"Preoperative Intravenous Vs Combined Intravenous Plus Intra-Incisional Antibiotic Administration In The Prevention Of Surgical Site Infections"

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LIST OF ABBREVIATIONS

SI No	ABBREVIATIONS	FULLFORM
1	AP	Antibiotic Prophylaxis
2	ASA	American Society of Anesthesiologists
3	BMI	Body Mass Index
4	BSR	Blood Sedimentation Rate
5	CDC	Centers for Disease Control and Prevention
6	CRP	C-Reactive Protein
7	ECDC	European Centre for Disease Prevention and Control
8	ELISA	Enzyme-Linked Immunosorbent Assay
9	IV	Intravenous
10	MIC	Minimum Inhibitory Concentration
11	MBP	Mechanical Bowel Preparation
12	MRSA	Methicillin-Resistant Staphylococcus Aureus
13	OABP	Oral Antibiotic Bowel Preparation
14	PCT	Procalcitonin
15	PMNs	Polymorphonuclear Leukocytes
16	RCT	Randomized Controlled Trial
17	ROC	Receiver Operating Characteristic
18	SSI	Surgical Site Infection
19	WHO	World Health Organization
20	WBC	White Blood Cell

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ABSTRACT

Background: Surgical Site Infections (SSIs) are among the most common healthcare-associated infections, contributing significantly to morbidity, prolonged hospitalization, and increased healthcare costs. Despite advancements in preoperative prophylaxis, SSI rates remain high, especially in abdominal surgeries. The use of intra-incisional antibiotic administration, in addition to conventional intravenous (IV) prophylaxis, has emerged as a potential strategy to reduce the risk of postoperative infections. This study evaluates the efficacy of combining preoperative intra-incisional and intravenous antibiotic administration in preventing SSIs in clean abdominal surgeries, particularly hernia repairs.

Objectives: The primary objective of this study is to determine the impact of preoperative intra-incisional antibiotic administration in conjunction with intravenous prophylaxis in reducing SSIs. Secondary objectives include comparing the efficacy of combined IV and intra-incisional antibiotic administration with IV antibiotics alone and assessing associated risk factors influencing infection rates.

Methods: A prospective hospital-based observational study was conducted over 18 months at a tertiary healthcare center. Patients undergoing clean abdominal surgeries, including inguinal and ventral hernia repairs, were randomly assigned to two groups: Group A (Control): Received standard IV antibiotic prophylaxis.

Group B (Test): Received both IV and intra-incisional ceftriaxone prior to surgery. Wound inspections were conducted postoperatively on days 3, 6, and 9, and the incidence of SSIs was documented. Data were analyzed using SPSS software, with statistical significance set at $p < 0.05$.

Results: The study found a significant reduction in SSIs in the intra-incisional antibiotic group (Group B) compared to the control group. 29% of patients in Group

A developed SSIs, whereas none in Group B had infections ($p = 0.001$). Additionally, postoperative complications such as erythema and wound discharge were more prevalent in the control group. Patients receiving intra-incisional antibiotics exhibited shorter hospital stays and lower readmission rates.

Conclusion: Intra-incisional antibiotic administration, combined with standard IV prophylaxis, significantly reduces SSI rates in clean abdominal surgeries. Given its safety, cost-effectiveness, and improved patient outcomes, intra-incisional ceftriaxone should be considered a standard preventive measure, particularly in hernia repairs. Further large-scale multicenter trials are needed to generalize these findings across different surgical disciplines.

Keywords: ***Surgical Site Infections (SSI), Antibiotic Prophylaxis, Intra-Incisional Antibiotics, Intravenous Ceftriaxone, Hernia Repair, Postoperative Infection, Surgical Prophylaxis, Risk Factors, Wound Contamination, Hospital-Acquired Infections***

INTRODUCTION

Approximately 0.5% to 3% of all surgical procedures result in surgical site infections (SSIs), making them one of the most prevalent infections linked to healthcare. SSI rates in Europe vary from 5% to 18%, with low-income nations reporting considerably higher rates. SSIs impose important economic pressure on medical systems. Beyond financial consequences, SSIs significantly worsen patient outcomes, increasing the risk of mortality by 2 to 11 times, prolonging hospital stays, and elevating hospital readmission rates[1-4].

Preventing SSIs remains a major focus in surgical practice. A recent Delphi survey identified SSI prevention, particularly in abdominal surgery, as the highest-priority area for surgical guideline development[5]. Many hospitals employ SSI care bundles, which are multifaceted infection control strategies that have been shown to reduce SSI rates by up to 40%, shorten hospital stays, and lower costs[6,7]. Surgeons play a crucial role in intraoperative SSI reduction strategies, but aside from prophylactic antibiotic administration, many intraoperative interventions have demonstrated limited effectiveness[8].

Historically, antibiotics were used postoperatively to treat SSIs once infections had developed. However, extensive research has demonstrated that preoperative antibiotic prophylaxis significantly reduces SSI incidence, leading to widespread adoption. The World Health Organization (WHO), the Centers for Disease Control and Prevention (CDC), and the National Institute for Health and Care Excellence (NICE) recommend intravenous (IV) antibiotics be administered before incision. Research indicates that a single dose of an antimicrobial agent with a half-life long enough to sustain activity during the procedure is generally sufficient, with re-dosing needed only in cases of excessive blood loss or prolonged surgery[9-15].

The effectiveness of antibiotics depends on when they are administered. Prophylactics are less effective if administered too soon or too late (more than 120 minutes prior to or following incision), which may raise the incidence of SSIs[16,17]. Antibiotics given within 120 minutes before incision did not enhance the incidence of surgical site infections, according to a meta-analysis on preoperative prophylactic timing; nonetheless, best practices advise giving antibiotics within 60 minutes before surgery[15,17]. However, despite these steps, SSI rates have stayed relatively constant over the past few decades, which calls for investigating different preventative strategies.

A major limitation of IV antibiotic administration is its systemic distribution—the drug initially disperses into the systemic circulation before reaching peripheral tissues, resulting in suboptimal antibiotic concentrations at the incision site, where infection risk is highest. Since bacterial presence at the incision site during wound closure is a key determinant in SSI pathogenesis, research has shifted toward methods that enhance local antibiotic availability[18].

One such promising alternative is intra-incisional antibiotic infiltration, a technique first introduced by Taylor in 1985[18]. This approach involves direct injection of antibiotics into the incision site before surgery, ensuring a high concentration of antimicrobial agents at the exact location where contamination occurs[19,20]. Intra-incisional antibiotics not only provide immediate localized protection, but they are also systemically absorbed, offering additional systemic coverage[20]. Unlike IV antibiotics, which must circulate through the bloodstream before reaching the incision, intra-incisional infiltration delivers antibiotics directly to the surgical wound, where they exert their maximal effect[20].

Numerous RCTs and meta-analyses have shown that intra-incisional antibiotics are more effective than intravenous (IV) treatment at preventing SSIs. A comparative study on hernioplasty patients found that preoperative intra-incisional ceftriaxone significantly reduced SSI incidence compared to IV administration alone (Pravindhas A, 2023)[20]. Similarly, a study evaluating preoperative intra-incisional cefotaxime in surgical patients found that SSI rates were significantly lower in the intra-incisional group compared to those receiving only IV antibiotics (Balraj G, 2023)[21]. Meta-analyses further confirm that combining IV and intra-incisional antibiotics results in the lowest SSI rates, with metronidazole-based regimens demonstrating particularly high efficacy (Yao J, 2023)[22].

Despite promising results, intra-incisional antibiotic prophylaxis is not yet widely adopted due to concerns regarding standardization of dosages, potential tissue toxicity, and procedural feasibility (Patil AN, 2018)[23]. However, given the growing burden of SSI and the limitations of IV antibiotics alone, further research into multimodal prophylactic strategies is essential (Badia JM, 2020)[24].

Research question:

To compare the standard practice of administering intravenous antibiotic prophylaxis alone with the effectiveness of combining preoperative intravenous and intra-incisional antibiotic administration in preventing surgical site infections in clean abdominal surgeries, including open inguinal and other ventral hernia repairs.

OBJECTIVE OF THE STUDY

PRIMARY OBJECTIVE:

- To study the effect of combining preoperative intra-incisional administration with intravenous antibiotic in the prevention of surgical site infections.

SECONDARY OBJECTIVE:

- To compare the efficacy of pre operative combined intravenous and intra-incisional antibiotics administration with intravenous alone in preventing surgical site infections during abdominal surgeries.

REVIEW OF LITERATURE

SURGICAL SITE INFECTIONS

Within 30 days following surgery, surgical site infections (SSIs) can arise at the procedure site or within the affected anatomical area, representing a large subgroup of healthcare-associated infections[25]. Because these illnesses are divided into many groups, medical practitioners have a well-organized framework for managing and preventing them.

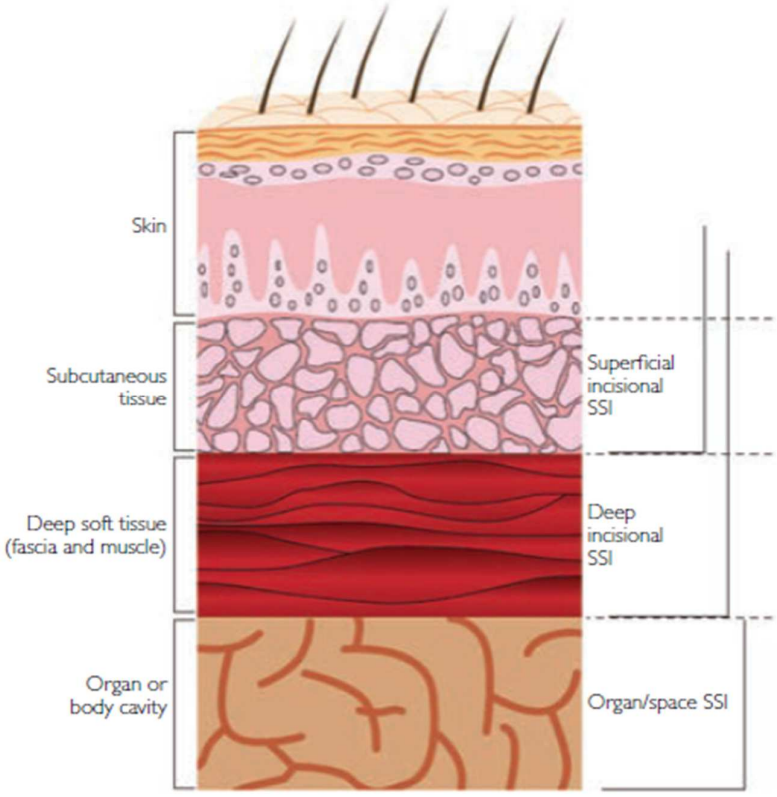
Surgical wounds can be divided into four primary categories by the CDC, each with a different infection risk level. Clean wounds must be handled carefully, especially during drainage operations, as they are uninfected surgical sites and show no inflammation symptoms. Clean-contaminated wounds are surgical procedures performed in the gastrointestinal, genitourinary, or pulmonary systems under aseptic settings with a low risk of infection. Acute inflammation or small lapses in sterility make contaminated wounds more vulnerable to infection. Finally, traumatic injuries with insufficient initial care, preexisting infections, or contamination by foreign objects are examples of unclean or infected wounds[25].

SSIs are classified into three groups based on their depth: superficial, deep, and organ space. A distinct management strategy is required for each of these categories[25].

Table 1. CDC classification of surgical wound infections.

Classification	**Definition**	**Criteria**
Superficial Incisional SSI	Infection occurs within 30 days after the operation and involves only skin and subcutaneous tissue of the incision.	Purulent drainage, with or without laboratory confirmation, from the superficial incision.
Deep Incisional SSI	Infection occurs within 30 days after the operation and involves deep soft tissues, such as fascial and muscle layers.	Purulent drainage from the deep incision but not from the organ/space component of the surgical site.
Organ/Space SSI	Infection occurs within 30 days after the operation and involves any part of the anatomy (e.g., organs or spaces) other than the incision, which was opened or manipulated during the operation.	Infection involving any part of the anatomy (e.g., organs or spaces) other than the incision, which was opened or manipulated during the operation.

Figure. 1 Levels of Surgical Site Infection.



