"INTERRUPTED VERSUS CONTINUOUS ABDOMINAL FASCIA CLOSURE IN PATIENTS UNDERGOING LAPAROTOMY TO OBSERVE INCIDENCE OF BURST ABDOMEN"

By

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IN

GENERAL SURGERY

Under the Guidance of
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2017

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Signature of the candidate

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ABSTRACT

INTRODUCTION:

Midline laparotomy is the most common technique of abdominal incisions in both emergency and elective settings because it is simple, provides adequate exposure to all four quadrants, affords quick exposure with minimal blood loss[1]. 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. Wound dehiscence is related to several factors pertaining to patient besides suture material and method of closure[2]. Numerous studies and meta-analysis have been conducted comparing all kinds of closure techniques and suture materials. The current opinion in west focuses on running mass closure of the abdomen in both emergency and elective settings as no significant difference has been reported in the above settings between the two methods of closure in terms of wound dehiscence and incisional hernia in most studies[3].

The type of closure may not be so important in elective patients who are nutritionally adequate, do not have risk factors for dehiscence and are well prepared for surgery. However, it may prove crucial in emergency patients with peritonitis who often have multiple risk factors for developing dehiscence[2].

There have been very few studies comparing the continuous method of closure with interrupted using absorbable and non-absorbable suture in patients undergoing midline laparotomy.

The objective of this study is to compare the continuous versus interrupted method of abdominal wall closure using non-absorbable suture in patients undergoing midline laparotomy.

OBJECTIVES OF THE STUDY:

1. Compare the post-operative complications of laparotomy wounds like burst abdomen.

2. Compare the operative time and healing time for interrupted and continuous of laparotomy wounds.

METHODOLOGY:

SOURCE OF DATA:

Patients undergoing laparotomy under the department of surgery in R.L.JALLAPPA HOSPITAL AND RESERCH CENTER are included in our study by applying the following inclusion and exclusion criteria.

A total of 52 patients are taken for the study and randomised into two groups by odds and even method , group 1 and group 2 with 26 in each respectively.

Patients under Group 1 have undergone interrupted closure of abdomen while Group 2 have undergone continuous closure of abdomen both will have the same suture material of prolene number 1 round body

INCLUSION CRITERIA:

- Patients aged 15-75 years.
- Patients posted for laparotomy, either elective or emergency(Peritonitis and intestinal obstruction)

EXCLUSION CRITERIA:

- Patients with co-morbid conditions like diabetes mellitus, immuno-compromised patients, patients on cancer chemotherapy, immunotherapy and on long term steroids.
- Patient posted for other elective cases
- Patients who underwent second laparotomy or re-laparotomy.

RESULTS:

In the total study of 52 cases, 2 patients had burst abdomen both belonging to the continuous group. However the time taken for the closure by interrupted was statically very significant, The length of suture material used in the interrupted was much greater than the continuous group, most interrupted group required two 70 cm lengths of number 1 prolene.

CONCLUSION:

Interrupted suturing was better compared to continuous in closure of abdominal fascia in midline laparotomy with respect to wound dehiensece

Keywords: Perforation, Prolene, interrupted , continuous, non absorbable , wound dehisense

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INTRODUCTION

INTRODUCTION

Midline laparotomy is the most common technique of abdominal incisions in both emergency and elective settings because it is simple, provides adequate exposure to all both quadrants, affords quick exposure with minimal blood loss[1]. 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. Wound dehiscence is related to several factors pertaining to patient besides suture material and method of closure[2]. Numerous studies and meta-analysis have been conducted comparing all kinds of closure techniques and suture materials. The current opinion in west focuses on running mass closure of the abdomen in both emergency and elective settings as no significant difference has been reported in the above settings between the two methods of closure in terms of wound dehiscence and incisional hernia in most studies[3]. As regarding the suture material, slowly absorbable suture seem to have an edge over non-absorbable suture because of similar incidence of wound dehiscence or incisional hernia but lesser chances of incisional pain and suture sinus[4].

The type of closure may not be so important in elective patients who are nutritionally adequate, do not have risk factors for dehiscence and are well prepared for surgery. However, it may prove crucial in emergency patients with peritonitis who often have multiple risk factors for developing dehiscence[2].

There have been very few studies comparing the continuous method of closure with interrupted using absorbable and non-absorbable suture in patients with peritonitis with delayed primary closure of skin.

The objective of this study is to compare the continuous versus interrupted method of abdominal wall closure using non-absorbable suture in patients undergoing laparotomy

AIMS
&
OBJECTIVES

AIMS AND OBJECTIVES

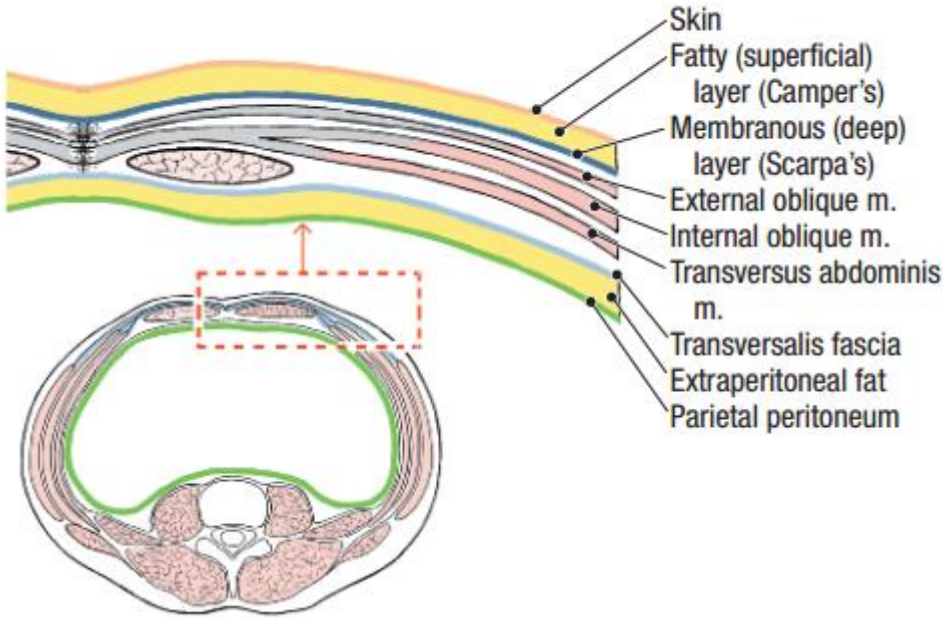
1. Compare the post-operative complications of laparotomy wounds like burst abdomen.
2. Compare the operative time and healing time for interrupted and continuous of laparotomy wounds.

REVIEW OF LITERTURE

REVIEW OF LITERATURE

ANATOMY OF ABDOMINAL WALL

The abdominal wall is a complex structure composed primarily of muscle, bone and fascia. Its major function is to protect the enclosed organs of the gastrointestinal and urogenital tracts buta secondary role is mobility, being able to flex, extend, rotate and vary its capacity. Flexibility requires elasticity and stretch which compromise abdominal wall strength[23]



LAPAROTOMY

An exploratory laparotomy is carried out in conditions where the need for an operation is recognized but where a definitive diagnosis cannot be made until the abdomen is opened. Whenever possible, however, an attempt should be made to arrive at an accurate, or at least a provisional, diagnosis before surgery. This not only allows the surgeon to plan the optimum surgical approach to the problem, but may also indicate an intra-abdominal pathology which would be more satisfactorily managed by non-operative means

Most exploratory laparotomies are performed in the emergency situation, where the value of exhaustive investigations has to be balanced against any deterioration which may occur in the patient's general condition during the inevitable delay. A short delay, during which both active resuscitation nd preliminary investigations are performed, is however usually beneficial as surgery on severely shocked or septic patients carries a high mortality. Intensive preoperative resuscitation has the potential to improve physiological status, and reduce the risk of perioperative death, but unfortunately deterioration can also occur. Cardiovascular stability,and adequate tissue perfusion, may not be attainable in the presence of continuing haemorrhage, and as total blood loss rises, coagulopathy may develop. Tissue already compromised by strangulation, or excessive dilatation, may infarct with resultant perforation and sepsis, and absorption of toxic products from any dead tissue will also continue The timing of surgery is therefore very important. The surgeon, aware of the deteriorating intra-abdominal situation, is often impatient to operate on a patient unfit for major intervention. The anaesthetist, in contrast, may strive too long to optimize a patient preoperatively in situations where deterioration is inevitable until the underlying

pathology has been addressed by urgent surgery. Any apparent conflict of interest between anaesthetist and surgeon needs discussion and compromise. An adequate level of postoperative care must be planned for such cases.

An emergency laparotomy may be required for major, or persistent, intra-abdominal haemorrhage, whether spontaneous or as a sequel to abdominal trauma. It is also necessary for any traumatic, infective or ischaemic condition in which the integrity of the gastrointestinal wall as a barrier is threatened, or has already been breached

Similarly, infective intra-abdominal pathologies, in the absence of any threat to gastrointestinal integrity, can often be successfully managed conservatively with antibiotic therapy. Inflammation willresolve and even small collections of pus can be re-absorbed.

Larger collections or pus must be drained, but a laparotomy can be avoided in many situations by the use of image guided percutaneous drainage techniques.[24]

PERITONITIS

Peritonitis[6] denotes an inflammatory process involving the peritoneum, most often due to infection. Inflammation of peritoneum can be caused by a number of etiological agents including bacteria, fungi, virus, chemical irritants (urine, bile etc), foreign bodies and faecal matter. The sequence of both local and systemic events that occur following the peritoneal insult represents a relatively constant response to a variety of infectious agents[6,7.]

Peritonitis can be divided into three types based on the source and nature of the microbial contamination[6]

- Primary peritonitis or Spontaneous bacterial peritonitis (SBP)
- Secondary peritonitis
- Tertiary peritonitis

a. **Primary peritonitis or spontaneous bacterial peritonitis (SBP)** - This is most often encountered in the setting of alcoholic cirrhosis and ascites in adults, and in children with nephrotic syndrome or systemic lupus erytheromatosus (SLE). Patients of ascites secondary to other causes such as cardiac failure, malignancy, and autoimmune disorders, are also at high risk for developing this condition.[9]

b. **Secondary peritonitis** -This can be caused by numerous intra abdominal disorders involving gastrointestinal or genitourinary tract with spillage of content into the peritoneal space. The majority of these episodes are as a result of primary lesion or perforation of a hollow viscus such as stomach, , small intestine, colon or appendix. Primary peritonitis can be diffuse (generalized) or localized (confined to a part of the peritoneal cavity).

c. **Tertiary peritonitis** - This refer to persistent diffuse peritonitis usually following the initial treatment of secondary peritonitis. It represents both the failure of host response and super infection[8]

Definitive treatment and management of secondary peritonitis demands operative intervention. Hence exploratory laparotomy is the usual procedure performed in the emergency settings with median laparotomy being the most common technique. A major problem after median laparotomy remains the adequate technique of abdominal fascia closure. Therefore, a great variety of suture materials and needles has been developed to provide an adequate closure of the fascia and thus the abdominal wall. Therefore the discussion regarding the optimal technique of abdominal fascia closure continues and most surgeons practice according to their own experience rather than acting evidence-based.

ABDOMINAL FASCIAL SUTURE CLOSURE: EXPERIMENTAL STUDIES

a) WOUND STRENGTH: Early studies on the healing of musculoaponeurotic incisions utilized excised segments and were specifically designed to place the greatest stress on the wound rather than distributing tension throughout the entire abdominal wall. Most of these studies demonstrated that the excised segments of tissue were never as strong as that of unwounded tissue. In the study by Fast and colleagues[10] of the gain in breaking strength of sutured paramedian incisions in rabbits, the wound with sutures present was 41.9% as strong as the undisturbed opposite side immediately after closure. This value dropped slightly during the next three days and then rose sharply, approaching 80% at 15 days. At six weeks after surgery, the sutured abdominal incisions never regained their postoperative strength, remaining at about 80% of the value. With a similar experimental model in the rabbit, Nelson and Dennis[11] assessed the strength of healing paramedian incisions. The results from the groups of animals in which the suture materials were removed before testing demonstrated that the suture contributed a major amount of strength to the healing wound during the first 14 days after wounding, after which the suture had a negligible role in wound repair. In the six weeks of observation, the healing abdominal wall wounds never attained the full strength of the unwounded side, remaining at about 80% of that value.

