"ONE YEAR RANDOMIZED CONTROL STUDY TO COMPARE THE EFFICIENCY OF CONTINUOUS VERSUS INTERRUPTED ABDOMINAL FASCIA CLOSURE IN PATIENTS UNDERGOING LAPAROTOMY USING POLYDIOXANONE SUTURE IN KLES DR. PRABHAKAR KORE HOSPITAL AND RESEARCH CENTRE, BELAGAVI."

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This is to certify that the dissertation entitled **"ONE YEAR RANDOMIZED CONTROL STUDY TO COMPARE THE EFFICIENCY OF CONTINUOUS VERSUS INTERRUPTED ABDOMINAL FASCIA CLOSURE IN PATIENTS UNDERGOING LAPAROTOMY USING POLYDIOXANONE SUTURE IN KLES DR. PRABHAKAR KORE HOSPITAL AND RESEARCH CENTRE, BELAGAVI "** is a bonafide research work done by **REG NO.-BH0116001**

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LIST OF ABBREVATIONS USED

CBC	-	Complete Blood Count
CDC	-	Centre for disease control
COPD	-	Chronic obstructive pulmonary disease
CT	-	Computerized Tomography
DPC	-	Delayed Primary Closure
EPA	-	Environmental Protection Agency
LFT	-	Liver function test
PC	-	Primary Closure
PDS	-	Polydioxanone
NS	-	Not significant
0R	-	Odds ratio
SD	-	Standard deviation
SSI	-	Surgical site infection
SL	-	Suture length
WL	-	Wound length

ABSTRACT

Background and objectives

The high combined incidence of surgical site incision (SSI), wound dehiscence and hernia formation indicates a dominant contribution of wound complications to surgical morbidity. Primary objective is to compare the efficiency of continuous versus interrupted abdominal fascia closure using PDS suture in terms of wound dehiscence and to adopt a better technique of closing abdominal fascia so as to prevent the surgical wound dehiscence and burst abdomen.

Methodology

The present one year randomized control study was undertaken in the Department of General Surgery, KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi from period January 2017 to December 2018. A total of 60 patients undergoing elective mid-line laparotomy were selected for the study. Post-operatively wound was examined on POD-03 and followed up at 1 week, 3 week, 6 week, 3 months and once in a month for a period of 6 months after surgery on OPD basis particularly to look for any suture sinus formation, surgical site infection, wound dehiscence or incisional hernia.

Results

Majority of patients in group A were males- 53.33% compared to females-46.67%, whereas majority of patients in group B were females-53.33% compared to males-46.67%. Surgical site infection in group A is 13.3% and in group B is 10.00%, which was statically not significant (p value-0.6876). Wound dehiscence rate in group A and B is 10% and 6.67% respectively, which is statistically not significant (p value-0.6406). The incidence of Incisional hernia in the study is zero in both the groups.

Conclusion and interpretation

Continuous suturing is comparable to interrupted suturing in terms of occurrence of wound infection, wound dehiscence and incisional hernia. Continuous closure is better than interrupted closure as it is faster, takes less suture material and there is no suture sinus formation. But, most of the time the technique of closure depends on the surgeon's choice and convenience. PDS can be considered as an ideal suture material for abdominal fascia closure due to its delayed absorbable property with significant reduction in the incidence of wound dehiscence.

Keywords

Surgical site infection, Wound dehiscence, Incisional hernia, PDS

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INTRODUCTION

Despite many recent advances in the field of surgery including surgical techniques, modern equipment and hospital c.are, complications after abdominal wall closure remains as a major threat to healthcare system. The ideal abdominal wall closure should provide strength and serve as an effective barrier to infection.

Wound complications make a dominant contribution to surgical morbidity. Multiple factors play a role in leading to increased incidence of wound failure, which includes Diabetes Mellitus, malnutrition, raised BMI and use of corticosteroids.[1] An evolving literature focuses mainly on the relative merits of multi-layered versus single-layer closure, closure with different suture materials and continuous versus interrupted closure.

The abdomen can be closed in multiple layers or en mass. Many studies were suggestive of increased incidence of dehiscence and incisional hernia formation with multiple layer closure, while few other studies show no significant difference in these incidences[2]. Due to shorter time required to close the fascial layers en mass, this method is usually preferred by the surgeons.

The relative advantages of resorbable versus nonresorbable suture for fascia closure have been debated since longtime. It has been observed that resorbable suture may lead to increased incidences of dehiscence and hernia formation due to intrinsic loss of its strength during the postoperative period.[3] But the literature has shown no significant association between wound failure and use of resorbable sutures.

Meta-analysis comparing permanent (Ethicon, Prolene or Nylon) and slowly resorbable suture (PDS and Maxon) have not came to any conclusion regarding

advantage of use of nonresorbable suture. Studies have shown some advantages to the use of slowly resorbable compared to rapidly resorbable suture, with significant reduction in wound dehiscence, suture sinus formation, postoperative pain and rate of hernia formation, when slowly resorbable suture were compared with rapidly resorbable sutures.[4]

It has been observed that continuous, running closure leads to even distribution of tension across the suture line with less resultant tissue strangulation and disruption of wound. But it has the disadvantage of its dependence on a single suture. Whereas interrupted technique reduces the risk of burst abdomen and wound dehiscence comparatively with the disadvantage of being time consuming to perform and of isolating the tension to each individual stitch.

The majority of the studies including meta-analysis and recent randomized trial comparing continuous and interrupted closure shows no significant difference in wound infection, dehiscence, suture sinus formation and rate of hernia formation.[5-8]

To summarize, an evidence based approach to laparotomy closure, which suggest the use of slowly resorbable suture in order to minimize the risk of post-operative wound complications. With PDS considering as a superior suture material compared to all other sutures[8,9], this study compares the post-operative wound complications in a patient undergoing elective mid-line laparotomy by comparing two techniques of mass abdominal fascia closure i.e., Continuous versus Interrupted technique using PDS.

OBJECTIVE

- Primary objective is to compare the efficiency of continuous versus interrupted abdominal fascia closure using PDS suture in terms of wound dehiscence.
- To adopt a better technique of closing abdominal fascia so as to prevent the surgical wound dehiscence and burst abdomen.

REVIEW OF LITREATURE

The impact of the planning, execution and closure of an incision on the outcome of an abdominal operation should never be underestimated. The high combined incidence of surgical site incision (SSI), wound dehiscence and hernia formation indicates a dominant contribution of wound complications to surgical morbidity. The incision should be well planned and should be executed in a fashion which anticipates a secure wound closure and interferes as little as possible with the function and cosmesis of abdominal wall.

Historical background

Owing to the fact that not many surgeons want their failures to be published, literature on wound failure in the past has been limited. But, literature on how to prevent wound failure is extensively available.

Incisions

Wound dehiscence, evisceration and incisional hernias have been associated with midline abdominal incisions in any age group. This has led to formulation and popularization of other abdominal approaches by various surgeons.

In 1951 Kraissl stated that elective incisions should be made on normal wrinkle lines if possible (wrinkle lines are lines of least tension in the body) [11]. But there are pragmatic reasons for making exceptions to this general rule e.g., where speed is an important essence in an emergency surgery or when access to a underlying lesion is critical than the most direct incision is applicable. Mid-line incision allows rapid access and adequate exposure of, almost every region of the abdominal cavity.

This is usually associated with little blood loss and does not requires transection of muscle fibers or nerves

Intraoperative measures

Over the period of time surgeons have taken measures to reduce intraoperative causes of wound dehiscence and failure.

Gloves

In 1858 - McBurney, Kern and Johnson each published reduction in their infection rates following use of rubber gloves which was introduced by Halsted. Paul Mikulicz is known to have changed gloves every two hours in long operations to keep infection rate low.[12] Today variety of surgical gloves are available in the markets, which are safe for both the patients and the surgeon.

Drains

Markoe (1885) described capillary drainage of wounds by Catgut strands under iodoform and dichloride gauze. Sands (1885) also employed rubber drains. But, Neuter opposed use of drains in clean wounds because “they act as foreign bodies and invite infection,” he mentioned in his study.[13]

Antibiotics

In 1939, use of sulphanilamide powder on surgical wounds was almost universal. It was sprinkled over the peritoneal cavity for peritonitis because it appeared to decrease morbidity. Today intravenous antibiotics have played their role well in reduction of wound sepsis and failure.[14]

Instruments

Retractors have also been designed to reduce tissue damage and skin ischemia. Introduction of Endotherm (diathermy) knife by Kelly (1926) reduced over clamping of tissue.[14]

Skin closure

Wound closure techniques have evolved with evolution of different closure materials which include:

a. Silk

b. Linen

c. Cotton

d. Bark fibers

e. Kangaroo tendons and animal intestinal strands.

f. Horse hair

g. Driver ant heads (current concepts of staples).

h. Wires made of precious metals.[14]

Disruption of abdominal wound was a major threat with mortality often in excess of 50% in early last century, which was addressed in a symposium by WC White in 1934, who recommend retention sutures of silk or preferably silver wire.[16] In 1912 Moynihan stated the qualities of ideal suture, which are listed below. He however did not mention anything to do with sizes.[18]

IDEAL SUTURE- Characteristics

- Monofilament.
- Can be used for any procedure.
- Easy to handle.
- Produce minimal tissue reactions.
- Have high tensile strength.
- Hold knots securely.
- Absorbable.
- Have predictable absorption pattern.
- Sterile

W E G Thomas[19] have revised the characteristics of an ideal suture and added that this suture material should also be-

- Non-electrolytic
- Non-allergenic
- Non-carcinogenic
- Inexpensive
- Pulls through tissues easily
- Should not shrink in tissues

Currently most manufacturers aim at making ideal sutures using the above standards. Varma S and colleagues compared abdominal wound closure by continuous or interrupted suture and recommended the former.[20] Abdominal wound disruption therefore occurs in varying rates and causes are multifactorial. Different western institutions have recorded different incidence, which shows minimal improvement in the first half of last century.

John Hopkins University:

From 1889 to 1923 it was 0.18%.

From 1923 to 1936 it was 0.86%.

In 1954 it was as high as 5.8 %.[14]

As at 1988 - Burst abdominal rates were recorded as follows

University of Missouri -1.1%.

Middlesex Hospital, London - 1.5 %.

St. Luke's Hospital, Cleveland- 2.5%.

University of Tennessee, USA- 9.36 %.[14]

SURGICAL SITE INFECTIONS (SSIs)

SSIs are the most commonly encountered Nosocomial infection in surgical practice, which has resulted in 7.3 additional inpatient days and adding burden over $3000 to the hospital charges.[15] The bacterial colony count at the surgical site makes a dominant contribution to the risk of development of wound infection; colony counts per gram of tissue of 10^5 or greater are associated with marked-increased risk. But, presence of any foreign body, may lead to infection at much lower bacterial count.

Factors affecting for the development of SSIs[15]

- ✓ Advanced age
- ✓ Obesity
- ✓ Diabetes Mellitus
- ✓ Smoking
- ✓ Malnutrition
- ✓ Altered Immune response
- ✓ Preoperative hospitalization

- ✓ Presence of infection at a remote body site
- ✓ Length of operation
- ✓ Use of surgical drains

CRITERIA FOR DEFINING SSI

SSIs are subdivided into two categories- INCISIONAL SSI

ORGAN/SPACE SSI

INCISIONAL SSI: Classified into Superficial and Deep Incisional

SUPERFICIAL INCISIONAL INFECTION	DEEP INCISIONAL INFECTION
Occurs within 30 days of surgery **and** involving only skin and subcutaneous tissue; **and** At least one of the following 1. Purulent discharge from the wound 2. Isolation of organisms from aseptically cultured fluid or tissue 3. At least one sign of infection: Pain or tenderness, localized swelling, redness and the incision is deliberately opened by the surgeon unless the incision is culture negative 4. Diagnosis of SSI by the surgeon or attending physician	Occurs within 30 days of surgery; or within 1 year of operation if implants are in place; **and** Infection involves deep soft tissue; **and** At least one of the following 1. Purulent discharge 2. Deep incision spontaneously dehiscences or is deliberately opened by a surgeon when the patient has at least one of the following symptoms: fever(38°C), localized pain or tenderness unless the site is culture negative 1. Evidence of deep infection on direct examination, during reoperation, or on radiological examinations 2. Diagnosis of SSI by the surgeon or attending physician

ORGAN/SPACE SSI
Infection which occurs within 30 days of surgery; or within 1 year of operation if implants are in place; **and** Infection involving any part of anatomy that was manipulated during an operation, other than the incision; **and** At least one of the following 1) Purulent drainage that is placed through a stab wound into the organ space 2) Organism isolated from and aseptically cultured fluid or tissue 3) Evidence of deep infection on the direct examination, during reoperation, or on radiological examinations 4) Diagnosis of SSI by the surgeon or attending physician

Wounds are classified by degree of contamination. Other risk scoring system have been developed to better anticipate the risk of wound infections.

1. **SENIC SYSTEM** (Study of the Efficacy of Nosocomial Infection Control)- Predicts risk associated with abdominal surgery, operations lasting longer than 2 hours, contaminated or dirty wound classifications and operation on the patients with three or more discharge diagnoses.[17]
2. **NNIS SYSTEM**(National Nosocomial Infection Surveillance)- Predicts risk associated with American Society of Anesthesiologists preoperative assessment scores of greater than 2, wound classifications of contaminated or dirty and increased duration surgery.[84]

CLASSIFICATION OF SURGICAL WOUNDS

TYPE OF WOUND	DEFINITION	RISK OF SSI
Class I: Clean	An uninfected operative wound in which there is no inflammation encountered and respiratory, alimentary, genital or uninfected urinary is not entered. They are primarily closed, and if necessary, drained with close drainage	1-5%
Class II: Clean-contaminated	An operative wound in which the respiratory, alimentary, genital, or urinary tracts are entered under controlled conditions and without unusual contamination. Particularly in surgeries involving the biliary tract, appendix, vagina and oropharynx are included in this category without any evidence of infection or a major break in technique is encountered.	2-9%
Class III: Contaminated	Open fresh accidental wounds. In addition, surgeries with major breaks in sterile techniques(e.g., open cardiac massage) or gross spillage from gastrointestinal tract, and incisions in which acute, non-purulent inflammation is encountered are included	3-13%
Class IV: Dirty-infected	Old traumatic wounds with retained devitalized tissue and those that involve existing clinical infection or perforated viscera	3-13%

CDC RECOMMENDATIONS TO PREVENT SURGICAL SITE INFECTION[85]

Preoperative Factors

Preparation of the patient:

1. Identify and treat all infections remote from the surgical site and postpone elective surgery until infection gets resolved.
2. Do not remove hair unless it interferes with surgery
3. If hair is to be removed, remove immediately preoperatively using clippers.
4. Ensure good blood glucose control in diabetic patients and avoid hyperglycemia.
5. Encourage cessation of tobacco use.(at least for 30 days before surgery, if possible)
6. Patient should shower or bathe with an antiseptic solution the night before surgery.
7. Should remove gross contamination from the surgical site before performing antiseptic skin preparation.
8. Should apply preoperative antiseptic solution for skin preparation in concentric circles moving outward toward the periphery.
9. Should keep the preoperative hospital stay as short as possible.

