



Efficacy of Interrupted-X Sutures in Midline Rectus Closure in prevention of Burst Abdomen : A Prospective Observational Study.

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ABSTRACT

BACKGROUND : Abdominal wound dehiscence is a common complication following laparotomy. It is associated with prolonged hospital stay, morbidity and mortality upto 30%. Its prevention is important to reduce post operative morbidity and mortality.

Aim :To assess the efficacy of Interrupted-X sutures over continuous sutures for midline laparotomy closure in preventing wound complications.

Objectives : 1.To apply Interrupted X suturing Continuous suturing for closure of midline laparotomy wound 2.To measure the risk of wound dehiscence and wound infection for the techniques applied.

Methods: A total of 60 patients undergoing midline laparotomy in department of general surgery , both elective and emergency cases ,who satisfy both inclusion and exclusion criteria were divided equally into 30 cases each in the study group(interrupted X)and control group (continuous suture) and were followed in the postoperative period.

Results :: Preoperative patient data among both the groups were comparable. Post operatively 3.34% developed wound dehiscence in the study group when compared to 26.67% in the control group. Wound infection rate were similar in both groups with 30% and 33.34% in study and control groups respectively. In emergency, rate of wound dehiscence in study group was 6.25% and in control group 35.29% whereas in elective surgeries wound dehiscence rate are 0% and 15.3% in study and control groups respectively.

Conclusion :Interrupted-X suture technique is better than continuous suture technique in preventing wound dehiscence in both emergency

and elective setting. However the rate of wound infection is similar in both groups.

Keywords :wound dehiscence, interrupted x and Continuous abdominal closure

I. 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. Wound dehiscence is one of the common and dreadful complication following midline laparotomy closure causing post operative morbidity and mortality.The choice of closure may not be a essential factor for patients undergoing elective laparotomy and with adequate nutritional status, but in a developing country like India, patients usually present with one or more risk factors like malnutrition and prolonged peritoneal sepsis. In india the prevalence of wound dehiscence is reported to range from 10-30%. Optimal technique of wound closure has been a topic of debate since long. Closure technique is one factor where the surgeon has total control, which can bring down the incidence of burst abdomen.

Aim

The study assesses the efficacy of interrupted X suture technique over the continuous sutures technique in midline laparotomy wound closure in terms of wound infection and wound dehiscence.

Objectives :

- To apply
 - Interrupted X suturing
 - Continuous sturing for closure of midline laparotomy wound
- The measure the risk of abdominal wound dehiscence for the the techniques applied



- To calculate the relative risk of burst between continuous and interrupted methods.

Materials and Methods :

This is a prospective randomized double blinded comparative study of different suturing techniques.

A total of 60 patients undergoing midline laparotomy after taking written and informed consent and were divided equally in to 30 cases each in the study group(interrupted X)and control group (continous suture).

Duration Of Study : December 2018 to December 2019

INCLUSION CRITERIA :

- Patients aged above 14 yrs of age
- All patients undergoing elective and emergency laparotomy by midline incision including cases like
 - Appendicitis
 - Intestinal obstruction
 - Intraabdominal malignancy
 - Peritonitis
 - Epigastric hernia
 - Obstructed hernia
 - Abdominal trauma
 - Intraabdominal abscess etc.
- All patients giving written and informed consent for enrolment in the study

EXCLUSION CRITERIA :

- Patients younger than 14yrs of age
- Patients who had undergone a previous laparotomy for any condition
- Patients refused to participate in the study.

PROCEDURE FOLLOWED

All patients were explained about the study and a written consent was signed. Patients were randomized to undergo either continuous or interrupted-X closure technique using simple random sampling. Patients were thoroughly examined, vitals recorded, patient checked for the presence of pallor, icterus, cyanosis, generalized lymphadenopathy and edema first.

Abdominal examination was done in detailed manner and checked for the presence of guarding, rigidity, distention, liver dullness or any scar from the previous surgery. Respiratory and cardiovascular system was evaluated. Routine investigations in the form of haemoglobin, TLC, DLC, Blood sugar levels, RFT, Serum electrolytes and CUE was done. Radiological examination was done with plain xray chest with both domes of diaphragm, xrayabdomen(erect and supine) and a ultrasound abdomen was done whenever indicated. Under general anesthesia, a midline abdominal was made in all the patients and a surgical procedure was performed according to the requirement of the underlying disease. The closure of the midline incision was carried out. Time required for completion of suturing noted. In hospital morbidity in the form of burst abdomen, wound infections, leakage of repair and re-exploration was taken as final outcome.

