The risk of developing an SSI will depend upon the patient's health status, age, gender, nutrition, smoking, alcoholism, co-morbidities, length of the surgical procedure, type of surgery, length of hospital stay, amount and type of local skin bacteria, preoperative glucose levels, core body temperature fluctuations, and incorrect or lack of antibiotic prophylaxis.[2,8] Site and complexity of surgical procedures is also a risk factor for developing SSI. Even with improvements made within operating room practices, instrument sterilization methods and the prevention strategies, SSIs continue as a major cause of nosocomial infection and the rates are increasing worldwide even in hospitals having modern facilities and with standard protocols for the pre-operative preparations and antibiotic prophylaxis.[9]

Proper antibiotic selection is based on the recommended guidelines for surgical procedures provided for national surveillance. The professional consensus supports the use of narrow-spectrum, first generation and second generation cephalosporins, which are considered to be inexpensive, safe, bactericidal, and have longer half-lives.[10] Inappropriate antibiotic selection, prolonged duration of administration of prophylaxis antibiotic, may cause complications and also raises the cost of therapy and produce more resistance against specific bacterial strain. Therefore rational use of antibiotics and close monitoring of antimicrobial resistance in postoperative patients with SSI are necessary to prevent the emergence and spread of resistance among the bacterial isolates.[11]

The microbiologist plays a major role in monitoring and warning the clinicians about infections and resistant strains.[12] In order to improve overall management of surgical wounds, enhanced education of the healthcare workers, patients and care givers, and sharing of clinical expertise will be required.[6]

The aim of the study is to evaluate the incidence of surgical site infection, bacteriological profile and prescribing pattern of antibiotics in a tertiary care hospital.

Subjects And Methods:-

A retrospective longitudinal descriptive study was carried out in a tertiary care teaching hospital in Mangaluru for a period of 6 months from October 2017 to March 2018. The study protocol was approved by the Institutional Ethics Committee (IEC).

1. Inclusion criteria-
   All patients who undergone surgeries
2. Exclusion criteria-
   Patients who are not undergone surgeries
   Patients who undergone surgery with previous infection

Sampling Method:-

Based on the inclusion and exclusion criteria, medical records of patients admitted to the hospital and who underwent surgery from July 2017 to December 2017 were obtained. A total of 264 case files of patients who underwent surgery met the selection criteria.

Study method and data analysis:-

A structured Data collection form was used to collect the data from MRD. Data collection form was designed with the help of resources and are validated by the expert committee in the Department of General Surgery. Ethical committee approval was obtained to conduct the study. The data was collected from the Medical record of patients

which are filled by doctors, nurses, pharmacist and other health care professionals. Data collected includes demographic details, past and present medical history, medication history, social history, diagnosis on admission, date of admission and date of discharge, laboratory investigations, and surgery details of the patient. Microbiological culture isolates and prescribed antibiotics were also collected. And all the details will be kept confidential.
Data analysis was carried out using Statistical Package for Social Sciences (SPSS), windows version 20.0 and Microsoft Excel 2013 version.

Results:-

During the study period, Medical record of 264 patients who underwent various surgical procedures from the hospital were collected based on the selection criteria. And out of 264 case files analyzed, 156 (59.1%) patients were male and 108 (40.9%) were female patients [Table 1]. Majority of the patients who underwent surgery belongs to the age group of 31 to 40 years (19.7%) [Table 2].

Table1:- Gender wise distribution of the study subjects

Gender	Count (n)	Percentage (%)
Male	156	59.1
Female	108	40.90

Table 2:- Age wise distribution of the study subjects

Age (years)	Count (n)	Percentage (%)
1-10	4	1.5
11-20	22	8.3
21-30	40	15.15
31-40	51	19.31
41-50	42	15.90
51-60	50	18.9
61-70	40	15.15
71-80	10	3.8
81-90	5	1.9

Surgical site infection (SSI) among the 264 study subjects was found to be 11 and the rate of infection was found to be 4.17% [Figure 1].

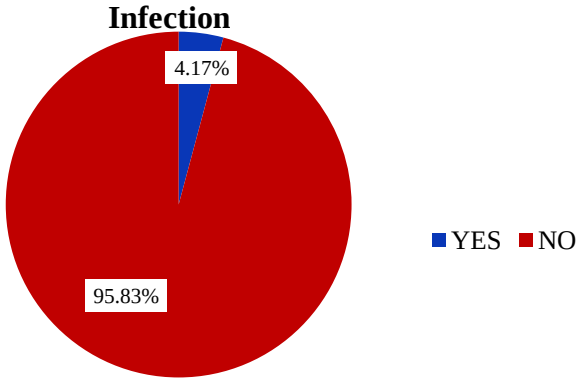

Figure1:- Infection rate in study subjects.