Hand/forearm antisepsis for surgical team:

1. Should keep nails short and do not wear artificial nails.
2. Perform a preoperative scrub for at least 2-5 minutes up to the elbows.
3. After performing the surgical scrub, keep the hands up and away from the body (elbows flexed) so that the water runs from the tips of fingers toward the elbows. Dry the hands with a sterile towel and wear a sterile gown and gloves.

4. Should clean underneath each fingernail.
5. Do not wear hand or arm jewelry.

Management of infected or colonized surgical personnel:

1. Education and encouragement of surgical personnel who is having signs and symptoms of a transmissible infectious illness to report promptly to their supervisor and occupational health personnel.
2. Develop well-defined policies concerning patient care responsibilities when personnel have potentially transmissible infectious conditions. These policies should be governed:
   I. Responsibility of personnel in using health services and reporting illness
   II. Clearance to resume work after an illness that required work restriction. The policies should also identify staff members that have the authority to remove personnel from duty.
3. Obtain appropriate cultures and exclude from duty surgical personnel who have draining skin lesions until infection has been ruled out, or until these personnel have received adequate therapy and infection has been resolved.
4. Do not routinely exclude surgical personnel who are colonized with organism such as Staphylococcus aureus or group A streptococci, unless they have been linked epidemiologically to dissemination of the organism.

ANTIBIOTIC PROPHYLAXIS

1. Administer a prophylactic antibiotic only when indicated, based on its efficacy against the most common pathogens causing SSI for a specific operation and according to guidelines with published recommendations.

2. Administer the initial dose of prophylactic antibiotic by IV route, timed such that bactericidal concentration of the drug should be established in the serum and tissue when the incision is made. Maintain therapeutic levels of the agent in the serum and tissues throughout the operation and for a few hours after the incision has been closed.
3. Before elective colorectal operations, mechanical preparation of the bowel by enemas and cathartic agents. Nonabsorbable oral antimicrobial in divided doses are indicated on the day before the operation.

INTRAOPERATIVE:

VENTILATION

1. Should maintain positive pressure ventilation in the operating room with respect to the corridors and the adjacent area.
2. Maintenance of minimum of 15 air changes per hour, out of which at least 3 should be fresh air.
3. Filter all air, recirculated and fresh, through the appropriate filters as per the American Institute of Architect's recommendations.
4. Introduce all air at the ceiling and exhaust air near the floor.
5. Do not use UV radiation in the operating room.
6. Keep the operating suite doors closed except as need for passage of equipment, personnel or patients.

Cleaning and disinfection of environmental surfaces:

1. When visible soiling or contamination of surfaces or equipment with blood or other body fluids occurs during an operation, use an Environmental Protection

Agency (EPA) approved hospital disinfection to clean the affected areas before the next operation.

2. Wet vacuum the operating floor with an EPA approved disinfectant after the last operation of the day or night.

Microbiological sampling

Do not perform routine environmental sampling of the operating room.

Sterilization of surgical instruments:

1. Sterilize all surgical instruments according to the published guidelines.
2. Perform flash sterilization only for patient care items that will be used immediately. Do not flash sterilize for reasons of convenience or save time.

Surgical attire and drapes:

1. Should wear a surgical mask that fully covers the mouth and nose when entering the operating room if an operation is about to begin or is underway, or if sterilized instruments are exposed. Wear the mask throughout the operation.
2. Should wear a cap or hood to fully cover hair on the head and face.
3. Wear sterile gloves if scrubbed as a surgical team member. Put on gloves after donning the sterile gown.
4. Use surgical gowns and drapes which are effective barriers when wet.
5. Change scrub suites that are visibly soiled, contaminated, and /or penetrated by blood or other potentially infectious material.

Asepsis and surgical technique:

1. Adhere to principles of asepsis while placing the intravascular devices, spinal or epidural anesthesia catheters, or when dispensing or administering IV drugs.
2. Assemble sterile equipment and solutions immediately prior to use.
3. Handle tissue gently, maintain effective hemostasis, minimize devitalized tissue and foreign bodies, and eradicate dead space at the surgical site.
4. Use delayed primary skin closure or leave an incision open if the surgeon considers the surgical site to be heavily contaminated.
5. If the drain is necessary, use closed suction drain and place it through a separate incision, away from the operating incision. Remove the drain as soon as possible.

POSTOPERATIVE INCISION CARE

1. Protect an incision that has been closed primarily with a sterile dressing with aseptic precautions for 24-48 hours postoperatively.
2. Wash the hands before and after changing the dressing and before and after any contact with surgical site.
3. Educate the patient and family regarding proper incision care, symptoms of SSI and need to report such symptoms.

SURVEILLANCE

1. Assign a surgical wound classification upon completion of an operation. A surgical team member should make the assignment of postoperative care.
2. Assign a surgical wound classification upon completion of an operation. A surgical team member should make this assignment.

3. Should periodically calculate operation-specific SSI rates stratified by variables shown to be associated with increased risk of SSI.
4. Should promptly report appropriately stratified-specific SSI rates to surgical team members. The optimum frequency and format of such rate computations will be determined by stratified case-load sizes and the objectives of local, continuous quality improvement initiatives.

MANAGEMENT OF SSIs:

- Common organisms responsible for SSI are Staphylococcus aureus and coagulase-negative staphylococci. After abdominal surgery, infection with enteric organisms- Escherichia coli and Enterobacter species is also prevalent
- Cefazolin or comparable first generation cephalosporin is the antibiotic of choice for upper gastrointestinal procedures. Metronidazole is added to this regimen for colorectal surgery.
- The administration of a mechanical and oral antibiotic bowel preparation has been recommended prior to colorectal surgery.
- Preoperative intravenous antibiotics should be administered 30-60 minutes before the incision is made to allow the agent to reach maximal tissue concentration.
- The antibiotic should be readministered after every two half-lives to maintain an effective serum concentration for long procedures.
- Treatment of incisional SSIs includes removal of skin stitches or staples to allow the drainage of any underlying collection.
- Antibiotics are indicated in presence of cellulitis.

  The effective use of antibiotics depends on

1. Appropriate coverage of the offending organisms
2. Maintenance of an adequate tissue concentration of the drug

- Cefazolin or equivalent first or second generation cephalosporin are indicated for uncomplicated SSIs. Wound cultures are obtained in the presence of purulent discharge and antibiotics are changed according to the sensitivity report.
- After draining the abscess, wounds are left open and allowed to close by secondary intention.
- Deep space SSIs require prompt drainage. This is achieved by percutaneous placement of a drain under ultrasound or CT guidance. Operative drainage is indicated if deep space infections are not amenable to percutaneous drainage.
- Broad-spectrum antibiotics are indicated until culture report is obtained at which point the spectrum should be narrowed to target the offending organism.

NECROTISING WOUND INFECTIONS

- Necrotizing soft tissue infections are heterogeneous group of clinical entities[21], but governed by fundamental concepts of treatment. Patients usually presents within 48 hours after surgery with complaint of pain at incision site followed by rapid onset of signs and symptoms of sepsis.
- Patients may also present with bulla or blebs, crepitus, cutaneous anesthesia and cellulitis which are refractory to the antibiotic therapy.[22] Tenderness that extends beyond the borders of the apparent cellulitis suggests progression of the infection to the deeper cutaneous layers and should raise suspicion for an early necrotizing process. But less than 40% of patients exhibit the classic symptoms and signs described and a high degree of suspicion has to be maintained in the postoperative patient with early signs of sepsis.[23,24]

- An elevated WBC count(15,400/mm^3) and hyponatremia(serum sodium level lower than 135 mmol/L) are sensitive markers for the presence of a necrotizing soft tissue infection; but , they are nonspecific.[25]
- Imaging studies- Plain X-ray and CT, may reveal the presence of soft tissue gas, though it is present in a minority of cases. The reported sensitivity of MRI for diagnosis of necrotizing soft tissue infection ranges from 89% to 100& and its specificity ranges from 46% to 86%.[26]
- Immediate surgical exploration and debridement is highly recommended in the suspected cases, which constitutes the mainstay single therapy. Clostridium Perfringens or group-A beta-hemolytic streptococci are the most frequently encountered organisms, but unfortunately necrotizing infections are polymicrobial.
- Debrided tissue sample should be sent for gram stain and culture. Initial therapy includes a broad spectrum of coverage (e.g., penicillin, clindamycin and an aminoglycoside).Wound should be reexamined frequently following initial debridement.
- Extension of the necrotizing process should prompt further debridement.

GAS GANGRENE

- It results from contamination with clostridia, typically from the alimentary tract or biliary system. Patients usually present with severe wound pain often associated with high degree fever and tachycardia. These wounds often appear edematous and erythematous, which later become dusky and necrotic.
- Wound crepitus and foul smelling watery discharge, so called “dishwater drainage”, are characteristics. Early surgical intervention with debridement of all infected and nonviable tissue is highly recommended in suspected cases.

- Hyperbaric oxygen is of considerable value in treating clostridial infection, with studies showing reduction in mortality rate from 66% to 23%.[27]
- Hyperbaric oxygen provides potential benefit with improved leukocyte function and increased tissue oxygen levels; it is bactericidal for C. perfringes and bacteriostatic for other anaerobic bacteria.

NECROTIZING FASCITIS

- Depending upon the implicated organisms encountered, this syndrome has been divided into two subcategories.
- Type I necrotizing fasciitis is a polymicrobial process; Type II necrotizing fasciitis is caused by group A streptococci.[28]
- Polymicrobial necrotizing infections are generally slowly progressive which affect the total thickness of the skin, without involving the deep fascia. Such infections are heralded by a nonspecific cellulitis around the wound which slowly extends over days. Later, the central area of the cellulitis becomes purple and then develops typical features of gangrene, which are referred to as Fournier's gangrene when they affect the perineum. The causative organisms are usually a mixture of anaerobes, gram-negative rods and enterococcus species. Broad-spectrum antibiotics should be initiated early and then tailored according to culture and sensitivity report.
- Necrotizing infections by group A streptococci are more rapidly progressive, which involves the subcutaneous fat, the superficial fascia and the deep fascia. The overlying skin will be intact in the early phase, but later they may be compromised following interruption of the deep blood supply. This condition should be clinically distinguished from gas gangrene by the absence of crepitus

and the muscle involvement. Early operative exploration is highly recommended in suspected cases. They are highly sensitive to penicillin, but the addition of clindamycin appears to have clinical benefit.[28]Treatment must include prompt early surgical exploration with debridement of the involved tissues.

SEROMA:

The significant clinical consequence of superficial seroma is rare even though it is exceedingly common. Most seromas can be observed; the rare large seroma that causes troubling symptoms like discomfort or is cosmetically unacceptable to the patient are usually managed with single aspiration, or serial aspirations. Refractory large seromas can be treated with percutaneous placement of a drain, which is maintained until the output is low (usually less than 30cc per day) or, rarely excision (i.e.,capsulectomy)

HEMATOMA:

Increased incidence of wound hematoma after abdominal surgery is attributed to the more liberal use of aspirin and heparins in the perioperative period, which ranges from 4-8%.[29] Small wound hematomas usually resolve without any intervention. Larger hematomas may lead to compromise the overlying skin or predispose to infection. These are usually treated by aspiration with single large-bore needle or evacuated by opening the wound. If overlying skin is under tension or ongoing extravasation of blood is noted, they are often better managed in operating room where active bleeding can be controlled, if encountered.

SUTURE SINUSES OR STITCH ABSCESS:

- They are more often seen at approximately on the 10th postoperative day, but may occur in earlier or weeks after the surgery.
- Superficial stitch abscess typically present with brown or mauve-colored circumscribed blisters in the line of the incision. The associated pain can be relieved by incising the overlying skin, evacuating the contents and by excising the residual suture material.
- Deep stitch abscess typically present with an indurated mass.
- Studies have shown that use of nonabsorbable suture such as polypropylene, has been associated with an increased incidence of deep stitch abscess when compared to closure with a slowly absorbing suture such as polydioxanone.[30]

WOUND DEHISCENCE AND EVISCERATION:

- Separation of abdominal wounds (i.e., dehiscence) with or without protrusion of intraabdominal contents (i.e., evisceration) has led to considerable morbidity and mortality. Contemporary series estimate an incidence between 1% and 3%. Mortality associated with dehiscence has been estimated at 16%. The mean time to wound dehiscence is 8-10 days after operation.[31]
- Classically dehiscence is heralded by a sudden rush of pink serosanguinous discharge from the wound. Sometimes, the acute evolution of a large subcutaneous hematoma or tympanic swelling that distends the wound reflecting herniation of bowel loops through the abdominal fascia is noted.[32]
- The literature on abdominal closure appears to favor a running mass closure with slowly resorbable or nonresorbable suture, based on the technical considerations. A variety of patient-associated risk factors for wound dehiscence

include- advanced age(>65 years), hypoalbuminemia, wound infection, ascites, obesity, steroid use, COPD, pneumonia, cerebrovascular accident with residual deficit, anemia(i.e., hematocrit <30), prolonged ileus, coughing, emergency operation and operative time greater than 2.5 hours.[31]

- Local and mechanical factors appear to be more important in wound dehiscence than systemic factors. Bringing a drain or stoma through the wound will obviously compromise the closure and contaminate the wound. Wound infection has been frequently implicated as a contributing factor to wound dehiscence and the development of incisional hernia. Smith and Enquist[33] found that a standardized staphylococcal wound infection produced significantly weaker fascial wound than the controls. Wound dehiscence is associated with causes of increased intraabdominal pressure to include abdominal complications (vomiting, ileus, or obstruction), pulmonary problems (atelectasis, bronchitis, or pneumonia), or the nature of the operation (repair of diaphragmatic hernia).[34]

In another study by, Tera and Alberg,[35] who measured the holding power of sutures in human musculo-aponeurotic incisions. The results of their landmark investigation in investigating wound dehiscence provided an ultimate scientific basis for the selection of suture placement and the type of laparotomy incisions. After evaluating a variety of laparotomy incisions (linea alba incision, transverse incision through linea alba, McBurney's incision, pararectal incision, paramedian incision), they reported that the strongest closure was obtained in midline incisions through the linea alba.

With the use of non-absorbable and synthetic absorbable sutures, wound disruptions are caused by the fascia tearing at the site of the suture. Most experimental studies demonstrated that placing the suture farther from the cut edges

of the fascia reduced the risk of wound disruption. Sanders and colleagues[36] reported that placing the suture 5 mm from the cut edges of the fascia resulted in a higher wound bursting strength than 1 to 2 cm from the fascial edges.