Only the skin or subcutaneous tissue is affected by superficial SSIs, typically manifest during the first 30 days after surgery. After surgery, deep incisional SSIs infiltrate deeper structures, including muscle and fascia, within 30 days or up to a year if an implant is present. The most severe type of SSIs, organ space SSIs, are more likely to cause morbidity and death. In implant cases, these infections can develop within 30 days or up to a year, affecting internal organs or body cavities that are changed following surgery[26].

RISK FACTORS:

SSIs are caused by several factors, including advanced age, immunosuppression, obesity, diabetes, the effectiveness of antimicrobial prophylaxis, tissue conditions at the surgical site (such as the presence of foreign material), and the degree of wound contamination[27]. Across a variety of surgical procedures, obesity has been identified as a significant risk factor for increased rates of surgical site infections (SSIs). Patients with obesity were more likely to develop SSIs for the majority of surgical procedures, according to a nationwide survey that included over 387,000 patients. The incidence of SSIs, for example, rose proportionately with body mass index (BMI) among 16,473 patients who had mastectomy; rates were 4.66% for patients with a BMI of 20–25, 7.06% for those with a BMI of 30–40, and 10.58% for those with a BMI above 40. In a similar vein, an examination of 29,603 laparoscopic cholecystectomy procedures revealed a clear link between elevated BMI and higher SSI rates, with infection rates of 8.57% for patients with a BMI between 20 and 25, 10.62% for those with a BMI between 30 and 40, and 17.11% for those over 40[27]. While certain risk factors, like obesity, tobacco use, and hyperglycemia, can be changed to prevent surgery potentially, other risk factors, like advanced age, cannot be changed and must be carefully taken into account when deciding on the best surgical strategy for a patient[28,29].

Table 2. Modifiable and Nonmodifiable Patient-Related Factors Associated with Surgical Site Infections

Factor	Pathophysiology
Diabetes	Hyperglycemia impairs the innate immune system and promotes glycosylation of proteins, which compromises wound healing. Diabetes can lead to higher perioperative glucose levels and hyperglycemia that is more difficult to treat.
Immunosuppressive medications and conditions	Immunosuppressive clinical conditions or medications diminish the inflammatory phase of wound healing
Malnutrition	Malnutrition can decrease collagen synthesis, granulation formation in surgical wounds, and result in poor tissue healing. Hypoalbuminemia weakens innate immunity by prompting macrophage apoptosis and diminishing macrophage activation. Low albumin also accelerates the seepage of interstitial fluid into the surgical wound and promotes general tissue edema.
Obesity	Adipose tissue has less blood flow, which inhibits the delivery of oxygen and antibiotics.
Preoperative infections	Prior to elective surgery, recognize and treat all infections (even if they are distant from the surgical site).
Tobacco use	Tobacco use causes vasoconstriction, which can progress to alterations in collagen metabolism, decreased inflammatory response, and relative ischemia.
Patient-related, nonmodifiable	
Age	The skin's basement membrane and dermis thin with increasing age, and the skin loses its reserve of cutaneous blood vessels and nerves that diminish wound healing[26,27].

History of prior skin and soft tissue infections	A history of skin and soft tissue infections may be indicative of issues with inherent immunity and propensity for infection.
History of radiation therapy	Treatment with radiation induces underlying tissue injury and inhibits wound healing.

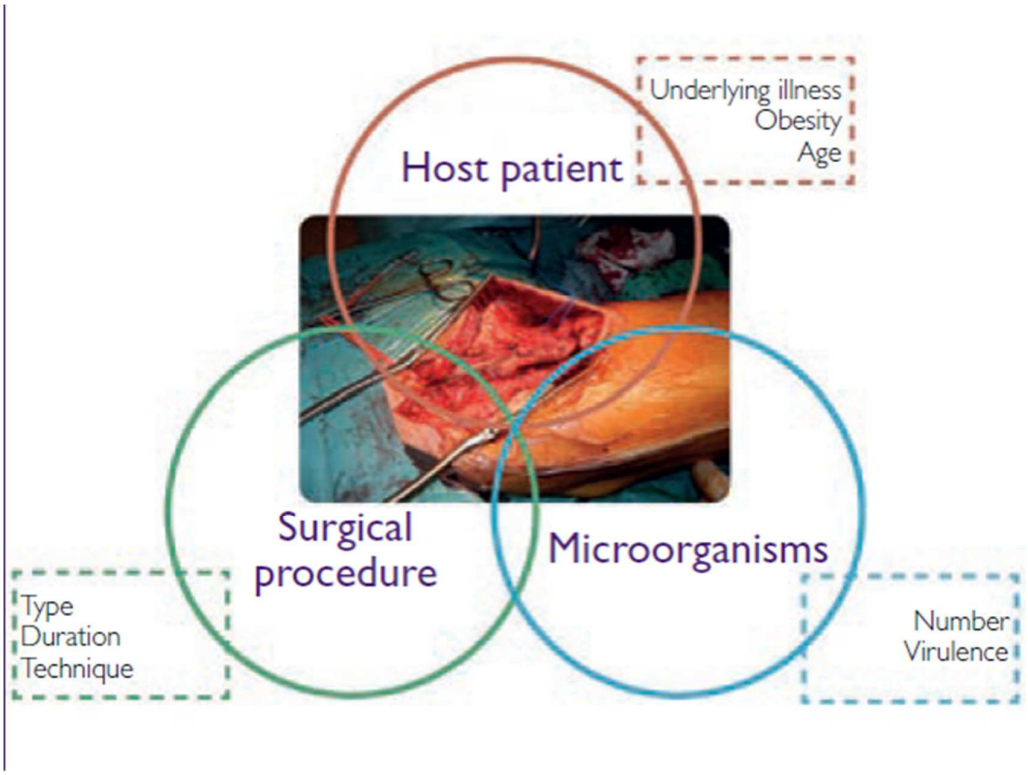
Table 3. Modifiable Operation-Related Factors Associated With Surgical Site Infections

Factor	Pathophysiology
Airborne contamination	Raising the amount of microorganisms in the operating room environment provides additional opportunity for surgical site infection. Most of the airborne pathogens are generated by persons in the operating room and their movements.
Anticoagulation	Anticoagulants may generate continual oozing of the incision and slow wound healing.
Blood transfusions	Blood transfusions impair macrophage activity and influence infection risk.
Decreased tissue oxygenation	Diminished tissue oxygenation lends itself to decreased oxidative killing by neutrophils and impaired tissue healing from depleted epithelialization, neovascularization, and collagen formation. Low oxygen settings can curtail the efficacy of perioperative antibiotics.
Foreign material	Foreign material stimulates inflammation at the surgical site and raises the risk of surgical site infection.

Operation length	Longer operative time is associated with higher damage to wound cells, wound contamination, and exposure to the outside environment.
Perioperative hypothermia	Perioperative hypothermia weakens immune system protection against surgical wound contamination: vasoconstriction leads to impaired tissue perfusion and less access for key immune cells, less motility of key immune cells, and decreased scar formation.
Postoperative hyperglycemia	Cellular functions of bactericidal activity, leukocyte adherence chemotaxis, and phagocytosis are enhanced by insulin and glycemic control, suggesting a direct relation between elevated blood glucose and cellular function deficits.This relationship is observed in patients with and without a diagnosis of diabetes.
Surgical technique	Wound healing is decreased by leaving behind devitalized tissues, inadvertent entry into hollow viscera, inadequate blood supply maintenance, rough manipulation of tissue, misplaced drains and sutures, and unsuitable postoperative wound care.
Wound care	Wounds that remain uncovered following surgery can be contaminated, or uncontrolled drainage can diminish the integrity of the surrounding skin.

Wound contamination from patient's own flora	Wound classification delineates the degree of contamination of a surgical wound at the time of the operation[43]. Skin preparation and perioperative antibiotic administration reduce but do not eliminate the introduction of microorganisms at the surgical site.Shaving leads to microscopic cuts in the skin that can become niduses for bacteria to multiply.Without appropriate drapes and barrier devices, bacteria from hair follicles and deeper skin layers can recolonize the surgical site.
Wound contamination from operating room personnel	Transition of microorganisms from the surgical personnel's shoes, mouths, or body can contaminate surgical wounds. Microorganisms from the hands of health care workers in the operating room can move onto the patient and operating field if personnel do not perform appropriate handwashing or gloving.
Wound contamination from surgical instruments	Sterilization eliminates all microorganisms on the surfaces of surgical instruments. Using insufficiently sterilized tools can lead to pathogen transmission.

Fig 2. Factors that contribute to the risk of SSI



Microbiology of SSI

The main cause of surgical site infections (SSIs) is bacteria. Staphylococcus aureus, Pseudomonas aeruginosa, Serratia marcescens, Corynebacterium spp. (diphtheroid's), Moreover, anaerobes like Prevotella spp. and Peptoniphilus spp. are among the most frequently isolated pathogens[30]. Furthermore, Enterococcus species and coagulase-negative Staphylococci are commonly linked to SSIs[31]. The nature and location of the surgical procedure significantly impact the microbial makeup that causes infection[32]. Although the surroundings of the operating room or medical staff can also cause infection, many of these pathogens are derived from the patient's natural microbiota[33]. For example, Staphylococcus aureus is the most common pathogen in the majority of SSIs, accounting for over 30% of cases[35], and is especially

linked to SSIs after breast cancer surgery[34]. Surgical procedures that involve hollow organs expose the surrounding tissues to anaerobes like Bacillus fragilis, Gram-positive species like Enterococcus spp., and Gram-negative bacteria like Escherichia coli[36].

Pathogenesis of SSIs

After surgery, SSIs can develop for a variety of reasons. An infection may be external, brought in by surgical tools, the operating room, medical personnel, or endogenous, resulting from the patient's skin flora, an open viscus, or deep tissue contamination. Prior to full closure, microorganisms may also infect the wound after surgery. SSI can occasionally be caused by haematogenous dissemination from a distant infection site, especially in individuals who have prosthetic implants[37].

The type of surgery influences the major bacterial species causing SSI. Staphylococcus aureus, including MRSA, is the most prevalent infection in clean surgical operations that do not involve the gastrointestinal or genitourinary tract and is frequently linked to worse clinical outcomes[38-41]. Conversely, hollow organ procedures like appendectomies, colorectal, gastroduodenal, biliary tract, and urological surgeries expose tissues to anaerobes, Enterococcus spp., and Gram-negative bacteria like Escherichia coli, Klebsiella spp., Proteus spp., and Enterobacter spp[42-44].

Because they are naturally present in the oropharynx, anaerobic pathogens such as Peptostreptococcus spp., Propionibacterium spp., Prevotella spp., Veillonella spp., Bacteroides spp., and Clostridium spp. are frequently used in head and neck surgeries[45]. Aerobic and anaerobic microbes coexist in polymicrobial surgical site infections (SSIs), commonly seen in surgeries involving the oropharynx, axilla,

perineum, and gastrointestinal systems. Candida species may occasionally also contribute to polymicrobial SSIs[46].

Factors Influencing SSI Development

The likelihood of an SSI is determined by four main factors:

1. **Bacterial Load (Inoculum Size)**

Procedures involving areas with high bacterial colonization are at greater risk for SSIs. For example, the distal small bowel contains 10^3–10^4 bacteria/mL, while the right colon harbors 10^5–10^6 bacteria/mL, and the rectum and sigmoid colon may contain up to 10^{10}–10^{12} bacteria/g of stool from approximately 600 different microbial species. Similarly, the female genital tract harbors 10^6–10^7 bacteria/mL, increasing the risk of infection during gynecological surgeries[46-49].

2. **Bacterial Virulence**

A bacterial strain's virulence determines the probability of generating an SSI. Certain bacteria can cause serious diseases with just a tiny inoculum. For example, with a low bacterial load, Streptococcus pyogenes, Clostridium perfringens, and Staphylococcus aureus can develop necrotizing infections that advance quickly. Bacteroides fragilis and Escherichia coli are two examples of bacteria that can display synergistic pathogenicity, leading to more severe infections when present together in significant numbers[50]. Additionally, antibiotic resistance contributes to bacterial pathogenicity. Patients with recent hospital admissions, prolonged preoperative stays, or prior antibiotic use are more likely to harbor resistant bacteria, increasing their risk of developing an SSI[50].