In an investigation of the healing of lumbodorsal aponeurotic incisions in rabbits, Douglas[12] noted that the strength of any of the wounds could not be detected until the sixth day after wounding. All wounds showed measurable strength by the eighth day, and thereafter, a rapid increase until about the end of the second month, when the curve of healing began to flatten out. Subsequently, a slow increase in strength was detectable, which continued throughout the duration of the study (one

year). At the end of two weeks, the wound approached 20% of that of unwounded tissue; at the end of one month, 50%; at two months, 60% to 80%; and one-year values, up to 90%. This investigator concluded that the repaired aponeurosis never reaches the strength of the unwounded tissue and never before both months after the incision.

Adamsons and'Kahan[13] demonstrated that musculoaponeurotic wounds in rabbits gained most of their strength during the first 30 days after wounding, after which the increase was minimal. Despite the most rapid gain in strength during the first 30 days, the muscle wound regained only 57% of the strength of the uninjured contra lateral muscle. The tensile strength measured over the same cross- sectional area was identical in wounds of skin and muscle during the first nine days of healing. The subsequent pattern of repair in these two tissues, however, was different. The skin wound gained tensile strength at a rapid pace, whereas the wound of muscle demonstrated a slow increase.

In studies of incised fascial wound in rabbits, Lichenstein and co-workers[14] reported that the wound strength after suture removal markedly increased during the first two weeks after wounding, after which the rate of gain was gradual, increasing to 41% at two months. The wounds with intact non-absorbable sutures were as strong the moment the operation was completed as they were two months later, 70% of the strength of the unwounded tissue.

This relative weakness of the musculoaponeurotic wounds in the rabbits may be species specific because it was not encountered in the studies by Adamsons and colleagues[13] on repaired paramedian incision in guinea pigs. Healing paramedian incisions in guinea pigs tested with non-absorbable sutures in situ regained the strength of original uninjured tissues by the ninth day after wounding and exceeded it

significantly by the forty-fifth day. Healing paramedian incisions tested with sutures removed regained 80% of the strength of the original uninjured tissue by the ninth day after wounding and 114% by day 45.

Experimental models in which the peritoneal cavity of the intact animal is distended to measure the burst strength of the abdominal wound simulate the clinical situation more closely than the breaking or tensile strength studies. With this abdominal wound burst model, Kon and associates[15] reported that abdominal disruption often occurred at a site distinct from the wound at one, two, and six months after wounding, indicating that the wound was stronger than the unwounded abdominal tissue.

Local and mechanical factors appear to be more important in 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’[6] found that a standardized staphylococcal wound infection produced significantly weaker fascial wound than the controls. Wound dehiscence is clearly associated with causes of increased intra-abdominal 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).[17] Since the direction, length, and location of the abdominal incision are not important determinants of wound disruption, primary consideration should be given to the location of the incision that provides adequate exposure to perform the operation.

With 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[18] 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 mm from the fascial edges. Leaper and colleagues[19] 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. In another study, Tera and Alberg[2°] measured the holding power of sutures in human musculoaponeurotic incisions. The results of their landmark investigation provide a 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.

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 pararectal 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.

Whipple and Elliott[21] indicated that tying sutures too tightly caused strangulation of the tissue with ischemic necrosis and was the most common error in abdominal wound closure. The suggestion was confirmed by studies of Nelson and Dennis,[1] Haxton,[22] and Sanders and associates.[18] 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 take into account the dynamic changes in wound length during distention.[23] 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.

With an intact animal model, Poole and co-workers[24] demonstrated that the continuous suture technique was associated with greater wound bursting pressure than the simple interrupted suture or figure-of-eight mattress suture. There are several clinical reports in which continuous sutures have been used with excellent results.

Most prospective studies of wound disruption report incidence rates of 1% to 3% after major abdominal operations.[25] Mortality after dehiscence is high, ranging from 9.4% to 43.8%. Factors associated with an increased risk of wound dehiscence include male sex, advanced age, hypoproteinemia, malnutrition, obesity, malignant disease, treatment with steroids, and uremia.[26]

Wound Healing and the Choice of Suture

The purpose of a suture is to hold tissue in apposition until healing is sufficient for the continued presence of the suture to be unnecessary. An ‘ideal’ suture, for all applications, does not exist and the choice of suture material is always, therefore, something of a compromise. When choosing a suture, consideration must be given to the strength of the tissue to be sutured, its healing rate and healing

capacity. This will largely decide the size of the suture required and whether the material should be absorbable or non-absorbable.

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 this period.[19,27] gradually, the tensile strength of the healing tissue increases and suture support becomes less important. Different tissues heal at different rates, but even a year or more after wounding most wounds will only have about 70% of tensile strength of the unwounded tissue.[12]In addition, several factors can delay healing; in particular, infection, hematoma, steroids and coexisting disease causing immune incompetence, malnourishment and cachexia. Tissues exposed to disrupting forces during healing, or which heal slowly, require prolonged support and generally require suturing with non-absorbable suture material (eg. abdominal wall closure).

Successful wound healing depends on an appropriate strength provided by the suture materials and a microenvironment in which the repaired tissues are likely to attach and grow. Choices of suture materials include an absorbable versus non absorbable material, monofilament versus multifilament and a single versus multiple suture lines. 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 that maintain the persistent tension may facilitate wound healing[28,29], these sutures predispose to suture sinus, pain or a buttonhole hernia.[30,3,] In addition sutures kept in trauma sites can induce a significant immune response. Absorbable sutures appear to be more promising if they retain their tension for a period sufficiently long for adequate wound repair. Notably, a single

stranded suture used in a continuous suture technique has the limitation of relying on the integrity of a single line for wound closure Monofilament sutures have no interstices in which to lodge bacteria but they are more difficult to handle and require more throws to each knot for security than braid-ed sutures. Monofilament sutures can be absorbable (e.g., polydioxanone) or non-absorbable (e.g., polypropylene). Multifilament sutures are generally easier to handle, with greater knot security, but do allow capillarity and interstitial bacteria colonisation.[34]These can increase the risk of wound infection, particularly with non-absorbable sutures. Multifilament sutures can be absorbable (e.g., polygalactin) or non-absorbable (e.g., silk). Sutures are dyed in a variety of colors to enhance their visibility during surgery. Dyes do not affect the absorption characteristics of the suture.

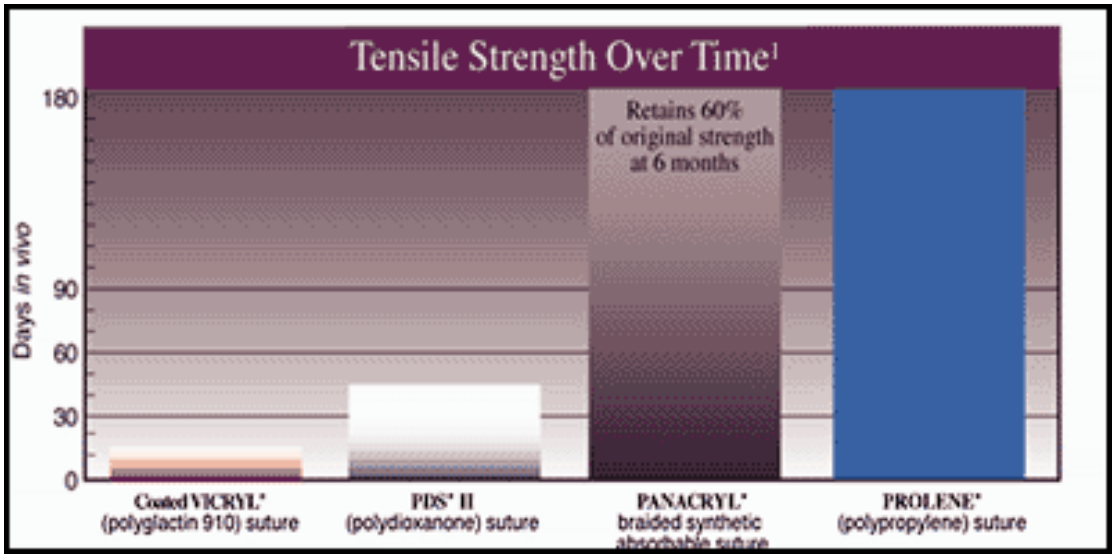


FIG 1. Showing the various tensile strength of suture materials

Sutures are foreign bodies and although modern synthetic monofilament sutures are almost completely inert, braided and 'natural' sutures can excite a significant inflammatory response. Bacteria can be difficult, or impossible, to eradicate once colonization of the suture or knot interstices has occurred. This can predispose the site to wound infection, with abscess and sinus formation, wound dehiscence and incisional hernias, It is known that the number of bacteria required to produce infection can be reduced by tissue in the presence of a silk suture.[34] 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. In practice, much larger sutures are usually used than are strictly necessary, in relation to the breaking strength of the tissues.[35] While most cases of 'burst abdomen' are probably due to cutting out intact sutures[36] premature suture failure can be responsible for late wound weakness and herniation.[37] Sutures are sterilized by manufacturers using ethylene oxide or gamma irradiation (catgut, silk, Nylon).

Steel sutures may be sterilized by autoclave, as can linen, Nylon, Dacron and polypropylene sutures.

The search continues for the ideal suture material for closure of an abdominal incision Moynihan[38] stated in 1920 that 'suture material should ideally achieve its purpose - be sufficient to hold parts together close a vessel, etc ,disappear as soon as its work is accomplished, be free from infection, and be nonirritant...'. These requisites were indeed right and still remain valid nowadays. However, Moynihan concluded: 'The only material which can be made to fulfill these conditions is catgut.'[7] However, catgut is rapidly absorbed, challenging the first item 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[39,40] of suture materials in vitro and similarly comprehensive in vivo comparisons[41,42] 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.

A study conducted by Rucinski et al on the outcome variables of dehiscence, infection, hernia formation, suture sinus formation, and pain were studied in 11856 patients.[15] studies from and the probability of their occurrence 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=.001) and suture sinus by 48% (p=.002). Absorbable monofilament suture material is superior to both absorbable braided and nonabsorbable suture for 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, have fallen into disfavor 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,[34] resulting in an increased incidence of wound infection and delayed formation of suture sinuses. Use of monofilament material avoids these problems. Wire, nylon, and polypropylene are reasonably inert in tissue and do not harbor bacteria. Nylon and polypropylene 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[3] .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.

Non absorbable sutures ordinarily remain where they are buried within the tissues. Improvements in absorbable sutures mean that they can be used in a variety of situations where previously surgeons would have recommended non-absorbable materials. It could be said that it is always best to use an absorbable suture unless there is a good reason not to. When used for skin closure, non-absorbable must be removed or they will lead to chronic sepsis.

Continuous Versus Interrupted

The ideal fascial closure should maintain tensile strength throughout the healing process. The dynamic process of wound healing can be divided into three phases.[69] The first exudative phase (days 1-4) is dominated by vascular, cellular and enzymatic processes, and does not provide any holding strength to the wound, It is followed by the proliferative phase (days 5-20), in which epithelialization, wound contraction and connective tissue repair take place.[68] During this phase, the tissue regains approximately 15- 30 per cent of its original tensile strength. The process can be delayed by wound infection or inflammation.

The best method of wound closure would be one that provides adequate tensile strength to the incision until the wound healed, approximates the tissue in a way that normal healing mechanisms can occur under optimal circumstances, remains secure even in the presence of local or systemic infection, the suture material is well tolerated on a short and long term basis and finally, should be able to be done with expediency. Most techniques of incisional closure had used interrupted sutures, but since 1970's several authors have used a continuous suture as an alternative method to close abdominal incisions. The continuous suture has an advantage of an 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 has been described by Everett[70] who claimed that the results were "excellent" in a large but uncontrolled clinical trial. Numerous centers have been practicing this method for at least a decade. There is no

clinical evidence to show that the incidence of wound rupture is reduced by using continuous rather than interrupted sutures.[71,73] But in an experimental study, Rodeheaver et al[74] 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. The critical tolerated intra-abdominal volume however, did differ when different materials and techniques were compared. 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 as Jenkins suggested.[23]The continuous suture provided the greatest wound security in terms of minimal dehiscence volume. No difference in bursting pressure was found. However, a difference in bursting pressure of the abdominal wall was found in an analogous study by Poole et al.[24] These authors were also in favor of the continuous suture.