Whipple and Elliott[38] who advocated that tying sutures too tightly leads to strangulation of the tissue with ischemic necrosis which was the most common error in abdominal wound closure. The studies by Haxton[39] and Sanders and associates[36] also advocated the same. These investigators reported that tight tying of interrupted sutures resulted in a lower wound strength than sutures tied when the wound edges were approximated. The selection of a wound closure technique must also be taken into the account of the dynamic changes in wound length during distention.[40] Measurements of the abdominal girth and xiphoid pubic distance before and after closure demonstrate that abdominal distention may lengthen the wound by 30%. When the stitch interval is 1 cm, it will become 1.33 cm when the wound is lengthened by 30% during abdominal distention. The continuous suture can accommodate this increase in the length of the incision by having an adequate reserve of suture length in the wound. Consequently, the continuous suture distributes its tension throughout the wound, limiting the forces on the tissues encircled by the suture. With interrupted closure, the suture cannot easily accommodate these changes in incisional length, and the tension remains isolated to each suture loop.

WOUND HEALING AND THE CHOICE OF SUTURE:

The search for the ideal suture material still continues for closure of an abdominal incision. Moynihan[18] stated in 1920 that ‘suture material should ideally achieve its purpose - be sufficient to hold parts together close a vessel, disappear as

soon as its work is accomplished, should be free from infection, and nonirritant...'. However these requisites were indeed right and still remain valid nowadays. But, Moynihan concluded: 'The only material which can be made to fulfill these conditions is catgut.' But, catgut is rapidly absorbed, challenging the first idea in Moynihan's definition. This illustrates the fact that the perfect suture material does not exist, since each era has had its own 'ideal' suture material. Despite detailed mechanical analyses[41] of suture materials in vitro and similarly comprehensive in vivo comparisons[42] of tissue reactivity of various sutures in the human, the choice of suture material is still predominantly a matter of personal preference, with considerable reliance on tradition and experience of the surgeon.

Wounds in the first few days of healing have little intrinsic strength: indeed, tissue strength is lost within 0.5 cm of the wound edges due to the action of collagenases. Adequate support of the wound with sutures placed beyond this area of tissue reaction is essential during postoperative period.[43] Gradually, the tensile strength of the healing tissue increases with the time and suture support becomes less important. Different tissues heal at different rates, but even a year or more after surgery most wounds will only have about 70% of tensile strength of the unwounded tissue.[38] In addition, several factors can delay the healing process; such as, infection, hematoma, use of corticosteroids and co-existing disease causing immune incompetence, malnourishment and cachexia. Tissues exposed to the disrupting forces during healing process, or which heal slowly, require prolonged support and usually require suturing with non-absorbable suture material (e.g. abdominal wall closure).

Successful wound healing mainly depends on an appropriate strength provided by the suture materials and a microenvironment in which the repaired tissues are likely to heal. Choices of suture materials include an absorbable versus non-absorbable material, monofilament versus multifilament. Non-absorbable sutures can retain their tensile strength for 1 year or longer, whereas the half-lives of tensile strength for absorbable sutures vary from one to several weeks. Although non-absorbable sutures which maintain the persistent tension may facilitate wound healing,[44] these sutures predispose to suture sinus, pain or a buttonhole hernia.[45] In addition sutures kept in trauma sites can induce a significant immune response. It seems absorbable sutures appear to be more promising if they retain their tension for a period sufficiently long for adequate wound repair. Furthermore, braided multifilament suture has a high incidence of wound infection and sinus formation compared to that of monofilament sutures.[46,47] But a single stranded suture used in a continuous suturing has its limitation of relying on the integrity of a single line for the wound closure. Whereas Monofilament sutures have no interstices to lodge the bacteria but they are more difficult to handle and require more throws to each knot for security than braided sutures. Monofilament sutures can be absorbable (e.g., Polydioxanone) or non-absorbable (e.g., polypropylene). Multifilament sutures are generally easier to handle, with comparatively greater knot security, but do allow colonization interstitial bacteria, [34] which can increase the risk of wound infection, particularly with non-absorbable sutures. Multifilament sutures can be absorbable (e.g., polyglactin) or non-absorbable (e.g., silk).

Sutures are foreign bodies and even though modern synthetic monofilament sutures are almost completely inert, braided. Natural sutures can provoke a significant inflammatory response. But once colonization of the suture or knot has

occurred, it is difficult to eradicate, which can predispose to the wound infection, with suture sinus, abscess formation, wound dehiscence and incisional hernias. Sutures should be avoided or used with caution in the presence of established infection or severe contamination, when healing by secondary intention, or delayed primary suture, should be employed[47]. In practice, much larger sutures are usually used than are strictlyneeded, in relation to the breaking strength of the tissues.[48] While most cases of 'burst abdomen' are probably due to cutting out of intact sutures, premature suture failure can be responsible for late wound weakness and herniation.[49] Sutures are sterilized by manufacturers using ethylene oxide or gamma irradiation (catgut, silk, Nylon).

A study conducted by Rucinski et.al.,[50] on the outcome variables of dehiscence, infection, hernia formation, suture sinus formation, and pain were studied in 11856 patients. The probability of their occurrence of wound dehiscence in association with different techniques were calculated. The study concluded that the use of absorbable suture decreased the incidence of incision pain by 50 %(p value-0.001) and suture sinus by 48% (p value-0.002). Absorbable monofilament suture material is superior to both absorbable braided and nonabsorbable suture for the abdominal fascial closure.

Non-absorbable sutures are favored by many surgeons because of the continued support provided to the wound during and after fascial healing. Braided organic materials, such as silk and cotton, are not favoured for closure of an abdominal wound because of the intense inflammatory response they elicit and because of the propensity for bacteria to grow in the interstices of the suture,[49] resulting in an increased incidence of wound infection and delayed formation of suture sinuses. Use of monofilament material avoids these problems. Nylon and

polypropylene are reasonably inert in tissue and do not harbor bacteria. They tend to slip and multiple throws must be placed; this may result in a persistent palpable knot, particularly in an asthenic patient. Another reported drawback of non-absorbable suture material is the incidence of 'buttonhole' incisional hernia formation.[51]This appears to be a late complication which is thought to be due to the cheese wire effect of the permanent suture material against the rectus sheath at the site of stitch penetration leading to multiple small incisional hernias.

Absorbable sutures offer the potential for removing foreign bodies from the wound by dissolution. Catgut, the collagen material made from animal intestines, is a complex material of non-uniform composition with many faults, including unpredictable absorption that is adversely affected by local tissue reaction and by the presence of bacteria. In a controlled clinical trial, Goligher et.al.,[52] demonstrated conclusively that layered closure with chromic catgut alone resulted in an unacceptably high incidence of wound disruption in the early postoperative period because of its absorptive characteristics.

Another meta-analysis by Hodgson et.al.,[53] concluded that the incidence of incisional hernias was reduced by 32%,when a nonabsorbable material was used regardless of incision type. All randomized clinical trials (total 32 in number) from 1966 to 1998 comparing at least two different suture materials or techniques for abdominal fascial closure were included. The OR of wound infection in the non-absorbable group versus the absorbable group was 0.90 and the OR of wound dehiscence was 1.25. Neither was statistically significant. Suture sinuses and wound pain were significantly more frequent in the non-absorbable group (OR 2.18 and 2.05 respectively).

The above finding is in broad agreement with a previous meta-analysis by Weiland et.al.,[54] where the authors concluded that continuous closure with a non-absorbable suture should be used to close most abdominal wounds. A total of 12,247 patients included in 25 studies from 1977 to 1997 were analyzed. Comparisons of continuous absorbable and non-absorbable suture showed that hernia formation was highly significant (p value-0.0007) if absorbable suture was utilized. Nonabsorbable sutures produced dehiscence at highly significant rates (p value-0.01), and infections approached significance (p value-0.08)

There have been many randomized trials comparing the relative merits and demerits between non-absorbable and absorbable sutures, but with conflicting results. Murray and Blaisdell[55] closed 650 consecutive abdominal and thoracic wounds with absorbable synthetic sutures with only one instance of dehiscence and a rate of infection of less than 1%. In a prospective randomized study conducted by Hsiao et.al., [56] comparing early absorbable (Polygalactin) and delayed absorbable suture materials (Polydioxaflone) found more incisional hernia development for polygalactin 910 sutures with marginal significance in malignant patients(4.7 % vs 0%) than in nonmalignant group(2.6% vs. 4.2%).

A study by Vant Riet et.al.,[57] considered the tensile strength of the sutures. They divided the materials of closing in 3 groups. Nonabsorbable, absorbable of average duration and delayed absorbable sutures. In this work 15 prospective studies were included in 1 year. The results shows that the delayed absorbable sutures have effectiveness similar to the nonabsorbable sutures i.e., superior to the absorbable one in terms of incidence of incisional hernia. With respect to strength of the wound, delayed absorbable sutures showed less complications than the non-absorbable one

(smaller incidence of sinus and wound pain). The study concluded that the absorbable suture of the long duration is the ideal material for general closing.

In a meta-analysis conducted by Rucinski et.al.,[58] the outcome variables of dehiscence, infection, hernia formation, suture sinus formation and pain were studied in 11,856 patients from 15 studies during 1980 to 1998 were analyzed. The probability of their occurrence in association with different techniques was calculated. In relation to the outcome features of dehiscence and infection no statistically significant difference was seen when absorbable suture material was compared with non-absorbable material. The use of absorbable braided suture increased the chances of developing incisional hernia by 93%. However the use of absorbable monofilament technique did not seem to increase the risk of hernia formation relative to the use of non-absorbable suture material. In general the use of absorbable suture decreased the incidence of pain at incision site by 50% (p value-0.001) and suture sinus by 48% (p value-0.002). Absorbable monofilament suture material is superior to both absorbable braided and non-absorbable suture for abdominal fascial closure.

NONABSORBABLE AND DELAYED ABSORBABLE SUTURE:

Polydioxanone (PDS) is the first delayed absorbable synthetic monofilament suture that was introduced for clinical use and is suitable for closure of an abdominal wound.[59] It has unique absorption features- 41 % of its tensile strength remains at six weeks, with a considerable improvement over polyglycolic acid and polygalactin.[60] Due to its monofilament nature, no bacterial impregnation is possible. Many surgeons believe that the absorbable braided synthetic sutures tend to drag through the tissues with repeated passage unlike with the monofilament PDS. PDS theoretically represent a superior absorbable suture material for closure of abdominal wounds.

Hodgson et.al., also demonstrated that PDS, unlike all other absorbable, sutures, did not have an increased risk of incisional hernia.[61] PDS is a slowly absorbable monofilament suture which retains its tensile strength for up to six weeks post-operatively. In addition to having a low incisional hernia rate comparable to non-absorbable sutures. PDS is associated with less chronic wound pain, suture sinuses and low incisional hernia rates compared with non-absorbable counterparts.[62,63,64]

In a prospective, randomized, multicenter study conducted by Fernando Docobo-Durantez et.al.,[64] in Spain from May 2003 to March 2005, comparing slow absorbable (PDS) and non-absorbable (nylon) in abdominal wall closure no statistically significant difference was found,770 patients were included with a follow-up period of 1.5 years. Study concluded that closing of abdominal wall with a slow absorbable suture in continuous manner, displays a similar incidence of incisional evisceration and hernia, and a greater biocompatibility than non-absorbable suture.

In 2005, a meta-analysis carried out by Ceydeli et.al.,[65] reviewing all articles from 1966 to 2003 on abdominal wall closure, showed no statistically significant differences in incidence of incisional hernia formation, wound dehiscence or infection between slowly absorbable (PDS) and nonabsorbable suture materials. In contrast to prospective studies as well as metaanalysis, non-absorbable suture materials have been associated with statistically higher rates of incision pain and suture sinus formation.[66]

MANAGEMENT

- Mainstay of treatment for disrupted wound is reclosure of the wound; particularly when dehiscence occurs in the postoperative period.
- If evisceration is present, the wound and protruding viscera should be bathed with warm normal saline solution and covered with a large sterile dressing before shifting the patient to operating room. In the operation theatre, the prolapsed bowel is replaced below the level of fascial edges. Necrotic wound edges are debrided after removing the residual suture material. Reclosure of the fascia is done using a monofilament nonabsorbable suture such as polypropylene.
- Although some surgeons advocate interrupted closure of fascia following dehiscence, two retrospective analyses have failed to demonstrate a reduction in the incidence of late lateral ventral hernia formation with this technique compared to a running closure.[32]
- Retrospective analyses have failed to demonstrate any benefit regarding retention suture placement, although a significant reduction in recurrent evisceration is frequently invoked. But many patients complaints of discomfort with retention

sutures.[67] Placement of resorbable mesh as an underlay may serve to reinforce the abdominal closure.

- Non-operative management is appropriate on the occasion, if the dehiscence is small, the patient is critically ill, or there is no evisceration. In these cases, the wound is packed with a moist sterile dressing. An abdominal binder can be used for further support. The dressing should be changed at regular intervals until the wound fills with granulation tissue. Delayed closure of skin is advocated in some cases at this stage. Alternatively, the use of a VAC dressing has been described in this setting.

INCISIONAL HERNIA

- It is due to failure of fascial tissues to heal and close following laparotomy, with highest incidence seen in midline and transverse incisions.[68] As the approximated fascial tissue separates, the bowel and omentum herniate through the opening, covered by peritoneal sac. These hernias can increase in size to enormous proportions, and giant ventral hernias can contain a significant amount of small or large bowel.
- Rates of incisional hernia range from 2% to 11%.[69] Longer-term data indicate that at least one-third of these hernias will present 5-10 years postoperatively.
- Risk factors for development of Incisional hernia

✓ Patient factors- Advanced age, malnutrition, presence of ascites, corticosteroid use, diabetes mellitus, cigarette smoking and obesity.

✓ Emergency surgery is known to increase the risk of incisional hernia.

✓ Wound infection is the most significant prognostic factor for development of incisional hernia.

- ✓ Postoperative sepsis
- ✓ Technical aspects-

Wound closed under excessive are more prone to fascial closure disturbance. Many authors advocate continuous closure to disperse the tension evenly throughout the length of the wound. Here 1 cm bites of fascia on either side of the incision are taken with each pass of the suture and the suture is advanced 1 cm at a time along the length of the incision

CLINICAL MANIFESTATIONS

- Patient will complain of a bulge in the abdominal wall originating deep to the skin scar. Symptoms get aggravated by coughing or straining as the hernia contents protrude through the defect. In case of large ventral hernias, the overlying skin may present with ischemic necrosis leading to frank ulceration. Some presents with incarcerated incisional hernia causing bowel obstruction, which is associated with a history of repeated mild attacks of colicky dull abdominal pain and nausea consistent with incomplete bowel obstruction.
- TREATMANT- Includes operative repair

Three general classes of operative repair have emerged in the modern era of surgical practice. These include

I. Primary suture repair of hernia
II. Open repair of the hernia with prosthetic mesh
III. Laparoscopic incisional hernia repair

CLOSURE OF ABDOMEN

Earlier most techniques of incisional closure had used interrupted sutures, but from 1970 onwards several surgeons started continuous suturing as an alternative method to close abdominal fascia. The continuous suture has an advantage of offering evenly distributed tension across the suture line and being more expedient: it has the disadvantage of being a single suture line holding the fascia together. The multiple interrupted suture method has been used successfully for many years, but has the disadvantages of being time consuming to perform and of isolating the tension to each individual stitch.