The Methods used for midline abdominal closure are as follows :

- (a) **Continuous Closure:** It was performed using loop ethilon, care being taken to place each bite 1-1.5 cm from the cut edge of linea alba and successive bites being taken 1cm away from each other. The edges of linea alba were gently approximated without strangulation with an attempt to keep a suture to wound length ratio of 4:1 [1,2].(Fig.1)

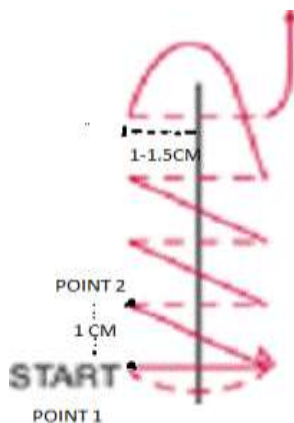


Figure 1 – Continuous suture



(b) Interrupted Double-X Closure: It was performed using No. 1 Prolenesuture (polypropylene). A large bite was taken on the cut edge of linea alba at point (1) from outside-in, 2 cm from edge. The needle emerged on the other side from point (2) inside-out diagonally 2 cm from the edge and 4 cm above or below the first bite. This strand was crossed or looped around the free end of suture and continued outside-in, at point (3) and comes at point (4), diagonally at 90 degree to the first diagonal. The two ends were tied just tight enough to approximate the edges of linea alba, taking care not to include bowel or greater omentum between the edges. The small free end of the

suture is passed deep to the X behind linea alba and again tied to the other end of the suture. This method of tying four throws in front and four throws behind the X created two X-like crosses - one on the surface and another deep to linea alba. The central knot allowed fixation of four arms of the X like a pivot. The next X-suture was placed 1 cm away (above or below) from the previous one. Thus, in a 14cm long wound, 3 X-sutures were applied (Fig. 2). The suture line was then palpated for any gap with the index finger. Any large gap permitting a finger was closed with a simple interrupted suture. [1,2]