3. Microenvironment of Site of the Surgery

Conditions at the surgical site can facilitate infection even in cases of low bacterial load. Factors such as hemoglobin levels, hematoma formation, foreign bodies, necrotic tissue from excessive electrocautery, and excessive traction pressure can compromise tissue integrity, making it easier for bacteria to establish infection[48,49]. Additionally, dead space in the wound can accumulate serosanguinous fluid, creating an ideal environment for bacterial growth while limiting the host's immunological response efficiency.

4. Host Immune Response

The capacity of the host to combat infection depends on intrinsic and acquired immune defenses. The intrinsic immune response is genetically determined and cannot be altered, whereas acquired immune dysfunction may result from chronic conditions such as diabetes mellitus, chronic kidney disease, liver disease, or lung disease. Additionally, acute factors like hyperglycemia, hypoxemia, hypoalbuminemia, hypothermia, or acute anemia can impair wound healing and immune function, increasing susceptibility to SSIs[47].

Once a wound is contaminated, a prolonged inflammatory response may ensue, characterized by sustained complement activation and an influx of polymorphonuclear leukocytes (PMNs) into the affected tissue. Monocytes release proinflammatory cytokines, and mast cells secrete serotonin, leading to vasodilation and increased vascular permeability. These processes contribute to the classic signs of inflammation—redness (rubor), swelling (tumor), heat (calor), and pain (dolor).

Signs and Symptoms of Surgical Site Infection (SSI)

Common indicators of SSI at the incision site include purulent discharge, tenderness, localized swelling, redness, and warmth. Symptoms typically appear within the first postoperative week. Superficial SSIs manifest with localized signs of infection, while deep and organ/space SSIs may show less obvious signs initially. In these cases, the first noticeable symptoms could be purulent wound drainage, unexplained fever, or abnormal laboratory results, such as increased C-reactive protein (CRP), blood sedimentation rate (BSR), pro-calcitonin levels, or elevated white blood cell count. Systemic inflammatory responses may also occur[51].

If an incision site shows dehiscence, tenderness, or fever, infection is likely, especially if microorganisms are identified[52]. However, Sandy-Hodgetts et al[53]. suggest that some cases of dehiscence may be due to non-infectious factors like obesity or chronic disease. For deep-seated or organ-related SSIs, a thorough clinical examination is crucial. This includes evaluating the surgical site, conducting imaging tests (X-rays, MRI, CT, ultrasound), blood cultures, tissue biopsies, or surgical sampling to confirm infection. According to the ECDC, nearly half of all reported SSIs are superficial (50%), while 30% involve deep tissues, and 20% affect organs or spaces. However, infection distribution varies depending on the type of surgery and the surveillance system used. Deep and organ/space infections may appear more frequently when monitoring only hospitalized patients. In procedures with short hospital stays, such as cesarean sections, most SSIs are diagnosed after hospital discharge[51].

Over time, SSI symptoms can become more pronounced and widespread (Fig. 1). Since skin naturally harbors microorganisms, the presence of bacteria alone does not confirm an SSI. Nonetheless, wound cultures can assist in determining the causative agent in patients exhibiting symptoms of infection (Appendix 2). Positive cultures from aseptically obtained fluid or tissue, as well as evidence of an abscess or infection verified by histological or radiographic evaluation, are the most trustworthy markers of an SSI[52]. SSI symptoms may take days, weeks, or even a year to manifest fully, particularly if foreign objects (such as sternal wires or prosthetic joints) are left in the body[53].

Table 4. Clinical Signs and Symptoms of Surgical Site Infection (SSI)[54-56]

Superficial SSI Symptoms	**Deep SSI Symptoms**	**Organ/Space SSI Symptoms***
Pain and tenderness at the incision site	Increased pain at the surgical site	Purulent discharge from a drain inserted into an organ or body cavity
Localized swelling and hardening	Spreading swelling and induration around the incision	Abscess in the affected organ or body space (diagnosed via imaging or biopsy)
Warmth and redness of the wound	Increased redness and warmth at the surgical site	Direct evidence of infection found during surgery
Purulent drainage	Purulent discharge from the incision	Unexpected postoperative fever with worsening wound pain or dehiscence
Cellulitis confined to the incision and nearby tissues	Expanding cellulitis at the surgical site	Abnormal blood test results (elevated CRP, WBC, BSR, pro-calcitonin)

Obvious superficial wound abscess	Deep wound abscess or necrotizing fasciitis	Positive results from blood cultures, deep tissue biopsies, or surgical sampling
Incision edges separating, exposing deeper tissues	Postoperative fever	

***Organ/Space SSIs** affect areas beyond the incision site, involving internal structures manipulated during surgery.

Abbreviations: CRP—C-reactive protein; WBC—white blood count; BSR—blood sedimentation rate.

Prevention of Surgical Site Infection (SSI)

The introduction of antibiotics marked a significant advancement in preventing wound infections. The concept of prophylactic antibiotics was developed in the 1960s when research demonstrated that antibiotics must be present in the bloodstream at sufficient levels during the time of incision to effectively prevent infection[30]. There is a consensus that prophylactic antibiotics are recommended for clean-contaminated and contaminated wounds. In cases of dirty wounds, antibiotics serve as a treatment rather than prevention since the infection is already present. The use of prophylactic antibiotics in clean surgical procedures remains debated. However, there is no doubt about their necessity in clean surgeries involving prosthetic device implantation, as an infection in such cases could be catastrophic. The role of prophylactic antibiotics in clean surgeries like breast surgery is still under discussion[58,59].

For prophylactic antibiotics to be effective, they must:

- Target **bacteria most likely to cause infections** in a given procedure.
- Have **good tissue penetration** to reach the surgical site.
- Be **cost-effective** while minimizing disruption of natural body flora (e.g., gut microbiota).
- Be administered at the correct **dosage and timing** to ensure **therapeutic levels are present at incision time** (CDC, 1996).

Timing of Antibiotic Administration:

- **Intravenous administration 30 minutes before incision** is recommended[33].
- Antibiotics **should not be given more than 2 hours before surgery**.
- For **colorectal surgery**, prophylaxis also involves **bowel clearance using enemas** and **oral non-absorbable antibiotics** taken one hour preoperatively.
- In **high-risk cesarean deliveries**, antibiotics should be given **immediately after clamping the umbilical cord** (CDC).

Table 5. Recommendations for Prophylactic Antibiotics Based on Expected Pathogens[60]

Surgical Procedure	**Expected Pathogens**	**Recommended Antibiotic**
Orthopedic surgery (including prosthesis insertion), cardiac surgery, neurosurgery, breast surgery, non-cardiac thoracic procedures	*Staphylococcus aureus*, *Coagulase-negative staphylococci*	Cefazolin (1–2 g)
Appendectomy, biliary	Gram-negative bacilli,	Cefazolin (1–2 g)

procedures	anaerobes	
Colorectal surgery	Gram-negative bacilli, anaerobes	Cefotetan (1–2 g) or Cefoxitin (1–2 g) + oral neomycin (1 g) and erythromycin (1 g) (3 doses starting 19h preoperatively)
Gastroduodenal surgery	Gram-negative bacilli, streptococci	Cefazolin (1–2 g)
Vascular surgery	*Staphylococcus aureus*, *Staphylococcus epidermidis*, gram-negative bacilli	Cefazolin (1–2 g)
Head and neck surgery	Gram-negative bacilli, enterococci, anaerobes, group B streptococci	Cefazolin (1–2 g)
Obstetric and gynecological procedures	Gram-negative bacilli, enterococci, anaerobes, group B streptococci	Cefazolin (1–2 g)
Urologic procedures	Gram-negative bacilli	Cefazolin (1–2 g)

Preoperative Preventive Measures

Preoperative planning plays a crucial role in reducing SSI risk. This includes:

1. Assessing the patient's overall health before surgery.
2. Optimizing nutrition, hemoglobin levels, and fluid-electrolyte balance.
3. Encouraging weight loss in obese patients.
4. Preoperative showering and scrubbing with antiseptic soap the night before surgery to lower skin infection.

5. Cleaning the surgical site only in the operating room immediately before incision.
6. Postponing surgery if the surgeon has open wounds or infections on hands or arms.
7. Minimizing preoperative hospitalization to prevent colonization with hospital-acquired microbes.
8. Providing appropriate prophylactic antibiotics at the correct timing and dose.
9. Ensuring tetanus prophylaxis where necessary.
10. Bowel preparation (controversial) for colorectal surgery.

Updated Recommendations for SSI Prevention (CDC & NICE, 2008)[61,62]

PREOPERATIVE PHASE

Decisive Period:

- The first 4 hours after the incision is critical, as bacteria can establish in tissues before immune defenses respond.
- Antibiotic prophylaxis should be administered to maintain therapeutic levels during this period, preventing a 6% risk of infection.

Antibiotic Prophylaxis Recommendations:

Administer before:

- Clean surgeries involving prosthesis placement
- Clean-contaminated procedures
- Contaminated procedures

Timing:

- A single intravenous dose at the start of anesthesia.
- If using a tourniquet, administer earlier.

Avoid prophylactic antibiotics in:

- Clean, non-prosthetic, uncomplicated surgeries.
- Extending antibiotics beyond 12 hours or until drains/lines are removed.

Choice of Antibiotic:

- Aerobic infections → Cefazolin
- Cephalosporin allergy → Clindamycin
- MRSA risk → Vancomycin
- Anaerobic infections → Bacteroides coverage
- Intestinal surgery → Cover gram-negative rods & anaerobes

Additional Preoperative Measures:

- Showering with soap or chlorhexidine before surgery.
- Hair removal only if necessary, using electric clippers (not razors).
- Minimizing unnecessary movements of staff in the operating room.
- Proper hand hygiene and avoiding jewelry/artificial nails for surgical staff.

INTRAOPERATIVE MEASURES

- Keep the operating room's ventilation at positive pressure
- At least 15 air changes per hour, including three fresh air changes.
- Ensure doors remain closed to prevent contamination.

- Use properly sterilized surgical instruments, avoiding flash sterilization except for immediate use.
- Limit the number of personnel in the operating room to reduce airborne contamination.
- Use ultra-clean air environments for orthopedic implant surgeries.
- Perform regular disinfection of operating room surfaces and floors.

Surgical Techniques:

- Hand hygiene: Perform a 5-minute scrub before the first surgery and a 3-minute scrub for subsequent cases.
- Use sterile gowns and gloves, considering double gloves for high-risk cases.
- Avoid non-iodophor incise drapes unless using iodophor-impregnated ones.
- Use antiseptic skin preparation (chlorhexidine or povidone-iodine), ensuring complete drying if alcohol-based solutions are used.
- Maintain normothermia, oxygenation (FiO2 80%), and perfusion during surgery.
- Avoid unnecessary insulin in non-diabetic patients for infection control.
- Use appropriate antiseptics before wound closure.

POSTOPERATIVE MEASURES

- Dressing care: Use aseptic non-touch techniques for wound dressing changes.
- Cleansing wounds with sterile saline for the first 48 hours, then tap water if the wound is open.

- Patients can shower safely after 48 hours post-surgery.
- Avoid topical antimicrobial agents on healing wounds.
- Do not use outdated antiseptic solutions (e.g., Eusol, mercuric antiseptics) for secondary healing wounds[63-68].

ROLE OF ANTIBIOTICS IN INFECTION MANAGEMENT

Antimicrobial therapy plays an important role in both preventing and treating surgical infections. Its main work is limiting or eliminating pathogenic organisms until the host's immune system can clear the infection. When selecting an antimicrobial agent, key factors include cost-effectiveness, toxicity, and effectiveness. An effective antimicrobial must:

1. Be proactive in combating the infections of interest.
2. Reach the infection site at adequate concentrations.
3. Maintain therapeutic levels for an appropriate duration.

Antibiotics are necessary, but they can also be hazardous. Idiosyncratic side effects include allergic reactions while organ-damaging side effects include renal toxicity and ototoxicity from aminoglycosides and amphotericin B. Furthermore, drugs cause microbial flora to undergo selection pressure, which fuels antibiotic resistance, a growing issue in hospital environments. The cost of the medication should not be the only factor taken into account. Administering fees, clinical time, fluids via intravenous infusing lines, and surveillance expenses are all included in the overall cost.

Distribution of Antimicrobial Agents[69]

An antibiotic must reach the infected tissue at therapeutic levels to effectively treat localized infections. To prevent bacterial development, the concentration of the drug in tissue should ideally be higher than the minimum inhibitory concentration (MIC).