Continuous suturing of laparotomy incisions was described by Everett[70] who stated that the results were “excellent” in a large but uncontrolled clinical trial. In an experimental study by Rodeheaver et.al.,[71] measured the dehiscence volume and pressure association with different kinds of suture techniques and showed that abdomens burst at a constant reproducible intra-abdominal pressure. This was independent of the kind of suture material and surgical technique as long as the same suture diameter was used. Continuous suturing stood up to more intraabdominal volume before breaking than interrupted sutures. This is important when considering that the intra-abdominal volume of patients after laparotomy increases. The continuous suture provided the greatest wound security in terms of minimal dehiscence volume. No difference in bursting pressure was found.

In a meta-analysis in 2005 by Fagniez et.al.[72] revealed no statistical significant difference regarding the incidence of dehiscence or hernia formation when both the techniques were compared. Proponents of continuous closure argued an even distribution of tension throughout the length of the incision and a more cost-effective

closure requiring half as much time and less suture material as definite advantages of continuous mass closure. It has also been shown experimentally that the bursting strength of a wound is significantly higher when a continuous closure is used by surgeons. Use of continuous closure minimizes the number of knots and has been associated with an equivalent or lower incisional hernia rate in this study. But the only theoretical disadvantage of continuous closure is that the security of the wound is dependent on a single strand of suture material and a limited number of knots. Disruption of the knot or the suture, however, has shown to be a rare cause of wound dehiscence.

In a study by Richards et.al.,[73] which included 571 laparotomy cases, shows no significant statistical difference in the rates of wound dehiscence and incisional hernia in comparing these two different techniques. He observed that an abdominal incision can be closed with continuous suture in approximately half the time for placing interrupted sutures (20 vs. 40 minutes). Gislason et.al.,[74] also confirmed these findings who found no significant difference in incisional hernia formation, when comparing continuous with interrupted closure and found that the former to be significantly quicker.

In 1998, Weiland et.al.,[54] reviewed the reliable published literature of techniques of abdominal wound closure in English between 1977 and 1997 which included 25 comparative articles, out of which 23 were randomized controlled studies. A total of 12,247 patients from nine countries were analyzed in this meta-analysis. But comparison of continuous and interrupted sutures failed to show any statistical significance among these two techniques. In analyzing dehiscence, he is not able to draw any conclusion, since the populations which were compared here are

disproportionate, creating a type I error, which lead to major drawback in this study. The infection rate was found to be significantly different in all types of comparisons.

The authors came to a conclusion that the suture material should be selected based solely on the rates of incisional hernia formation i.e., when continuous chosen, non-absorbable sutures are used, if interrupted technique is chosen, absorbable sutures should be appropriate. However, although the authors in their meta-analysis, used the Stouffer method the standard deviation Z score, with a special attention to type II errors, the drawn conclusions are difficult to generalize and was not statistically significant.

In 2000, Hodgson et.al.,[53] reviewed all the randomized controlled trials between 1966 and 1998, excluding those comparing 2 sutures of the same category and with the same technique. Strict methodological barriers for inclusion were adopted for the study. Incisional hernias were 32% less frequent with non-absorbable sutures as compared with absorbable sutures. Although the infection rates were not significantly different, non-absorbable sutures were associated with an increased rate of suture sinuses and pain at operated site. The running type of suturing was associated with significantly lower rates of incisional hernia. The authors recommended the use of running non-absorbable sutures as the standard modality of wound closure.

Thus the authors came to conclusion that a continuous suture equalizes tension difference between individual stitches and distributes the tension evenly across the suture line more evenly than an interrupted closure, which is said to minimize the risk of “tissue strangulation” and late “cut through” due to sub optimally placed sutures. But it is certainly true that it has the advantages in terms of ease and expediency of

closure and in terms of cost benefit as less suture material is required. The same fact has been advocated in all the recent meta-analysis.[54]

Authors who supports interrupted technique argues that continuous closure leaves more foreign material in the wound and breakage of the thread automatically jeopardizes the closure of the entire wound. Trimbos and van Rooij[75], however showed in a laboratory study that the same spacing and distance from the wound edge, continuous suturing takes less suture material than the interrupted suturing. Furthermore, necrosis caused by ischemia is reduced because the continuous suture can be considered as a continuous spiral that itself is able to adjust to postoperative strains in the wound and evenly distributes any increased tension over the entire wound.

Closure of laparotomy incisions with a continuous suture has the additional advantage that only two knots are necessary to secure the wound, which is the weakest part of the suture. In addition, each knot is an accumulation of suture material in the wound, increasing the risk of wound infection. Furthermore, a continuous suture minimizes the number of knots, thus reducing the risk of knot slippage. Authors have argued that it is more difficult to concentrate maximally when tying 20 or more interrupted sutures than when tying one important knot.

In a Indian clinical trial by Srivastava et.al.,[76] in 2004, prevention of burst abdomen was tested by a new technique interrupted X-suture and compared with the conventional continuous closure. The study consists of 100 patients undergoing emergency laparotomy and 110 undergoing elective laparotomy. Burst abdomen occurred in 1/46 (2.17%) in the interrupted group and in 8/54 (14.8%) in the continuous group undergoing emergency laparotomy whereas 2/52 in interrupted

group and 0/56 in continuous group suffered burst in elective settings. The relative risk for burst with peritonitis as exposure was 1.86. It is concluded that the risk of burst was less with interrupted X-suture than with continuous method.

SUTURE LENGTH TO WOUND LENGTH RATIO-

Suture length-to-wound length ratio, (SL: WL) is thought to be important factor in the prevention of formation incisional hernia. Jenkins[77] was the first to define an ideal ratio on the basis of both clinical trials and a mathematical model. He recommended that for safe closure of laparotomy wounds a SL: WL ratio of at least 4:1 is necessary. It is obvious that the size of the tissue bite and the diameter of the suture bear an inverse relationship to the distribution of tension at the tissue-suture interface. i.e., large tissue bites taken with a thick suture have fewer tendencies to cut through tissues. But, Jenkin's mathematical model has been challenged by Varshney et.al.,[78] who proposed that an ideal SL:WL ratio should approach 6:1.They argued that Jenkins original model failed to take into account the three dimensional nature of the wound and approximately 6 cms of suture material is required per stitch when taking 1 cm by 1 cm bites. Leaper and colleagues[37] recorded the suture holding strength of abdominal wall structures in cadavers and noted that the holding strength of sutures placed 1 cm from the fascial edge was 7.16 kg compared with 3.93 kg for sutures placed 0.5 cm from the wound edge.

When the sutures were placed laterally to the transition between the linea alba and rectus sheath, the paramedian incision was found to give the weakest closure, followed by the only slightly stronger Para rectal incision. The optimal depth of the suture bite in the linea alba had to be at least 4 mm. The ideal interval between sutures

approached 6 mm. Most surgeons who use midline incision closure advocate placing the suture at least 1 cm from the divided edge of the fascia, a distance that would be beyond this transition zone.

In a large prospective trial by Israelsson and Jonsson[79] who performed numerous clinical and experimental studies on SL: WL ratio, they found that SL: WL ratio was an independent predictor for the development of an incisional hernia. The rate of incisional hernia could be reduced from 21 % to 9% when a ratio of greater than 4:1 was achieved and independent type of suture material used. Study also showed showed a decrease in incisional hernia formation at one-year period from 19% to 11 % when surgeons were presented with their own poor results and then made a conscious effort to achieve a suture to wound length ratio of 4:1 or more, in a series of 86 laparotomies.[80] They also concluded that many surgeons are unaware of the importance of SL:WL ratio and not all cultivated an ideal technique.

PRIMARY VERSUS DELAYED PRIMARY CLOSURE-

Primary Closure (PC) and Delayed Primary Closure (DPC) are two commonly employed methods, but there is no consensus in the literature regarding the optimal method.

In a prospective randomized trial comparing the two wound strategies for dirty abdominal wounds (PC and DPC) on 51 patients between Jan and July 1999, the wound infection rate in patients in PC group was found to be 48% as compared to 12% in DPC group. The study concluded that a strategy of DPC of dirty abdominal wounds when clinically appropriate appears to decrease the rate of wound infection

when compared with PC without increasing hospital charges or the length of stay.[81] In a study conducted in Indian set up from July 1998 to December 2000[82], which included 235 patients undergoing emergency laparotomy were included. Wound infection rate in DPC was 5.53% compared to 39% for primary closure. The overall complication rate was 20% with mortality rate of 1.7%. Overall hospital stay, morbidity profile, patient satisfaction were comparable to that of primary closure. The

METHODOLOGY

The present study was undertaken in the Department of General Surgery, KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi from period January 2017 to December 2018.

Study Design

The study is a one year randomized control study.

Study period and duration

One year- January 2017 to December 2017

Source of Data

Patients admitted to KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi undergoing elective mid-line laparotomy from January 2017 to December 2017 were studied.

Sample size

A total of 60 patients undergoing elective mid-line laparotomy were selected for the study.

Sampling procedure

The sample size was calculated based on the formula mentioned below

$$N = \frac{2(Z_{\ } + Z_{\ })\ p\ q}{(P_1 - P_2)^2}$$

P_1 reference value for group 1

P_2 reference value for group 2

$$P = \frac{P_1 + P_2}{2}$$

q = 100-P

Sampling method

Patients fulfilling the inclusion criteria were enrolled considering simple random sampling.

Selection Criteria

Inclusion Criteria

- All patients undergoing elective mid-line laparotomy aged more than 18 years.

Exclusion criteria

- Cases of Primary Peritonitis, Ileostomy and Colostomy
- Pre - existing co-morbid conditions like severe renal and liver disease, Severe anemia, Uncontrolled Diabetes, Hypoalbuminemia.
- Patients on Chemotherapy
- Patients who had previous laparotomies through mid-line incision.

Ethical clearance

Prior to the commencement, the study was approved by the Institutional Ethics Committee of Jawaharlal Nehru Medical College, Belagavi.

Informed consent

Patients admitted in the Department of General Surgery, KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi from period January 2017 to December 2018 and planned for elective mid-line laparotomy were evaluated based on the selection criteria. Those who fulfilled the selection criteria were briefed about the nature of the study and a written & informed consent was obtained (Annexure- 1)

Data collection

Demographic data like gender and sex were collected and the patients were interviewed for the relevant history such as diabetes mellitus, hypertension and other co-morbidities. A thorough general physical examination was conducted to assess vital parameters followed by systemic examination.

Investigations

Under strict aseptic precautions blood samples were drawn and subjected to following investigations

Complete blood count

Renal Function Test

Liver Function Test

Coagulation Profile

Urine examination- Routine and microscopy

HIV, HBsAg

Other imaging modalities as per the requirement of the patient

Design of Study

Patients were be allotted to group A and group B by using Closed envelop method.

- ***Group A-*** Abdominal fascia closed with continuous technique with PDS.
- ***Group B-*** Abdominal fascia closed with interrupted technique with PDS.
- Post-operatively wound was examined on POD-03 and followed up at 1 week, 3 week, 6 week, 3 months and once in a month for a period of 6 months after

surgery on OPD basis particularly to look for any suture sinus formation, surgical site infection, wound dehiscence or incisional hernia.

- Necessary intervention such as regular dressing done in post-operative period regularly.
- Secondary suturing done in cases of wound Gaping.
- Few patients with wound gaping were let for wound healing by secondary intention.

Statistical Analysis

The data thus obtained was tabulated on Microsoft excel spreadsheet. The categorical data was expressed as ratios and percentages. Chi-square test was used to assess the association. Continuous data was expressed as mean ± standard deviation (SD) and then the comparison was done using independent sample 't' test. A probability value ('p' value) of less than or equal to 0.050 was considered to be statistically significant.

RESULTS

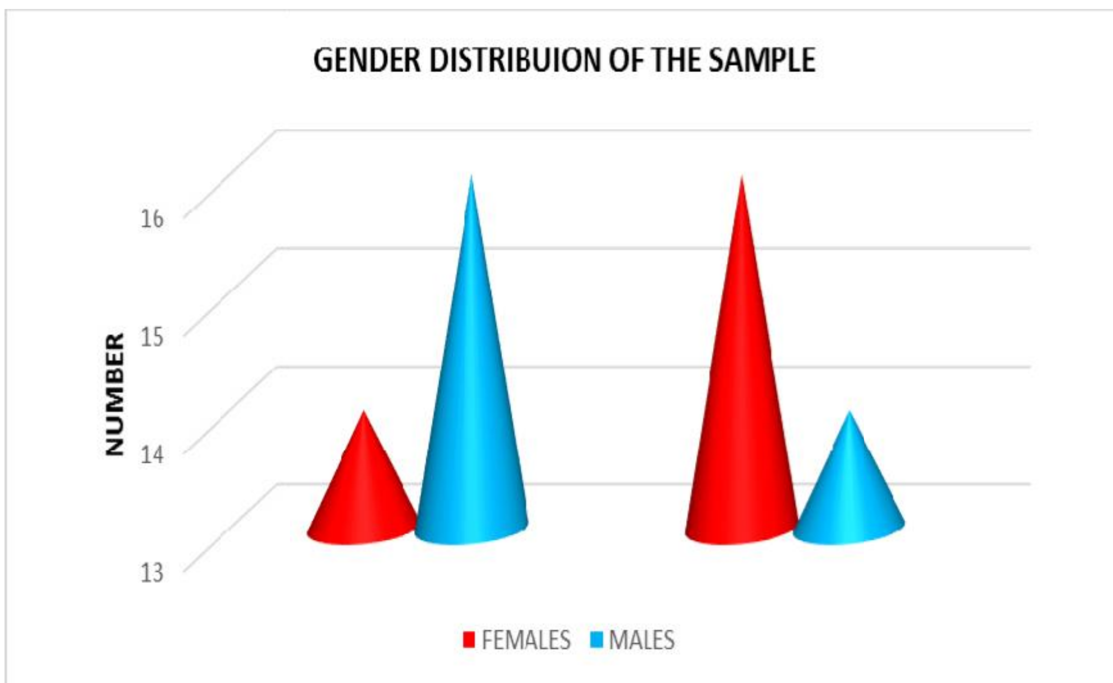
This one year randomized control study was conducted in the Department of General Surgery, KLES Dr. Prabhakar Kore Hospital, Belagavi. A total of 60 patients who were planned for elective mid-line laparotomy were included in the study. The data obtained was tabulated, final observations and results were tabulated as below.