The fear of jeopardizing the integrity of the whole wound dates back to the time when wounds were closed with catgut; the strength and absorption of which was unpredictable and was indeed a threat to the integrity of the wound. With the new suture materials that are available at present this risk has largely been eliminated. While most surgeons use continuous mass closure there have been trials of continuous versus interrupted closure. Wissing et al carried out a randomized prospective trial of almost 1500 patients comparing continuous closure with polygalactin[9,l0], with nylon or polydioxanone interrupted closure with polygalactin[9,10,28] They found the highest rate of incisional hernias with continuous polygalactin[9,lO] and the lowest with continuous nylon.

A meta-analysis done by Fagniez et al[105] in 2009 shows no difference in the incidence of dehiscence or hernia formation when either technique is used.Proponents of continuous closure cite an evenly distributed 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. Continuous closure minimizes the number of knots and has been shown to be associated with an equivalent or lower incisional hernia rate in this meta-analysis. 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.

Richards et a1[47], in a study of 571 laparotomy wounds, found no significant difference in the rates of wound dehiscence and incisional hernia formation using these two different techniques. An abdominal incision could be closed with continuous suture in approximately half the time for placing interrupted sutures (20 vs. 40 mins).This finding was confirmed by Gislason et a1[75] who found no difference in incisional hernia formation, when comparing continuous with interrupted closure and found the former to be significantly quicker.

In 1998, Weiland et a1[55] reviewed the medical world literature of techniques of abdominal wound closure between 1977 and 1997 and found 25 comparative articles of which 23 were randomized. A total of [12,2,47] patients from nine countries were analyzed. Comparison of continuous and interrupted sutures failed to reach significance. In analyzing dehiscence, conclusions could not be drawn, since the

populations compared were disproportionate, creating a type I error. The infection rate was significantly different in all types of comparisons.

The authors concluded that the choice of suture material should be based solely on the rates of incisional hernia formation. When continuous closures are chosen, non-absorbable sutures are appropriate. If interrupted closures are chosen, absorbable sutures should be favored. Layered closure increase the risk of infection, hernia and dehiscence as compared with mass closure. 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.

In 2000, Hodgson et a1[54] reviewed all randomized trials conducted in adults and published in English between 1966 and 1998, excluding those comparing 2 sutures of the same category and with the same technique. Strict methodological barriers for inclusion were set, including mainly the Jadad Quality Score. Incisonal 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 cutaneous sinuses and wound pain. 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 it has been proved beyond doubt that a continuous suture equalizes tension differences between individual stitches and distributes the tension across the suture line more evenly than an interrupted one. This is said to minimize the risk of "tissue strangulation" and late "cut through" due to sub optimally placed sutures. it is certainly true that it has advantages in terms of ease and expediency of closure and in

terms of cost benefit as less suture material is required[32,43,48,52,56,58,64].The same fact has been validated in all the recent meta-anaiysis.[34,53,55]

Opponents of the continuous technique think that it leaves more foreign material in the wound and that breakage of the thread automatically jeopardizes the closure of the entire wound. Trimbos and van Rooij[76], 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 is able to adjust itself to postoperative strains in the wound and distributes any increased tension evenly 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 likelihood of knot slippage. It can also be argued that it is more difficult to concentrate maximally when tying 20 or more interrupted sutures than when tying one important knot.

In a historic study by Richards et al, [47] patients were stratified according to the type of wound into clean, clean-contaminated and grossly contaminated surgeries.21 patients in contaminated group were subjected to continuous suturing and 25 patients to interrupted suturing. In the contaminated group wound, there was 4.8% dehiscence in continuous group and 4.2% in interrupted group, which was statistically non-significant. Fagniez et al[51] demonstrated in their multicentric randomized prospective study that the dehiscence rate in interrupted suture group was significantly higher than in continuous suture group only in the stratum of contaminated wounds. Gislason et

al[75] concluded that wound infection in clean and contaminated operations (13%) were much lower than that compared to dirty wounds (30%). Further in the operations classified as dirty, burst abdomen rate of 7% and incisional hernia rate of 14% were found as compared to 2% and 7% respectively in clean elective cases. Incisional herniation was found to be related to emergency operations or length of incisions. Very few studies have been carried out exclusively in emergency settings which have compared the closure of abdominal fascia.

A meta-analysis study of 23 trails conducted in July by Himanshu et al in 2008 has demonstrated a reduction in the odds of wound-closure burst to half, using the interrupted method of abdominal wall closure. Incisional hernias occur with the same frequency with both the interrupted technique of laparotomy wound closure and the continuous technique.

INSECT study in 2005 was designed and carried out by the Study Centre of the German Surgical Society (SDGC).This concluded that surgical expertise is largely a personal conviction and an apprenticeship with surgical techniques passed from one surgical generation to the next .Most surgeons rather use particular techniques because they are trained in than using the most evidence based technique. As the abdominal fascia closure is largely based on tradition rather than evidence, the results of the INSECT trial will help to create more evidence and to guide surgeons to a critical review of their surgical routine.

Other Techniques

Another regularly used technique is the figure-of-eight (or far and near).[77] this suture forms an inner and an outer loop. As the figure-of-eight sutures are pulled taut the wound edges are well approximated. If in the postoperative phase the tensile forces on the wound increase, the outer loop, which contains more tissue than the inner loop, pulls the inner loop tight. The wound remains well approximated instead of diverging as a simple continuous suture does. Some authors assert that this is the reason that patients experience less wound pain when coughing if the laparotomy is closed with the figure-of-eight technique.[78]A potential disadvantage of this technique is that as in the animal study of Rodeheaver et al[74] wounds burst at a relatively small intra-abdominal volume compared with simple continuous or interrupted sutures.

Some authors have attempted develop alternative suture technique to replace the continuous running suture (CRS). One such method a continuous double loop closure technique (CDLC) described Niggebrugge et al. This is basically a continuous mattress suture which incorporates inner and outer loops.[79] The theoretical advantage proposed by the authors was that stress on the outer loop causes tightening of the inner loop which in theory should allow the wound to resist high intra-abdominal pressures and still maintain close tissue approximation. It became apparent, however, halfway through the study that patients in the CD group were experiencing a significantly higher rate of pulmonary complications and post-operative mortality, 5.4%vs. 17.2% (p= 0.0002) and 8.3% vs. 21% (p = 0.0004), respectively. This technique therefore, was quickly abandoned. It is thought that the decreased compliance of the abdominal wall leads to sustained increased intra-abdominal pressure. It is imperative, therefore that any closure technique has enough ‘give’ or

elasticity to accommodate the raised intra-abdominal pressure which inevitably occurs after laparotomy.

Indian Studies

In one of the earlier and benchmark studies comparing abdominal wound closure with monofilament polyamide and chromic catgut, proved the overall superiority of monofilament polyamide over chromic catgut.[80] 200 consecutive patients admitted in the hospital including emergency as well as routine cases were included. There was 30% burst abdomen in the infected wounds of the catgut type but only 2 in 31 infected cases of the nylon group($p<.001$). More number burst abdomen cases occurred in emergency operated cases. Length of incision did not correlate with wound failure. In the catgut group, burst abdomen occurred in 26% as compared to only 2% in the nylon group. Superficial wound infection leading to failure of skin wound occurred in 16.9% patients of the catgut type and 10.1% of the nylon group.

Mean hospital stay in the nylon group was 10 days as compared to 14 days in the catgut type. Incidence of incisional hernia/burst abdomen was significantly reduced by using monofilament polyamide.

In another study evaluating technique of abdominal wall closure in both emergency and routine cases, the rate of complications was much less with a single layer polyamide closure than with conventional technique of suturing parietal peritoneum and posterior rectus sheath together with continuous chromic catgut.[81] Sixty patients who underwent laparotomy either as an emergency or routine formed the material of the study. The rate of complications was found higher in emergency surgeries (15%) as compared to elective cases (10%). In catgut group 16.6% cases had wound sepsis as compared to 6.6% in nylon group. Incidence of stitch abscess

was higher in catgut group than in nylon. The incidence of wound dehiscence was 10% in catgut group and 0 % in nylon group.

In a trial by Srivastava et a1[82] in Indian set up in 2004, prevention of burst abdomen was tested by a new technique interrupted X-suture and compared with the conventional continuous closure. The study enrolled 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 in emergency laparotomy whereas 2/52 in interrupted group and 0/56 in continuous arm suffered burst in elective settings. The relative risk for burst with peritonitis as exposure was 1.86 (95% CI; 1.36-2.55). The attributable risk fraction is 46.3% (95% Cl; 26.3-60.8%, p=.031). It concluded that the risk of burst was less with interrupted X-suture than with continuous method.

Although suture length-to-wound length ratio, (SL: WL) is thought to be important in the prevention of incisional hernia formation, there is no evidence from randomized controlled trials to support this. Jenkins 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.[23] It is known that the size of the tissue bite and the diameter of the suture bear an inverse relationship to the distribution of forces at the tissue-suture interface. In other words, large tissue bites taken with a thick suture have fewer tendencies to cut through tissues. Recently, Jenkin's mathematical model has been challenged by Varshney et al who proposed that an ideal SLWL ratio should approach 6:1.[83] They contend that Jenkins' original model failed to take into account the three dimensional nature of the wound and that approximately 6cm of suture material is required per stitch when taking 1 cm by 1 cm bites. Israelsson and Jonsson[50](1994) performed numerous

clinical and experimental studies on SL:WL ratio. In a large prospective trial 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 was independent of suture type.[84] In addition, they showed a decrease in incisional hernia formation at one-year 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.[85] The authors also demonstrated that although surgeons unaware of the importance of SL:WL ratio, not all employ an ideal technique. Although there has been no randomized trial looking at SL:WL ratio, Kendall et a1[86], who compared mass and layered midline closure (fascia and peritoneum) in a randomized clinical trial, had a SL:WL ratio of 3.7:1 in the layered group and 5: I in the mass closure group (p<0.O01). Despite this there was no difference in incisional hernia rates at one-year follow-up and suggests that SL: WL may not be as critical as suggested by lsraelsson and Jonsson Similarly, Weiland et al in their meta-analysis found that a SL: WL of >4 could not be validated by meta-analysis.[55] Trimbos and van Rooij[76,] 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 more suture material though was required for continuous sutures 1cm apart compared with interrupted sutures 1.5cm apart. In all the recent meta-analysis SL: WL of 4:1 was considered to be appropriate.[3,4,53,55]

There are several factors that can affect SL: WL ratio, not least being the tension applied by the surgeon as well as individual interpretation of the size and interval of fascial bites taken. The issue regarding the amount of tension to apply to a continuous running suture is unclear. In a randomized trial by Mayer et al comparing

normal closure with a fixed compression of 5kg, incisional hernia rates of 10% were noted for the normal closure group, compared with 5.5% for the compression group.[87] This difference, however, only reached statistical significance when the Registrar applied the compression. No difference in postoperative pain or pulmonary function between the groups was noted. The mean length of suture used for each stitch in the normal group was 4.87cm, compared with 3.53cm for the compression group.

To summarize, the recent meta-analysis have debated continuous closure and interrupted, is expedient and requires less suture material. Regarding the complications it is a controversy for the type of closure in terms of wound dehiscence and incisional hernia but at the same time causes less pain and less suture sinus formation.. However, prospective trials comparing continuous and interrupted suturing non-absorbable sutures are lacking in the Indian population in patients undergoing midline laparotomies.

MATERIALS & METHOD

MATERIALS AND METHODS

The study was conducted in patients undergoing laparotomy under the department of surgery in R.L.JALLAPPA HOSPITAL AND RESERCH CENTER are included in our study by applying the following inclusion and exclusion criteria.

Out of the 52 patients will be randomized to have the abdominal wall closed either of technique and they will be grouped as group 1 and group 2 with 26 in each respectively.

