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A Prospective Clinico-Bacteriological Study of Surgical Site Infection

Dr. Raghuveer M.N.[1], Dr. Ashwin M. Hatwalne[2], Dr. Varun H.U.[3], Dr. Kuldeep R.[4], Dr. Hemanth Kumara G.K. [5], Dr. Ashwin M.V.[6]

1Associate Professor, Department of General Surgery, Mysore Medical College & Research Institute, Mysore, Karnataka, India.
[2]Postgraduate Student, Department of General Surgery, Mysore Medical College & Research Institute, Mysore, Karnataka, India.
[3]Postgraduate Student, Department of General Surgery, Mysore Medical College & Research Institute, Mysore, Karnataka, India.
[4]Postgraduate Student, Department of General Surgery, Mysore Medical College & Research Institute, Mysore, Karnataka, India.
[5]Postgraduate Student, Department of General Surgery, Mysore Medical College & Research Institute, Mysore, Karnataka, India.
[6]Postgraduate student, Department of General surgery, Mysore Medical College & Research Institute, Mysore, Karnataka.

Corresponding Author
Dr. Ashwin M. Hatwalne, Postgraduate Student, Department of General Surgery, Mysore Medical College & Research Institute, Mysore, Karnataka, India.

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ABSTRACT

Background
Surgical Site Infections (SSI) continue to be a major concern after surgical procedures and are the third most commonly reported hospital-acquired infections. SSIs substantially contribute to increased healthcare costs, primarily due to extended hospital stays and lost work days.

Objective
This study aims to determine the incidence of SSI, identify associated risk factors, and analyze the common organisms isolated, along with their antibiotic sensitivity and resistance patterns.

Methods
This prospective study involved 100 surgeries. Infected samples from patients were collected under strict aseptic conditions and promptly processed using standard microbiological techniques.

Results
The overall infection rate was found to be 19 %. The incidence of SSI increased with patient age and emergency surgeries showed a significantly higher SSI rate compared to elective surgeries. The infection rate also increased notably with longer surgery duration. The most frequently isolated organism from SSIs was E. coli (36.8%), followed by staphylococci and pseudomonas (15.7%).

Conclusions
A majority of the isolated organisms were multidrug-resistant. The high resistance rates highlighted the need for a policy to encourage the more rational use of antibiotics.

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Keywords: Surgical site infection, National Nosocomial Infections Surveillance (NNIS), Risk Index, Antibiotic prophylaxis

INTRODUCTION

Surgical infections are defined as those that develop after a surgical procedure or those that need to be treated with surgery. They are typified by a breakdown of anatomical or mechanical defence mechanisms (barriers), and they are linked to higher rates of illness, substantial death, and higher healthcare costs. The well-known quote "I dressed the wound,God healed it" is attributed to French physician Ambroise Pare in the sixteenth century. The idea was that, with proper local care, wounds will heal by some unexplained, mysterious force. Sadly, this mindset has persisted. As a matter of fact, it is but a charming vestige of the ignorance that persisted well into the twenty-first century.

Even with the advancements in the field of surgery, post-operative wound infection continues to be a prevalent consequence.If this issue is not assessed and addressed right away, there may be serious consequences.

By their very profession, all surgeons deal with infection, which always compromises the host's first line of defence. The first step towards infection is the penetration of microorganisms into the host tissue through the epidermal or mucosal barrier. Both the prevention and treatment of infections have advanced significantly throughout time. Ever since the discoveries of Pasteur, Cohn, Lister, Koch, and Klebs, humanity has endeavoured to fight illness.

Although remarkable discoveries have been made that have saved lives, the hunt is still ongoing since infection-causing organisms have also been able to successfully fend off medications. One cannot easily quantify the costs of an infected operation in terms of dollars and rupees for the patient and the community. A surgeon should analyse the true cost in terms of both financial and morbidity. Every action taken to lower the infection rate has a financial cost, hence it is critical to assess the efficacy of any newly implemented protocols.

SSI has the potential to double a patient's hospital stay, which raises medical expenses. Re-operation, additional nursing care and interventions, and drug treatment expenses account for the majority of the increased costs. Less research has been done on the indirect costs, which include decreased quality of life, patient unhappiness, litigation, and lost productivity. SSI has the potential to double a patient's hospital stay, which raises medical expenses. Re-operation, additional nursing care and interventions, and drug treatment expenses account for the majority of the increased costs. Less research has been done on the indirect costs, which include decreased quality of life, patient unhappiness, litigation, and lost productivity.