Table 1. Demographic Data

SEX	GROUP A	PERCENTAGE	GROUP B	PERCENTAGE	TOTAL
FEMALES	14	46.67	16	53.33	30
MALES	16	53.33	14	46.67	30
TOTAL	30	100.00	30	100.00	60

	GROUP A				GROUP B					
VARIABLES	MEAN	SD	MIN	MAX	MEAN	SD	MIN	MAX	p VALUE	INFERENCE
AGE	52.3	15.96	20	80	49.67	15.36	19	72	0.5175	NS

The above table depicts the age and sex distribution among both the groups. In the present study, there is no statistically significant difference seen in distribution of population among both the groups. Mean age in group A is 52.3 years and in group B is 49.67 years, with p value of 0.5175, which is statistically not significant(NS).


GENDER DISTRIBUION OF THE SAMPLE
NUMBER
16
15
14
13
FEMALES
MALES

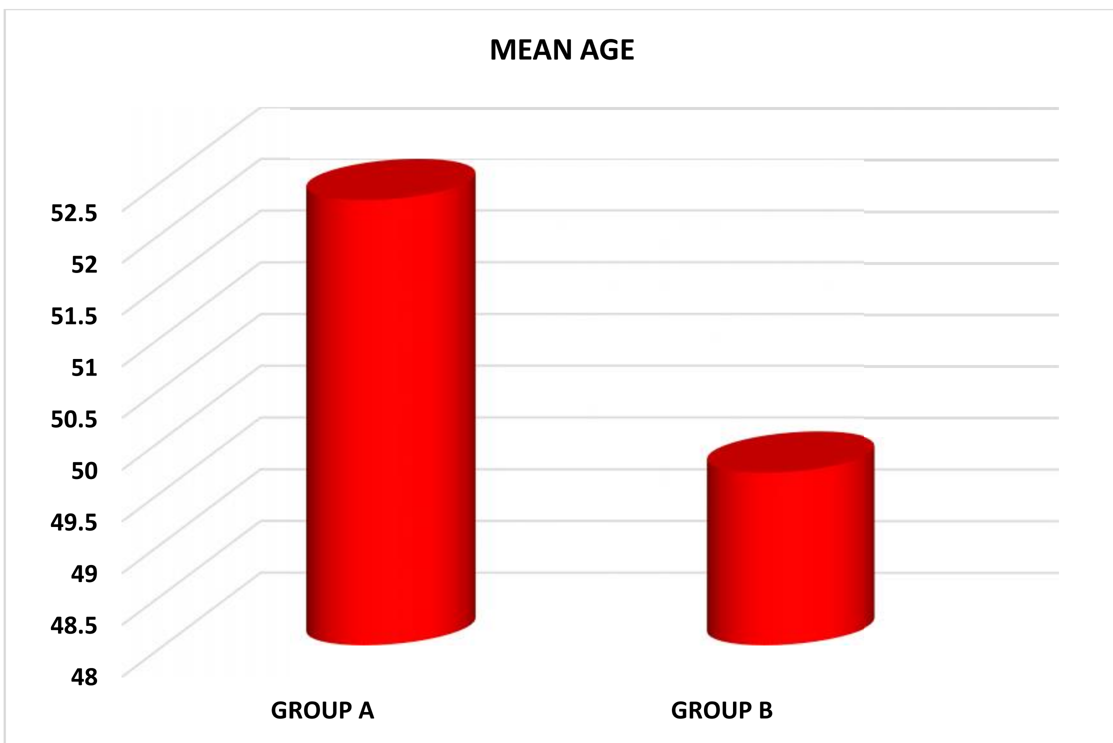

MEAN AGE
52.5
52
51.5
51
50.5
50
49.5
49
48.5
48
GROUP A
GROUP B

Table 2. BMI

	GROUP A				GROUP B					
	MEAN	S.D.	MIN	MAX	MEAN	S.D.	MIN	MAX	p VALUE	INFERENCE
BMI	21.88	1.85	18.2	26.5	22.88	2.20	19.3	27	0.0622	NS

The above table depicts the comparison of BMI among the individuals of both the groups. The mean BMI levels in group A is 21.88 Kg/m^2 and in group B is 22.88 Kg/m^2. Chi-square test performed shows p value- 0.00622, which is statistically not significant (NS).

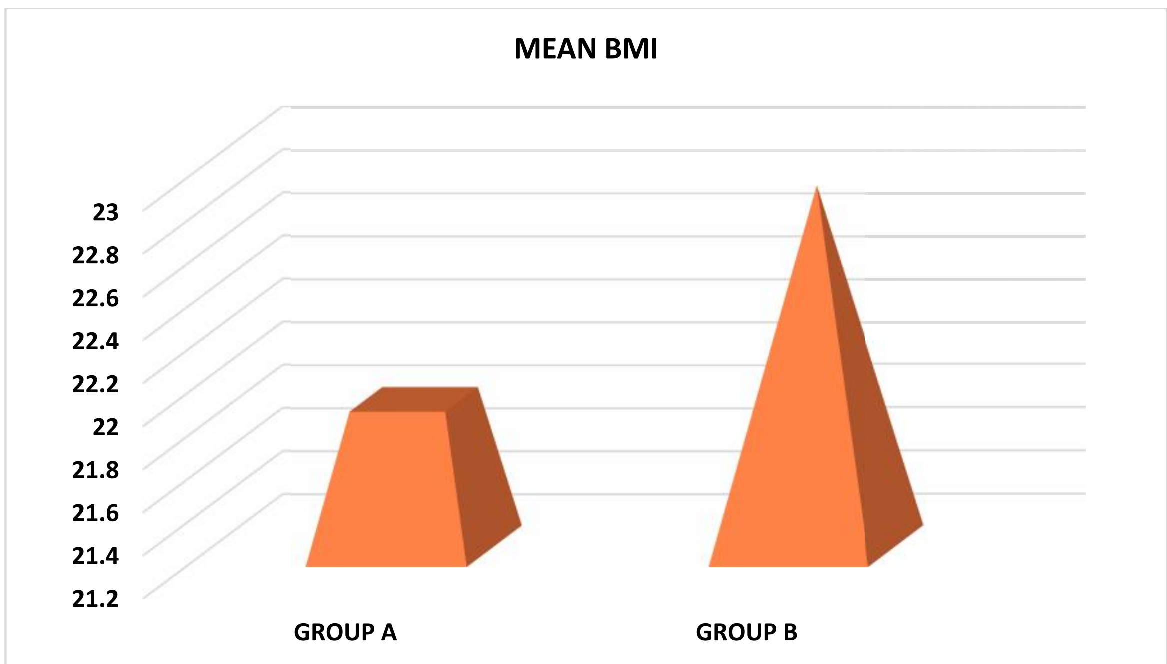


Table 3. Burst abdomen

BURST ABDOMEN	GROUP A	PERCENTAGE	GROUP B	PERCENTAGE	TOTAL
PRESENT	0	0.00	0	0.00	0
ABSENT	30	100.00	30	100.00	60
TOTAL	30	100.00	30	100.00	60

The above table depicts the incidence of Burst abdomen among both the groups, with zero incidence among both the groups.

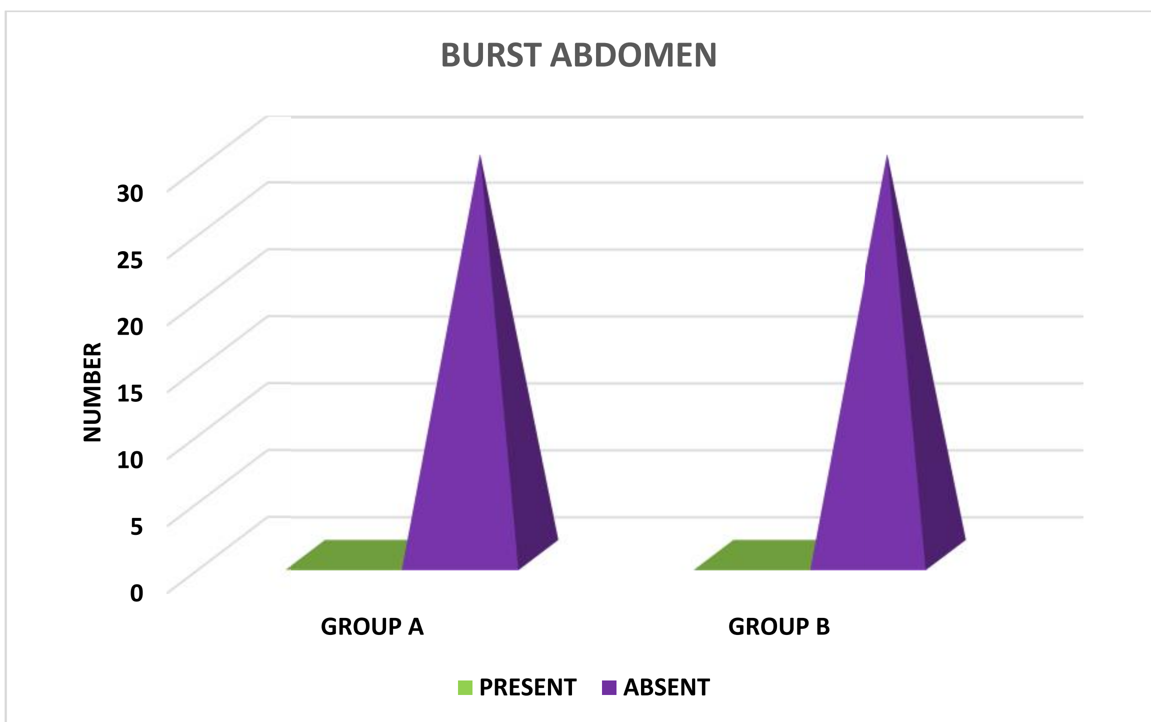


Table 4. Seroma

SEROMA	GROUP A	PERCENTAGE	GROUP B	PERCENTAGE	TOTAL
PRESENT	5	16.67	1	3.33	6
ABSENT	25	83.33	29	96.67	54
TOTAL	30	100.00	30	100.00	60

The above table depicts the incidence of seroma in both the groups. Out of 30 patients in each group, 5 patients in Group A and 1 patient in Group B developed seroma. The p value using Chi-square test is *0.0872*, which is statistically not significant (NS).

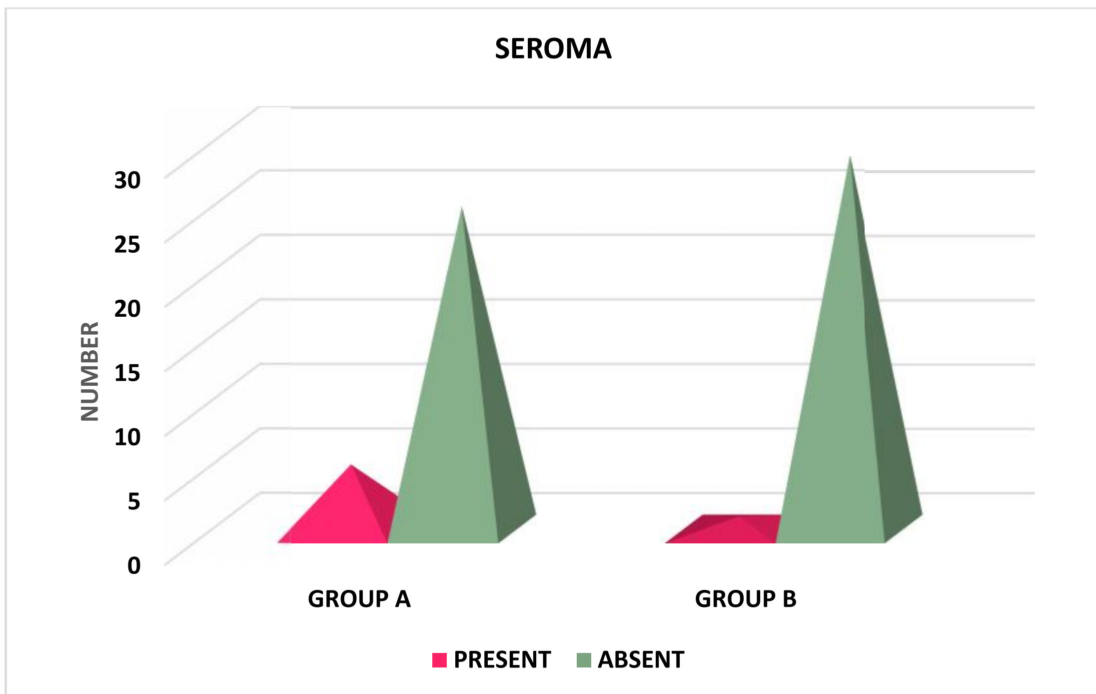


Table 5. Hematoma

HEMATOMA	GROUP A	PERCENTAGE	GROUP B	PERCENTAGE	TOTAL
PRESENT	2	6.67	1	3.33	3
ABSENT	28	93.33	29	96.67	57
TOTAL	30	100.00	30	100.00	60

The above table depicts the incidence of Hematoma in both the groups. Out of 30 patients in each group, 2 patients in Group A and 1 patient in Group B developed Hematoma. The p value using Chi-square test is 0.5536, which statistically not significant (NS).

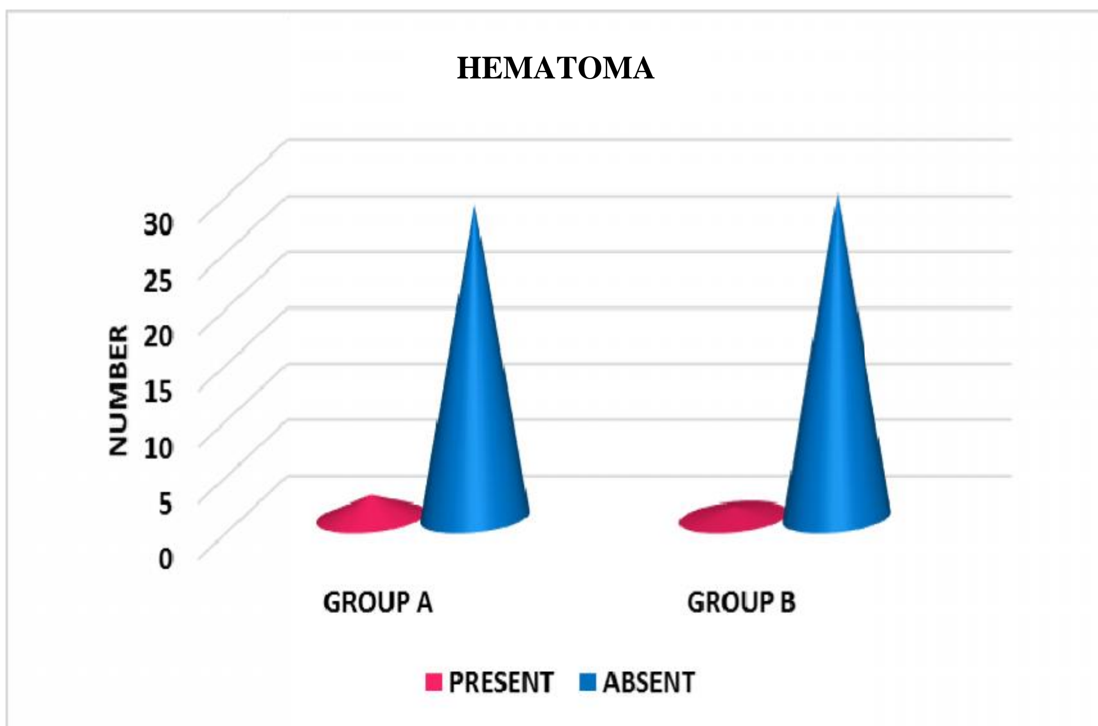


Table 6. Surgical Site Infection

SURGICAL SITE INFECTION	GROUP A	PERCENTAGE	GROUP B	PERCENTAGE	TOTAL
PRESENT	4	13.33	3	10.00	31
ABSENT	26	86.67	27	90.00	29
TOTAL	30	100.00	30	100.00	60

The above table depicts the incidence of SSI in both the groups. Out of 30 patients in each group, 4 patients in Group A and 3 patient in Group B developed Hematoma. The p value using Chi-square test is 0.6876, which statistically not significant (NS).