The pathogens isolated from patients with postoperative SSIs were found to be Escherichia coli (33.33%), Klebsiella pneumonia (27.78%), Enterococcus faecium (16.67%), Acinetobacter species (5.55%), Citrobacter freundii (5.55%),Staphylococcus aureus (5.55%), Enterococcus faecalis (5.55%) [Table 3].

Table 3:- Bacteriological profile of SSI patients.

Causative organism	Category	Count(n)	Percentage(%)
Escherichia coli	Gram negative	6	33.33
Klebsiella pneumonia	Gram negative	5	27.78
Enterococcus faecium	Gram positive	3	16.67
Acinetobacter species	Gram negative	1	5.55
Citrobacter freundii	Gram negative	1	5.55
Staphylococcus aureus	Gram positive	1	5.55
Enterococcus faecalis	Gram positive	1	5.55

When considering the antibiotics prescribing pattern, prophylactic antibiotics was given in 249 (94.31%) cases. The most frequently prescribed pre-operative antibiotics were found to be Cefuroxime+Sulbactam 2.25g followed by Ceftriaxone 1g and Metronidazole 500mg [Figure 2]. And the commonly used post operative antibiotics were Cefuroxime+Sulbactam 2.25g followed by Metronidazole 500mg and Ceftriaxone 1g [Figure 3].

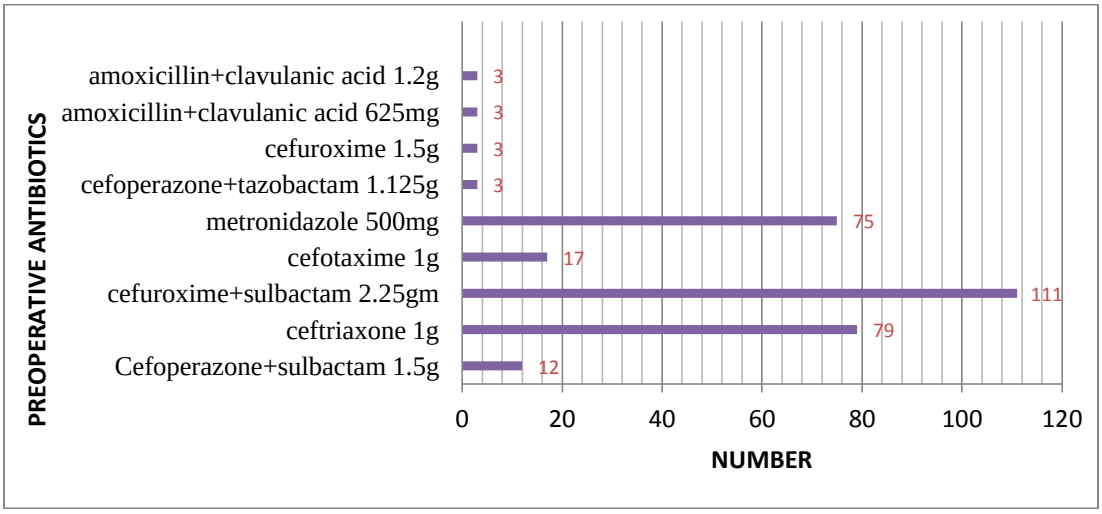

Figure2:- Prescribing pattern of preoperative antibiotics.