AIMS

One of the most frequent side effects of hospital stays is surgical site infection, which can have detrimental effects on both expenses and results. A variety of risk variables, including as age, sex, immunity and diet, prophylactic antibiotics, kind and duration of surgery, shaving technique, and subsequent infections, may be involved. Finding the risk variables influencing surgical site infections and their frequency at KRH, Mysore, was the goal of this investigation.

OBJECTIVES:

1. To study the incidence and risk factors associated with surgical site infections.
2. To identify most common organism involved in SSI and its antibiotic sensitivity and

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resistance pattern specific to the institute.
3. To identify high risk patients with possibility of developing post-operative infections.

MATERIALS & METHODS

This prospective study was conducted on 100 patients for a period 18 months from July 2022 to January 2024. The patients who underwent surgery in the Department of General Surgery at Krishna Rajendra Hospital, Mysore. The surgical site was deemed infected based on NNIS's definition. The U.S. National Research Council's wound contamination class system was used to categorise the wounds.

Inclusion Criteria

All patients aged between 18 to 65 years undergoing surgery in Department of General Surgery.

Exclusion Criteria

1.Patients with co-morbid conditions such as HIV.
2. Patients on steroid medications.
3.Patients undergoing revision surgery.
4.Stitch abscess cases.

Method of collection of data

Analysis of these cases is done including to the date of admission, the patient's history, the clinical features, the type of surgery, whether it was elective or emergency, preoperative planning, and postoperative care, . After the patient is discharged from the hospital, the patient is monitored on an outpatient basis for any indications of a wound infection.

The wounds were inspected for any suggestive signs or symptoms of infection during the healing process, while the dressings were being applied, or while they were soaked. The history was taken for coexisting infections at a distant body site, duration, related diseases, and personal history pertaining to alcoholism, smoking, and diet. Operative results were examined, including the kind of incision made, the contamination of the wound, the kind of drain used, and the length of the procedure. The day of wound infection, the day of the first dressing, and the frequency of dressing changes were among the postoperative findings. The day the wound infection was diagnosed, the following symptoms were noted: fever, erythema, discharge, type, and colour. A sterile cotton swab was used to collect exudate from the depth of the wound, which was then sent to the microbiology department for culture & sensitivity.

Methodology in the laboratory:

The swabs were inoculated onto blood agar plates, McConkey's agar plates, and nutrient broth in the microbiology department. For 24 to 48 hours, inoculated media were incubated aerobically at 37°C. In the event that the initial plates failed to produce organisms, nutrient broth was subcultured. The morphological and cultural traits of the isolated bacteria allowed for their identification. The gathered samples underwent the following processing steps:

a) Direct microscopic analysis of the gram stained smear
b) Inoculation of samples on different culture media to enable growth and identification of aerobic and anaerobic organisms
c)Bio-chemical testing
d)Antibiotic sensitivity

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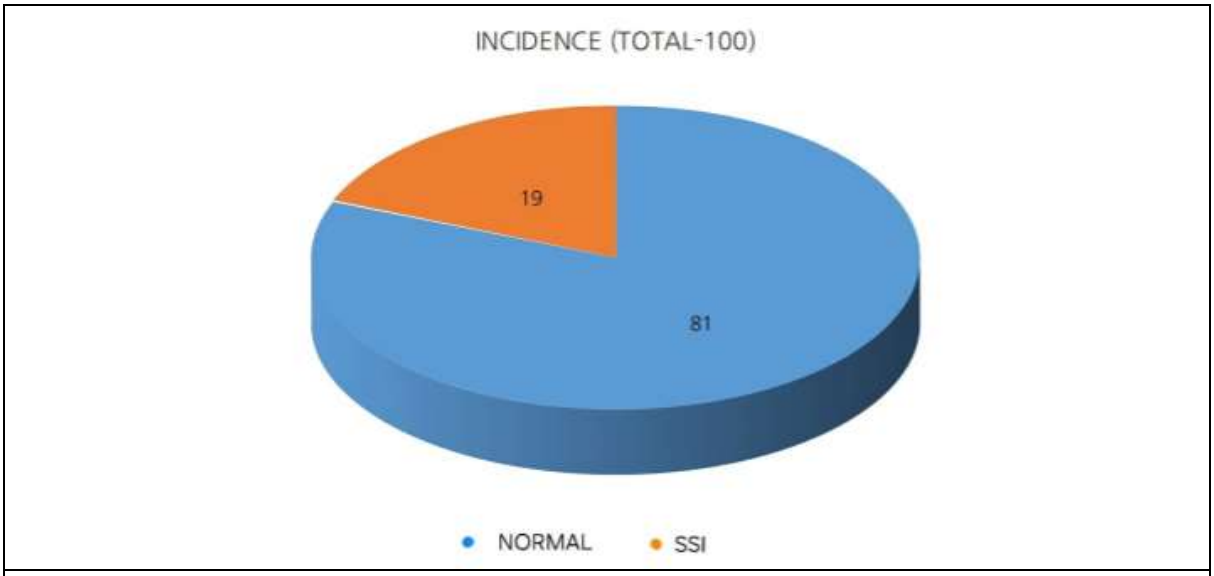
SAMPLE SIZE