Patients under Group 1 will undergo interrupted closure of abdomen while Group 2 will undergo continuous closure of abdomen both will have the same suture material of prolene (polypropylene) 1-0 round body

Inclusion criteria:

- Patients aged 15-75 years.
- Patients posted for laparotomy, either elective or emergency(Peritonitis and intestinal obstruction)

Exclusion criteria:

- Patients with co-morbid conditions like diabetes mellitus, immuno-compromised patients, patients on cancer chemotherapy, immunotherapy and on long term steroids.
- Patient posted for other elective cases
- Patients who underwent second laparotomy or re-laparotomy.

Preoperative evaluation:

All the patients who were included in the study underwent the following investigations:

Preoperative investigations essential for the preanaesthetic check-up fitness. These included hemogram, serum electrolytes, blood sugar, blood urea and serum creatinine, total bilirubin, alkaline phosphatase, SGOT/SGPT, total proteins with serum albumin, x-ray abdomen (erect and supine), Chest x-ray Electrocardiogram and body mass index.

Procedure

Under all aseptic precautions the patient in preferred anesthesia either being spinal or general or epidural .All patients were given pre-operative dose of antibiotics which were intravenous administration of Ceftriaxone 1gm and Metrogyl 500mg. Exploratory laparotomy was carried out through a midline vertical incision. The incision was made in skin using blade no. 22 or no.23.The incision was further developed in layers using electrocautery dividing the subcutaneous adipose tissue. The rectus sheaths were opened up with electrocautery. The peritoneum was opened up between two hemostats with the help of metzenbaum scissors. Necessary procedure was carried out according to the operative findings. Peritoneal drains were inserted accordingly and taken out at the level of umbilicus lateral to the rectus muscle. Peritoneal cavity was washed thoroughly with warm normal saline till the effluent was clear.

Methods of Closure

The randomisation of the patients was done with computer generated . Written informed consent was taken from all the patients. Patients were subsequently divided into the following both groups for closure:

1. **Group 1 (Interrupted Non-Absorbable):** Non-absorbable No. 1 polypropylene was used taking interrupted sutures at a distance of 1-2cm from the divided edge with a distance of 1cm between two consecutive sutures taking 5-6 squared knots in a single suture tie

2. **Group 2 (Continuous Non-Absorbable):** Non-absorbable No.1 polypropylene was used in a simple running technique starting just proximal to the incision. The bites were taken 1-2cm from the divided edge with a distance of 1cm between the two consecutive bites in a non-interlocking manner

The required closure was performed accordingly. The time taken for closure was noted. The total length of the suture material used was noted along with the suture pieces. The skin was sutured with a nylon monofilament 2-0. The wound was cleaned povidone-iodine solution prior to closure.

The primary dressing was removed after 48 hours and povidone iodine solution was used for skin dressing . The wound were inspected for signs of infection and dehiscence before each dressing. Swab cultures form the wound were sent for microbiological culture and antibiotic sensitivity on evidence of any signs of

infection. Patient were then put on antibiotics according to the culture and sensitivity report if they showed any systemic sign of infection (eg: fever, sinus tachycardia, raised total leukocyte counts >11000 cells per cubic millimetre).

Evaluation parameters:

1. Operative time: Time of closure was noted from the start of the closure of abdominal fascia to the close of the abdominal fascia
2. Length of suture material: For continuous closure, suture length was calculated by subtracting the length of suture material remaining at the end of closure from the total length of suture taken at the start of procedure. For interrupted closure, suture length was calculated by subtracting the length of suture material remaining at the end of closure and the suture lengths that were wasted while dividing suture after tying knots from the total length of suture taken at the start of procedure
3. Wound infection: was defined as redness, edema ,rise of local temperature with either of serous or purulent discharge.
4. Wound dehiscence: was defined as post operative missing continuity of the abdominal fascia with bursting open or splitting along sutured lines.
5. Length of hospital stay
6. Patient were followed upto discharge and condition of wound at discharge was noted

Follow up: Patients were followed up and re-evaluated at 1,2,3 and 4 weeks after surgery in out patient department. The patients were examined for following complications:

1. Wound infection

2. Suture sinus: was defined as abnormal protrusion of underlying suture threads through an intact skin, may or may not requiring removal.
3. Burst abdomen/Incisional hernia: was defined as postoperative evidence of a fascia dehiscence after completed superficial wound healing with or without prolapse of abdominal organs.

Patients were also evaluated for patient satisfaction index in terms of local wound pain and discomfort on all the both outpatient visits.

Statistical Analysis:

For qualitative data, significant difference between means was computed by using chi square test. Data was entred into excel sheet and transferred to SPSS after cleaing and coding. Analysis was done using SPSS software. For quantitative data, significant difference between the means was calculated by unpaired T test . Data will be expressed as mean.

RESULTS

The study was conducted in patients undergoing laparotomy under the department of surgery in R.L.JALLAPPA HOSPITAL AND RESERCH CENTER. The study included 44 patients

1. **Group 1 (Interrupted Non-Absorbable):** Non-absorbable No. 1 polypropylene was used taking interrupted sutures at a distance of 1-2cm from the divided edge with a distance of 1cm between two consecutive sutures taking 5-6 squared knots in a single suture tie
2. **Group 2 (Continuous Non-Absorbable):** Non-absorbable No.1 polypropylene was used in a simple running technique starting just proximal to the incision. The bites were taken 1-2cm from the divided edge with a distance of 1cm between the two consecutive bites in a non-interlocking manner

Table 1: - Comparison of Mean age between groups

	Group	Mean	Std. Deviation	P value
AGE (In years)	Interrupted closure	35.73	11.069	0.03
	Continuous closure	30.27	6.290	

The mean age was 35.7 and 30.2 in interrupted and continuous groups which was insignificant and other studies had similar results

Figure 1: - Graph showing Comparison of Mean age between groups
Group 1= Interrupted closure, Group 2= Continuous closure

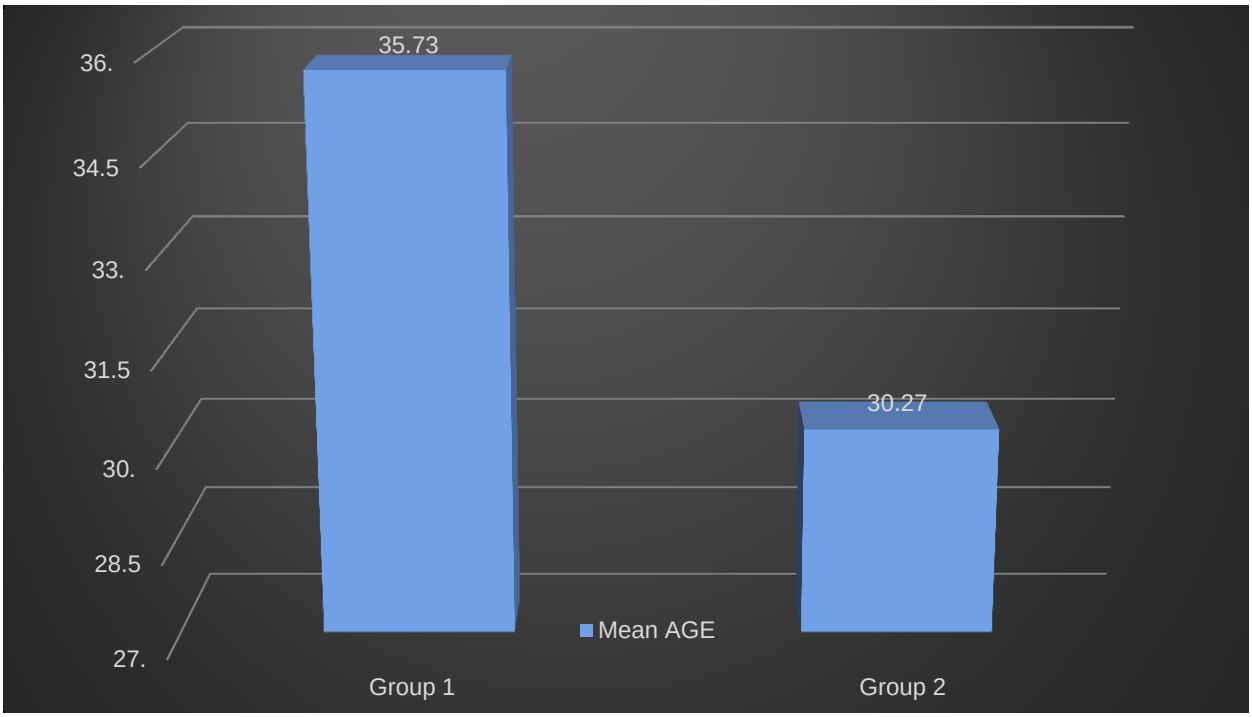


Table 2: - Distribution of cases according to sex between groups

SEX	Group		Total	P value
	Interrupted closure	Continuous closure		
Female	9	9	18	1.00
Male	17	17	34	
Total	26	26	52	

The sex distribution in both groups were equal and both interrupted and continuous groups showed more predisposition to males than females. Other studies showed a similar male preponderance.

Figure 2: - Graph showing Distribution of cases according to sex between groups
Group 1= Interrupted closure, Group 2= Continuous closure

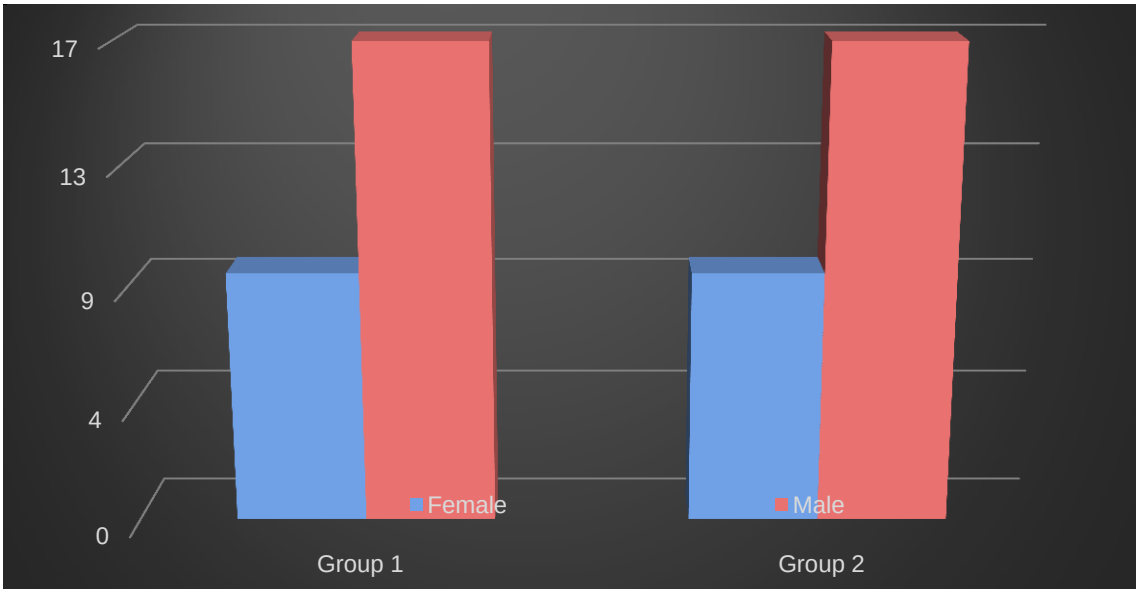


Table 3: - Distribution of cases according to diagnosis between groups

DIAGNOSIS	Group		Total
	Interrupted closure	Continuous closure	
Appendicular mass	1	0	1
Intussusception	1	0	1
Gastric.Ca	2	0	2
Stab injury	0	2	2
Bull gore injury	2	0	2
Gastric perforation	3	0	3
Intestinal obstruction	2	2	4
Appendicular perforation	2	7	9
perforation	4	6	10
Pre pyloric perforation	9	9	18
Total	26	26	52

P value 0.116

In our study the most common cause of midline laparotomy was prepyloric which was 9 in each group and showing a total of 18. Second cause was duodenal perforation which was mostly male. The third most common cause was appendicular perforation. Two cases of gull gore injury and a single case of adult intussusception and undergone interrupted suturing . In a few international and Indian studies the most common cause was perforation.