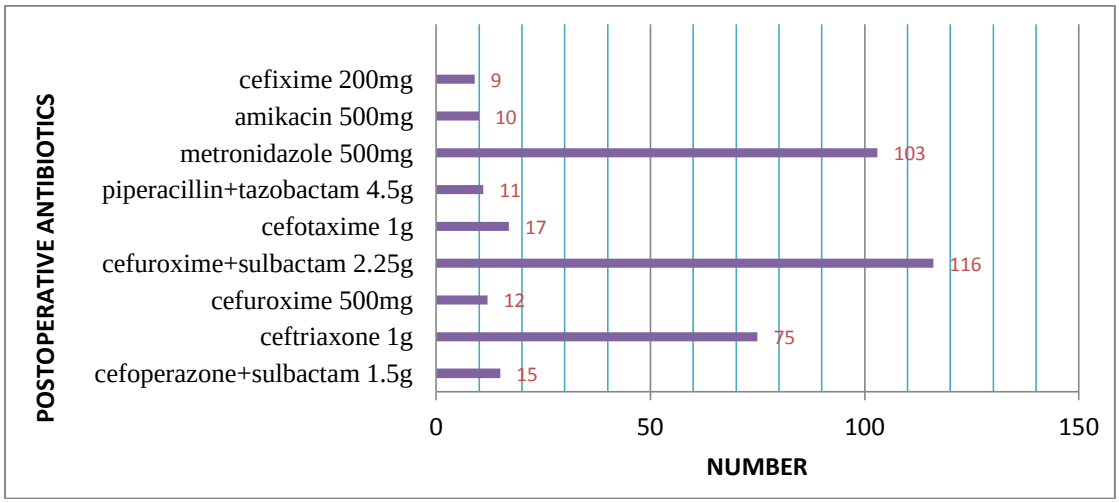

Figure3:- Prescribing pattern of postoperative antibiotics.

The predominantly observed surgical procedure were found to be Appendicectomy 46(17.4%), Inguinal hernioplasty 42(15.9%), Cholecystectomy 29(11.0%), Hemorrhoidectomy 17(6.4%) and Umbilical hernioplasty 10(3.8%) [Figure 4].

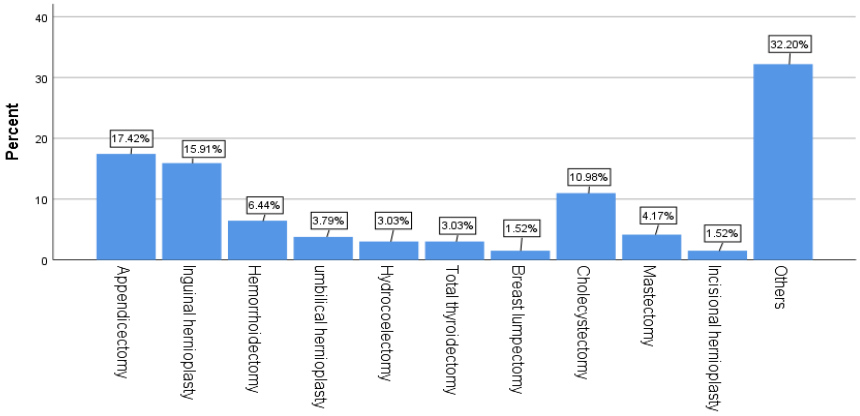

Figure4:- Surgical procedures among study subjects in percentage

The susceptibility pattern of major organisms such as Escherichia coli, Klebsiella pneumonia and Enterococcus faecium to antimicrobials is illustrated [Table 4]. Escherichia coli were found to be highly resistant to Ampicillin, Amoxicillin+Clavulanic Acid, Cefazolin, Cefuroxime, Cefotaxime, Cefoperazone+Sulbactam and Azithromycin. Klebsiella pneumonia was found to be highly resistant to Ampicillin, Amoxicillin+Clavulanic Acid, Cefazolin, Cefuroxime whereas Enterococcus faecium was found to be highly resistant to Ampicillin, Imipenem, Meropenem, Piperacillin+Tazobactam, Azithromycin, Ciprofloxacin and Levofloxacin.

Table 4:- Susceptibility Pattern of organisms to Antibiotics.

Organism	Escherichia coli		Klebsiella pneumonia		Enterococcus faecium	
Antibiotics	Resistancen (%)	Sensitivity n(%)	Resistancen (%)	Sensitivityn (%)	Resistancen (%)	Sensitivityn (%)
Ampicillin	3(100%)	0	5(100%)	0	3(100%)	0
Amoxicillin+Clavulanic Acid	3(100%)	0	5(100%)	0	1(50%)	1(50%)
Cefazolin	3(100%)	0	5(100%)	0	0	0
Cefuroxime	3(100%)	0	5(100%)	0	0	0
Cefotaxime	4(100%)	0	4(80%)	1(20%)	0	0
Cefoperazone+Sulbactam	3(100%)	0	1(25%)	3(75%)	0	0
Azithromycin	1(100%)	0	0	0	2(100%)	0
Ciprofloxacin	5(83.3%)	1(16.67%)	1(50%)	1(50%)	2(100%)	0
Levofloxacin	5(83.3%)	1(16.67%)	2(66.67%)	1(33.33%)	2(100%)	0
Co-Trimoxazole	2(66.67%)	1(33.33%)	3(75%)	1(25%)	0	0
Piperacillin+Tazobactam	3(75%)	1(25%)	2(50%)	2(50%)	1(100%)	0
Gentamycin	2(50%)	2(50%)	3(75%)	1(25%)	0	0
Amikacin	1(25%)	3(75%)	2(66.67%)	1(33.33%)	0	0
Imipenem	0	5(100%)	1(33.33%)	2(66.67%)	3(100%)	0
Meropenem	0	4(100%)	1(25%)	3(75%)	3(100%)	0
Tigecycline	0	2(100%)	0	1(100%)	0	0