With the prevalence of surgical site infections of 38.3% (p) based on previousstudies . Level of significance 5% (a)
Absolute allowable error of 10% (d).
Using estimation setup technique for proportion:
Sample size = 4*PQ/d2
The Calculated sample size is 94
The Inflated Sample size is 100

RESULTS

A study of 100 operated cases was done out of which 19 were diagnosed to have developed surgical site infections as per CDC criteria. Hence the incidence of SSI in this study is 19%



Graph 1: Incidence of SSI

Gender	No of cases	Infected cases	Percentage
MALE	71	12	16.9
FEMALE	29	7	24.1

Table 1: Incidence in relation to gender

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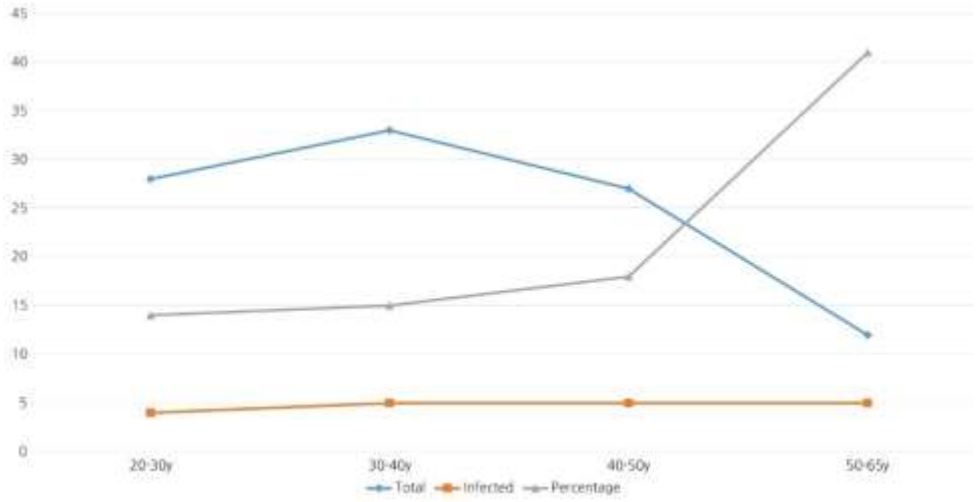

Graph 2: Age based incidence of SSI

Infection is more commonly seen in age group of 51 to 60 years with an incidence rate of 41%.

Type of operation	No. of cases	Infected cases	Percentage
Elective	63	10	15.8
Emergency	37	9	24.3

Table 2: Incidence in relation to type of operation

Incidence of infection is more among emergency surgeries-24% whereas elective cases was 15%.

Risk factor	Total cases	Infected cases	Percentage
Anemia	16	4	25
Diabetes	20	6	30
Hypoproteinemia	13	3	23
Others	5	2	40

Table 3- Incidence in relation to pre-op risk factors

Infection incidence rate was individually highest among cases with diabetes mellitus

Diagnosis	Total cases	Infected cases	Percentage
Perforation	12	5	41
Intestinal obstruction	8	2	25
Appendicitis	17	2	11
Inguinal hernia	28	3	10
Cholelithiasis	7	1	14
Ventral hernias	13	5	38
Others	15	1	6

Table 4 - Incidence in relation to diagnosis

Inguinal hernias-hernioplasty and appendicitis-appendicectomy were the most commonly