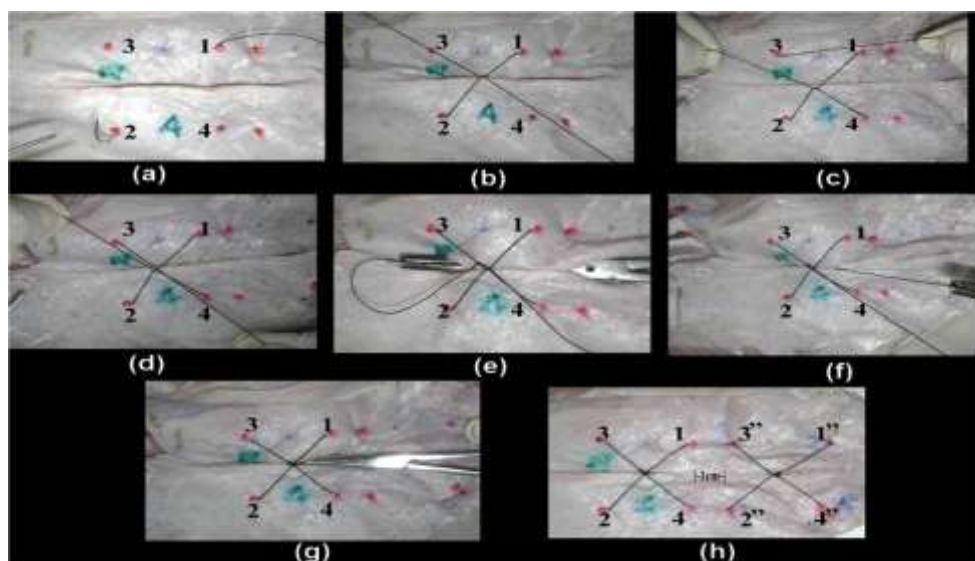


Fig. 2 Interrupted X-suture. (a) A bite is taken at (1)—a point 2 cm from cut edge. The needle emerges at (2) another point 2 cm from cut edge, 4 cm cranial or caudal to (1). (b)The two ends of suture strand crossed. (c)The needle enters at (4) and comes out at (3). Point (3) is 4 cm away from (1) and 2 cm from cut edge. Point (4) is 4 cm away from (2) and 2 cm from cut edge. (d) The two ends of suture being tied in front of linea alba. (e)The small free end of suture pulled inside with an artery forceps or right angle forceps. (f) The small free end of suture tied with long strand of suture. (g) Knot being buried behind linea alba to prevent sinus formation. (h) Two interrupted X-sutures applied, 1 cm apart

Follow-UP:

Each incision was specifically followed and investigated for hematoma, infection, any discharge from wound, dehiscence or burst abdomen. The wound was managed by daily antiseptic dressings and intravenous antibiotics. The patients who developed wound infection, twice daily change in dressing done. Any discharge from wound sent for culture and sensitivity and accordingly intravenous injectable were started. Each patient was followed up on 1st week, 2nd week than on 4th week after surgery to determine the risk of Abdominal wound dehiscence or burst abdomen.

VARIABLES MEASURED:

The main outcome was presence of wound infection and abdominal wound dehiscence or burst. A burst was considered present when abdominal viscera were seen in the abdominal wound up to 30 days from the date of operation.

The following predictor variables were also be recorded:

- (a) Intra-peritoneal sepsis.
- (b) Cough
- (c) Diabetes- Its presence is defined as fasting blood sugar >140 mg/dl or random blood sugar >200 mg/dl.



- (d) Uraemia- Its presence was defined as blood urea greater than 50 mg/dl.
- (e) Abdominal distension
- (f) Malnutrition-Its presence was defined as weight <70 % of expected weight.
- (g) Anaemia-Its presence was defined as haemoglobin less than 10 g/dl.
- (h) Smoking
- (i) Alcohol
- (j) Duration of Surgery - long >2 hours/ short ≤2 hours.

- (k) Duration of illness -<3 days/ ≥ 3days .

II. RESULTS

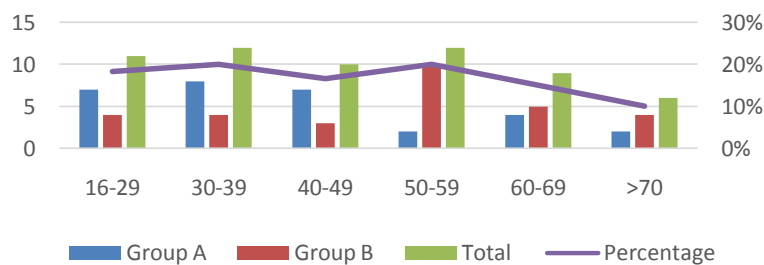
Data was collected from 60 patients who were selected based on the inclusion criteria. The patients were divided into 2 groups. For the ease of representation the groups were named as following

1. Group A (conventional Continuous suturing)
2. Group B (Interrupted-X sutures)

Distribution of demographic variable Age of Presentation

Age distribution	Group A	Group B	Total	Percentage
16-29	7	4	11	18.3
30-39	8	4	12	20
40-49	7	3	10	16.6
50-59	2	10	12	20
60-69	4	5	9	15
>70	2	4	6	10
	30	30	60	