Figure 3: - Graph showing Distribution of cases according to diagnosis between groups

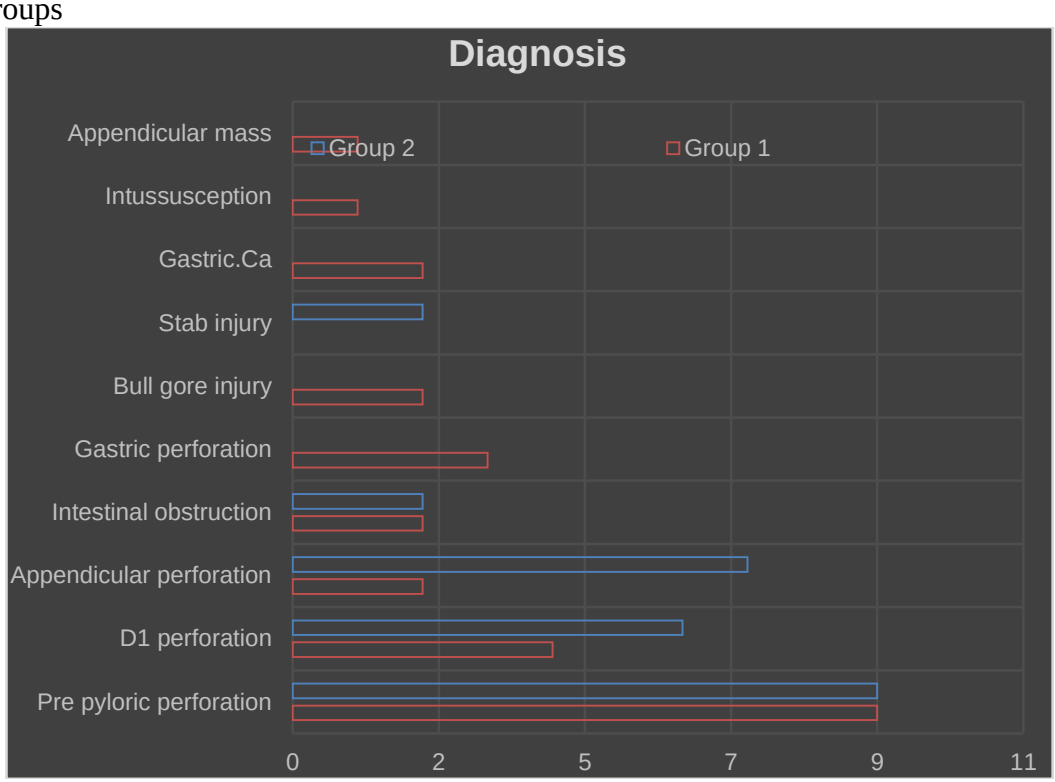


Table 4: - Distribution of cases according to length of suture material used

Suture length	Mean	Std. Deviation	P value
Interrupted closure	121.7692	20.88886	<0.0001
Continuous closure	68.2308	4.09202	

The mean suture length used for interrupted was 121.76 cm and for continuous was 68.23 which was statistically significant . This was probably mainly due to the number of knots for each interrupted and cutting caused a loss in the length material. While the continuous used a single pack of prolene number 1, which is 70 cm , the interrupted used about two suture packs.

Figure 4: - Graph showing Distribution of length of suture material used

Group A= Interrupted closure, Group B= Continuous closure

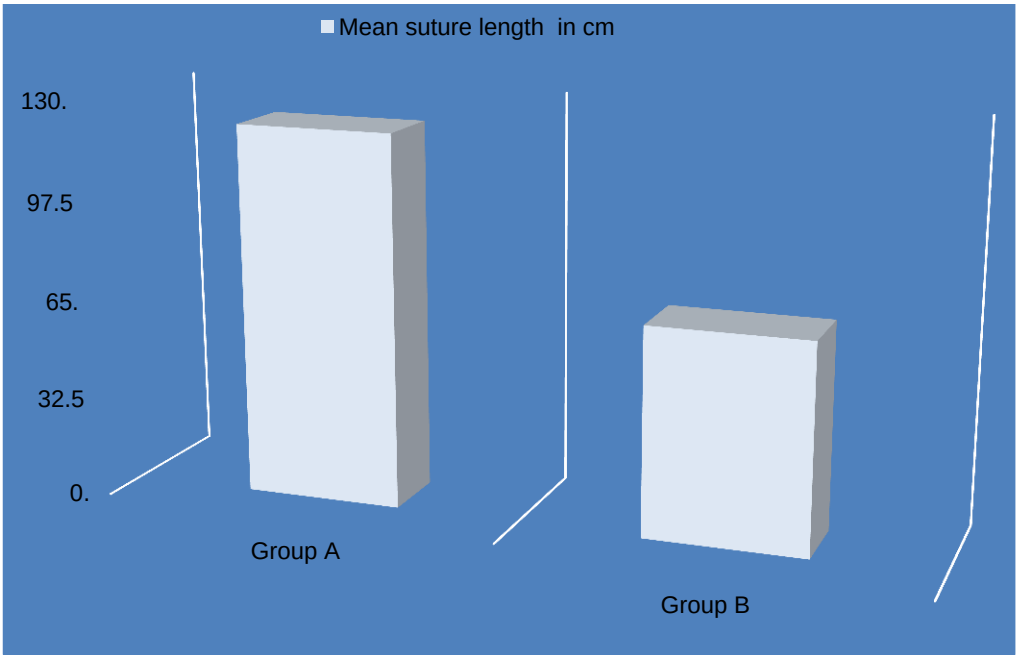


Table 5: - Comparison of Mean Time for closure between groups

	Group	Mean	Std. Deviation	P value
Mean Time for closure (in Minutes)	Interrupted closure	24.81	3.847	<0.001
	Continuous closure	16.35	1.696	

The mean time of closure in interrupted and continuous was 24.81 and 16.34 respectively. This statistically significant (<0.001)There is about a 8 min difference which means the duration under the anesthesia increase though this study didn't show any adverse effects and neither did the studies conducted at other institute. The excess time maybe attributed to the knotting and cutting of suture material at regular intervals

Figure 5: - Graph showing Comparison of Mean Time for closure between groups
Group 1= Interrupted closure, Group 2= Continuous closure

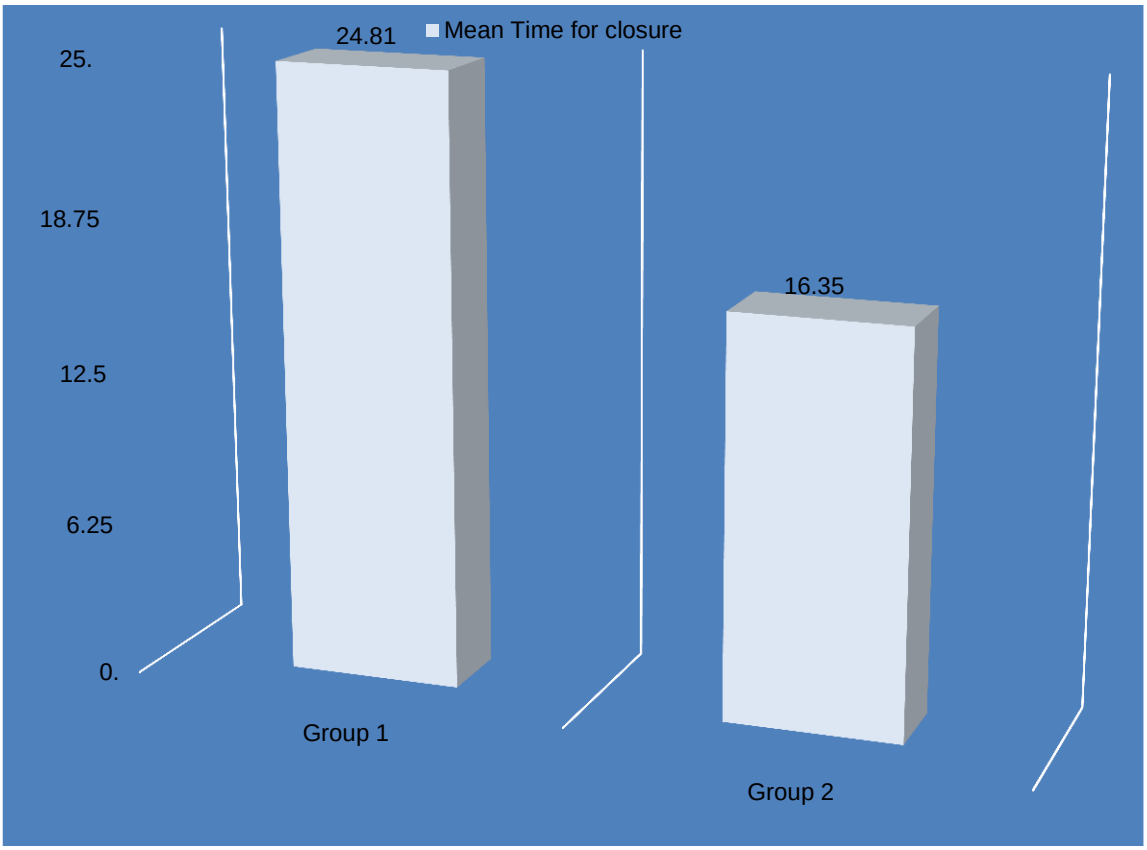


Table 6: - Comparison of Mean Duration of stay between groups

	Group	Mean	Std. Deviation	P value
Mean Duration of stay (in Days)	Interrupted closure	9.19	2.498	0.142
	Continuous closure	10.58	4.022	

The duration of stay in hospital were insignificant while comparing both the groups and recent studies showed that unless there was a severe wound infection or intubated for prolonged time , the hospital stay of 10days was sufficient for the assessment of the wound and general outcome of the patient.

Figure 6: - Graph showing Comparison of Mean Duration of stay between groups

Group 1= Interrupted closure, Group 2= Continuous closure

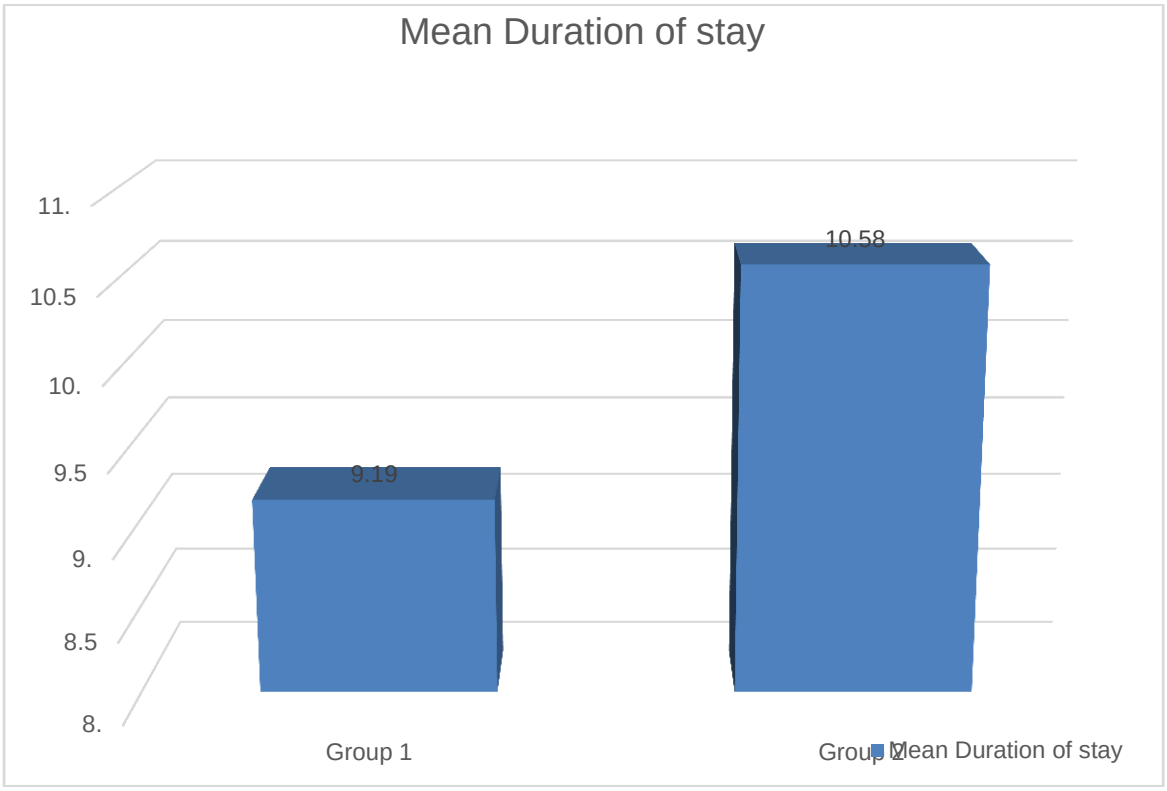


Table 7: - Distribution of cases according to superficial surgical site infection Between groups

Superficial Surgical site Infection	Group		Total	P value
	Interrupted closure	Continuous closure		
No	24	22	46	0.334
Yes	2	4	6	
Total	26	26	52	

The wound infection is not uncommon in midline laparotomy as in most of midline laparotomies are contaminated in nature. Hence wound complication s is common and the rates have been shown to be about 10% to as high as even 30%. In our study we had highest of 15% in continuous group and interrupted had about 7% superficial surgical site infection . The culture was sent and the appropriate antibiotic was started.