Factors affecting antibiotic distribution:

- **Protein binding:**Only the unbound fraction of an antibiotic can cross capillary walls and act against bacteria.

- **Lipid solubility:** Affects penetration into tissues.

Table 6. Specific sites of antibiotic distribution:

Body Compartment	**Key Considerations**
Blood	Protein binding and excretion rate determine antibiotic half-life. Highly protein-bound antibiotics have longer half-lives. The efficacy of penicillins, cephalosporins, and other cell wall inhibitors depends on the time serum levels remain above MIC, rather than peak concentration.
Urine	Many antibiotics achieve high urinary concentrations (50–200x serum levels). Exceptions include erythromycin and chloramphenicol. Treating urinary infections in renal-compromised patients can be more challenging due to reduced antibiotic concentration.

Bile	Biliary concentrations of certain penicillins (e.g., nafcillin, piperacillin, azlocillin) and cephalosporins (e.g., cefazolin, cefamandole, cefoperazone, cefadroxil) often exceed serum levels.
Intestinal Fluids & Tissues	High serum levels and low protein binding favor tissue penetration. However, bound antibiotics may not be available for bacterial inhibition.

Principles of Antibiotic Therapy

1. Targeted therapy – Choose an antibiotic based on the sensitivity of the organism.
2. Proper dosage – Ensure the drug reaches peak concentration at the site of infection.
3. Direct contact – Antibiotics must physically reach the pathogen.
4. Dosing schedule – Administer based on half-life and elimination route.
5. Bactericidal preference – Combine antibiotics only when synergistic effects are beneficial.
6. Synergy when needed – Combine antibiotics only when synergistic effects are beneficial.
7. Avoid antagonism – Do not use antibiotic combinations that counteract each other.
8. Narrow-spectrum choice – Use the most specific antibiotic to limit resistance.
9. Monitor side effects – Balance risks vs. benefits.

10. Appropriate duration – Prolonged therapy increases resistance risk, while short therapy may not eradicate the infection.

If a single effective, non-toxic antibiotic can prevent or eradicate early infections, chemoprophylaxis is often successful[70].

Prophylactic Antibiotics[71]

Since their discovery, antibiotics have been crucial in preventing infections in surgical practice. Over the past 25 years, the importance of prophylaxis has been increasingly recognized. The primary goal is maintaining high antibiotic levels at the surgical site to reduce postoperative infection risk.

Selection and Administration of Prophylactic Antibiotics[72]

An ideal prophylactic antibiotic should:

- Effectively target expected pathogens.
- Achieve therapeutic tissue levels.
- Have minimal side effects.
- Be cost-effective.

The hospital environment and expected wound flora influence antibiotic selection, but coverage should primarily target common postoperative pathogens. First-generation or third-generation cephalosporins are generally sufficient for clean and clean-contaminated procedures.

When to Administer Prophylactic Antibiotics[73]

The longer the interval between infection and dosage, the less effective preventive antibiotics are.

- Optimal timing: Administer before taking incision 30 minutes (not before 2 hours).
- For long surgeries: Re-dose every 1–2 times the drug's half-life to maintain adequate tissue levels.
- For clean surgeries: A single, high-dose, long-acting antibiotic is preferred.
- For contaminated wounds: Extend prophylaxis only when gross contamination occurs (e.g., ruptured viscus, trauma)[74].

Common Prophylactic Antibiotics[75]

An ideal prophylactic agent should balance safety and efficacy. Commonly used classes include:

β-Lactam Antibiotics

The largest group of antibiotics is characterized by a four-membered β-Lactam ring. Includes penicillins, cephalosporins, monobactams, and carbapenems.

Penicillins

- The first β-lactams are derived from Penicillium notatum.
- Molecular modifications have expanded antibacterial activity.

Cephalosporins

- The largest β-lactam subgroup, produced by *Cephalosporium fungi*.

- Each generation broadens the spectrum of activity.

Table 7. Cephalosporins

Generation	**Examples**	**Spectrum of Activity**
First-Generation	Cephalothin, Cefazolin, Cephalexin	Effective against **gram-positive organisms** (e.g., *Staphylococcus*, *Streptococcus*). **Ineffective** against anaerobes and many gram-negative bacteria.
Second-Generation	Cefoxitin, Cefuroxime, Cefotetan	Increased **gram-negative coverage** and **moderate anaerobic activity**.
Third-Generation	Cefotaxime, Ceftizoxime, Ceftriaxone	**Resistant to β-lactamases**, strong **gram-negative** activity, but **poor anaerobic coverage**.
Fourth-Generation	Cefepime, Cefpirome	Broad-spectrum, effective against **both gram-positive and gram-negative organisms**.

Table 8. Other Antibiotic Classes

Class	**Examples**	**Key Features**
Glycopeptides	Vancomycin	**Effective against MRSA, *Clostridioides difficile***. Used for **pseudomembranous colitis**.
Carbapenems	Meropenem, Ertapenem, Imipenem	**Broad-spectrum**, β-lactamase-resistant, effective against **aerobes & anaerobes**.

Imidazoles	Metronidazole	**Strong anaerobic activity** (e.g., *Bacteroides, Clostridia*). Used for **intra-abdominal & gynecological infections**.
Aminoglycosides	Gentamicin, Amikacin	**Effective against aerobic gram-negative bacteria**. Ototoxic & nephrotoxic.
Tetracyclines	Doxycycline, Minocycline	**Broad-spectrum**, effective against *Rickettsia, Chlamydia*, *Mycoplasma*.
Quinolones	Ciprofloxacin, Ofloxacin	**Effective against gram-negative bacteria**, some gram-positive activity.

RELATED STUDIES:

1. Singh A (2019)[76] evaluated the effectiveness of preoperative intra-incisional infiltration of ceftriaxone in reducing surgical site infections (SSI) and found that administering ceftriaxone directly into the incision site before surgery dramatically reduced the number of SSI. For the trial, 120 patients were randomized to one of two equal groups, contrasting intra-incisional delivery of ceftriaxone prior to surgery (Group B) with the conventional single-dose intravenous administration (Group A). The findings showed that whereas only 5% of individuals in Group B experienced SSI, 25% of patients in Group A did . Escherichia coli was the most frequently found pathogen, accounting for 72.22% of SSIs. In addition, hospital stays for patients who contracted an infection were almost twice as lengthy as those for individuals who did not. The study concluded that preoperative intra-incisional ceftriaxone administration led

to a statistically significant reduction in SSI rates across various wound classes, with a P value of less than 0.005, highlighting its potential as an effective preventive strategy.

2. In a study conducted by Patil AN (2018)[77] to evaluate the effectiveness of intravenous versus intra-incisional cefotaxime preoperative single doses in avoiding surgical site infections (SSI) after surgery following appendicectomy, it was observed that intra-incisional administration could be a viable alternative to systemic antibiotic use. Sixty individuals with uncomplicated appendicitis were randomized into two equal groups for the study. One gram of cefotaxime was administered intravenously to Group B and intraincisionally to Group A. Following surgery, from day three until the sutures were removed, the incision sites were checked every other day. According to the results, only 3.3% of patients in Group A and 13.3% in Group B experienced SSI, although the difference was not statistically significant ($p > 0.05$). The presence of SSI prolonged the hospital stay of affected patients. The study concluded that while both administration routes were effective, intraincisional cefotaxime demonstrated a trend toward reducing SSI rates. These results suggest a potential strategy for minimizing systemic antibiotic usage in abdominal surgery patients, thereby reducing unnecessary antibiotic burden.
3. In a meta-analysis conducted by Lalla SC (2022)[78] to evaluate the risks and benefits of antibiotic prophylaxis (AP) in dermatologic surgery, it was found that AP significantly reduces the risk of surgical site infections (SSI) without increasing adverse events (AEs). The study systematically reviewed randomized controlled trials (RCTs) from multiple databases, analyzing 12,958 surgical wounds from 12,698 participants undergoing elective clean and

clean/contaminated surgical procedures. The results demonstrated that postoperative SSIs were significantly lower in the AP group (3.4%) compared to the control group (7.4%), with an incidence rate ratio (IRR) of 0.48, indicating high-certainty evidence. Subgroup analysis further highlighted substantial reductions in SSI risk for Mohs micrographic surgery (IRR 0.22), dermatologic surgery (IRR 0.29), and plastic or breast surgery (IRR 0.60). Notably, the use of AP did not lead to a significant increase in adverse events. The study concluded that while AP effectively lowers SSI rates in clean and clean/contaminated cutaneous surgical procedures, its use should be carefully weighed against factors such as cost, potential drug interactions, antibiotic resistance, and surgical contexts with inherently low infection risk.

4. In a study conducted by Inderchand S (2021)[79] to assess the systemic absorption and effectiveness of antibiotics administered at the incision site, it was found that locally administered antibiotics provide high concentrations precisely during the period of maximum contamination. This is attributed to the antibiotic binding to the tissues along the incision, ensuring sustained local availability. The study involved two groups, with Group 1 showing a significantly higher incidence of surgical site infections (SSI) at 11.7% compared to only 1.7% in Group 2. Although the difference in SSI rates was notable, the P value was greater than 0.05, indicating statistical insignificance. Additionally, 3.33% of patients in Group 1 required resuturing, whereas no patients in Group 2 needed resuturing, though this difference was also not statistically significant ($P > 0.05$). The study concluded that incision-site antibiotic administration could potentially reduce SSI rates, although further research is necessary to establish statistical significance and confirm its broader clinical implications.

5. In a study conducted by Dogra B (2013)[80] to compare the efficacy of preoperative intra-incisional antibiotic infiltration with prophylactic parenteral antibiotic therapy in reducing surgical site infections (SSI), it was found that intra-incisional administration provided better infection control than intravenous administration alone. This randomized controlled study involved 120 patients divided into three groups of 40 each. Group A received local infiltration of 1 gram of cefotaxime around the incision site 20 minutes before anesthesia induction, Group B was administered a single dose of 1 gram of cefotaxime intravenously 20 minutes before the surgical incision, and Group C received both intra-incisional and intravenous cefotaxime. The study included patients aged 20–60 years undergoing clean or clean-contaminated procedures lasting less than two hours, while patients with diabetes or those on steroid therapy were excluded. The results showed that the overall incidence of SSI was 10% in Group A, 18% in Group B, and only 2.5% in Group C. The infections were predominantly caused by gram-positive bacteria, with Methicillin-Sensitive Staphylococcus aureus (MSSA) being the most frequently isolated pathogen. The study concluded that intra-incisional antibiotic infiltration was more effective in reducing SSI than intravenous administration alone, and the combination of both methods resulted in the lowest infection rate. Furthermore, there was no significant correlation between the duration of surgery and SSI incidence in this study.
6. In a study conducted by Narayana V (2024)[81] to evaluate the efficacy of preoperative intra-incisional infiltration of ceftriaxone in reducing surgical site infections (SSI), it was found that this method provided a significant advantage over traditional intravenous administration. SSI accounts for 20% of all

hospital-acquired infections in surgical patients, leading to increased healthcare costs and patient dissatisfaction. Initially, antibiotics were administered postoperatively to treat established infections, but prophylactic use through intravenous and intra-incisional routes has since been introduced. While IV antibiotics distribute across systemic and peripheral pools, resulting in lower concentrations at the wound site, intra-incisional infiltration ensures a high local concentration when the wound is most vulnerable to infection. This study, conducted at the Vydehi Institute of Medical Sciences and Research Centre from July 2022 to June 2024, analyzed multiple factors, including gender distribution, SSI incidence, duration of surgery, cultured organisms, wound classification (clean, clean-contaminated, contaminated), SSI categories, timing of SSI onset, and its prevalence among diabetic patients. The findings confirmed that intra-incisional ceftriaxone administration significantly reduced SSI rates, reinforcing its potential as a superior method for prophylactic antibiotic administration in elective and clean abdominal surgeries.