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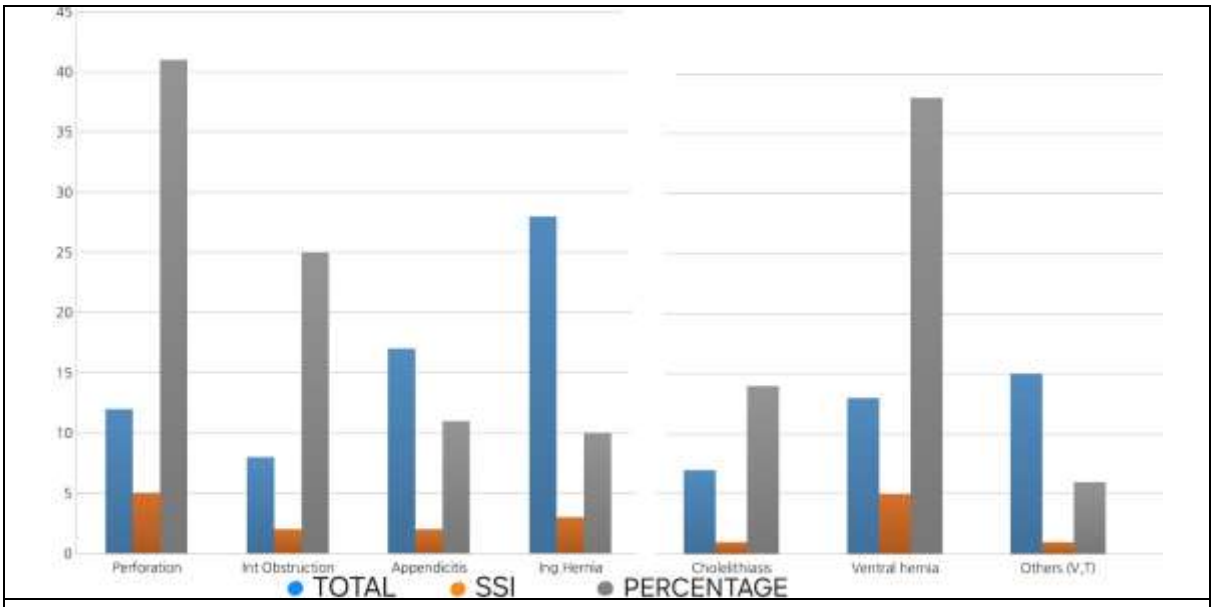
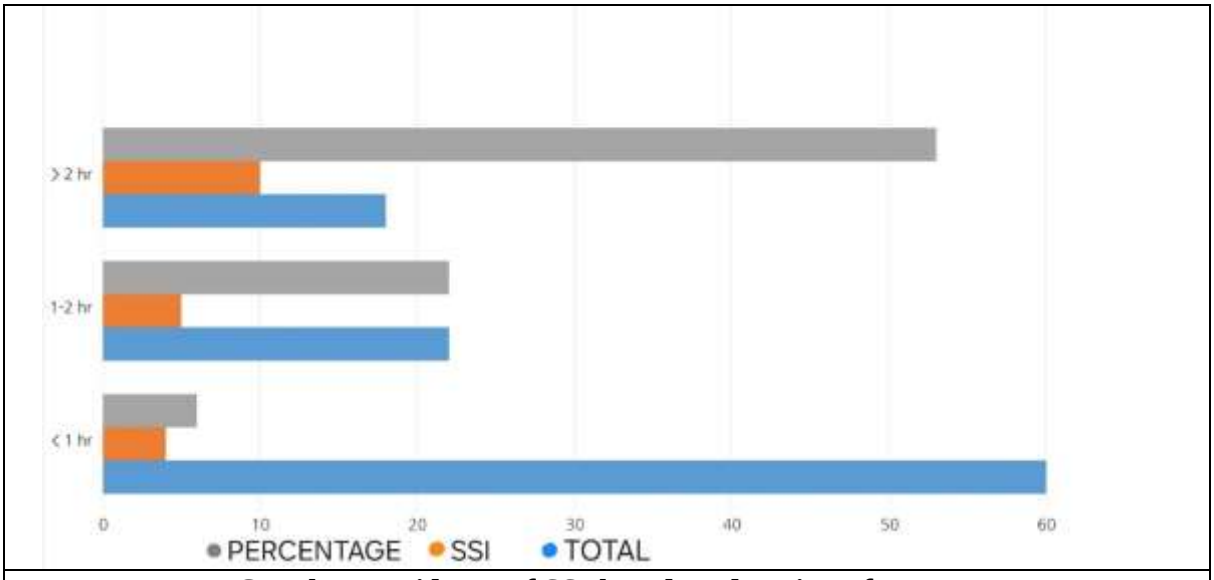
operated procedures, but surgical site infection was more common in perforations followed by ventral hernias.