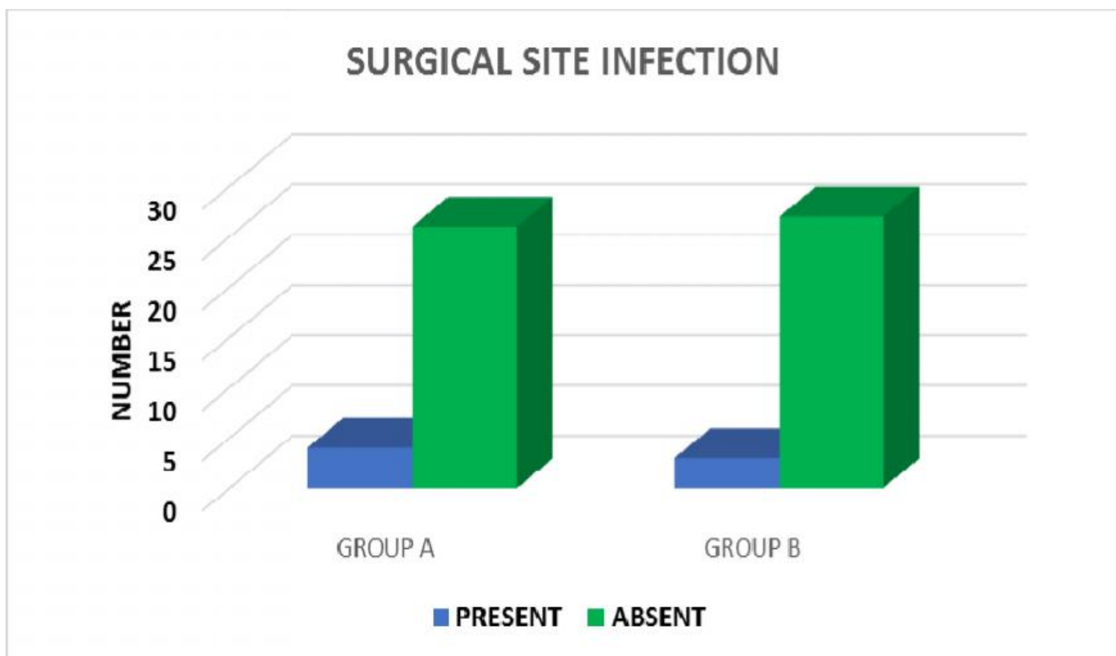


Table 7. Suture Sinus

SUTURE SINUS	GROUP A	PERCENTAGE	GROUP B	PERCENTAGE	TOTAL
PRESENT	0	0.00	0	0.00	0
ABSENT	30	100.00	30	100.00	60
TOTAL	30	100.00	30	100.00	60

The above table depicts the incidence of Suture sinus among both the groups, with zero incidence among both the groups.

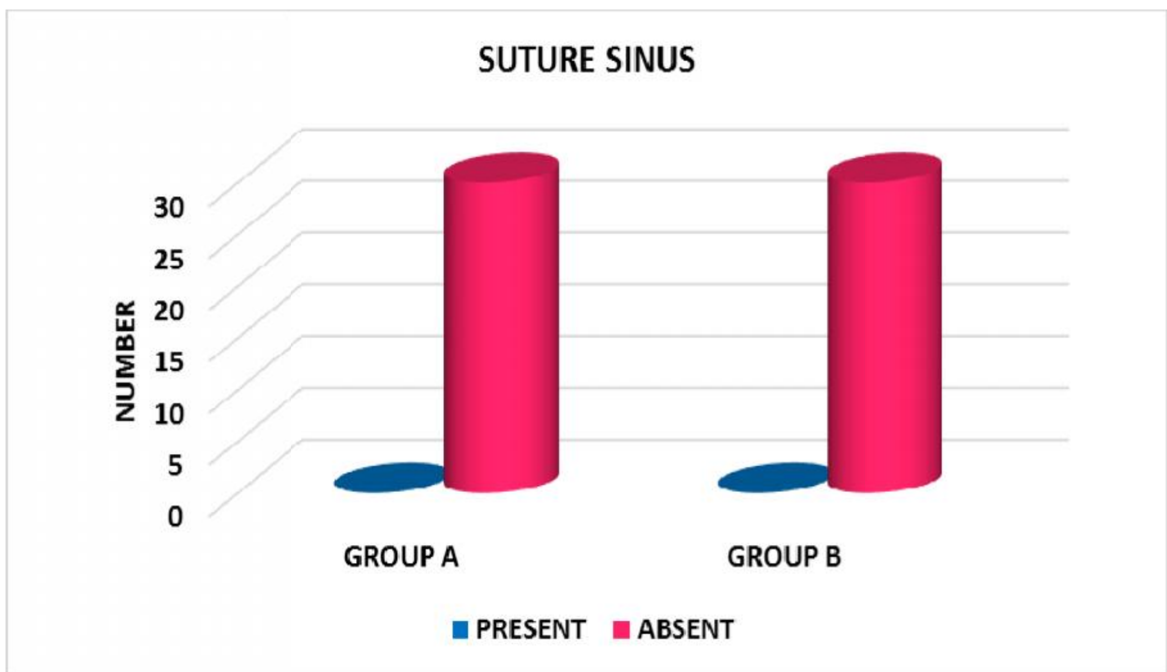


Table 8. Wound Dehiscence

WOUND DEHISCENCE	GROUP A	PERCENTAGE	GROUP B	PERCENTAGE	TOTAL
PRESENT	3	10.00	2	6.67	2
ABSENT	27	90.00	28	93.33	43
TOTAL	30	100.00	30	100.00	60

The above table depicts the incidence Wound Dehiscence of in both the groups. Out of 30 patients in each group, 3 patients in Group A and 2 patient in Group B developed Wound Dehiscence. The p value using Chi-square test is 0.6406, which is statistically not significant (NS).

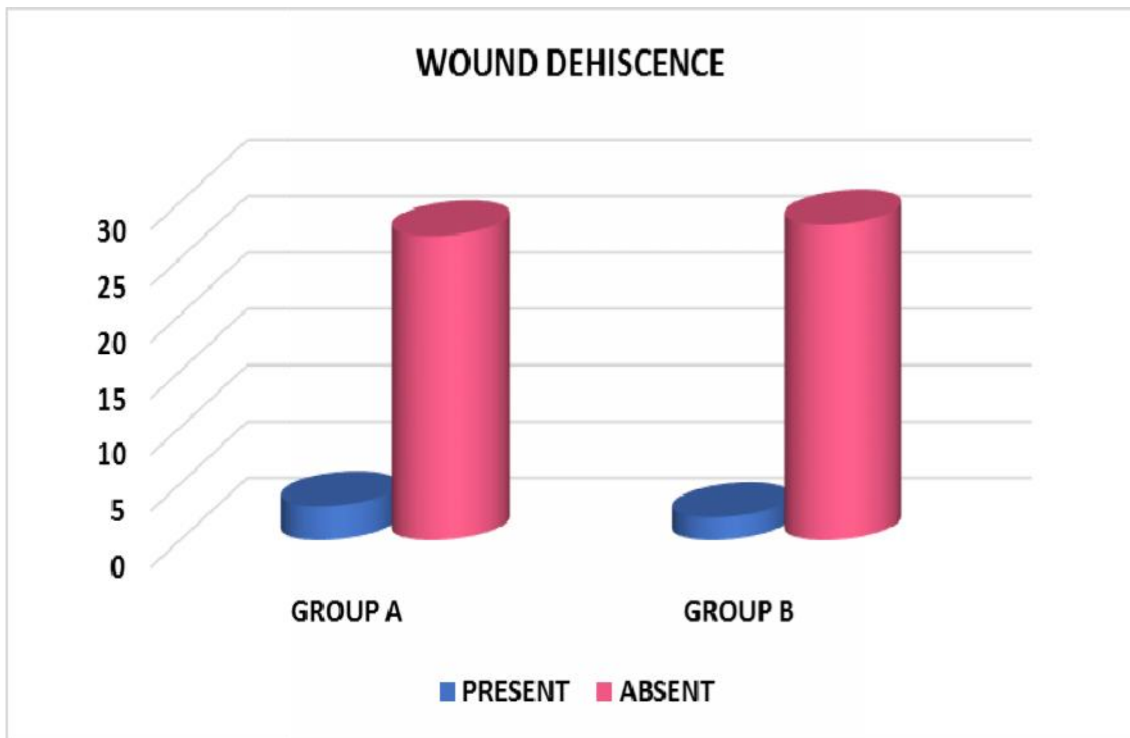


Table 9. Incisional Hernia

INCISIONAL HERNIA	GROUP A	PERCENTAGE	GROUP B	PERCENTAGE	TOTAL
PRESENT	0	0.00	0	0.00	0
ABSENT	30	100.00	30	100.00	60
TOTAL	60	60	60	60	60

The above table depicts the incidence of Incisional Hernia among both the groups, with zero incidence among both the groups.

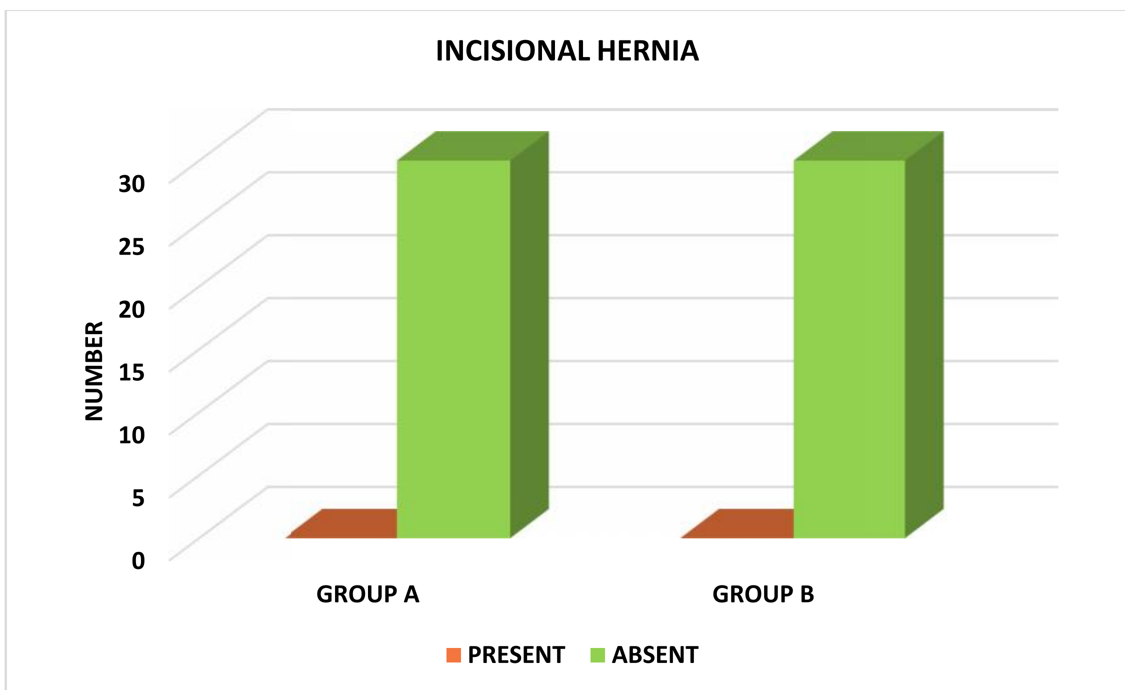


Table 10. Comparison of Interventions done among both the groups

INTERVENTION	GROUP A	PERCENTAGE	GROUP B	PERCENTAGE	TOTAL
DRAINAGE OF HAEMATOMA AND REGULAR DRESSINGS FOLLOWED BY SECONDARY SUTURING	2	6.67	1	3.33	3
DRAINAGE OF SEROMA AND REGULAR DRESSINGS	1	3.33	2	6.67	3
REGULAR DRESSINGS AND WOUND HEALED BY SECONDARY INTENTION	4	13.33	0	0.00	4
REGULAR DRESSINGS FOLLOWED BY SECONDARY SUTURING	1	3.33	3	10.00	4
NIL	22	73.33	24	80.00	46
TOTAL	30	100.00	30	100.00	60

The above table depicts the interventions done among both the groups during post-operative period following any complication. On comparing the type and total number of interventions done in both the groups, the p value obtained using chi-square test is 0.2183, which is statistically not significant (NS).

DISCUSSION

The ideal method of abdominal closure is the one that maintains the integrity and tensile strength of the wound throughout the healing process with good tissue approximation, does not promote wound infection or inflammation, technically simple and expedient and is well tolerated by patients. Due to difficulties arising from differently tailored study designs and surgical techniques, the surgical literature has not clearly demonstrated an ideal technique to close the abdominal fascia.

Many studies including meta-analysis have conflict results regarding the ideal technique of abdominal closure. Even though suture material used and the technique of closure play important role in preventing wound dehiscence, other patient factors such as anemia, hypoalbuminemia, presence of peritonitis and advanced malignancy on chemotherapy also have a great impact on the wound and the general condition of the patient itself. So in order to minimize all these errors, we excluded the patients with above mentioned drawbacks and study was conducted in patients undergoing elective surgery.

This randomized control trial was undertaken to compare the efficacy of continuous and interrupted technique of abdominal closure using PDS, so as to make an attempt to adopt an ideal technique of closure, which has been a topic of debate since decades. The study included a total of 60 patients, undergoing elective mid-line exploratory laparotomy in the department of general surgery KLES Dr. Prabhakar Kore Hospital, Belagavi. The various observations and results have been discussed between two techniques i.e., Continuous and Interrupted technique.