Linezolid	0	0	0	0	0	3(100%)
Vancomycin	0	0	0	0	0	3(100%)

Some of the risk factors associated with surgical site infection in patients were found to be advanced age, females, preoperative hospital stay, surgical status, social habits like smoking and alcoholism, co-morbid conditions like diabetes and cancer.

Among these 156 male patients, 5 (3.20%) got infected and among 108 female patients, 6 (5.55%) got infected [Table 5]. The age of infected patients were categorized as less than 60 years and greater than or equal to 60 years. And the rate of infection was found to be highest in the age group greater than or equal to 60 years (63.63%) [Table 6].

Table 5:- Gender wise distribution of the infected subjects.

Gender	Infected Patients (n)	Percentage %
Male	5	3.20
Female	6	5.55

Table 6:- Age wise distribution of the infected subjects.

Age (years)	Infected Patients (n)	Percentage (%)
less than 60	4	36.36%
Greater than or equal to 60	7	63.63%

Most of the patients underwent elective surgery (85.60%) compared to emergency surgery. In patients with emergency surgery, the infection rate was 2.63% (1/38) and in elective surgery, the infection rate was 4.42% (10/226) [Table 7].

Table 7:- Surgical status of the infected subjects.

Surgery status	Count (n)	Infection (n)	Percentage (%)
Elective	226	10	4.42
Emergency	38	1	2.63

The number of patients having preoperative hospital stay of one day or less was found to be 40.15% (106/264) and their infection rate was 0.94% (1/106), in patients with preoperative hospital stay up to one week was found to be 51.51% (136/264) and the infection rate was 5.14% (7/136) and in patients with preoperative hospital stay more than one week was 8.33% (22/264) and the infection rate was 13.63% (3/22) [Figure 5].

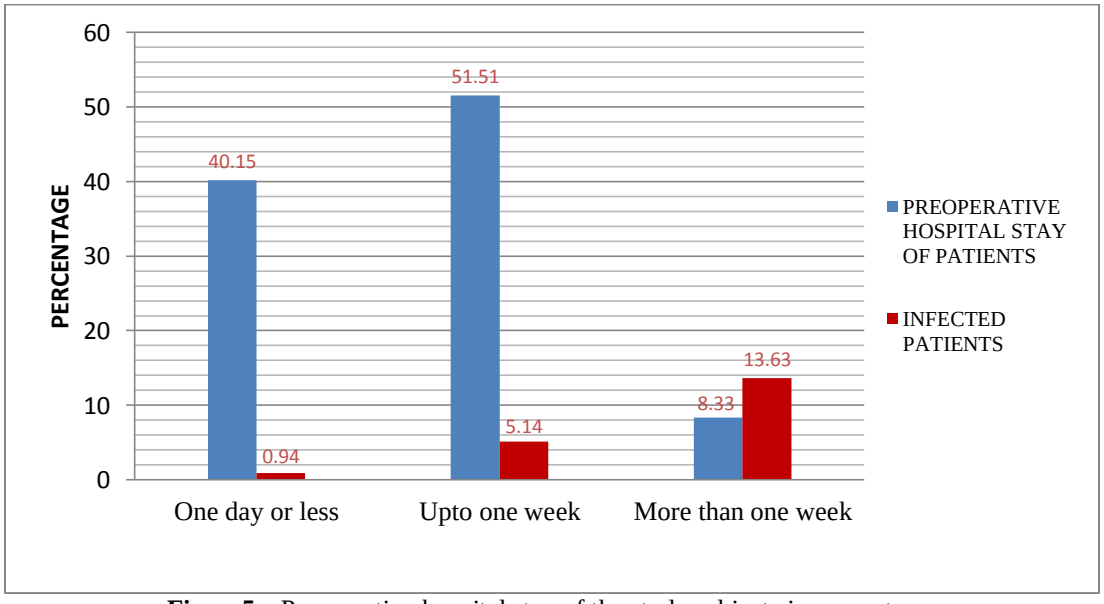

Figure5:- Preoperative hospital stay of the study subjects in percentage.