Graph 3: Incidence of SSI with diagnosis

TYPE OF SSI	NO OF CASES	PERCENTAGE
SUPERFICIAL	11	57.8 %
DEEP	6	31.5 %
ORGAN SPACE	2	10.5 %

Table 5: Incidence in relation to type of SSI



Graph 4: ***Incidence of SSI based on duration of surgery***

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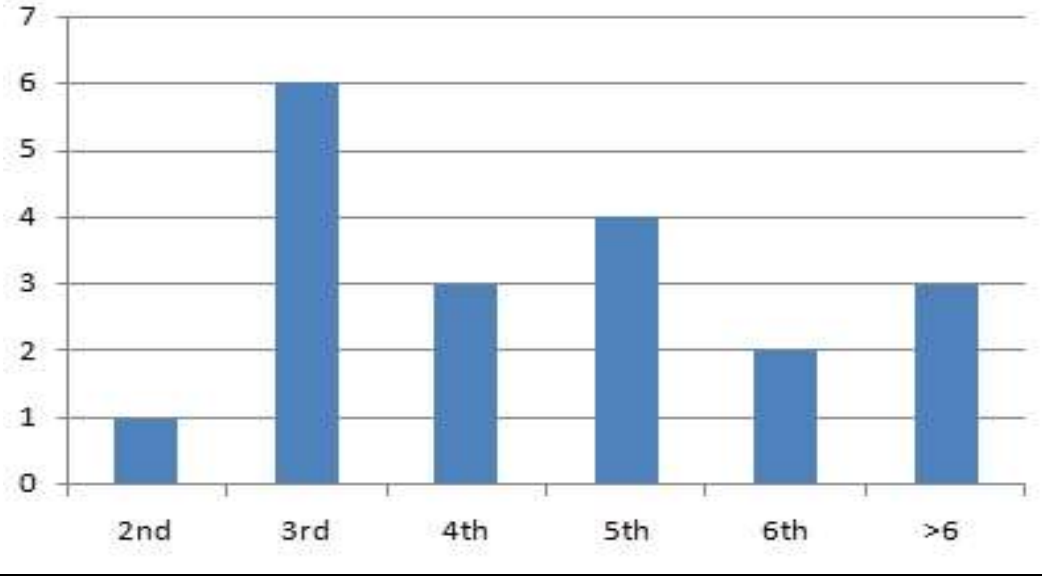
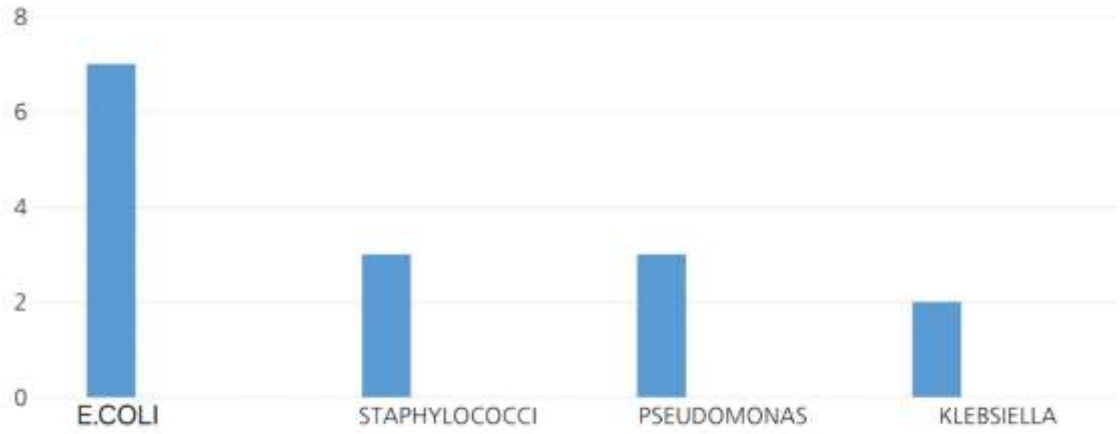
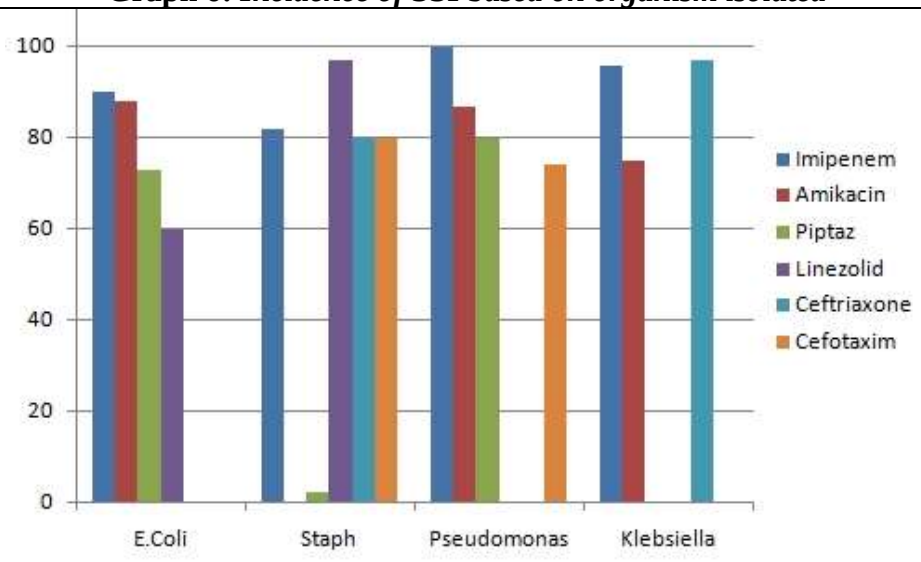