Chart Title

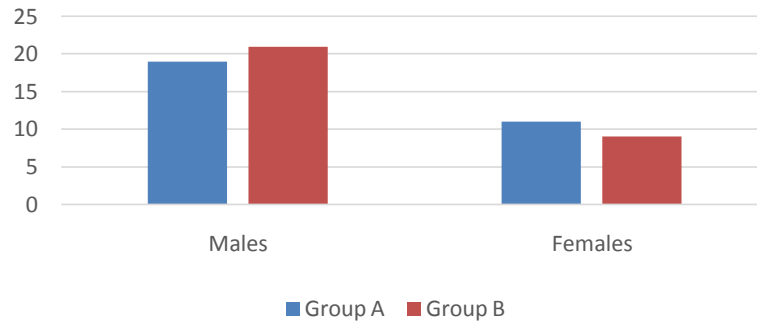


Gender Distribution

Sex	Group A	Group B	Total
Males	19	21	40
Females	11	9	20
Total	30	30	60



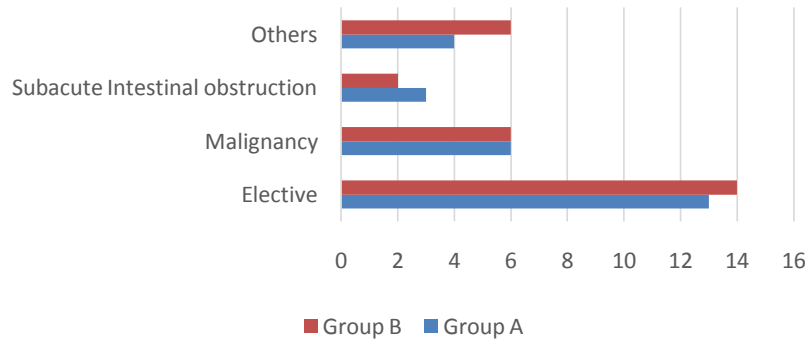
Gender Distribution



Distribution of various etiologies in between the groups

Primary Etiology	Group A	Group B	Total
Elective	13	14	27
Malignancy	6	6	12
Subacute Intestinal obstruction	3	2	5
Others	4	6	10

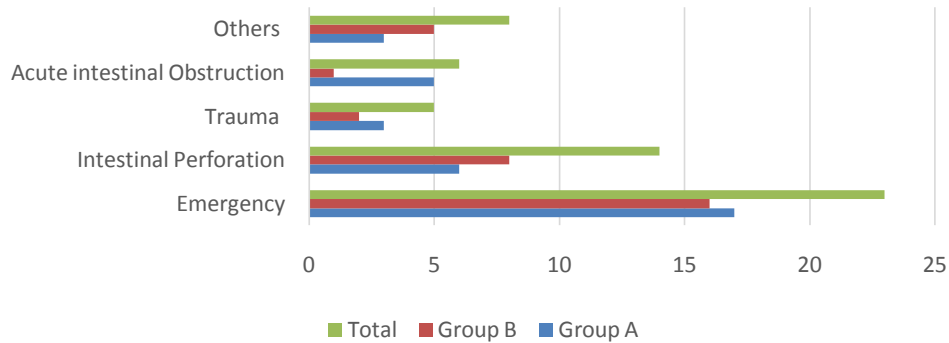
Primary Etiology in Elective Surgery



Primary Etiology	Group A	Group B	Total
Emergency Intestinal Perforation	17	16	23
Trauma	6	8	14
Acute intestinal Obstruction	3	2	5
Others	5	1	6
Others	3	5	8