Malignancy is one of the major risk factor for the incidence of surgical site infection. The rate of infection was 11.90% (5/42) in patients with malignancy. The cancers found in those patients with SSIs were rectal cancer, ovarian cancer, colon cancer and breast cancer. Out of 22 patients with diabetes, the rate of infection was found to be 4.54% (1/22). The infected diabetic patient was an elderly female with the co-morbidity of carcinoma rectum. The number of patients who had the habit of smoking was 7 and the rate of infection was 14.28% (1/7) and the patients who had the habit of alcoholism was 11 and the infection rate was 9.09% (1/11).

Discussion:-

Surgical site infection is a hospital acquired infection that occurs at or near the incision site within 30 days of surgery. Incidence of surgical site infection differs from hospital to hospital based on procedures and systems practiced by the hospital for controlling the infection.

The present study was carried out in a tertiary care teaching hospital located in Mangaluru. The study included with case files of 264 patients who underwent various surgical procedures in the general surgery. Incidence rate of SSI in the present study was found to be 4.17%. As per various studies the incidence of SSI ranges from 2.6-35.6%.[3,5,7,13] The Lower rate of infection is reported by Shrestha S et al., (2.6%).[3]

From the study we found that Escherichia coli (33.33%) followed by Klebsiella pneumonia (27.78%) and Enterococcus faecium (16.67%) were the predominantly isolated organism from the surgical site.Literature review revealed Staphylococcus aureus (37.83%) as the most commonly isolated pathogen from wound site.[4] Raza MS et al., found that S. aureus(37.5%) was the single predominant bacterial isolate followed by E.coli (25%) and Klebsiella pneumonia (10.41%).[14] Shah KH et al., states that Escherichia coli (34.8%) followed by Klebsiella pneumonia (15.2%), Staphylococcus aureus (10.9%) were the most common causative pathogen isolated from SSI.[12]

In the present study we found that the most commonly used preoperative antibiotics were cefuroxime+sulbactam 2.25g (33.33%) followed by ceftriaxone1g (23.72%) and metronidazole 500mg (22.52%) and the most commonly used post operative antibiotics were cefuroxime+sulbactam 2.25g (27.03%) followed by metronidazole 500mg (24%) and ceftriaxone 1g (17.48%). Shrestha S et al., shows that most commonly prescribed prophylactic antibiotics were ceftriaxone(35.9%) followed by cefuroxime(22.2%) and cefotaxime(15.3%).[3] Osakwe JO et al., found that third generation cephalosporins and metronidazole were used in more than 40% of the patients.[15] Nguyen D et al., states that the most commonly used antibiotics were first-generation cephalosporins (33.4%) and aminoglycosides (30.4%), followed by penicillin (14.4%) and second-generation cephalosporins (5.3%).[16]

From the study we found that appendicectomy, inguinal hernioplasty, cholecystectomy,hemorrhoidectomy, umbilical hernioplasty, hydrocoelectomy, total thyroidectomy, breast lumpectomy, mastectomy and incisional hernioplasty were the common surgical procedures. According to the study done by Patel SM et al., hernia operation, laparotomy, cholecystectomy were the commonly observed surgical procedures.[11] Bibi S et al., states that abdominal surgeries (38.92%), laproscopic cholecystectomy(15.08%), hernioplasty(9.19%), thyroidectomy(5.62%) and mastectomy(4.55%) were the common procedures.[17] According to Eriksen HM et al., the most common procedures performed at the wards were exploratory laparotomy (15.4%), appendectomy (15.4%), hernia repair (8.8%), colon surgery (8.3%), thyroidectomy (8.1%).[7]

The present study revealed that E.coli was highly resistant to drugs like ampicillin, amoxicillin+clavulanic acid, cefazolin, cefuroxime, cefotaxime, cefoperazone+sulbactam, azithromycin and was highly sensitive to drugs like imipenem, meropenem and tigecycline. Klebsiella pneumonia was highly resistant to drugs such as ampicillin, amoxicillin+clavulanic acid, cefazolin, cefuroxime and was highly sensitive to drug tigecycline. Enterococcus faecium was highly resistant to drugs such as ampicillin, ciprofloxacin, levofloxacin, piperacillin+tazobactam, imipenem, meropenem, azithromycin and was highly sensitive to linezolid, vancomycin. Study conducted by Dessie W et al., found that E. coli were resistant to tetracycline, cefotaxime, ampicillin, cefuroxime sodium, ceftriaxone, amoxicillin/clavulanic acid, cephazoline, ciprofloxacin and was sensitive to Chloramphenicol. Klebsiella pneumonia showed higher resistance to ampicillin, amoxicillin, cephazoline, ceftriaxone, ceftazidime, cefotaxime cefuroxime sodium and higher sensitivity to ciprofloxacin, tetracycline, chloramphenicol, gentamicin.[18] Similarly, Paul M et al., states that Enterococcus shows 100% susceptibility to vancomycin, linezolid and teicoplanin and resistance to