Graph 5: ***SSI observed on post-operative day***



Graph 6: ***Incidence of SSI based on organism isolated***



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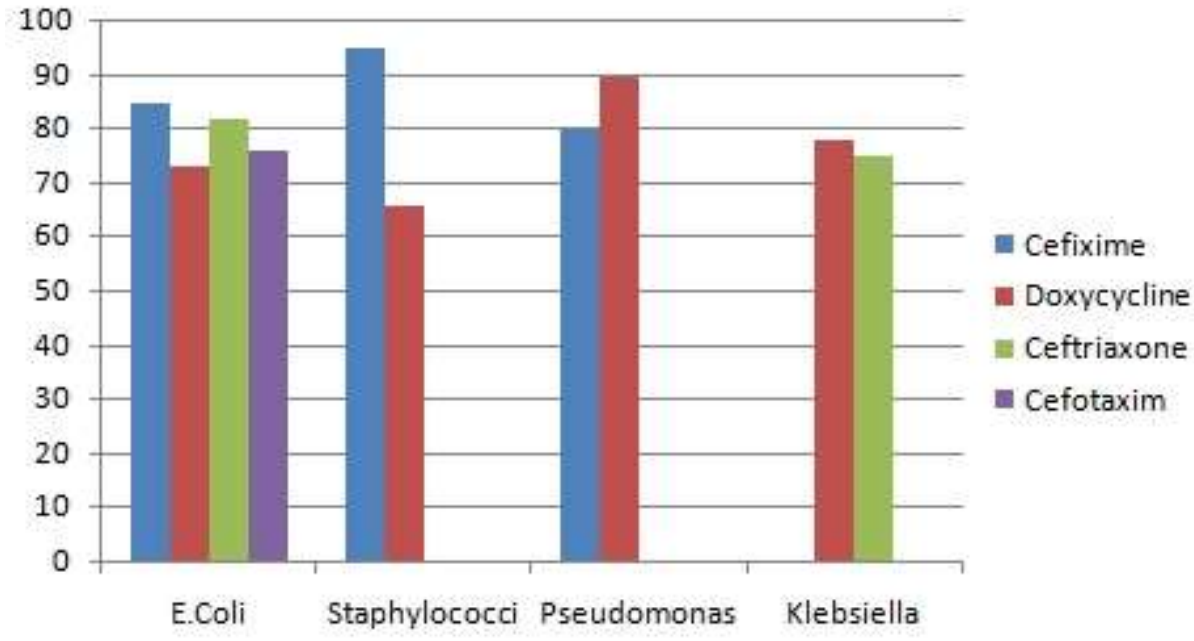
Graph 7: Antibiotic sensitivity spectrum



Graph 8: **Antibiotic resistance spectrum**

DISCUSSION

The present study was conducted at department of General Surgery at KR Hospital, Mysore This is a prospective study of 100 cases who underwent and were followed up for 30 days from the day of surgery to check for development of surgical site infections.