The mean age of the patient is 52.30 years and 49.67 years in group A and group B respectively. Both the groups were comparable in terms of age as there was

no statistically significant difference between the mean age of the groups. Cameron et.al.,[62] included patients with mean ages of 61.6 years in patients undergoing closure with PDS. In one more study by Richards et.al.,[73] mean age of patients was 48 years in elective surgeries. The study by McNeill et.al.,[83] mean ages of patient is 35±12 years in interrupted group and 38±11 years in continuous group. Therefore there is no significant difference in the age profile of the patients as compared to most of the studies.

Majority of patients in group A were males- 53.33% compared to females- 46.67%, whereas majority of patients in group B were females-53.33% compared to males-46.67%. But there statistically no significant difference seen in the distribution of sex among both the groups. This could be attributed to distribution of sex while dividing the patients into continuous and interrupted group by closed envelop method. In the study by Richards et.al.,[73] in which 70-80% males were included in each group. McNeill[83] also reported a similar distribution of sex (87 males, 13 females). The heavy preponderance of males could be attributed to adverse sex ratio in that country and disease profile of the patients.

Surgical site infection in group A is 13.3% and in group B is 10.00%, which was statically not significant (p value-0.6876). Wound infection rate has been found to be present in 3-10% patients undergoing clean elective laparotomy. No statistically significant difference was observed in the wound infection rate between the continuous and interrupted closure by Sahlin et.al.,[86] (10% in continuous and 11% in interrupted). The wound infection was not found to be statistically affected by the technique employed. No statistically significant difference in wound infection rates was observed with either technique. In another study by Krukowski[87], comparing PDS and polypropylene, wound infection was found to be present in 3.2% of patients in

PDS group as compared to 8% in polypropylene, which was statistically significant. Hence, study supports PDS as a near ideal suture for abdominal fascia closure.

Wounds were followed up for signs of infection till 12 weeks. No wound infection persisted till 12 weeks which can be explained because of delayed primary closure of skin only after appearance of healthy granulation tissue, use of antibiotics according to culture and sensitivity and daily regular dressings. In one of the follow-up study by Larsen et.al.,[88] demonstrated a wound infection rate of 5.5% at the end of 12 weeks. Wound infection rate was found to be considerably lower than in other studies because our study included only patients undergoing elective surgeries.

Wound dehiscence rate in group A and B is 10% and 6.67% respectively, which is statistically not significant (p value-0.6406). Many Indian studies have reported burst abdomen to occur in 10-30% of emergency cases,[89,90] could be attributed to higher wound infection rate and poor nutritional status . Cameron et.al.,[62] noted 1/143 dehiscence in PDS and 9/141 dehiscence in polypropylene, the difference being statistically significant (p value-0.018). Sahlin et.al.,[86] including both elective and urgent operations showed no significant difference in rates of wound dehiscence between continuous (4/345) and interrupted closure (3/339). Richards et.al.,[73] also demonstrated no significant difference in wound disruption in the immediate postoperative period between the continuous method and interrupted closure.

In a study by Srivastav et.al.,[76], burst abdomen occurred in 1/46(2.17%) in interrupted group and 8/54(14.8%) in continuous group on 100 patients undergoing emergency laparotomy, the difference being statistically significant. Patients were followed up for evidence of burst abdomen till 6 weeks. No evidence of burst abdomen was present after 2 weeks in both the group.

No suture sinus was present till 6 weeks of follow-up in both the groups. Wissing et.al.,[28] in their study while comparing PDS, polygalactin and nylon, concluded that PDS was comparable to nylon in terms of wound dehiscence and incisional hernia but more favorable than nylon as it lead to significantly less suture sinus(39% vs. 7.7%) formation and less wound pain than nylon. Schoetz et.al.,[91] reported no suture sinus formation with PDS in 200 patients undergoing both elective and emergency procedures.

The incidence of Incisional hernia in the study is zero in both the groups. No statistically significant difference in the incidence of incisional herniation was observed in the review of literature by Wadstrom et.al.,[46] between the two techniques. In other studies by Rucinski et.al.,[92] and Weiland et.al.,[54] consistently proved beyond doubt that continuous closure technique is comparable to interrupted suturing in terms of incisional hernia. For obvious reasons, incidence of incisional hernia was much greater with rapidly absorbable suture as they lose most of their strength in 2 to 3 weeks during the period when the wounds needs to be strengthened additionally by sutures as they regain only 15-30% of their original strength by that time.

The most of patients have been followed up only for 6 months, which forms the main drawback of the study. The overall frequency of incisional hernia estimated at 3 months by Larsen et.al., was just 1/224 which increased to 7/224 after one year follow up thus illustrating the need for long follow-up, which was even suggested by Ellis et.a., also. Richards et.al.,[73] also showed that no hernia developed within 30 days after operation. He stated significant additional hernias could also be identified between 2.5 and 5.5 years of operation.

CONCLUSION

Based on the findings of this study, it may be concluded that-

1. Continuous suturing is comparable to interrupted suturing in terms of occurrence of wound infection, wound dehiscence and incisional hernia.
2. Continuous closure is better than interrupted closure as it is faster, takes less suture material and there is no suture sinus formation. But, most of the time the technique of closure depends on the surgeon's choice and convenience.
3. PDS can be considered as an ideal suture material for abdominal fascia closure due to its delayed absorbable property with significant reduction in the incidence of wound dehiscence.

SUMMARY

Midline laparotomy is the most commonly employed technique of abdominal incisions in both emergency and elective settings as it provides adequate exposure to all four quadrants of abdomen, affords quick exposure with minimal blood loss compared to other incisions. Secure wound closure and wound care is an essential requirement for an expedient recovery after laparotomy.

One of the most common and major complication associated with the closure of midline laparotomy is wound dehiscence which is a major cause of postoperative morbidity. Many studies including meta-analysis have been done and published which have investigated the optimal suturing technique and ideal suture material for closure of abdominal fascia especially in elective settings. But, the ideal technique of closure still remains as a topic debate since decades. The consensus that has been built by these studies is of using delayed absorbable suture in continuous fashion. But there is paucity of reliable data regarding adopting ideal technique of abdominal fascia closure in emergency as well as elective set-up on Indian population. The present randomized control study was designed to evaluate the two techniques of abdominal fascia closure-Continuous and Interrupted technique using PDS in patients undergoing elective laparotomy.

The present study was undertaken in the Department of General Surgery, KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi. The study included 60 patients, which were equally divided into groups.

- ***Group A-*** Abdominal fascia closed with continuous technique with PDS.
- ***Group B-*** Abdominal fascia closed with interrupted technique with PDS.

Both the techniques were evaluated and efficacy of both techniques in terms of following were studied

1. Wound dehiscence
2. Surgical site infection
3. Incisional hernia

Post-operatively wound was examined on POD-03 and followed up at 1 week, 3 week, 6 week, 3 months and once in a month for a period of 6 months after surgery on OPD basis particularly to look for any suture sinus formation, surgical site infection, wound dehiscence or incisional hernia.

The parameters thus obtained were studied in detail, data was entered to excel spread sheet and appropriate statistical analysis tests were applied. No statistical difference in either technique was observed in

terms of wound infection, wound dehiscence and incisional hernia formation. Continuous suturing was found to be easier, faster and economical due to less length of suture material required to close the abdomen. PDS can be considered as an ideal suture material for abdominal fascia closure due to its delayed absorbable property with significant reduction in the incidence of wound dehiscence.

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ANNEXURE - I – CONSENT FORM

Title of Research Study:

ONE YEAR RANDOMIZED CONTROL STUDY TO COMPARE THE EFFICIENCY OF CONTINUOUS VERSUS INTERRUPTED ABDOMINAL FASCIA CLOSURE IN PATIENTS UNDERGOING LAPAROTOMY USING POLYDIOXANONE SUTURE IN KLES DR. PRABHAKAR KORE HOSPITAL AND RESEARCH CENTRE, BELAGAVI.

Principal Investigator-

Dr. ____________

Post-Graduate student

Dept. Of General Surgery

J.N. Medical College

Introduction and Purpose-

To compare the efficiency of Continuous versus Interrupted abdominal fascia closure in patients undergoing laparotomy, which is a commonly done procedure in surgical practice.

Procedure – If you agree to enroll yourself in my study of the research study, you will be interviewed regarding your present, past and family history and then you will be clinically examined in detail and investigated accordingly.

You will be randomly allocated using sealed envelope method into Group A (Interrupted method) and Group B (Continuous method). The proposed surgery- Laparotomy and proceed will be done by a Consultant General Surgeon.

Post-operative analgesia is standardized in both groups.

Post-operative examination of the surgical site will be done at regular intervals and necessary intervention such as

- Regular dressing.
- USG abdomen will be done, if any collection beneath the skin is suspected.
- Secondary suturing will be done in case of wound gaping.
- Surgical intervention in case of Burst Abdomen.
- Screened for Incisional Hernia in future visits.

Risks and Benefits:

Risks related to the surgical procedure and anesthesia such as injury to intra-abdominal structures, hemorrhage, post-operative infection, surgical site infection, Pneumonia and other co-morbid complications

There will be no risks associated by participating in this study. It helps to know the outcome of the surgery in terms of wound dehiscence and need for further management in successive follow-ups.

No bias will be done to the patients who are not willing to participate in the study from the treatment point of view.

VOLUNTARY PARTICIPATION / WITHDRAWL FROM THE STUDY:

Taking part in the study is voluntary. You may choose not to enroll yourself in the study and may choose to leave the study anytime in between.

ALTERNATIVES:

Your decision regarding participation in study will not change present or future health care services offered to you at KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belgaum. You would simply be excluded from the study if you wish to and all your details shall be kept confidential and you will get routine line of management.

PRIVACY AND CONFIDENTIALITY:

All data collected or disclosed by you during the course of participation of study, will be kept fully confidential. If however during the course it becomes necessary for the progress of the course to disclose the identity, it would be done so only after your informed and written consent.

The only people to know that you are a research subject are members of research team. No information about you will be disclosed to other without your written permission except:

-In emergency to protect your rights and welfare.

-If required by law.

AUTHORIZATION TO PUBLISH RESULT:

The results of the study may be used to publish an article. When the results of research published or discussed, in a conference, no information will be displayed that would disclose your identity. Any information obtained in connection with this study and that can be identified with you will remain confidential.

FINANCIAL INCENTIVES FOR PARTICIPATION:

No additional costs shall be incurred upon you for the purpose of this study. It is purely being done with idea of research and all the cost of study will be borne by the investigator.

COMPENSATION:

In the event that you become injured as a result of taking part in this study, treatment will be offered to you at KLES Dr Prabhakar Kore Hospital and Medical Research Centre, Belgaum or you will be given information about where to receive medical care. However, no reimbursement, compensation or free medical care will given.

QUESTIONS/CONTACT DETAILS:

You shall be free to contact the below mentioned name and addresses anytime during the study period for any clarifications or help as you may desire for.

Dr.____________________

MS (Post Graduate Student)

Department of General Surgery,

Jawaharlal Nehru Medical College,

Nehru Nagar,

Belgaum 590010

Mobile NO- ________________

Dr.________________

MS General Surgery,

Associate Professor

Department of General Surgery,

Jawaharlal Nehru Medical College, Nehru Nagar,

Belgaum 590010

Mobile NO- ________________

In case you need any further information regarding your rights as study participant you may contact:

Dr. ____________________

Professor, Department of Pathology &

Chairman, JNMC Institutional Ethics

Committee on Human Subjects Research,

Jawaharlal Nehru Medical College, Nehru Nagar,

Belgaum 590010

Mobile NO- ______________

CONSENT STATEMENT

I the undersigned Mr/Mrs do hereby give consent for my participation in this research study after being explained in depth about the important elements of this study in my own vernacular language.

I give this consent voluntarily in my sound mind and good faith, knowing very well the risks involved and been given enough time to clear my doubts and other queries to participate as a SUBJECT in this study. I do hereby also give consent for publication of this article in any media / journal and have no objections whatsoever.

Participants Name-

Signature-

Witness/Guardian's Name-

Signature

Investigator's Name – **Dr.**_________________

Signature-

Guide's Name - **Dr.** _________________

Signature-

Date: Time:

Place: Belagavi

ANNEXURE - II - PROFORMA

Title of Research Study:

ONE YEAR RANDOMIZED CONTROL STUDY TO COMPARE THE EFFICIENCY OF CONTINUOUS VERSUS INTERRUPTED ABDOMINAL FASCIA CLOSURE IN PATIENTS UNDERGOING LAPAROTOMY USING POLYDIOXANONE SUTURE IN KLES DR. PRABHAKAR KORE HOSPITAL AND RESEARCH CENTRE, BELAGAVI.

Case no-

Name-

Age/Sex-

Occupation

IP No-

Date of admission-

Date of discharge-

CHIEF COMPLAINTS-

History of other illness-

History of previous illness-

GENERAL PHYSICAL EXAMINATION:

Pulse rate-

BP-

Respiratory rate-

Temperature-

SYSTEMIC EXAMINATION-

PER-ABDOMEN-

PER-RECTAL EXAMINATION-

RESPIRATORY SYSTEM-

CARDIOVASCULAR SYSTEM-

CENTRAL NERVOUS SYSTEM-

INVESTIGATIONS:

Complete Blood Count-

RBS-

BLOOD UREA-

SERUM CREATININE-

LIVER FUNCTION TEST-

PT/INR-

HIV-

HBsAg-

HCV-

CULTURE AND SENSITIVITY REPORT

IMAGING:

- CHEST X-RAY:

- ULTRASOUND ABDOMEN AND PELVIS:

- CT SCAN- ABDOMEN AND PELVIS:

DIAGNOSIS:

PROPOSED SURGERY:

FOLLOW-UP:

- **POD-03:** Signs of induration or redness-

  Any discharge from the surgical site (serous/serosanginous/purulent)-

  Intervention-

- **POD-07:** Signs of induration or redness-

  Any discharge from the surgical site (serous/serosanginous/purulent)-

  Intervention-

- **POD-21:** Signs of induration or redness-

  Any discharge from the surgical site (serous/serosanginous/purulent)-

  Signs of Wound gaping-

  Intervention-

- **After 6 weeks:** Signs of induration or redness –
- Any discharge from the surgical site (serous/serosanginous/purulent)-