drugs such as ciprofloxacin, ampicillin, quinpristin-dalfopristin, nitrofurantoin, high level gentamicin and streptomycin.[19]

In the present study patients were divided into 9 age groups. The rate of infection was found to be highest in the age group greater than or equal to 60 years (63.63%). Similarly, Dhamecha M et al., found that the infection rate was highest (50%) in extremes of age (51-60 years).[20] Patel S M et al., states that the rate of SSI was highest in age group >55 years (36.3%), This is due to poor immune response, existing co morbidities in old patients and reduced compliance with treatment.[11] Shah KH et al., reported that the rate of infection was highest in age group more than 55 (4.61%).[12]

According to our study, surgical procedures were predominantly done in male patients (156) (59%) compared to females. Isik O et al., also found that males mostly underwent surgery (51.94%).[21] Setty NK et al., states that significant proportion of males (29.1%) developed SSI compared to females.[22] Study conducted by Ntsama EC et al., states that most of the patients who underwent surgery were females (60.78%) and the rate of SSI was also higher in females than in males.[13]

From the study we found that SSI rate was higher in elective surgeries (4.42%) than in emergency surgery (2.63%).Nguyen D et al., also found that emergent surgeries had lower rates of SSI than elective procedures (13.1%).[16] Dhamecha M et al., states that the rate of SSI was lower in emergency surgeries (3.58%) as compared to elective surgeries (7.89%).[20] Shahane V et al., states that SSI occurred more in elective surgeries 7.9%, than in emergency surgeries 2.7%.[23]

From the present study we found that the infection rate was higher in patient with preoperative hospital stay more than 1 week (13.63%). Laloto TL et al., also found that preoperative hospital stay for more than 7 days increased the risk of SSIs by 22.44 times compared with preoperative hospital stay less than 7 days (51.9%).[9] Shrestha S et al., mentioned that infection rate was highest in the patient with preoperative hospital stay up to one week (3.3%).[3]

The present study revealed that diabetes mellitus (4.54%), alcoholism (9.09%), cancer (11.90%), and smoking (14.28%) were some of the risk factors for SSI in patients. Several studies reported that diabetes mellitus, obesity, smoking, alcoholism, cancer, malnutrition and other infection were the risk factors for SSI.[3,4,12] Lubega A et al., states that smoking has been shown to be an independent risk factor of SSI. Smoking delays the healing of SSIs by causing local and systemic vasoconstriction which results in tissue hypoxia and hypovolemia, an environment conductive to SSI. Heavy alcohol consumption weakens immunity and increases the risk of SSI.[24] Nwankwo EOet al., states that poorly controlled diabetes adversely affects the ability of leukocytes to destroy invading bacteria and to prevent the harmful proliferation of usually benign bacteria present in the healthy body.[25]

Limitations Of The Study:-

The study can be strengthened by conducting the study with large population in multiple centers. Also study duration was less, so other possible risk factors like hair removal at a surgical site, skin preparation for surgery, blood glucose level, hypothermia during surgery, antiseptics used for patient preparation cannot be analyzed in this study.

Conclusion:-

From the present study we found that the incidence of surgical site infection among the post operative patients at the tertiary care teaching hospital was found to be less when compared to that in other hospitals. The overall incidence of infection rate was found to be 4.17%. This evidence shows that the infection control committee in the hospital has taken preventive measures in reducing the incidence of SSI. A long term surveillance system should be established to detect the risk factors associated with SSI in patients undergoing general surgery so that preventive measures can be taken to prevent the incidence of infection rate. The practice of proper aseptic techniques during and after the surgery and the use of rational antimicrobial therapy will help to limit the spread of resistance and occurrence of infection. It is therefore important to have a clinical pharmacist, microbiologist and a strict infection control committee in all hospitals, if it is lacking, so as to monitor and provide recommendations at all level of prevention of infection. This would enable us to overcome the economic loss and hospital morbidity and mortality caused by SSI.

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