Incidence of SSI

Out of 100 cases, 19% of them had an overall infection rate. The incidence rate observed in this study falls comfortably between 6% and 38% of infection rates reported in other studies conducted in India at various locations. Hospital infections in India are far higher than in other nations; in the USA, for example, the rate is 2.8%, while in European nations, it is between 2 and 5%. The increased infection rate in Indian hospitals could be brought on by both inadequate hospital design and a disregard for fundamental infection control procedures.The rate of SSIs in male patients were 16.9% and in female patients they were 24.1%.

AGE

According to the current study, the incidence of SSI is highest in the 51–65 year old age group, then in the 41–50 year old group. This is likely due to high number of surgeries performed in these age groups. SSI was less common in the younger age groups, this supports the notion that the incidence of wound infection gradually increases with age. Similarly, older patients have a higher risk of infection in clean wounds than younger patients, according to Cruse and Foord's research. Mead et al. showed similar results, showing a higher rate of wound infection in patients under one year of age and above 50years of age.

The high incidence of 41% in patients between the ages of 51 and 65years in our study may be brought on by a decline in immunocompetence as well as a higher likelihood of co-morbid conditions such as diabetes mellitus, hypertension, chronic illnesses like asthma,

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diseases that require steroid therapy, and personal habits like alcoholism and smoking. Clearly, age is an unchangeable aspect of the patient, and even if it does pose a risk for wound infection, it seems to be a very small one.[1]

Emergency / Elective

In elective surgeries, the SSI rate was found to be 15.8%; in emergency cases, it was found to rise to 24.3%. Our outcomes closely match the outcomes attained by other researchers. Similar findings for elective (7.61%) and emergency (21.05%) were reported by Mahesh C B et al. in 2010. Inadequate preoperative care, underlying medical conditions that made the emergency surgery more likely, and the higher frequency of contaminated wounds in emergency surgeries are all responsible for the high infection rates in these procedures.[2]

Risk factors

Incidence among all the risk factors , highest being diabetes mellitus (30%), followed by Anemia (25%), Hypoproteinemia (23%) and other risk factors like respiratory infections, malignancies. These are seen mainly due to immnunocompromised states, reduced wound healing and pre-existing infections.

Preparation

In every case, shaving was done prior to the operation. Every elective case had their hair cut within 24 hours before surgery, and every emergency case had it done a few hours beforehand. Nonetheless, emergency cases had a higher SSI rate. The majority of studies, however, contrasted shaving with non-shaving or alternative hair removal methods. Shaving and no hair removal were compared in Court Brown (1981) and Rojanapirom (1992). Swabs and observations were used in both trials, which involved abdominal surgery, to assess infection. Of those who got shaved, 9.6% (17/177) developed an SSI, compared to 6% (11/181) who were not shaved.[3]

Incidence in relation to type of SSI

Majority of the SSIs were of superficial type compared to deep and organ space infections.

Incidence in relation to duration of surgery

60% cases had operation in less than 1hr with incidence of infection of 6%, 22% of cases had operation in 1 to 2 hrs with an incidence of infection of 22% and 18% cases had operation >2 hrs with incidence of 53%, Incidence was more with longer the duration of surgery. Similar results were present in many studies, Seyd Mansour Razavi 2005; Lul Raka et al in 2006, Mahesh C B et al in 2010 all had similar results.[1,4]

Incidence of SSI noted on post-operative day

Abdominal surgical site infection was noted majority on post-op day 3 in our study. Similar results were seen in other studies such as at Irani Hospital 2005.[5]

Organism Isolated

In our study, E. Coli accounted for 36.8% of all isolates, with Staphylococci coming in second at 15.7% and Pseudomonas at 15.7%. Similar results have been found in other studies, such as Umesh S. Kamat's (2008) prospective study of surgical site infections in a teaching hospital in Goa, which found that 79.33% of the isolates wer gram-negative bacteria, with pseudomonas being the most common and Staphylococcus pyogenes second. In other investigations, such as Mofikoya Bo et al.'s 2009 study, Bacterial Agents of Abdominal Surgical Site Infections in Lagos, Nigeria, Pseudomonas was the most frequently isolated

type. Out of the 144 patients that were studied, 25 (17.4%) experienced surgical site infections. In 28% (n=7) of the cultures, pseudomonas was the most often grown aerobic organism, whereas Bacteroides species was the most often isolated anaerobe.[2,6]

The majority of gram-negative bacilli that we found is consistent with the findings of other researchers. The patient's endogenous flora is typically the organism in the majority of SSI cases. Our study revealed that the possibility of coliforms and gram negative bacteria is increased when the gastrointestinal tract is opened during abdominal surgeries. Due to their ease of transmission from one object to another, resistance to common antiseptics, and difficulty in long-term eradication, this particular group of organisms is known to be endemic in hospital environments. An increasing number of hospital acquired infections are caused by this group of organisms.