Figure 7: - Graph showing Distribution of cases according to superficial surgical site Infection Between groups

Group 1= Interrupted closure, Group 2= Continuous closure

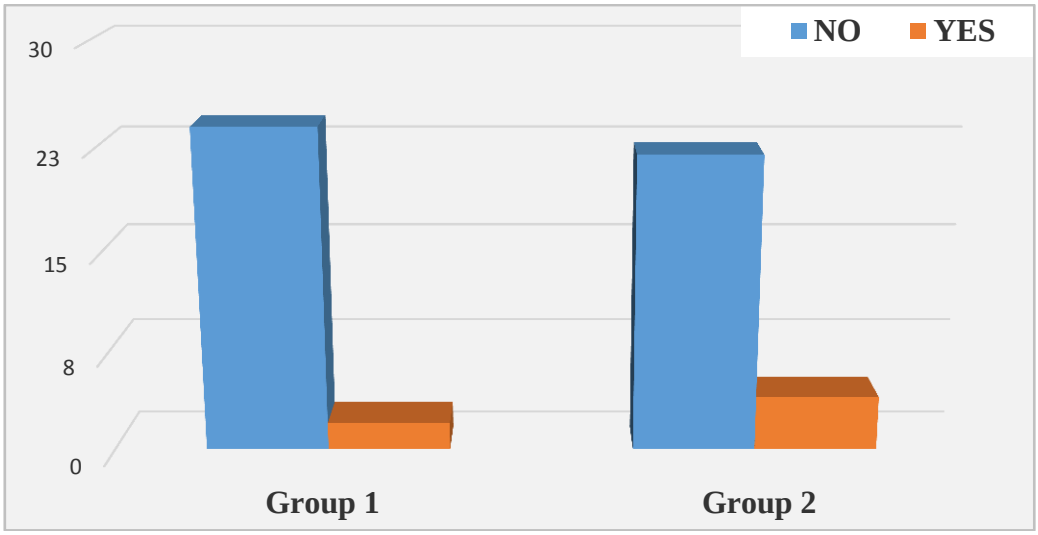


Table 8: - Distribution of cases according to Burst Abdomen Between groups

BURST ABDOMEN	Group		Total	P value
	Interrupted closure	Continuous closure		
No	26	24	50	0.353
Yes	0	2	1	
Total	26	26	52	

There were two case of burst abdomen in the continuous group, though it was statistically insignificant . Other studies have found higher rates of burst abdomen and they did have morality with continuous technique. Relevant studies concluded that in case of excessive contamination , interrupted method of closure is preferred.

Figure 8: Graph showing Distribution of cases according to Burst Abdomen Between groups

Group 1= Interrupted closure, Group 2= Continuous closure

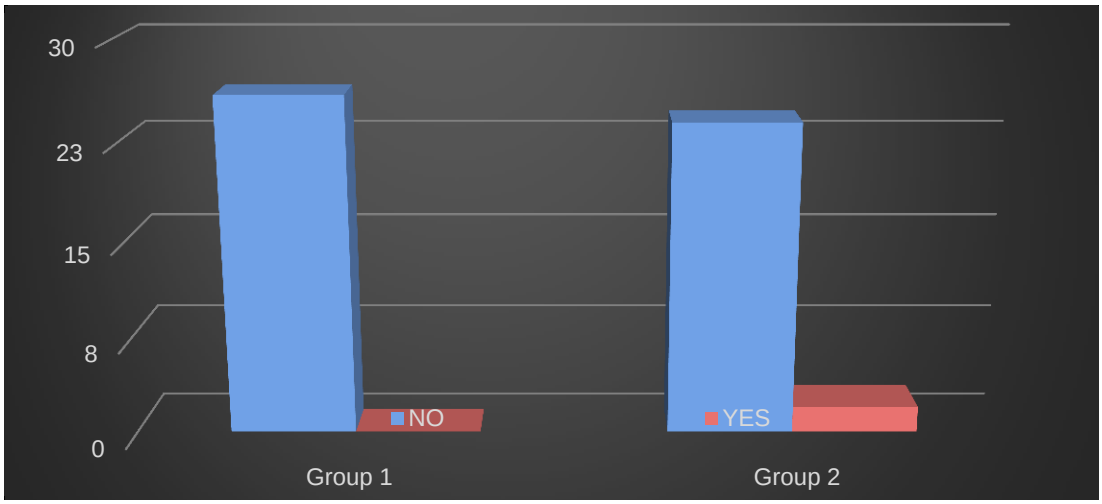


Table 9: - Distribution of cases according to suture sinus Between groups

SUTURE SINUS	Group		Total
	Interrupted closure	Continuous closure	
No	26	26	52
Yes	0	0	0
Total	26	26	52

In relation to the suture sinus , none of the cases of both the groups had suture sinus.

Figure 9: - Graph showing Distribution of cases according to suture sinus Between groups

Group 1= Interrupted closure, Group 2= Continuous closure

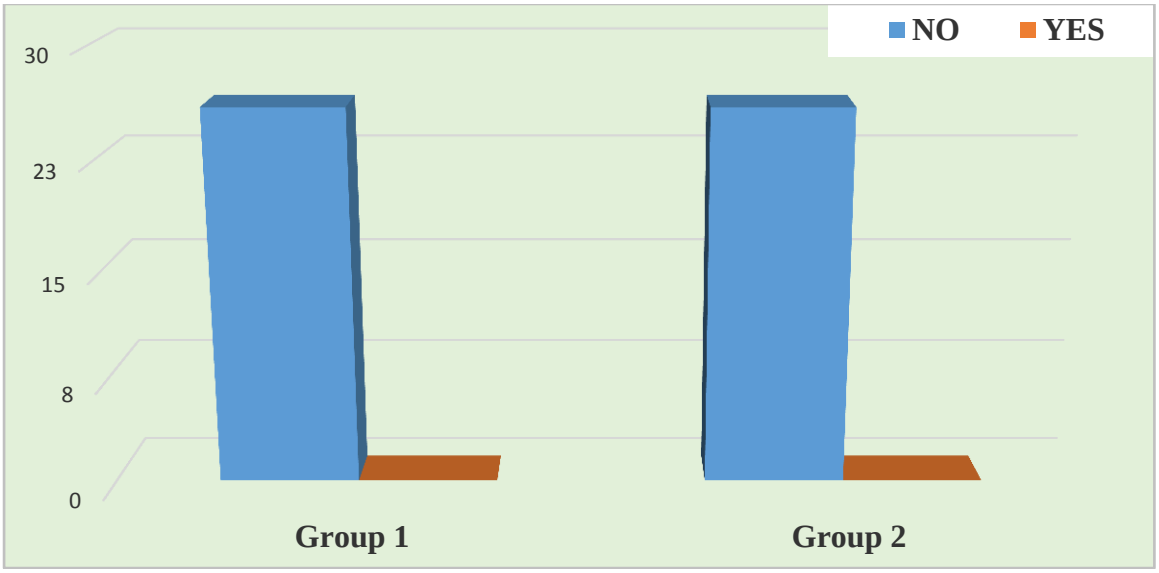


Table 10: - Distribution of cases according to follow up weeks Between groups

Follow up	Group		Total	P value
	1	2		
1	16	14	30	0.675
2	7	8	15	
3	1	3	4	
4	2	1	3	
Total	26	26	52	

The follow up of the cases was good for about 45 patients for 2 weeks and 3 patients were hospitalized for up to 4 weeks due to burst abdomen. Similar results in view of burst abdomen and wound dehiscence was studied and the patients were followed up to 6 months.

Figure 10: - Graph showing Distribution of cases according to follow up weeks Between groups

Group 1= Interrupted closure, Group 2= Continuous closure

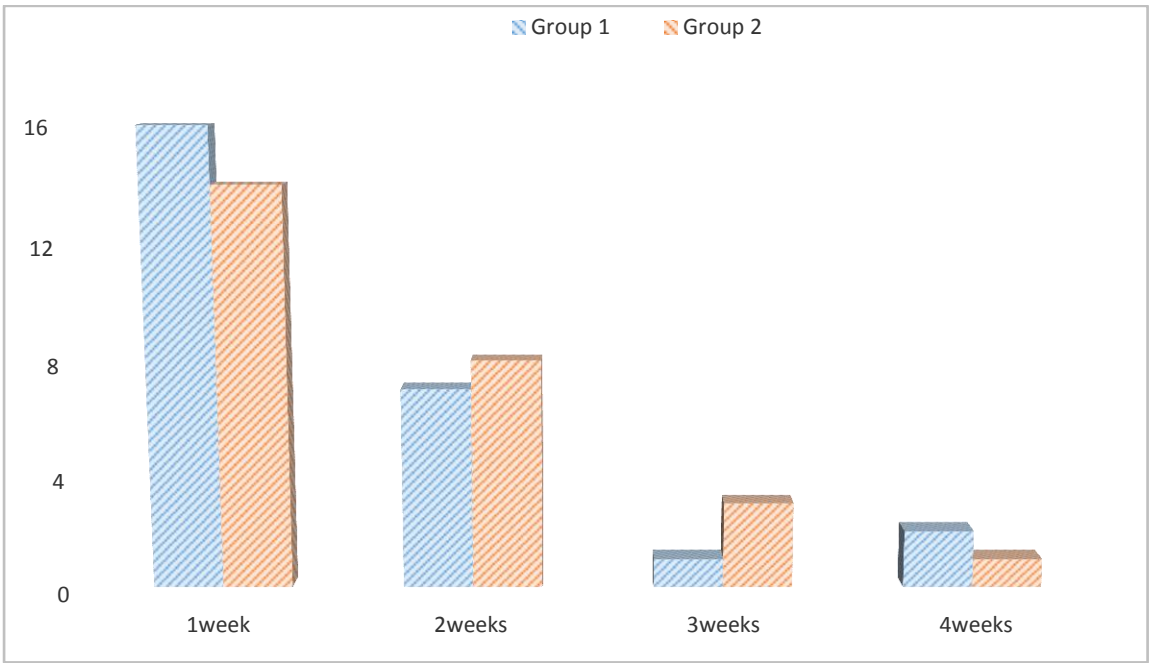
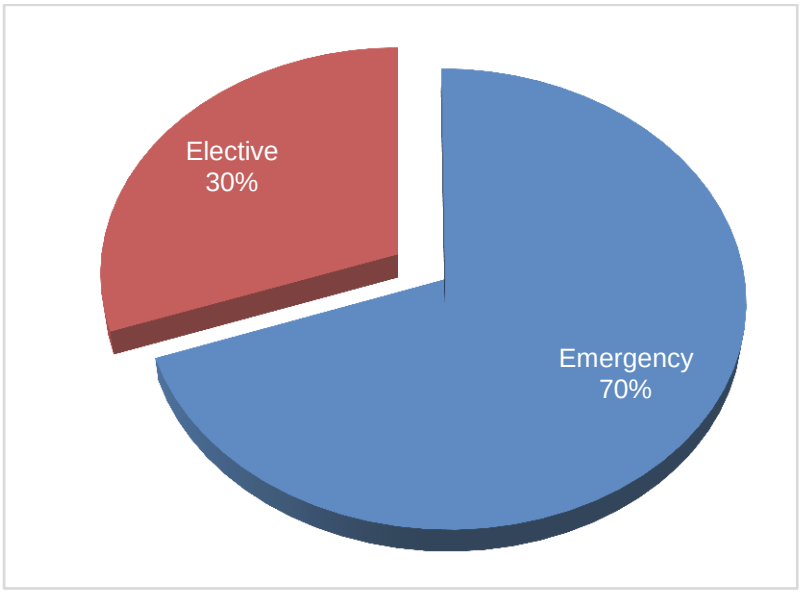


Table 11: - Distribution of cases according to emergency and elective Between groups

Operative	Group		Total
	Interrupted closure	Continuous closure	
Emergency	16	14	30
Elective	7	8	15
Total	26	26	52

There were more number emergency case than the elective case. The recent studies show than elective cases have lower incidence of burst abdomen than emergency. This could be possible due the already comprised nutritional state of patient in emergency situation and infective pathology as such.