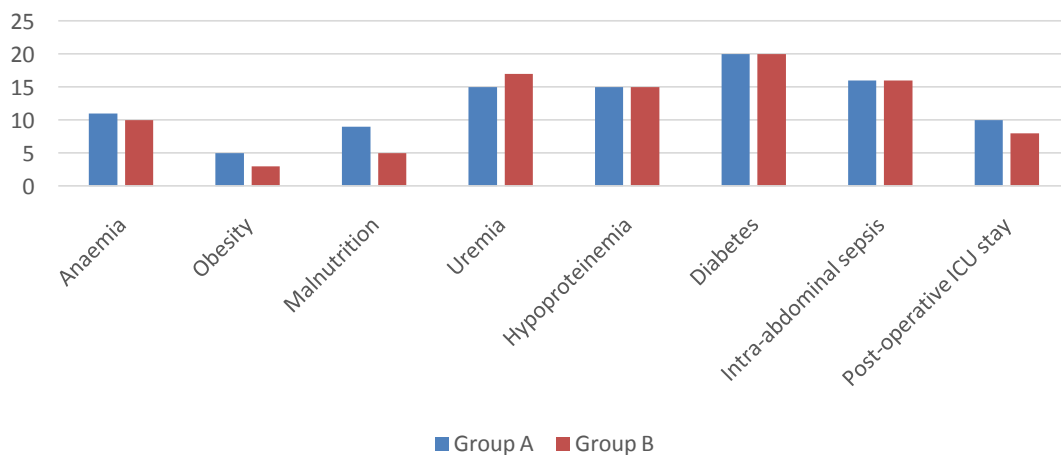
Primary Etiology in Emergency



Comparison of baseline variables among both groups

Clinical Variables	Group A	Group B
Anaemia	11(36.67)	10(33.37)
Obesity	5(16.67)	3(10)
Malnutrition	9(30)	5(16.67)
Uremia	15(50)	17(56.67)
Hypoproteinemia	15(50)	15(50)
Diabetes	20(66.67)	20(66.67)
Intra-abdominal sepsis	16(53.34)	16(53.34)
Post-operative ICU stay	10(33.37)	8(26.67)

Comparison Of Baseline Variables





Intra operative data comparison

	Group A	Group B
Average Closure time	12.2 min	21.4 min
Mean Suture Length	78.3+-12.4	110.6+-11.14
Suture : wound length ratio	4.1	5.9

Percentage of wound dehiscence and wound infection rates in emergency setting in different suturing groups

Suturing technique	Emergency	Wound dehiscence rate	Wound infection rate
Continuous suture	17	6(35.29%)	7(41.1%)
Interrupted-X Suture	16	1(6.25%)	6(37.5%)
Total	23	7(30.4%)	13(56.5%)

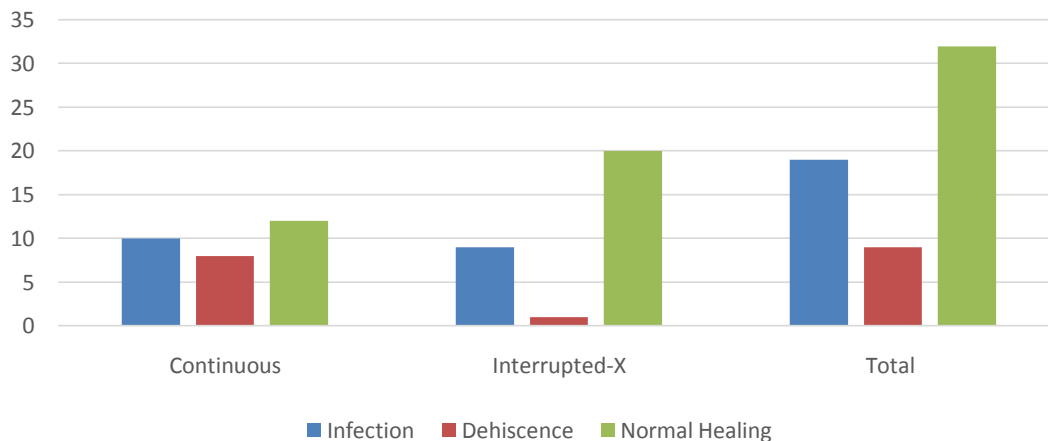
Percentage of wound dehiscence and wound infection in elective surgeries

Suturing Technique	Elective	Wound dehiscence	Wound infection
Continuous suture	13	2(15.3%)	3(23.1%)
Interrupted-X	14	0	3(21.4%)
Total	27	2(7.4%)	6(22.2%)

Post Operative Outcome in both groups

Suturing technique	Infection	Dehiscence	Normal Healing	Total
Continuous	10	8 (26.7%)	12	30
Interrupted-X	9	1 (3.34%)	20	30
Total	19	9	32	60
		p-value is .011378	p-value is .781375	

Post Operative wound outcomes in both groups



III. DISCUSSION

The study was conducted on patients whose age was >16yrs, and most of the patients were noted in the age group <60yrs (75%). There were around 10% of the patients with age more than 70.

For a particular wound to heal, the incidences of early and late complications are the better measurements. The early complications after

abdominal wound closure include infection and dehiscence, and the late complications include hernia, suture sinus, and incisional pain[3]. In this study, the emphasis was made on the early complications, i.e., wound infection and wound dehiscence.