Antibiotic sensitivity & resistance

The results of our study indicate that E.Coli is most susceptible to Imepenem (90%), Amikacin(88%), and Piperacillin-Tazobactum (73%), Azithromycin (66%), Linezolid (60%). Staphylococci is most sensitive to Linezolid(97%), Imipenem(82%), Cefotaxim (80%), and Ceftriaxone (80%).

Pseudomonas is most sensitive to Imipenem(100%), then Amikacin (87%), Piperacillin-Tazobactam (80%) and Cefotaxim (74%).

Klebsiella is most sensitive to Imipenem (96%), followed by Amikacin (86%), Azithromycin (75%) and Ciprofloxacin (75%).

The most resistant strains of E.coli are to Cefixime(85%), Ceftriaxone (82%), Cefotaxim(76%), doxycycline (73%) and Gentamycin (70%).

The most Staphylococci are resistant to Cefixime (95%), then Doxycycline (66%), Amikacin (60%) and Piperacillin-Tazobactam (46%)

Pseudomonas is resistant to Doxycycline (90%), Cefixime (80%), Ceftazidime (68%) and Ciprofloxacin (60%)

Pseudomonas species was found to be 37.5% sensitive to ceftaxidine, 12.5% sensitive to ceftriaxone, and most resistant to cefotaxime by Mofikoya Bo et al.

The Cefoperazone-sulbactum combination sensitivity was 21.4% for pseudomonas reported by Umesh S. Kanat in 2008. As much as 63.93% (39/61) of the bacteria that were tested were resistant to every antibiotic.

The majority of the research revealed that almost all of the pathogens were resistant to antibiotics that are often prescribed, like ampicillin and doxycyclin. Additionally, in more than 80% of the infected patients, the cultured aerobes showed less than 50% sensitivity to the cephalosporins tested (ceftaxidine, cefuroxime, and ceftriaxone). This discovery could be a reflection of the pervasive misuse of antibiotics and adds credence to the widely recognised high frequency of multiple antibiotic-resistant nosocomial pathogens in our environment [7]

Additionally, the relative frequency of various isolates varied amongst studies. Therefore, it can be said that the organisms responsible for SSIs vary from location to location and occasionally even within a single location.[8] The majority of the isolates tested positive for multiple drugs when tested for antibiotic sensitivity. A review of the literature shows that the majority of the organisms isolated from surgical patients have a progressive increase in drug resistance to numerous antibiotics. Our research shows that, despite extensive research over the years, surgical site infections (SSIs) continue to rank among the leading causes of morbidity and death among patients undergoing surgery.[9] The efforts made to lower SSIs are still insufficient. Adequate infection control measures & antibiotic policy might reduce SSIs in the future.

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CONCLUSION

- Incidence of surgical site infection in this study is 19%
- Maximum of the patients in the study belong to age group 30-40 years which accounts for 33%
- Emergency cases had more incidence of 24.3% compared to elective cases having 15.8%.
- Majority of the cases had SSI development on post-op day 3.
- Overall Diabetes Mellitus was found to be the main risk factor for SSIs.
- Longer duration of surgery had strong association with SSIs.
- Rate of infection increased from clean type wounds to contaminated wounds, highest incidence in perforation cases.
- E.Coli was the most organism isolated out of all specimens.
- Overall Imipenem was the most sensitive antibiotic and Cefixime the most resistant antibiotic.

RECOMMENDATIONS

- Formulating an antibiotic policy for the institution and strict adherence to it.
- Setting up hospital infection control committee.
- Pre-op optimisation of the patients.
- Minimising the duration of surgery.
- Following good surgical techniques.
- Reducing the pre-op and post-op hospital stay.
- Regular surveillance and surgical auditing.
- Early diagnosis of surgical site infections.
- Proper method of collection of samples from surgical site.

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