  Signs of Wound gaping-

  Intervention-
- **After 1 month:** Signs of induration or redness-

  Any discharge from the surgical site (serous/serosanginous/purulent)-

  Signs of Wound gaping-

  Signs of Incisional hernia-

  Intervention-
- **After 3 months:** Signs of induration or redness-

  Any discharge from the surgical site (serous/serosanginous/purulent)-

  Signs of Wound gaping-

  Signs of Incisional hernia-

  Intervention-
- **Further follow-ups:**

- **REMARKS:**

ANNEXURE - III - PHOTOGRAPHS

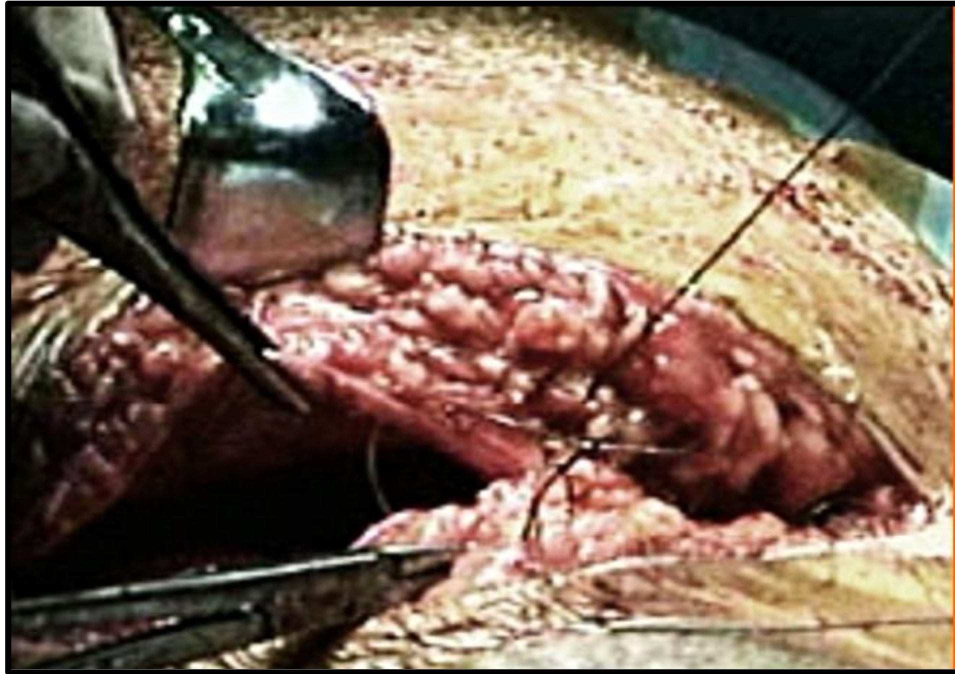

FIG 1- CLOSURE WITH CONTINUOUS TECHNIQUE

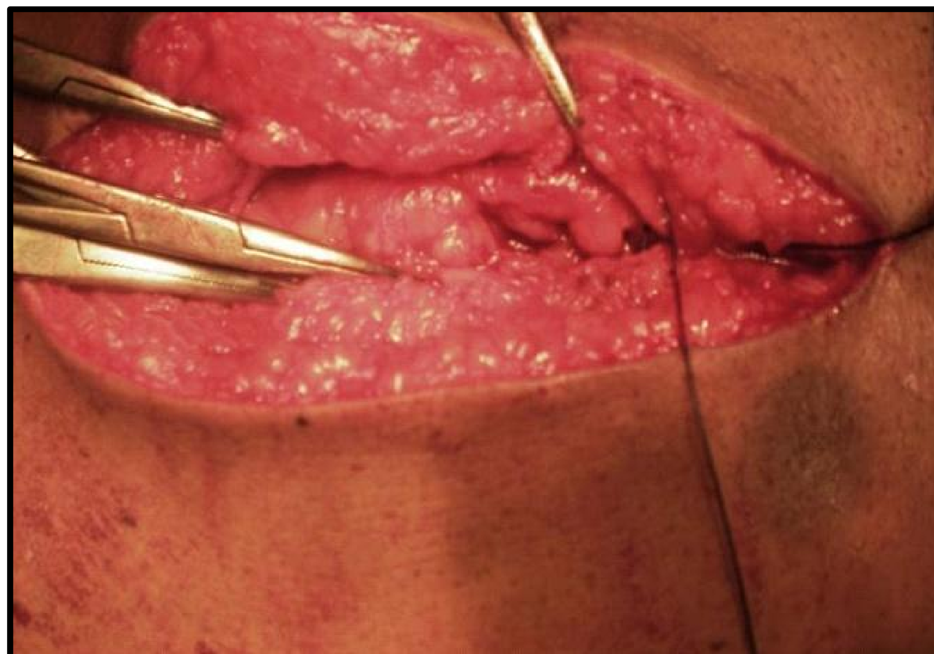

FIG 2- CLOSURE WITH INTERRUPTED TECHNIQUE

FIG 3- SSI WITH PARTIAL WOUND DEHISCENCE

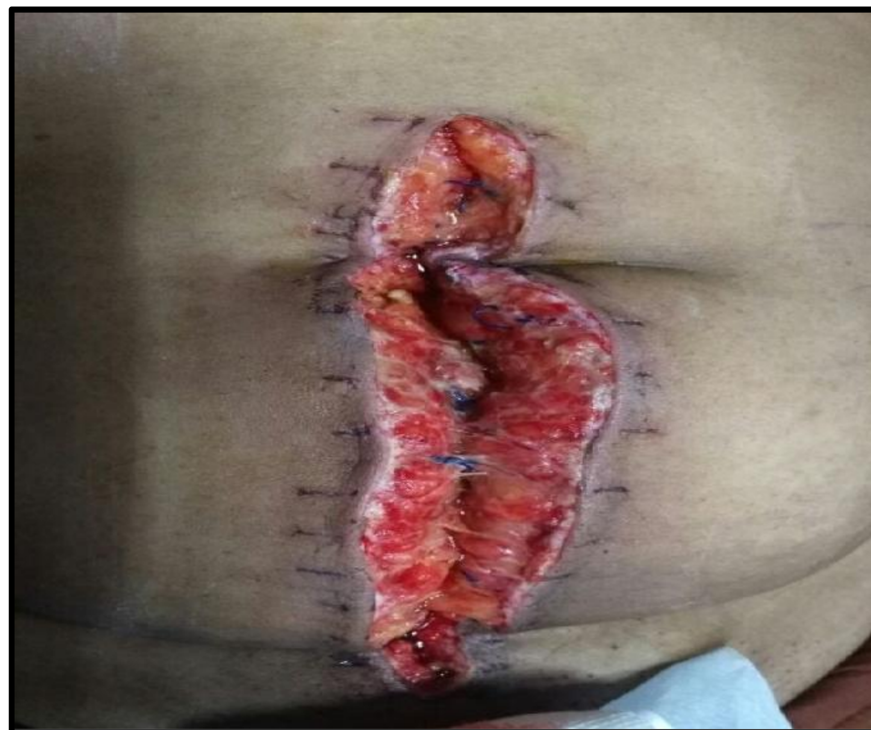

FIG 4- COMPLETE WOUND DEHISCENCE

ANNEXURE IV – KEY TO MASTER CHART

BA	-	Burst Abdomen
BMI	-	Body Mass Index
DOH	-	Drainage of Hematoma
DOS	-	Drainage of Seroma
H	-	Healthy
Hem	-	Hematoma
IH	-	Incisional Hernia
IP	-	Inpatient
P	-	Purulent Discharge
POD	-	Post Operative Day
RD	-	Regular Dressing
S	-	Serous Discharge
SS	-	Suture Sinus
SSI	-	Surgical Site Infection
W	-	Wound
WD	-	Wound Dehiscence

IP NUMBER	GROUP	AGE	SEX	BMI	DIABETES	FINAL DIAGNOSIS	POD-03	POD-07	POD-14	POD-21	POD-6 WEEKS	BA	SSI	SS	SEROMA	HAEMATOMA	WD	IH	INTERVENTION
772766	A	40 YEARS	F	24	+	GIST	W- H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
773206	A	65 YEARS	M	22	-	CARCINOAM OF RECTUM	W-H	W-S	W-H	W-H	Sc-H	-	-	-	+	-	-	-	D0S+RD
783456	A	50 YEARS	F	20.4	-	B/L OVARIAN CYST	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
788746	A	30 YEARS	M	21.4	-	CHOLELITHIASIS+CBD STONES	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
808377	A	31 YEARS	M	22.2	-	PSEUDOCYST OF PANCREAS	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
809706	A	68 YEARS	M	20.2	+	CHOLELITHIASIS+CBD STONES	W-H	W-H	W-Hem	W-H	Sc-H	-	-	-	-	+	-	-	D0H+RD
812376	A	36 YEARS	F	24.5	-	FIBROID UTERUS	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
814573	A	80 YEARS	F	22.4	-	CHOLELITHIASIS+CBD STONES	W-H	W-P	W-P	W-H	Sc-H	-	+	-	-	-	+	-	RD+SS
816235	A	58 YEARS	F	21	-	FIBROID UTERUS	W-S	W-S	W-S	W-H	Sc-H	-	-	-	+	-	-	-	RD+SS
816872	A	64 YEARS	M	22.2	-	CARCINOMA OF URINARY BLADDER	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-		NIL
817001	A	63 YEARS	M	21.1	+	CARCINOMA OF STOMACH	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
817557	A	42 YEARS	M	22.3	+	RECTAL PROLAPSE	W-H	W-H	W-H	W-H	Sc-H	-		-	-			-	NIL
818088	A	45 YEARS	M	25.2	+	GASTRIC-OUTLET OBSTRUCTION	W-S	W-S	W-S	W-H	Sc-H	-	-	-	+	-	-	-	RD+SS
830035	A	44 YEARS	F	21.1	-	CHOLELITHIASIS+CBD STONES	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
841036	A	68 YEARS	M	19.2	-	CARCINOMA OF STOMACH	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
837482	A	51 YEARS	F	20.2	+	CARCINOMA OF OVARY	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
837938	A	71 YEARS	M	18.2	-	CARCINOMA OF THE HEAD OF THE PANCREAS	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
838519	A	55 YEARS	F	20.2	-	CARCINOMA OF BLADDER	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
843555	A	73 years	M	21.2	-	CARCINOMA OF RECTUM	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
844962	A	65 YEARS	M	20.1	+	CARCINOMA OF URINARY BLADDER	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
845128	A	70 YEARS	M	22.2	-	CARCINOMA OF RECTUM	W-P	W-P	W-H	W-H	Sc-H	-	+	-	-	-	+	-	RD+SS
846125	A	47 YEARS	F	23.4	-	BILATERAL OVARIAN CYST	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
846241	A	61 YEARS	F	22.2	-	GASTRIC GIST	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
846527	A	40 YEARS	F	21.1	-	GIST	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
850519	A	46 YEARS	F	25.5	+	BILATERAL OVARIAN CYST	W-H	W-H	W-Hem	W-H	Sc-H	-	-	-	-	+	-	-	DOH+RD
861783	A	68 YEARS	M	23.2	-	CHOLELITHIASIS+CBD STONES	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
864622	A	61 YEARS	F	21.1	+	CHOLELITHIASIS+CBD STONES	W-S	W-S	W-H	W-H	Sc-H	-	-	-	+	-	-	-	RD+SS
865039	A	25 YEARS	M	23.3	-	PSEUDOCYST OF PANCREAS	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
878077	A	32 YEARS	F	19.2	-	CARCINOMA OF STOMACH	W-H	W-S	W-H	W-H	Sc-H	-	-	-	-	-	-	-	DOS+RD
880933	A	20 YEARS	M	23.2	-	GASTRIC-OUTLET OBSTRUCTION	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
776346	B	19 YEARS	M	23.3	-	ILEO-CAECAL INTUSSUSCEPTION WITH MECKEL'S DIVERTICULUM	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
779560	B	55 YEARS	M	22.4	-	ILEO-CAECAL STRICTURE	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
781496	B	45 YEARS	F	27	-	LEFT OVARIAN CYST	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
782384	B	27 YEARS	M	26	-	PSEUDOCYST OF PANCREAS	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
813446	B	45 YEARS	M	23.2	+	COLO-COLIC INTUSSUSCEPTION	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
813551	B	45 YEARS	F	24	+	SUB-ACUTE INTESTINAL OBSTRUCTION SECONDARY TO COMPRESSION BY PELVIC TUMOUR	W-P	W-P	W-H	W-H	Sc-H	-	+	-	-	-	-	-	RD+SS
813612	B	52 YEARS	F	26.2	+	RECTAL PROLAPSE	W-H	W-Hem	W-H	W-H	Sc-H	-	-	-		+	-	-	D0H+RD
814847	B	60 YEARS	F	23.4	+	CHOLELITHIASIS+CBD STONES	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
815424	B	32 YEARS	M	24	-	ILEO-ILEAL INTUSSUSCEPTION	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
816498	B	60 YEARS	F	23.2	+	SUB-ACUTE INTESTINAL OBSTRUCTION DUE TO OVARIAN MASS	W-S	W-S	W-S	W-H	Sc-H	-	-	-	-	-	-	-	NIL
816872	B	64 YEARS	M	20.2	-	GIST	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
818151	B	65 YEARS	M	22.2	-	GASTRIC-OUTLET OBSTRUCTION	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
818324	B	35 YEARS	M	21.2	+	CARCINOMA OF SMALL INTESTINE	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
828304	B	45 YEARS	F	20.1	-	CARCINOMA OF OVARY POST NACT	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
830308	B	33 YEARS	F	24.3	-	MESENTERIC CYST	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
838945	B	19 YEARS	F	21.2	-	GIST	W-P	W-P	W-P	W-H	Sc-H	-	-	-	-	-	-	-	RD+SS
839022	B	65 YEARS	F	19.4	-	CARCINOMA OF ENDOMETRIUM	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
839513	B	41 YEARS	F	20.2	+	CARCINOMA OF OVARY	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
841844	B	70 YEARS	M	20.3		CARCINOMA OF GE JUNCTION	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
841955	B	60 YEARS	F	22.2	+	CARCINOMA OF ENDOMETRIUM	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
846350	B	70 YEARS	F	25.4	+	BILATERAL OVARIAN CYST	W-S	W-H	W-H	W-H	Sc-H	-	-	-	+	-	-	-	RD+SS
846527	B	50 YEARS	F	23.8	+	SPINDLE CELL NEOPLASM ARISING FROM MID-JEJUNUM	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
846587	B	72 YEARS	F	25.8	+	CARCINOMA PF OVARY	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
847402	B	50 YEARS	M	26.2	+	CARCINOMA OF DUODENUM	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
849779	B	42 YEARS	M	22.2	+	CARCINOMA OF RECTUM	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
850519	B	46 YEARS	F	21.1	-	MESENTERIC CYST	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
850548	B	35 YEARS	F	23.7	-	CARCINOMA OF CERVIX	W-S	W-S	W-H	W-H	Sc-H	-	-	-	+	-	-	-	RD+SS
851636	B	72 YEARS	M	19.3	+	CARCINOMA OF GE JUNCTION	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
861783	B	68 YEARS	M	23.8	-	CHOLELITHIASIS+CBD STONES	W-H	W-H	W-H	W-H	Sc-H	-	-	-	-	-	-	-	NIL
874733	B	48 YEARS	M	26.1	+	PSEUDOCYST OF PANCREAS	W-P	W-P	W-P	W-H	Sc-H	-	-	-	-	-	+	-	RD+SS