The purpose of any suturing technique is to provide proper support during wound healing until adequate tensile strength is regained. The best



abdominal fascial closure should be easy, simple, and fast and prevent postoperative complications. The type of suturing technique is one factor that can be controlled by the surgeon among the others, causing postoperative complications. This led to a variety of abdominal fascial closure techniques which have been described and are being practiced all over the world. There are trials being conducted still to identify the ideal closure technique for preventing post-operative dehiscence.

The present study was started with the aim to identify the most effective method of midline fascial closure following both emergency and elective settings. The present study has taken 2

different techniques of suturing, i.e., Conventional Continuous Suturing and Interrupted-X suturing techniques.

The baseline variables considered in the study were almost equal in both groups.

Many studies have been done in the past comparing both the sutures. In the present study, the incidence of dehiscence among conventional continuous group was 26.67%, whereas that with the interrupted X technique was only 3.34%, which is statistically significant ($P < 0.05$)

The incidence of wound infection among the groups were 33.34% and 30% respectively, which is statistically not significant. ($P > 0.05$)

Comparison of the wound dehiscence rate among the 2 groups in various studies :

Comparitive Studies	Continuous	Interrupted-X
Kunju et al [6]	16 %	6.6 %
Kumar et al [5]	21.05 %	5.66 %
Songara et al [7]	19.5 %	7.9 %
Balaji et al [8]	36 %	10 %
Present study	26.67 %	3.34 %

Comparison of Wound Infection rates among various studies with the present study in case of Conventional Continuous and Interrupted X techniques :

Comparitive Studies	Continuous	Interrupted-X
Kunju et al [6]	56.6%	36.64%
Balaji et al [8]	32%	32%
Songara et al [7]	26.3%	29.3%
Present Study	33.34 %	30%

There were other studies conducted which proved that continuous was better in emergency settings. Like, Fagniez et al. [4], as cited by Kumar et al. [5], titled as "abdominal midline incision closure," was a multicenter randomized prospective trial of 3135 patients. This large trial compared continuous and interrupted poly-glycolic acid sutures and came out with an overall dehiscence rate of 1.6% in the continuous group versus 2% in the interrupted group, which was significantly higher[9].

A meta-analysis by Gupta et al. [10] on 23 trials comparing continuous and interrupted techniques demonstrated a reduction in risk of wound dehiscence to half with the interrupted technique.

Furthermore, all these studies considered only in emergency settings. However, the present study included even the elective cases along with emergency cases in order to find out the influence of the type of surgery on dehiscence and wound

infection. Out of 33 emergency cases 7 cases(21.2%) had wound dehiscence and of 27 elective cases only 2 cases(7.4%) had wound dehiscence.

The low infection and dehiscence rates in the elective setting can be explained by the fact that most of these patients have less intra-abdominal sepsis, and also all the systemic factors are properly evaluated and corrected pre-operatively[8]. Also, in the elective setting, cases are operated under controlled settings, and thus, errors of the technique are further minimized.

IV. CONCLUSION

In the present study, interrupted X sutures were statistically significant in preventing wound dehiscence and infection, whereas higher rates of dehiscence were reported with the continuous group. This mainly was because of the less hacksaw effect with the Interrupted X technique, and also blood supply to the healing edges is not disturbed with the X suture as it does not have any



vertical or horizontal limbs. The Hughes repair was equally better among the interrupted techniques as tension load is evenly distributed both along and across the suture[11]. However, further studies and analyses are required to consider an ideal suturing technique.

Thus the integrity of abdominal wound repair depends upon the tissue holding capacity of the suture and the suture holding capacity of the tissue. Hence, the secret of successful abdominal closure lies in following a good surgical technique, and it is a part of every aspiring surgeon to identify and practice a correct surgical technique.

However, the limitations of the present study were, a shorter period of follow-up could not describe the risk of other delayed complications like hernia with the suturing techniques. Moreover, the sample size was small, and better results could be interpreted if the sample was large.

Analyses of both suturing techniques and in comparison with the literature, a distinct set of technical components are superior in preventing post-operative complications –

1. Mass closure compared with layered closure.
2. Interrupted closure compared with running continuous closure
3. Suture length to wound length ratio of 4:1.
4. Achieving proper control of systemic risk factors pre or post-operatively. It is, however, a surgeon's own preference in deciding the proper surgical technique for his own patient benefits.

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