Figure 11: - Graph showing Distribution of cases according to follow up weeks Between groups
Group 1= Interrupted closure, Group 2= Continuous closure



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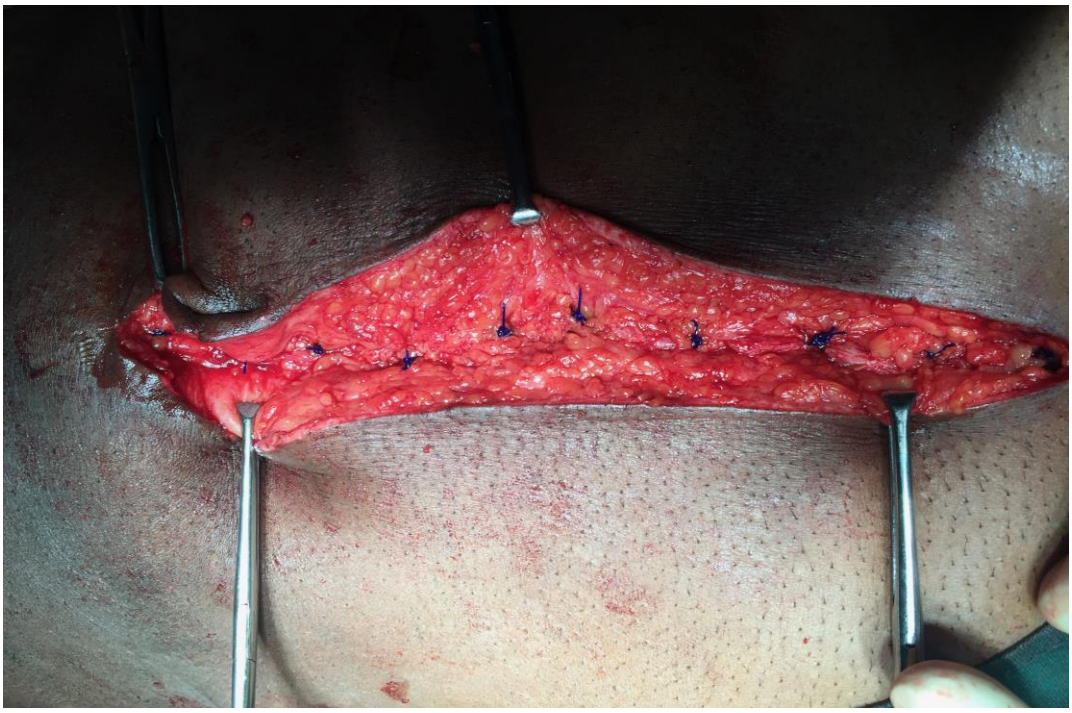

FIG.1 . Midline laparotomy for prepyloric perforation – Interrupted closure

FIG. 2. Midline laparotomy for D1 perforation – Interrupted closure

FIG. 3. Midline laparotomy for intestinal obstruction – Interrupted closure

FIG. 4. Midline laparotomy Bull gore injury – Interrupted closure

FIG.5. Midline laparotomy D1 perforation– Interrupted closure

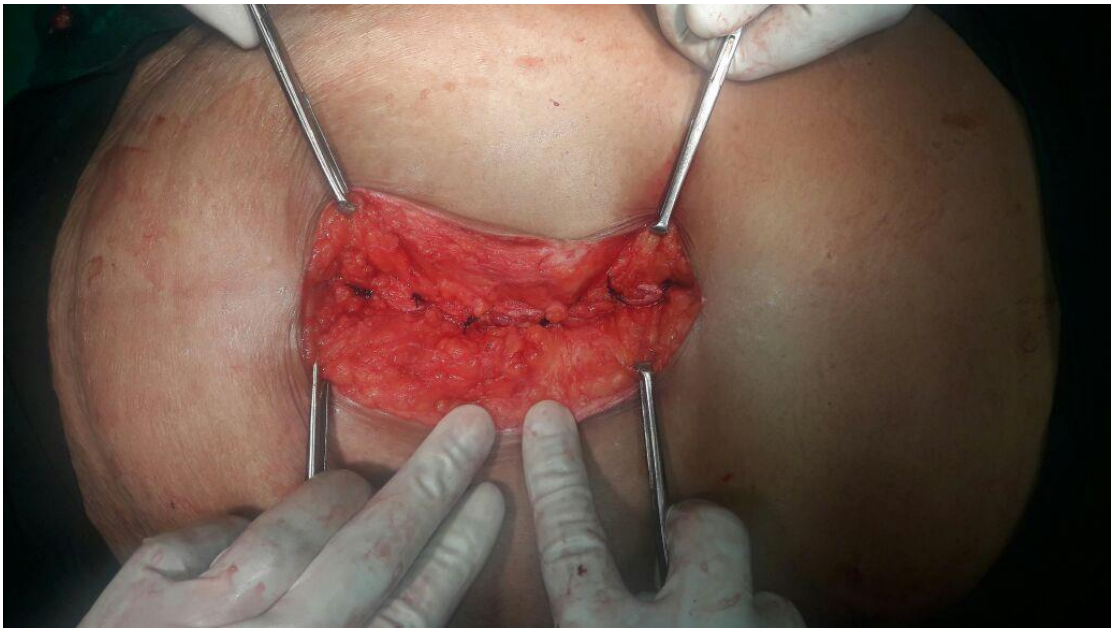

FIG.7. Midline laparotomy Prepyloric perforation– Interrupted closure

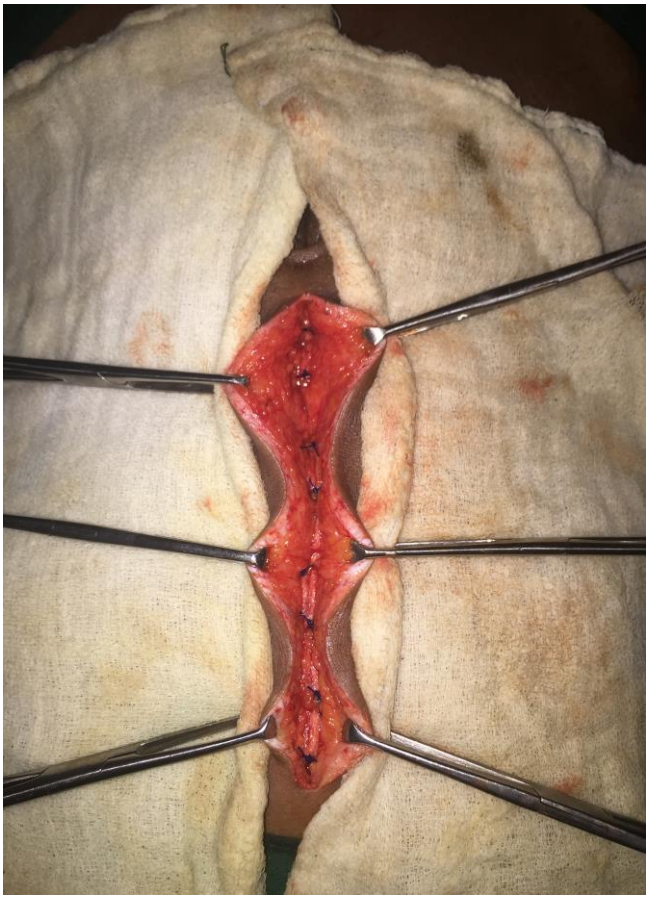

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FIG.9. Midline laparotomy prepyloric perforation– Interrupted closure

DISCUSSION

DISCUSSION

The best method of abdominal closure is one that maintains tensile strength throughout the healing process with good tissue approximation, does not promote wound infection or inflammation, is well tolerated by patients and is technically simple and expedient. The specific technique used in closure of the abdominal fascia for the individual is frequently based on nonscientific factors. Because of difficulties arising from differently tailored study designs, the surgical literature has not clearly demonstrated an optimal technique to close abdominal fascia, especially in emergency settings. This prospective, randomized trial was undertaken to study and compare the ideal technique and suture for closure of abdominal fascia. This study included 52 patients with diagnosis of secondary peritonitis, undergoing exploratory laparotomy through a midline incision in emergency set-up in department of surgery, SDUMC Hospital. The patients were further divided equally into two groups namely continuous non-absorbable VS interrupted non-absorbable. The various results and observations have been hereby discussed under two subheadings i.e between continuous and interrupted technique

1. Age

The mean age of the patients was 35.73 in interrupted group and 30.27 year's in continuous group respectively.60% of the total patients belong to 18-70years. Both groups were comparable in terms of age as there was no statistical significant difference between the mean ages both groups. . Cameron et a1[63] included patients with mean ages of 60.2±17 years in silk group and 61.6±15.2 years in polydioxanone group. In a retrospective study on 2006 emergency laparotomy by Stone et a1[48], the median age of the patients was 27 years (18-78 yrs). Richards et a1[47] had mean age of patients ranging from 48 years in clean surgeries to 36.3 years in contaminated

surgeries. The study by McNeil et al[52] had mean ages of patients as 35±12 years in interrupted group and 38±11 years in continuous group. Hence there was no significant difference in the age profile of the patients as compared to most of the studies.

2. Sex

Majority of the patients were males (34/52). Both groups were comparable in terms of sex distribution. The heavy preponderance of males could be attributed to adverse sex ratio in our state and disease profile of the patients with prepyloric perforation peritonitis being the most common. Similar distribution of sex in both groups was present in the study by Richards et a1[47] in which 70-80% males were included in each group. McNeil[52] also reported a similar distribution of sex (87 males, 13 females) while dividing patients in continuous and interrupted group.

3. Diagnosis

The most common diagnosis of the patients was of pre pyloric perforation peritonitis with 18 patients along with perforation peritonitis in 10 patients followed by appendicular perforation peritonitis in 9 patients. There were two case of bull gore injuries in interrupted and a case of adult intussception. In a study conducted by Pradeep et al the most common diagnosis was TB abdomen, followed by post operative adhensions.Another study showed the most common cause of midline laparotomies.

4. Suture Length

Mean suture length used in continuous suturing was 121.76 cms compared to 68.23 cms for interrupted suturing, the difference being statistically highly significant($p<0.001$). INSECT study showed that the interrupted used more suture material be it absorbable or non absorbable. The main cause for this the fact that there needs to multiple knots for securing the suture. Another study conducted by Dwyer et al in 2003 concluded the same , be it a transverse incision or a horizontal incision the amount of suture material used was significantly higher than the continuous group. To summarize the length of suture material used is usually more than that of continuous group.