7. In a meta-analysis conducted by Yao J (2023)[82] to compare the effectiveness of oral antibiotic bowel preparation (OABP) versus other regimens in preoperative preparation for elective intestinal surgery, it was found that OABP significantly reduced the incidence of surgical site infections (SSI). The study analyzed data from 35 randomized controlled trials (RCTs) involving 8,445 adult patients, with 29 RCTs incorporating OABP regimens combined with intravenous antibiotic prophylaxis (IVAP). The results indicated that the overall SSI rate was lower in the OABP group compared to those receiving IVAP alone or a combination of IVAP and mechanical bowel preparation (MBP) (RR 0.56, 95% CI 0.46–0.69, $P < .00001$, $I^2 = 47\%$). Among various antibiotic combinations,

metronidazole with either quinolones or aminoglycosides demonstrated the most effective reduction in SSI. Additionally, OABP combined with both preoperative and postoperative IVAP was associated with a significantly lower SSI rate, with IVAP administered before and within 24 hours after surgery showing the greatest benefit. However, OABP alone, without IVAP, did not significantly reduce SSI compared to the control group. The study also found that OABP regimens effectively lowered the incidence of organ space SSI, superficial SSI, deep SSI, and overall mortality. The study concluded that OABP, combined with preoperative IVAP and continued within 24 hours postoperatively, is an effective strategy for reducing SSI in intestinal surgeries, with metronidazole-based regimens showing the best efficacy.

8. In a study conducted by Badia JM (2020)[83] to evaluate effective measures for preventing surgical site infections (SSI), it was emphasized that SSI leads to prolonged hospital stays, increased morbidity and mortality, higher healthcare costs, and diminished patient quality of life. Recognizing the importance of evidence-based practices, many hospitals have implemented scientifically validated guidelines to improve postoperative outcomes. The Surgical Infection Division of the Spanish Association of Surgery critically reviewed the latest scientific evidence and international guidelines to identify the most effective preventive measures for implementation in Spanish surgical services. The key recommendations included avoiding the removal or clipping of hair from the surgical field, utilizing alcohol-based solutions for skin decontamination, administering systemic antibiotic prophylaxis within 30–60 minutes before the incision as a single preoperative dose (with intraoperative re-dosing if necessary), maintaining normothermia throughout surgery, and ensuring

perioperative glucose level control. The study concluded that adherence to these high-evidence measures significantly reduces SSI incidence and enhances surgical outcomes.

9. In a study conducted by Pravindhas A (2023)[84] to compare the efficacy of preoperative single-dose ceftriaxone infiltration at the incision site versus preoperative intravenous ceftriaxone in preventing surgical site infections (SSI) in hernioplasty, it was found that intra-incisional administration resulted in significantly lower infection rates. This prospective interventional study was conducted at SRM Medical College and Research Institute, Tamil Nadu, over 18 months, including 100 patients diagnosed with inguinal hernia. Patients were randomly divided into two groups: Group A, which received a preoperative intra-incisional injection of ceftriaxone, and Group B, which received preoperative intravenous ceftriaxone. The study monitored patients on postoperative days 3, 7, and 14 for SSI development. The results indicated a male predominance (91%) among the participants, with the majority (54%) aged between 41 and 60 years. SSI developed in 20% of patients who received only intravenous antibiotics, whereas only 6% of those who received intra-incisional ceftriaxone developed SSI, with a statistically significant p-value of 0.037 (<0.05). Among the affected patients, Staphylococcus aureus was the most frequently isolated organism (38.5%).Additionally, all 13 patients who developed SSI had preexisting comorbidities, and 84% of them underwent surgeries lasting more than 30 minutes. The mean hospital stay for most patients was 3–5 days (87%). The study concluded that preoperative intra-incisional ceftriaxone administration resulted in a significantly lower incidence of SSI compared to intravenous administration alone. The higher antibiotic

concentration achieved at the incision site played a crucial role in infection prevention, reinforcing the effectiveness of intra-incisional prophylaxis in hernioplasty procedures.

10. In a study conducted by Balraj G (2023)[85] to evaluate the efficacy of preoperative intra-incisional infiltration of cefotaxime in preventing surgical site infections (SSI), it was found that combining intra-incisional and intravenous antibiotic administration led to the lowest infection rates. This prospective study included 120 patients randomly divided into three equal groups. Group A, considered the control group, received a single dose of intravenous cefotaxime (1g), Group B received intra-incisional cefotaxime before surgery, and Group C received both intravenous and intra-incisional cefotaxime. The results indicated that SSI occurred in 15% of patients in Group A, 12% in Group B, and only 5% in Group C. The study demonstrated that intra-incisional administration alone resulted in a lower infection rate than intravenous administration alone. However, combining both methods provided the most effective protection against SSI. The study concluded that preoperative intra-incisional cefotaxime, particularly when combined with intravenous administration, significantly reduces SSI prevalence, reinforcing its potential as an optimal prophylactic strategy for infection prevention in surgical procedures.

MATERIALS AND METHODS

- **STUDY DESIGN:**Hospital-Based Observational Prospective Study
- **STUDY DURATION:** 18 months (June 2023- December 2024).
- **STUDY AREA:** KAHER's Dr. Prabhakar Kore Charitable Hospital and Medical Research Centre, Nehru Nagar, Belagavi.
- **STUDY PARTICIPANTS:** Patients above 18 years of age who have come for abdominal hernia surgery in KAHER's Dr. Prabhakar Kore Charitable Hospital and Medical Research Centre, Nehru Nagar, Belagavi.

- **INCLUSION CRITERIA**

1. Patients of both the sex.
2. Patients of age group > 18 years.
3. Patients giving consent to take part in the study.
4. Patients undergoing clean open abdominal surgeries, including inguinal hernia, umbilical hernia, and para-umbilical hernia repairs.

- **EXCLUSION CRITERIA**

1. Age of the patient less than 18 years.
2. Age more than 80 years.
3. Laparoscopic surgery.
4. Patient with type 2 Diabetes mellitus.
5. Patient with a known history of immunodeficiency.
6. Patient with a history of taking systemic corticosteroid therapy.

7. Presence of preexisting systemic/ local infection.

8. Patients with strangulated or obstructed hernia.

9. Patients developing hypersensitivity reaction to the antibiotic.

Sampling technique: Computer-generated random numbers assign the patient a control or test group, i.e., Group A (control – only intravenous) and Group B (test – intravenous plus intraincisional).

METHOD OF COLLECTION OF DATA:

Patients undergoing clean open abdominal surgeries, including inguinal hernia, umbilical hernia, and para-umbilical hernia repairs in KAHER's Dr. Prabhakar Kore Charitable Hospital and Medical Research Centre, Nehru Nagar, Belagavi, were included in the study. Clearance from the institutional ethical committee was taken before starting the study. Study participants were included in the study using by Purposive Sampling technique.

The study participants were included until the sample size was reached. Written informed consent/assent was taken from the parents before collecting the data. A pre-tested, semi-structured questionnaire was used to collect information on socio-demographic variables and history by interview method. Patients will be categorized into either the control group (Group A) or the test group (Group B) using a lottery system, with subsequent patients being assigned alternately to each group. One day before surgery, all patients will receive a test dose of the antibiotic to screen for hypersensitivity, and those exhibiting allergic reactions will be excluded from the study. Standard preoperative protocols, including routine site preparation, tetanus toxoid administration, and other necessary preoperative measures, will be followed.

Anesthesia will be administered per the procedural requirements, and the surgical site will be painted with betadine, draped, and cleaned with methylated spirit to ensure sterility.

Both Group A (control) and Group B (test) will receive intravenous ceftriaxone (1 gm) just before incision as part of routine prophylaxis. However, only Group B will receive an additional intra-incisional dose of ceftriaxone (1 gm diluted in 10 ml distilled water), administered subcutaneously along the incision line immediately before making the incision. Group A will not receive this intra-incisional antibiotic. Both groups will be managed with the same routine postoperative antibiotic regimen postoperatively.

Wound inspection will be conducted on postoperative day 3 and every alternate day until suture removal. Any signs of wound gapping, discharge, or fluid collection will be noted as indicators of infection. If an infection occurs, pus or wound culture will be obtained, and antibiotic treatment will be adjusted based on culture sensitivity results to ensure appropriate management.

STATISTICAL ANALYSIS:

The data was collected and compiled in MS Excel. Descriptive statistics has been used to present the data. To analyse the data SPSS (Version 26.0) was used. The significance level was fixed as 5% ($\alpha = 0.05$). Qualitative variables are expressed as frequency and percentages, and Quantitative variables are expressed as Mean and Standard Deviation.

SAMPLE SIZE ESTIMATION

$$n = \frac{(Z_{1-\alpha/2} + Z_{1-\beta})^2 (p1q1 + p2q2)}{(p_1 - p_2)^2}$$

$P_1 = 3.3\%$, $p_2 = 27.6\%$,

$Z_{1-\alpha/2} = 1.96$, $Z_{1-\beta} = 0.842$

95% CI

80% power

n = 30.8

n = 31 per each group;

Total: 62

RESULTS

The study compares the incidence of surgical site infection (SSI) between two groups undergoing hernia repair surgery. Both Group A (control) and Group B (test) received intravenous ceftriaxone (1 gm) before incision as routine prophylaxis. However, Group B received an additional intra-incisional dose of ceftriaxone (1 gm diluted in 10 ml distilled water) subcutaneously along the incision line before making the incision.

TABLE 9: AGE GROUP

Age Group		**Group**		**P VALUE**
		A	**B**	
21-30 years	**Count**	5	4	0.438
	%	16.10%	12.90%	
31-40 years	**Count**	5	1	
	%	16.10%	3.20%	
41-50 years	**Count**	5	5	
	%	16.10%	16.10%	
51-60 years	**Count**	6	10	
	%	19.40%	32.30%	
>60 years	**Count**	10	10	
	%	32.30%	32.30%	
Total	**Count**	**31**	**31**	
	%	**100.00%**	**100.00%**	

The age distribution between the two groups is relatively similar, with the majority of patients falling in the 51–70 years range. In Group A, 29% were in the 61–70 years category, whereas in Group B, the highest representation was in the 51–60 years category (32.3%). There was no statistically significant difference in age distribution between groups (p = 0.438).

FIGURE 3: AGE GROUP

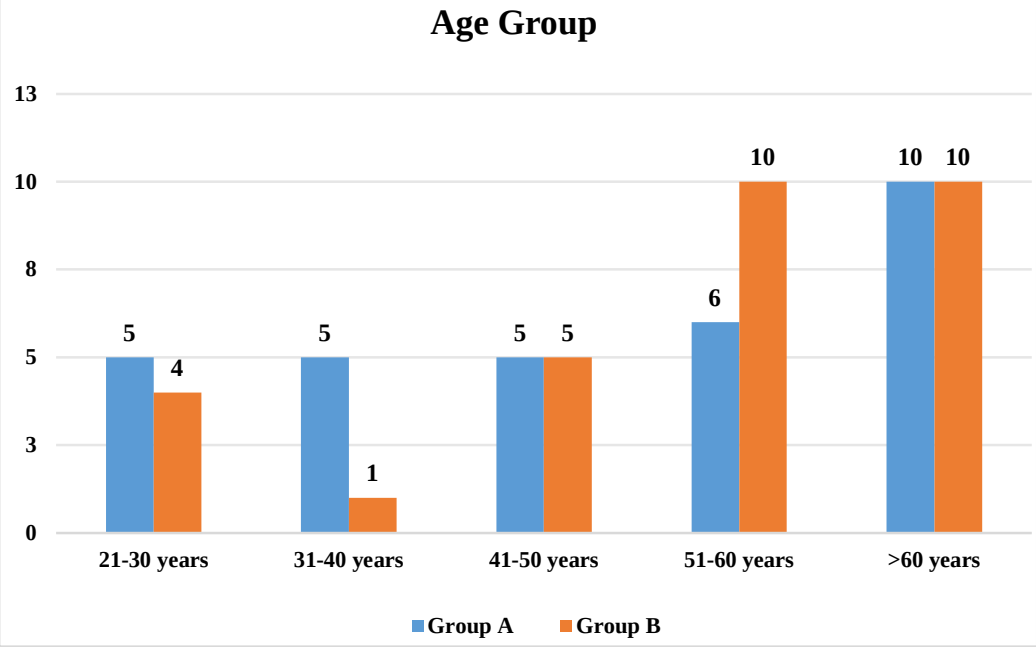


TABLE 10. GENDER

Gender		Group		P VALUE
		A	B	
Male	**Count**	20	21	0.788
	%	64.50%	67.70%	
Female	**Count**	11	10	
	%	35.50%	32.30%	
Total	**Count**	**31**	**31**	
	%	**100.00%**	**100.00%**	

Both groups had a similar gender composition, with a majority of male patients (64.5% in Group A and 67.7% in Group B). The difference was not statistically significant (p = 0.788).

FIGURE 4. GENDER

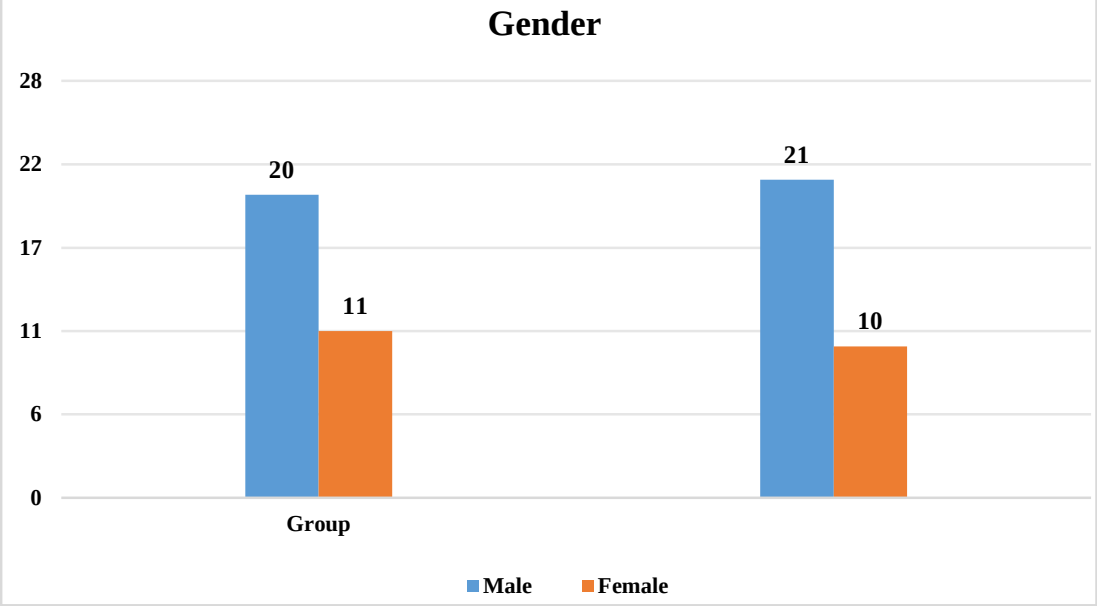


TABLE 11. ASA

ASA		Group		P VALUE
		A	B	
1	Count	18	17	0.34
	%	58.10%	54.80%	
2	Count	10	7	
	%	32.30%	22.60%	
3	Count	3	7	
	%	9.70%	22.60%	
Total	**Count**	**31**	**31**	
	%	**100.00%**	**100.00%**	

The ASA (American Society of Anesthesiologists) classification was comparable between groups. Most patients fell into ASA category 1 (58.1% in Group A and 54.8% in Group B). However, there were slightly more ASA 3 patients in Group B (22.6%) compared to Group A (9.7%). This difference was not statistically significant (p = 0.34).

FIGURE 5. ASA

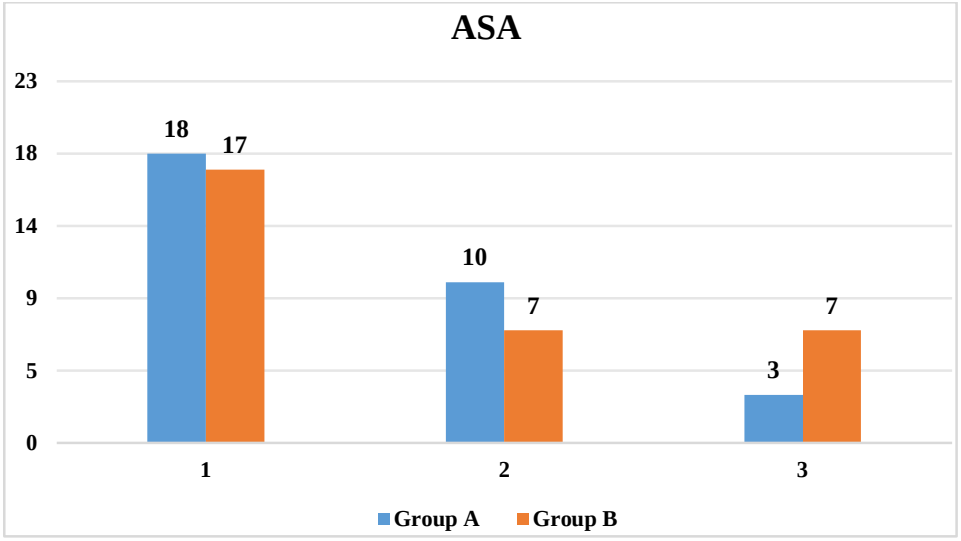
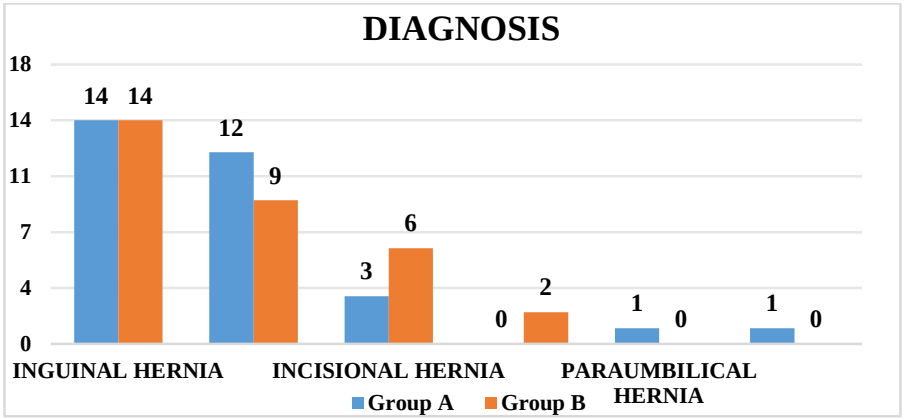


TABLE 12. DIAGNOSIS

DIAGNOSIS		Group		P VALUE
		A	B	
INGUINAL HERNIA	Count	14	14	0.423
	%	44.1%	44.1%	
UMBILICAL HERNIA	Count	12	9	
	%	38.80%	29.00%	
INCISIONAL HERNIA	Count	3	6	
	%	9.70%	19.40%	
EPIGASTRIC HERNIA	Count	0	2	
	%	0.00%	6.50%	
PARAUMBILICAL HERNIA	Count	1	0	
	%	3.20%	0.00%	
VENTRAL HERNIA	Count	1	0	
	%	3.20%	0.00%	
Total	**Count**	**31**	**31**	
	%	**100.00%**	**100.00%**	

FIGURE 6. DIAGNOSIS



The primary diagnosis in both groups was inguinal hernia (44.1% each), followed by umbilical hernia (38.8% in Group A, 29% in Group B). Group B had a higher proportion of incisional hernias (19.4% vs. 9.7%) and epigastric hernias (6.5% vs. 0%). The distribution of diagnoses between the groups was not statistically significant ($p = 0.423$).

TABLE 13. SURGERY

SURGERY		Group		P VALUE
		A	B	
Mesh Hernia Repair	Count	31	31	1.000
	%	100.00%	100.00%	
Total	Count	31	31	
	%	100.00%	100.00%	

All patients in both groups underwent mesh hernia repair (100%), confirming uniformity in the surgical approach. The p-value (1.00) suggests statistical significance, likely because all patients underwent the same procedure.

FIGURE 7. SURGERY

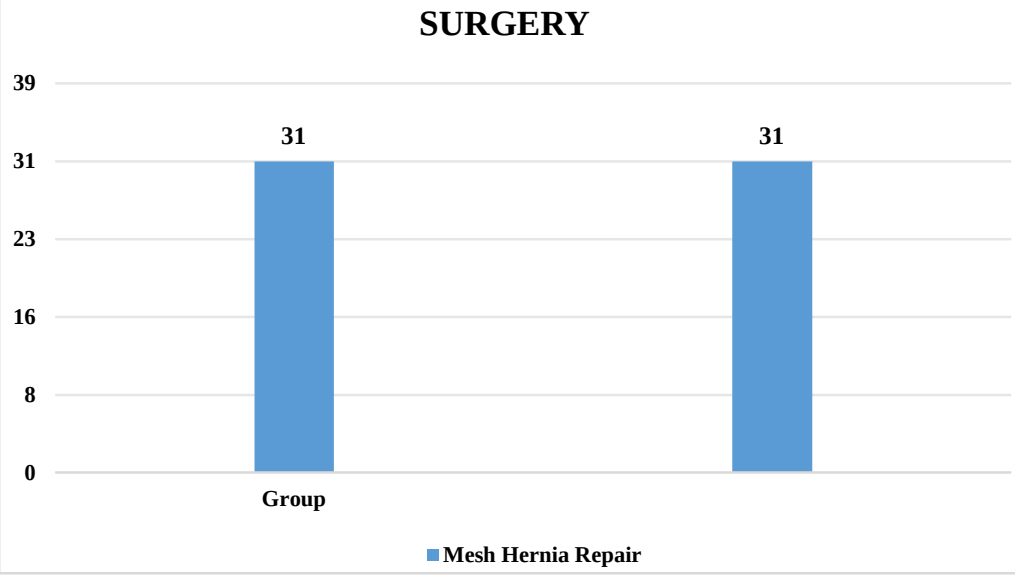
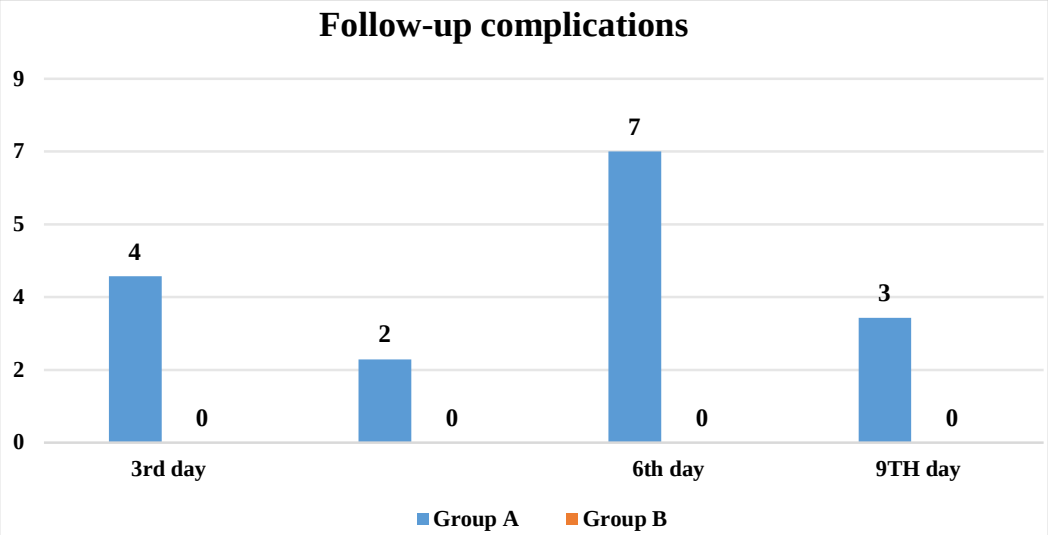


TABLE 14. Follow-up complications

Follow-up complications			Group		P VALUE
			A	B	
3rd day	Discharge	Count	4	0	0.036
		%	12.90%	0.00%	
	Erythema	Count	2	0	
		%	6.50%	0.00%	
6th day	Discharge	Count	7	0	0.005
		%	22.60%	0.00%	
9TH day	Discharge	Count	3	0	0.076
		%	9.70%	0.00%	

FIGURE 8. Follow-up complications

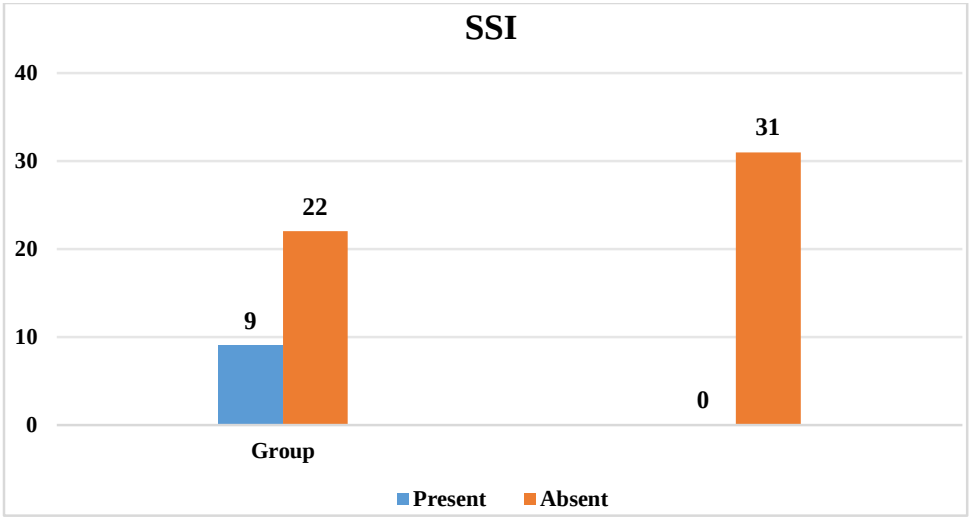


On the 3rd day, 12.9% of Group A patients were discharged, while none in Group B were discharged (p = 0.036). Additionally, 6.5% of Group A patient's showed erythema, whereas none in Group B exhibited this complication. On the 6th day, 22.6% of Group A patients were discharged, compared to none in Group B (p = 0.005). On the 9th day, 9.7% of Group A patients were discharged, whereas no patients were discharged in Group B (p = 0.076).

TABLE 15. SSI

SSI		Group		P VALUE
		A	B	
Present	**Count**	9	0	**0.001**
	%	29.00%	0.00%	
Absent	**Count**	22	31	
	%	71.00%	100.00%	
Total	**Count**	**31**	**31**	
	%	**100.00%**	**100.00%**	

FIGURE 9. SSI



SSI was present in 29% of Group A patients, whereas none of the patients in Group B developed SSI (p = 0.001), indicating a statistically significant difference. Infection-free rates were 71% in Group A and 100% in Group B, further supporting the hypothesis that intra-incisional ceftriaxone reduces the incidence of postoperative infections.

DISCUSSION

Surgical site infections (SSIs) remain a major concern in surgical practice, contributing to prolonged hospital stays, increased healthcare costs, and patient morbidity (Singh A. et al[76].; Pravindhas A. et al[84].). To address this challenge, various prophylactic antibiotic strategies have been explored, with intra-incisional administration emerging as a promising method (Narayana V et al[81].; Karlatti S et al[86].). Our study aimed to evaluate the effectiveness of intra-incisional ceftriaxone in reducing SSI rates in mesh hernia repair, comparing it with conventional intravenous prophylaxis.

Previous studies have reported mixed results regarding intra-incisional antibiotic administration. While some studies demonstrate a significant reduction in SSIs with intra-incisional ceftriaxone (Singh A et al[76].; Narayana V et al[81].; Karlatti S et al[86].), others have shown either a modest effect or, in some cases, a paradoxical increase in SSIs (Patil AN et al[77].; Dogra B et al[80].). This variation highlights the need for further investigation into patient selection, surgical techniques, and perioperative factors that may influence outcomes.

This discussion compares our findings with previous studies, analyzing demographics, SSI rates, bacterial involvement, and postoperative recovery patterns. By integrating these results, we aim to determine the clinical relevance of intra-incisional ceftriaxone as an effective SSI prevention strategy and provide evidence-based recommendations for future practice.

Demographics and Baseline Characteristics

In our study, the age distribution was comparable between the two groups, with most patients in the 51–70 years range. Group A had 29% of patients in the 61–70 years category, while Group B had the highest representation in the 51–60 years

category (32.3%). No statistically significant difference in age distribution was found (p = 0.438). Similarly, Singh et al[76]. found that most patients belonged to the 46–60 years group, with the highest SSI incidence (20%) occurring in the 31–45 years range. However, their study found no statistical correlation between age and SSI (p = 0.3679). Patil et al[77]. also reported a mean age of 30.8 ± 12.62 years in Group A and 30.3 ± 10.29 years in Group B, indicating a younger population than our study.

Regarding gender distribution, our study found a male predominance (64.5% in Group A and 67.7% in Group B, p = 0.788). Singh A. et al[76]., Balraj G. et al[85]., and Pravindhas A. et al[84]. also reported a higher male prevalence, with male-to-female ratios of 5:1 in some cases. This confirms that hernia and other surgical conditions studied are more prevalent in males.

Surgical Site Infection (SSI) Incidence

Our study demonstrated a significant reduction in SSI incidence in Group B, with 29% of Group A developing SSI, whereas no patients in Group B developed an infection (p = 0.001).

Similarly, Singh et al[76]. reported a significant decrease in SSI with intra-incisional ceftriaxone, where SSI rates dropped from 25% (Group A) to 5% (Group B). Pravindhas A et al[84]. found a 6% SSI incidence in the intra-incisional group and 20% in the intravenous group (p = 0.037).

Conversely, Patil et al[77]. reported a higher SSI incidence in Group B (13.3%) compared to Group A (3.3%), which contrasts with our findings. Dogra B et al[80]. also observed a higher SSI incidence in Group B (18%) than in Group A (10%), indicating variability in outcomes across different patient populations and study methodologies. In the study by Karlatti S et al[86]., 0% of Group A (IV ceftriaxone) developed SSI, while in Group B (no antibiotic prophylaxis), 16% developed

infections, reinforcing the importance of prophylactic antibiotics. Our findings align more closely with Narayana V et al[81]., where SSI incidence decreased from 32% (Group A) to 8% (Group B, p = 0.005), supporting the role of intra-incisional ceftriaxone in SSI prevention.

Postoperative Complications

In our study, postoperative complications differed between groups. On the third postoperative day, 12.9% of Group A patients were discharged, while none in Group B were discharged (p = 0.036). Additionally, 6.5% of Group A patients developed erythema, whereas none in Group B did. By the sixth day, 22.6% of Group A was discharged, compared to none in Group B (p = 0.005).

Sophy JL et al[87]. found that SSI was significantly lower in the cases group (12 out of 50) compared to the control group (29 out of 50, p < 0.001). Their study also highlighted earlier SSI onset (5th–7th day), contrasting with our findings, where complications appeared across the 3rd to ninth postoperative days.

Our study proves that intra-incisional ceftriaxone is highly effective in reducing SSI incidence in mesh hernia repair surgeries. Group B had 0% SSI, whereas Group A had a 29% infection rate (p = 0.001), highlighting a significant protective effect. Comparison with other studies reinforces our findings, with Singh A. et al[76]., Narayana V. et al[81]., and Karlatti S et al[86]. demonstrating similar reductions in SSI with intra-incisional ceftriaxone. Pravindhas et al[84]. further support the role of intra-incisional prophylaxis in preventing deep infections. However, some studies (Patil et al[77]. and Dogra B et al[80].) reported higher SSI rates in intra-incisional groups, indicating the need for larger multicenter trials to confirm the generalizability of our findings.

LIMITATIONS

- Our study focused solely on hernia repair procedures, limiting generalizability to other surgical types.
- Long-term SSI outcomes were not assessed, preventing the evaluation of delayed infections.
- Bacterial culture analysis was not performed, making it unclear which organisms were most effectively targeted by intra-incisional ceftriaxone.
- Surgical duration and blood loss were not evaluated, which could have provided further insights into SSI risk factors.

RECOMMENDATIONS

1. **Routine Use of Intra-Incisional Ceftriaxone:** Based on the findings from our study and supporting literature, intra-incisional ceftriaxone should be incorporated into standard surgical prophylaxis protocols for mesh hernia repair to reduce SSI incidence significantly.

2. **Extended Studies Across Multiple Surgical Procedures:** While our study focused on hernia repair, further research should evaluate the efficacy of intra-incisional ceftriaxone across different surgical specialties, including gastrointestinal, orthopedic, and oncologic surgeries.

3. **Bacterial Culture Analysis in Future Studies:** Since our study did not identify specific pathogens responsible for SSIs, future research should include microbiological analysis to determine the most common bacterial species and antibiotic resistance patterns.

4. **Long-Term Follow-Up for SSI Incidence:** Future research should assess SSI rates beyond the immediate postoperative period (e.g., 30-day or 90-day follow-up) to evaluate late-onset infections.

5. **Surgical Duration and Blood Loss as Risk Factors:** Given findings from other studies, future research should explore the impact of surgery duration and intraoperative blood loss on SSI incidence, particularly in intra-incisional antibiotic prophylaxis.

CONCLUSION

Surgical site infections (SSIs) pose a significant burden on patients and healthcare systems. Our study provides strong evidence that intra-incisional ceftriaxone is highly effective in preventing SSIs in mesh hernia repair surgeries, reinforcing the potential role of intra-incisional ceftriaxone in modern surgical prophylaxis protocols. Our study supports the widespread adoption of intra-incisional ceftriaxone as an adjunct to intravenous prophylaxis, particularly in mesh hernia repair surgeries. Future research should focus on long-term outcomes, pathogen-specific efficacy, and broader surgical applications to optimize the clinical impact of intra-incisional antibiotic administration.

SUMMARY

A Hospital Based Observational Prospective Study was done at KAHER's Dr. Prabhakar Kore Charitable Hospital and Medical Research Centre, Nehru Nagar, Belagavi, for a period of 18 months (June 2023- December 2024) to study the effect of combining preoperative intra-incisional administration of antibiotic with intravenous antibiotic in prevention of surgical site infections and to compare the efficacy of preoperative combined intravenous and intra-incisional antibiotic administration with intravenous alone in prevention of Surgical site infections in abdominal surgeries.

The key findings of the study are as follows.

Age and Gender: No significant difference between groups ($p = 0.438$ and $p = 0.788$, respectively).

SSI Incidence: 29% in Group A, 0% in Group B ($p = 0.001$).

Postoperative Complications: Group B had fewer early discharges but no erythema or SSI.

Limitations: No bacterial culture analysis, surgical duration, or long-term SSI follow-up.

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ANNEXURE 01-CONSENT

KAHERs JNMC BELAGAVI

INFORMED CONSENT FORM

TITLE**: "Preoperative intravenous vs combined intravenous plus intra-insicional antibiotic administration in the prevention of Surgical site infections"**

Name of Student/Principal Investigator: BH0122008

Name of Guide/Co Investigators:

Introduction: Infection of surgical wound is one of the most common problems after surgery. To prevent this various precautions are followed before, during and after the surgery like parts preparation, hand washing before surgery, wearing sterile gloves, cleaning the surgery site with antiseptics, antibiotic injection before surgery. Usually antibiotic will be given through veins before surgery. In this study we are going to check the effectiveness of giving the antibiotic through the skin around the surgery site and we will see how many patients getting wound infection.

Explanation of procedure: Patients who are getting abdominal surgeries will be taken for the study. They will be divided into 2 groups. One group will receive antibiotics only through veins as usual. Other group will receive antibiotics both through veins and through the skin. After surgery we will check the patients for infection of wound till we remove the sutures. Both the groups will compared and we will find out which group is getting more wound infection.

Withdrawal from participation in the study: Participation in this study in voluntary. You will be free to decide whether to participate in this study or continue participation once enrolled. In case you decide to withdraw your participation, you are free to do so. However, please convey the decision to the principal investigator.

Possible benefits from participating in the study: You will get benefits by participating in this study. You will get extra protection against infection during surgery. The data gathered will help population at large.

Possible risks from participating in the study: There are no risks involved in participating in this study.

Privacy and confidentiality: The information collected from you will be coded, to prevent any person to identify you. Your identity will never be revealed. The data collected from you will be kept confidential and only processed or aggregated data will be used for publication.

Financial incentives: You will not receive any payment for participating in this study.

Cost of investigations No such extra investigations will be done. Routine investigations are alone will be done.

Authorization for publication of aggregated data: Results obtained after processing of the aggregated data will be published for scientific purpose and or presented to scientific groups. However, your identity will never be revealed.

Questions:

If you have any question or complaints with regard to your right as study participant you may contact Dr Harsha Hegde, Chairperson, Ethical committee of JNMC, 0831-2473777 Extension 4052.

Legal rights: By signing this consent form, we are not waving any of your legal rights

CONSENT STATEMENT

I am making a voluntary decision to participate in the study "Preoperative intravenous vs combined intravenous plus intra-incisional antibiotic administration in the prevention of Surgical site infections" My signature below indicates that I have decided to participate and I have read the information provided above or the information provided above has been read to me in the language that I understand best. I was given the opportunity to ask questions and that they have been answered to my satisfaction.

Name of the participant:

Signature or left thumb impression of the participant:

Name of the witness:

Signature or left thumb impression of the witness:

Name of the investigator:

Signature of the investigator:

ANNEXURE 02 - PROFORMA

Title**: Preoperative intravenous vs. combined intravenous plus intra-incisional antibiotic administration in the prevention of surgical site infections.**

Date: Case number:

Name: Inpatient number:

Age: Sex:

Address:

Phone number:

Chief complaints:

History of presenting illness:

Past history:

Diabetes -

Hypertension -

Other comorbidities -

Treatment/ surgical history:

Personal history:

Smoking/ alcohol/ drug use history -

Known drug allergies -

Family history:

General physical examination:

PR RR

BP Spo2

Pallor Icterus Cyanosis

Clubbing Oedema Lymphadenopathy

Systemic examination:

CNS:

CVS:

RS:

PA:

Local examination:

Investigations:

Haemoglobin		Creatinine	
WBC		Sodium	
Platelets		Potassium	
Urea		Others	

Diagnosis:

Surgery:

Postoperative day	**Wound examination**
3rd day	
6th day	
9th day	
Final result:	

ANNEXURE 03 – PHOTOGRAPH

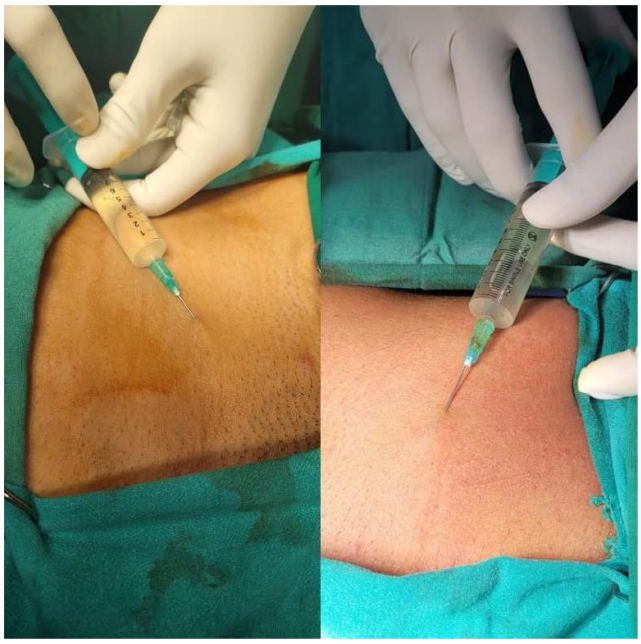

FIGURE 10. Injection certrixone 1 gram diluted in 10 ml distilled water being injected locally at the site of incision

FIGURE 11. Injection Certrixone 1 Gram

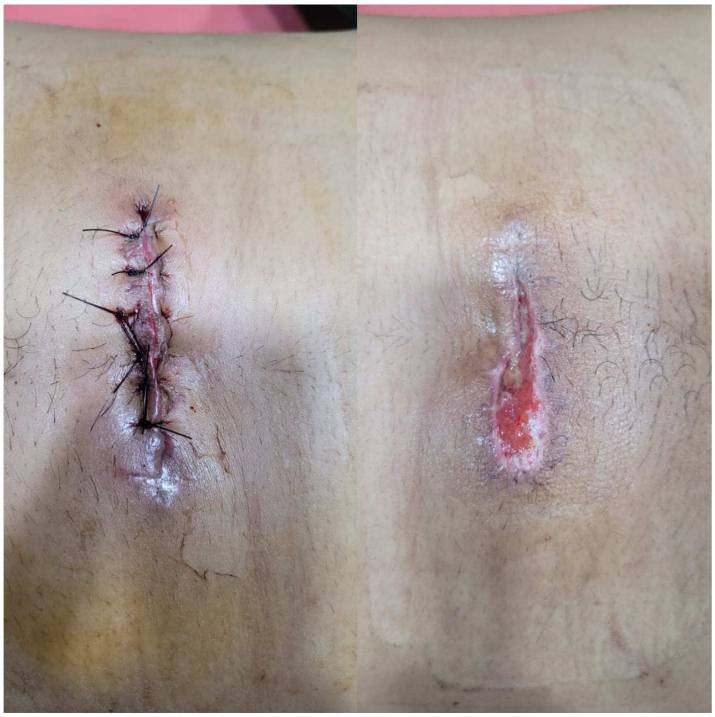

FIGURE 12. Surgical site infection noted in a case of umbilical hernia of control group in form of tenderness and erythema with mild discharge. Sutures were removed and pus drained.

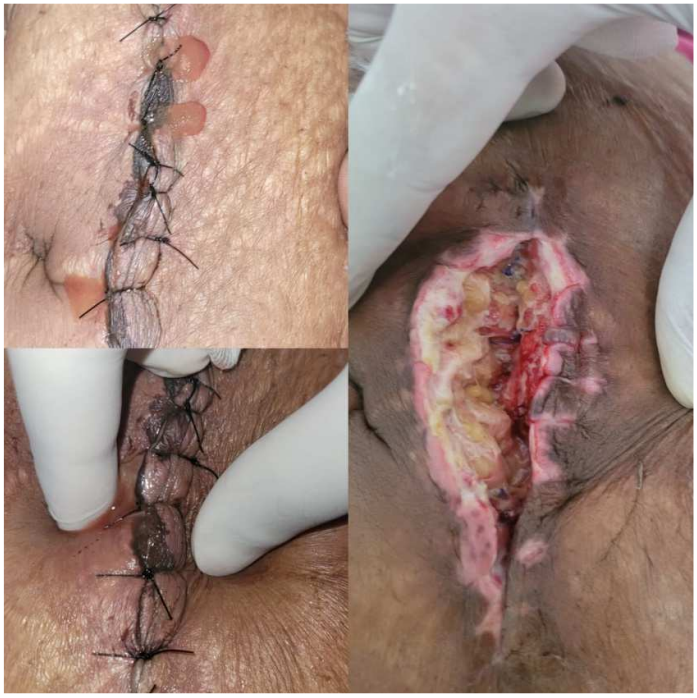

FIGURE 13. Surgical site infection noted in a case of incisional hernia of control group. Seropurulent discharge noted from suture site on day 3 of surgery, sutures opened and pus drained.

ANNEXURE 04 – MASTER CHART

IP No	Age (in years)	Gender	ASA	Diagnosis	Surgery	Experimental Group	3rd day	6th day	9th day	SSI
10038976	63	Male	1	U/L INGUINAL HERNIA	Mesh Hernia Repair	IV	-	-	-	Absent
10039020	60	Male	3	U/L INGUINAL HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent
10039133	73	Male	3	U/L INGUINAL HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent
10039128	58	Male	1	U/L INGUINAL HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent
10069538	48	Female	2	VENTRAL HERNIA	Mesh Hernia Repair	IV	-	-	-	Absent
10083802	21	Male	1	U/L INGUINAL HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent
10084988	71	Male	1	U/L INGUINAL HERNIA	Mesh Hernia Repair	IV	Dischrage	Dischrage	-	Present
10085059	63	Male	2	UMBILICAL HERNIA	Mesh Hernia Repair	IV	-	Dischrage	-	Present
10085039	51	Female	2	UMBILICAL HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent
10085303	57	Male	2	U/L INGUINAL HERNIA	Mesh Hernia Repair	IV	-	Dischrage	Dischrage	Present
10084936	67	Male	2	U/L INGUINAL HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent
10080563	68	Female	1	UMBILICAL HERNIA	Mesh Hernia Repair	IV	-	-	-	Absent
10082638	53	Male	2	UMBILICAL HERNIA	Mesh Hernia Repair	IV	-	-	-	Absent
10081808	38	Male	3	UMBILICAL HERNIA	Mesh Hernia Repair	IV	-	-	-	Absent
10085056	55	Male	2	U/L INGUINAL HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent
10083080	44	Female	1	UMBILICAL HERNIA	Mesh Hernia Repair	IV	-	-	-	Absent
10073297	19	Male	1	U/L INGUINAL HERNIA	Mesh Hernia Repair	IV	Erythema	-	-	Present
10081687	52	Male	3	UMBILICAL HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent
10082693	60	Female	1	UMBILICAL HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent
10072653	63	Male	1	U/L INGUINAL HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent
10072611	53	Male	1	UMBILICAL HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent
10073144	27	Male	2	U/L INGUINAL HERNIA	Mesh Hernia Repair	IV	-	-	-	Absent
10075885	60	Male	1	U/L INGUINAL HERNIA	Mesh Hernia Repair	IV	Dischrage	-	-	Present
10075876	60	Male	1	UMBILICAL HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent

10078538	46	Male	2	UMBILICAL HERNIA	Mesh Hernia Repair	IV	-	Dischrage	-	Present
10075347	65	Female	2	INCISIONAL HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent
10012959	62	Female	1	UMBILICAL HERNIA	Mesh Hernia Repair	IV	Dischrage	Dischrage	Dischrage	Present
10078355	64	Male	1	UMBILICAL HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent
10078306	30	Male	1	U/L INGUINAL HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent
10078381	44	Male	1	UMBILICAL HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent
10041968	63	Female	1	INCISIONAL HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent
10011209	29	Female	1	UMBILICAL HERNIA	Mesh Hernia Repair	IV	-	-	-	Absent
10037426	60	Male	2	UMBILICAL HERNIA	Mesh Hernia Repair	IV	-	-	-	Absent
10009547	77	Male	3	B/L INGUINAL HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent
10038310	63	Male	1	U/L INGUINAL HERNIA	Mesh Hernia Repair	IV	-	-	-	Absent
10036821	49	Male	3	UMBILICAL HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent
10039163	56	Female	1	INCISIONAL HERNIA	Mesh Hernia Repair	IV	-	-	-	Absent
10113916	52	Male	1	B/L INGUINAL HERNIA	Mesh Hernia Repair	IV	-	-	-	Absent
10115074	26	Male	1	U/L INGUINAL HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent
10114794	62	Female	2	UMBILICAL HERNIA	Mesh Hernia Repair	IV	-	-	-	Absent
10103771	29	Male	1	EPIGASTRIC HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent
10103170	31	Female	1	INCISIONAL HERNIA	Mesh Hernia Repair	IV	-	-	-	Absent
10104394	52	Female	2	INCISIONAL HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent
10113980	31	Female	1	INCISIONAL HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent
10086006	42	Male	3	U/L INGUINAL HERNIA	Mesh Hernia Repair	IV	-	-	-	Absent
10087087	83	Male	3	U/L INGUINAL HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent
10071286	66	Male	3	UMBILICAL HERNIA	Mesh Hernia Repair	IV	-	-	-	Absent
10115734	62	Male	1	U/L INGUINAL HERNIA	Mesh Hernia Repair	IV	-	-	-	Absent
10103170	31	Female	1	UMBILICAL HERNIA	Mesh Hernia Repair	IV	Erythema	Dischrage	-	Present
10104733	45	Male	1	U/L INGUINAL HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent
10110236	39	Female	1	PARAUMBILICAL HERNIA	Mesh Hernia Repair	IV	-	-	-	Absent
10109825	40	Male	1	U/L INGUINAL HERNIA	Mesh Hernia Repair	IV	-	-	-	Absent

10112536	47	Female	1	UMBILICAL HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent
10113106	60	Male	2	U/L INGUINAL HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent
10115074	26	Male	1	U/L INGUINAL HERNIA	Mesh Hernia Repair	IV	-	-	-	Absent
10115734	62	Male	2	EPIGASTRIC HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent
10115440	30	Female	1	INCISIONAL HERNIA	Mesh Hernia Repair	IV	-	-	-	Absent
10087678	50	Male	2	U/L INGUINAL HERNIA	Mesh Hernia Repair	IV	Dischrage	Dischrage	Dischrage	Present
10110045	62	Female	1	U/L INGUINAL HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent
10093867	64	Male	2	U/L INGUINAL HERNIA	Mesh Hernia Repair	IV	-	-	-	Absent
10090305	75	Female	3	INCISIONAL HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent
10116062	48	Female	1	INCISIONAL HERNIA	Mesh Hernia Repair	IV+LA	-	-	-	Absent