5. Time taken for closure of rectus sheath

Mean time taken for closure of rectus sheath in both groups was 24.81 and 16.35 minutes respectively. Mean time taken for closure in continuous technique used was 16.35 minutes as compared to 24.81 minutes in interrupted group, the difference being statistically highly significant($p<0.001$). The difference in time can be attributed to running closure in continuous suturing without having to tie multiple knots. Richards et a1[47] did not record the exact closing time in 571 patients consistently, but the closing time for continuous method was 20-25 minutes while it was 40-45 minutes. In 1983 Stone et a1[48] reviewed 2006 emergency laparotomy retrospectively and suggested that anesthesia and operating time could be reduced by using a continuous closure, although the exact closing time was not calculated. Overall, anesthesia and operating time were prolonged by 11 and 10 minutes respectively by use of an interrupted suture. The difference was statistically significant ($p=0.02$). In a prospective, randomized comparison by McNeil et al[52,] continuous closure was accomplished in significantly less time (21±8 minutes) than

interrupted closure (43±19) minutes but this also included the time taken for closure of skin. Hence the time for closure for interrupted is longer than that of continuous

6. Length of hospital stay

Mean duration of hospital stay in interrupted was 9.19 days and continuous was 10.58 days respectively. There was no statistically significant difference in the duration of total hospital stay when it comes to the technique employed or suture used. Similar results have been quoted by Richards et a1[47] with mean 11.3 days stay in continuous group with 17.5 days in interrupted, the difference being statistically non-significant. There is paucity of data in the literature comparing the duration of hospital stay in continuous and interrupted groups.

7. Superficial surgical site infection

Wound infected in interrupted was 2 and continuous 4 patients respectively. The total wound infection rate was 22%. Wound infection rate in continuous group was 15% as compared to 7% in interrupted group, which was statistically non-significant. Wound infection rate has been found to be present in 3-10% patients undergoing clean elective surgeries. Similarly higher incidence of infection (14%) was also present in a study by Gislason et a1[75] which also included high proportion of emergency operations (32%). Cruse and Foord 90 found in a retrospective survey a wound infection rate of (4%) among 2,093 dirty wounds but they did not specify how skin closure was performed. Stone et a1[48] also reported a similar incidence of wound infection (14%) in emergency laparotomy in retrospective study whereas the same was reduced to 2% and 11% in trauma patients with negative and positive laparotomy in the prospective study. No statistically significant difference was observed in the wound infection rate between the continuous and interrupted closure by Sahlin et a1[58] (10% in continuous and 11% in interrupted).

8. Burst Abdomen

Burst abdomen was noted in 3% of the total 52 patients. Both patients belonging to the continuous group. No significant difference was present in continuous and interrupted groups.

Indian authors have reported burst abdomen to occur in 10-30% of emergency cases[77,78,98]. High percentage of wound dehiscence could be attributed to higher wound infection rate and malnourishment. Consistent with our results, all the five recent meta-analysis trials have shown that there is no significant difference in terms of wound dehiscence while comparing the technique of closure or suture material. Cameron et al[63] noted 1/143 dehiscence in polydioxanone and 9/141 dehiscence in polypropylene, the difference being statistically significant (p0.018). Krukowski et al[49] in another study reported 0.3% dehiscence in both polydioxanone and polypropylene groups. lsraelsson and Jonsson[84] et al (1994) noticed no significant difference in the wound dehiscence rate in polydioxanone and nylon group. Cleveland et al[99] reported a wound dehiscence rate of 0/51 and 1/55 in polypropylene and polydioxanone respectively. Sahlin et al[58] including both elective and urgent operations showed no significant difference in rates of wound dehiscence between continuous (4/345) and interrupted closure (3/339). Gislason et a1[75] reported a dehiscence rate of 2% with a high proportion of emergency surgery (32%). Richards et al[47] also demonstrated no significant difference in wound disruption in the immediate postoperative period between the continuous method and interrupted closure. The 2% dehiscence rate for continuous method is similar to other reports of continuous closure in which the incidence of disruption ranged from 0 to 2.8%[1 56,100] The 0.9% of dehiscence for interrupted method is also comparable to other series of interrupted closure in which the incidence ranged from 0 to 4%43102 There were

more wound dehiscence in interrupted closure (21/392) than in continuous closure(10/388) in contaminated operations, the difference being statistically significant($p<0.05$)[53].

In Indian set-up, burst abdomen occurred in 1/46(2.17%) in interrupted group and 8/54(14.8%) in continuous group in a study by Srivastav et al[82] 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 any group as majority of the wounds were sutured by that time. In a retrospective study by Larsen et al[75] patients were reviewed for burst abdomen and forty-five of 3768 patients burst their abdomen within 30 days of midline laparotomy. The abdomen bursts after a mean of 8 days.

High rates of wound dehiscence in our study can be primarily explained by the fact that our study was conducted in patients undergoing emergency surgery for peritonitis which constitutes a major source of sepsis. Richards et a1[47] also concluded that statistically significant difference in incidence of dehiscence is present in infected wounds than in noninfected wounds ($p<0.02$) Protein calorie malnutrition is widely prevalent in the Indian population. The problem gets compounded further with the onset of consuming diseases like tuberculosis, typhoid, cancer etc. many patients undergoing emergency laparotomy suffer from one of the co-morbid conditions detrimental to healing like anaemia, poor nutritional status, post-operative pulmonary complications etc. Often patients are managed on conservative treatment in peripheral health centers as a result of which they often present in hypovolemic or septiceamic shock. Haemodynamic instability has been described as a significant risk factor for burst abdomen[2].

9. Suture sinus

No suture sinus was present till 4 weeks of follow-up. The recent meta-analysis has consistently shown that non-absorbable sutures are significantly associated more with suture sinus formation. Various studies have estimated the formation of suture sinus from 0-13%, with almost no suture sinus formation seen in polydioxanone. Wissing et a1[28] concluded in their study while comparing polygalactin[9,10], nylon and polydioxanone that polydioxanone was comparable to nylon in terms of wound dehiscence and incisional hernia but more favourable than nylon as it caused significantly less suture sinus(39% vs. 7.7%) formation and less wound pain than nylon. Schoetz et al[61] reported no suture sinus formation with polydioxanone in 200 patients undergoing both elective and emergency procedures. Cameron et al[63] showed only 1/90 case of suture sinus in polypropylene while there was none in polydioxanone. In another study comparing polypropylene and polydioxanone by Krukowski et a1[49] on 757 patients, no case of suture sinus was seen in polydioxanone whereas polypropylene showed 0.3% suture sinus formation. Iwase et al[67] concluded that the incidence of late suture sinus formation with polydioxanone was 1.3% as compared to silk (7.1%) and it healed within 1 week after percutaneous drainage unlike silk which required on an average 16 days to heal.

There was no suture sinus formation in our study as compared to the studies that have been earlier published regarding the same.

CONCLUSION

CONCLUSION

1. Interrupted sutures and continuous are comparable terms of occurrence of superficial surgical site infection and wound dehiscence .
2. It was observed in my study that there wound dehiscence rate were more in the continuous sutures of abdominal wall compared to that of the interrupted sutures.
3. The time taken for interrupted closure was observed to more than 5 minutes.
4. Hence the preferred method closure of abdominal fasica in midline laparotomy is interrupted closure especially in emergency settings.

SUMMARY

SUMMARY

Midline laparotomy is the most common technique of abdominal incisions in both emergency and elective settings because it is simple, provides adequate exposure to all both quadrants, affords quick exposure with minimal blood loss secure wound closure is an essential requirement for an uncomplicated and expedient recovery after laparotomy. One of the most common and major complication associated with the closure of median laparotomy are wound dehiscence and incisional hernia formation which are a major cause of postoperative morbidity. Several studies have been carried out and published which have investigated the optimal suturing technique and ideal suture material for closure of abdominal fascia especially in elective settings. The consensus that has been built upon by these studies is of using interrupted or continuous technique for abdominal fascia closure in emergency set-up on Indian population. The present study was designed as a prospective randomized trial to evaluate the two techniques of fascial closure namely continuous and interrupted undergoing emergency and elective surgery.

The study was conducted in the the Department of Surgery , R.L.Jallappa hospital , Tamaka , Kolar, Karnataka. The study included 52 patients, who were divided into both groups:

- Group A: 26 patients who underwent interrupted closure of abdominal wall using non-absorbable monofilament suture.
- Group B: 26 patients who underwent continuous closure of abdominal wall using non-absorbable monofilament suture

Both the techniques and suture material were evaluated intra-operatively and in terms of early and late complications. The various intra-operative parameters that were studied are:

1. Operative time
2. Length of suture material
3. Time taken for wound closure
4. Incidence of burst abdomen

The patients were followed up in out patient department at 1, 2, 3 and 4 weeks.

The parameters thus obtained were studied in detail and appropriate statistical analysis tests were applied. No statistical difference in either technique was observed in terms of wound infection, wound dehiscence, incisional hernia formation and total duration of hospital stay. Interrupted suturing was found to have similar benefits as that of continuous .

Interrupted can also be preferred method of closure for abdominal fascia closure for midline laparotomy.

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SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCHCENTRE, TAMAKA, KOLAR-563101.

Group 1		Group 2	

PROFORMA

Name :

Age:

Sex:

Address:

Date of admission- / /

Date of laparotomy- / /

Chief complaints:

Presenting illness :

- Pain
- Duration
- Site
- Radiating /non- radiating
- Fever
- Nausea
- Vomiting

- Episodes-
- Vomitus – Food /bilious / blood

Bowel
Bladder

Past history:
DM/SHT/EPILEPSY/TB/JAUNDICE
Similar complaints in the past-
Previous surgeries-

Menstrual history :
Duration
Clots- Y/N
White Discharge- Y/N

Obstetric history:
LMP:
LCB:
Tubectomy- Y/N

Personal history:
Veg. / Non Veg.
Normal sleep
Bowel and bladder

Allergic history:

Treatment history:

General examination

Pallor/ Icterus / Cynosis / Clubbing/ Lymphadenopathy/ Edema

Febrile/Afebrile

Pulse rate: /min **Blood pressure**: **mm of Hg**

Conscious / oriented

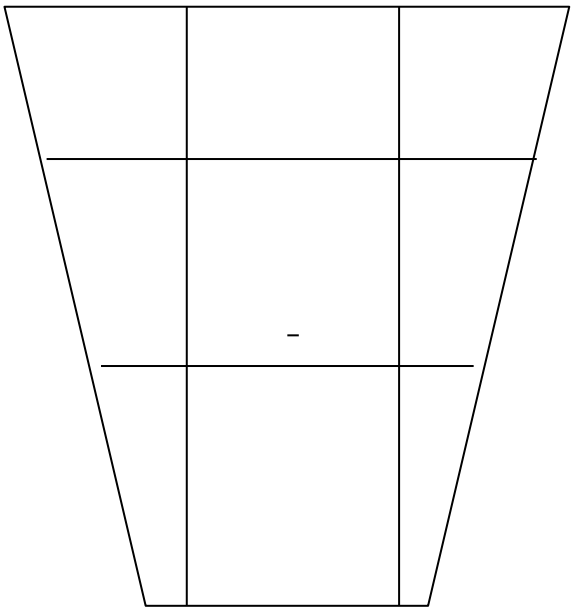
System examination in proper

Inspection :

Shape of abdomen
Umblicus
Flanks
Skin

- Scars
- Sinuses

Distension
Visible peristlalsis
Visible Veins
Hernia orifice
External genitalia



Palaption:
Soft/rigid/guarding
Tenderness

- Region
- Radiated from which region

Organomegaly
Hernia orifice
External genitalia

Percussion:

Liver dullness
Liver span

Auscultation:

Bowel sounds

Systemic examination:

CVS:-

RS:-

CNS:-

Investigations

COMPLETE BLOOD COUNT

Hb:- %
TLC:-
DLC:-
N
L
E
PCV:- %
Plt-
ESR:-
RBS:- mg/dl

RFT

S.Creatinine:- mg/dl
BUN:- mg/dl

ELECTROLYTES

Na:- mEq/L
K:- mEq/L

Blood grouping and Typing
Bleeding time:
Clotting time:

Abdominal X-Ray:

Chest X-Ray

USG abdomen and Pelvis:

CONSENT FORM

I exercising my free power of choice, hereby give my full free and voluntary., consent for myself to be a subject of an operative study **'INTERRUPTED VERSUS CONTINUOUS ABDOMINAL FASCIA CLOSURE IN PATIENTS UNDERGOING LAPAROTOMY TO OBSERVE INCIDENCE OF BURST ABDOMEN".**

I have been informed to my satisfaction by attending surgeon Dr…… the purpose of the study, the clinical and radiological investigations that are to be carried out and the nature and consequences of the surgery, anesthesia and the likely complications in my own language.

I am aware of my right to not opt for this study without having to give reasons for doing so.

Signature of the attending surgeon Signature of the patient

Date: