Original Research Article

Comparison of interrupted-X technique closure versus conventional continuous closure of rectus sheath: a randomized control study

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ABSTRACT

Background: A major surgical complication after emergency midline laparotomy is abdominal fascial dehiscence. Dehiscence is associated with increased morbidity and mortality rates up to 30%, prolonged hospital stay, and a long-term risk of developing incisional hernia. The risk factors of Wound dehiscence can surgeon factors or patient factors. This study was aimed at comparing effectiveness of interrupted-X technique versus conventional continuous closure of rectus sheath in midline laparotomy in emergency setting.

Methods: This study was conducted in a total of 100 patients underwent midline laparotomy for perforation peritonitis in emergency setting. Out of which 50 patients underwent rectus sheath closure by interrupted-X technique (group A) and 50 patients by conventional continuous closure (group B) using non-absorbable, monofilament, no.1 polypropylene suture. Necessary preoperative patient data, wound length, the time taken for rectus closure, length of the suture material used, post-operative complications like wound dehiscence, surgical site infection, period of hospital stay were recorded for analysis.

Results: Preoperative patient data among both the groups were comparable. Group A was found to have less wound dehiscence (p=0.001 for partial and p=0.008 for complete) and less period of hospital stay (p=0.054), which were statistically significant. Surgical site infections were similar in both groups. Group B was found to have less time taken for closure (p=0.003) and less length of suture material used (p=0.003), which were statistically significant.

Conclusions: Interrupted-X technique of rectus sheath closure reduces the rate of wound dehiscence and period of hospital stay, although it consumes more length of suture material and more time for suturing as compared to conventional continuous closure.

Keywords: Interrupted-X technique, Conventional continuous closure, Wound dehiscence, Midline emergency laparotomy

INTRODUCTION

A major surgical complication after emergency midline laparotomy is abdominal fascial dehiscence. It may appear either as an early (burst abdomen with evisceration, partial dehiscence) or a late (incisional hernia) complication. Postoperative complete wound dehiscence is an unfortunate condition, and serious complication is associated with a high morbidity and mortality rate. These patients usually undergo multiple dressings, fecal fistula formation, surgery for secondary fascial closure, which is associated with markedly increased morbidity, with high incidence of incisional hernia(up to 45%).[1]

The choice of method of closure may not be very crucial in patients undergoing elective laparotomy with adequate nutritional status and no other risk factor for burst, but in

developing countries such as India, most patients present with one or more risk factors such as prolonged intra-peritoneal sepsis and malnutrition.[2] Dehiscence is associated with increased morbidity and mortality rates up to 30%, prolonged hospital stay, and a long-term risk of developing incisional hernia.[3] Conventional continuous closure technique has been shown to compromise blood supply and thereby poor wound holding, during initial phases of wound dehiscence. Surgeons have been continuously striving to overcome postoperative complications associated with laparotomy wound closure using newer techniques and newer suture materials. Several reviews have studied the optimal suture repair for closing the abdominal fascia, but no consensus has been reached. Hence, it is imperative for us to ascertain better method of closing the abdomen. This study is aimed at comparing effectiveness of interrupted-X technique versus continuous closure of rectus sheath with non-absorbable monofilament polypropylene no.1 suture in midline laparotomy in emergency setting.

METHODS

This is a randomized control study conducted among the patients presenting to the department of general surgery Maulana Azad Medical College and Associated Lok Nayak Hospital, New Delhi during the period of March 2018 to March 2019. The inclusion criteria were patients who underwent laparotomy for perforation peritonitis in emergency settings by midline incision and age more than 18 years. The exclusion criteria were the patients with history of previous midline laparotomy. The primary outcome variable was to determine the incidence of wound dehiscence (Post-operative separation of musculo-aponeurotic layers of abdominal wall within 10 days of surgery) and secondary outcome variable was to duration of hospital stay. Simple randomization design was used for test and control groups using computer generated random number tables at the time of closure.

Group A: 50 patients (Interrupted-X technique group)– test group.

Group B: 50 patients (Conventional continuous closure group)– control group.

Detailed methodology

This study has been reported in line with Consolidated Standards of Reporting Trials (CONSORT) guidelines. Decision for emergency laparotomy made based on thorough history, clinical examination, emergency laboratory investigations such as hemogram, blood dextrose, blood urea, serum creatinine, liver function tests. Emergency radiological investigations such as ultrasound abdomen, chest skiagram postero anterior view, abdomen skiagram erect and supine views, computed tomography (wherever indicated).

Informed consent was taken before enrollment into study. All patients were given prophylactic antibiotics with injection ceftriaxone 1 gram and injection metronidazole 500 mg intravenously during anesthetic induction. However post-operative antibiotics were decided according to pathology found. Patients who had procedures lasting more than 4 hours were given second dose of antibiotics. Skin disinfection was done with povidone iodine and spirit. Emergency laparotomy was made with midline incision. Intra operative findings were recorded. After necessary procedures were carried out for the pathology identified. Thorough peritoneal lavage was given and abdominal drains placed. Rectus sheath was closed with following techniques. Suturing was done by senior residents who had done more than ten interrupted-X suture technique or conventional continuous technique of rectus closure with the suture material No.1 polypropylene in both groups.

Group A underwent interrupted-X technique closure of rectus sheath as follows: A bite taken at (a)—a point 2 cm from cut edge. The needle emerge at (b) another point 2 cm from cut edge, 4 cm cranial or caudal to (a). Two ends of suture strand crossed. Needle enters at (d) and come out at (c). Point (c) 4 cm away from (a) and 2 cm from cut edge. Point (d) 4 cm away from (b) and 2 cm from cut edge. Two ends of suture tied in front of linea alba. Small free end of suture pulled inside with an artery forceps or right angle forceps. Small free end of suture tied with long strand of suture. Knot buried behind linea alba to prevent sinus formation. After initial few cases, burying of knots behind linea alba appeared to impinge of bowel loops. So the knot burying step was modified to bury it on the wound edges on its superior surface. Two interrupted X-sutures applied 1 cm apart.

Group B was conventional continuous closure of rectus sheath as follows: Each bite taken 1inch from the cut edge of linea alba. Successive bites taken 1 cm from each other. The edges of linea alba gently approximated without strangulation with an attempt to keep suture to wound length ratio of ≥4:1.

Patient were assessed during postoperative period till discharge, and subsequent follow up at 2 weeks and 1 month of procedure for wound dehiscence, sinus formation, and surgical site infection. It was defined as an infection that occurs within 30 days after the operation and involves the skin and subcutaneous tissue of the incision (superficial incisional) and/or the deep soft tissue (for example, fascia, muscle) of the incision (deep incisional) and/or any part of the anatomy (for example, organs and spaces) other than the incision that was opened or manipulated during an operation (organ/space).[4] Length of wound (sterile ruler was used), time taken for closure, length of suture material, duration of hospital stay, wound complications were recorded. Factors influencing wound healing such as anemia, hypoproteinemia, immuno-compromised states, diabetes

mellitus, hypertension, liver disorders, renal disorders were recorded.

Statistical analysis

Statistical analysis was done using MS-Excel and SPSS version 17. For quantitative variables parametric data, comparison done by unpaired student t test. For qualitative variables parametric data, comparison done by chi-square test. For quantitative variables non parametric data, comparison done by Mann Whitney U test. For qualitative variables non parametric data, comparison done by chi-square test. $p < 0.05$ was considered statistically significant.

RESULTS

This study was conducted in the Department of General Surgery, Maulana Azad Medical College and associated Lok Nayak Hospital for the period of one year. A total of 100 patients were included in the study. They were randomized into two groups (group A and group B) using Computer generated random number table, each having 50 patients. Group A underwent rectus closure with interrupted-X technique and group B underwent rectus closure with conventional continuous closure technique.

Table 1: Patient characteristics.

Parameters	Total (n=100)	Group A (n=50)	Group B (n=50)
Age (years)	36.31	34.58±14.46	38.14±14.96
Gender			
Male	58	25	25
Female	42	33	17
Body mass index	23.61	23.26±2.96	23.92±4.02
Hemoglobin <10 g/dL	24 (24%)	12 (12%)	12 (12%)
Total leucocyte count (<4000 or >11000 cells/mm^3)	43 (43%)	17 (34%)	26 (52%)
Azotemia	7 (7%)	3 (6%)	4 (8%)
Diabetes mellitus	4 (4%)	2 (4%)	2 (4%)
Chronic liver disease	14 (14%)	8 (16%)	6 (12%)
Serum albumin (<3 g/dL)	47 (47%)	20 (40%)	27 (54%)
Smoking	38 (38%)	18 (36%)	20 (40%)
Alcoholism	23 (23%)	5 (10%)	18 (36%)
Days elapsed on presentation	7.67	7.82±4.49	7.52±4.77
Amount of pus	542	531±325.59	553±401.46

Table 2: Output characteristics.

Parameters	Total (n=100)	Group A (n=50)	Group B (n=50)	P value
Wound dehiscence				
Partial	9 (9%)	2 (4%)	7 (14%)	0.001
Complete	14 (14%)	3 (6%)	11 (22%)	0.008
Day of wound dehiscence	5.99	5.6±0.55	6.38±1.50	0.001
Surgical site infection	32 (32%)	16 (32%)	16 (32%)	1
Day of surgical site infection	4.28	4.06±1.12	4.50±1.31	0.74
Period of hospital stay	13.59	12.08±6.74	15.11±10.23	0.054
Length of incision	16.30	17.04±2.72	17.27±3.13	0.44
Time taken for rectus closure	14.07	14.72±3.18	13.43±3.02	0.003
Length of suture material	82.25	86.24±14.25	78.17±13.64	0.003
Ratio of WL:SL		1: 5.1	1: 4.6	

The distribution of females was relatively more in group A and number of alcoholics was more in group B. But on further multivariate regression analysis as in Table 3 with wound dehiscence, none of them found to be statistically significant.

Outcome characteristics

The interrupted-X rectus closure (group A) as compared to the conventional continuous closure (group B) has significantly less wound dehiscence (p=0.008); less

period of hospital stay (p=0.054); more length of suture material (p=0.003); and more time taken for suturing with mean time difference of one to two minutes (p=0.003) as highlighted in Table 2. The ratio of wound length to suture length was 1:5.1 and 1:4.6.

Regression analysis for wound dehiscence

On univariate and multivariate regression analysis as in Table 3 for wound dehiscence with all parameters; surgical site infection and period of hospital stay are significant.

Table 3: Multivariate regression analysis for wound dehiscence.

Parameters	Group A (p value)	Group B (p value)
Age (years)	0.96	0.39
Gender	0.74	0.67
Body mass index	0.37	0.54
Hemoglobin <10 g/dL	0.09	0.63
Total leucocyte count (<4000 or >11000 cells/mm^3)	0.33	0.36
Azotemia	0.80	0.65
Diabetes mellitus	0.69	0.075
Chronic liver disease	0.70	0.31
Serum albumin	0.83	0.36
Smoking	0.36	0.55
Alcoholism	0.62	0.37
Days elapsed on presentation	0.34	0.524
Amount of pyoperitoneum	0.26	0.19
Surgical site infection	0.008	0.0009
Period of hospital stay	0.69	0.01
Length of incision	0.72	0.86
Time taken for rectus closure	0.91	0.92
Length of suture material	0.72	0.82

DISCUSSION

The major cause of acute abdomen in 70-80% patients without trauma is intestinal perforation peritonitis. It can be of various sites of gastrointestinal system. Exploratory laparotomy is the mainstay of management in such patients after intensive stabilization. Apart from all possible intraoperative procedures, Postoperative wound dehiscence is the surgeon's nightmare. The common causes of acute wound failure are suture tearing out of the tissue and the faulty technique of rectus sheath closure. Although, more than 100 years the technique of rectus closure is evolving, still the incidence of wound dehiscence (1-3%) seems unchanged. Indian authors have reported wound dehiscence to occur in 10% to 30% of emergency cases.[5]

Both the groups were comparable except for more female patients in group A and more alcoholics in group B. This could be due to demographic differences in the presentation. On regression analysis, it was not significant.

In this study, (23 patients) 23% of patients were having wound dehiscence. Of which (9 patients) 18% were partial and (14 patients) 28% were complete dehiscence. Out of 23 patients (5 patients) 10% in group A, (18 patients) 36% in group B. This is statistically significant (p value of 0.001). In general the rate of wound dehiscence was more in our study. This could be due to

risk factors like delayed presentation, more amount of pyoperitoneum. Though most of the factors were equally distributed and comparable in both of our study groups, the wound dehiscence rate of interrupted–X technique was significantly less than conventional continuous closure technique as in previous studies. The rates of partial wound dehiscence were also documented in this study. In nearly half of the wound dehiscence, the complete wound dehiscence is prevented by cutting one or two stitches in case interrupted-X technique and tying the cut end of continuous rectus suture to the possible nearby suture while removing in case of conventional continuous closure. May be due to that, we had partial type of dehiscence in conventional continuous suture technique. Otherwise we would have had complete type of dehiscence in all wound dehiscence patients. The mean day of wound dehiscence in our study was 5.99 days with the range of (5-9days). In the Meta analysis by Gupta H, et al.[6] In the literature, documented the day of wound dehiscence ranges from 6th day to 9th day as it was almost 6 days in our study.

In this study, 32% of patients were having surgical site infection. This was equal in both the groups with no statistical significance. Studies by Agarwal et al, Dhamnaskar et al, Odiya et al, Gurjar et al, found statistical significant difference among the groups.[2,7-9] However on regression analysis with the wound dehiscence, p values of 0.008 and 0.009 for group A and group B respectively; which is statistically significant.

Thus surgical site infection is important factor influencing wound dehiscence.

In this study, the mean period of hospital stay was 13.59 days. The difference among both groups is statistically significant (p value of 0.05). This could be due to more number of patients with wound dehiscence in group B leading to more period of hospital stay because of need for long term wound dressing in that group. Study by Sharma et al, also documented 13 days of mean period of hospital stay.[1]

In this study, the mean time taken for rectus closure was 14.07. The difference among both groups is statistically significant (p value of 0.003). This could be due to the technique of suturing in group A takes more time taken for rectus closure. The mean time taken for interrupted-X suturing was as comparable as conventional continuous suturing, which was only one to two minutes more. Studies done by Sharma et al (17 minutes); Shashikala et al, (20.5 minutes) with statistically significant results in terms of time taken for rectus closure.[1,10] As the learning curve is steep, initially the interrupted-X technique consumes more time consuming for beginners. Still our study had taken less time as compared to previous studies.

After lot of studies, Jenkins framed the rule for use of a suture length. Wound length of greater than 4:1 for running mass closure (Jenkins' rule).[11]

In this study, the ratio of suture length and wound length was 1:5.1 (group A) and 1:4.6 (group B). This ratio is slightly more in interrupted-X group could be due to more length of suture material used in suturing using this technique. Though more length of suture material used for rectus sheath closure in interrupted-X closure group, the cost of extra suture length probably outranked the cost of dressing materials and hospital stay in the management of wound dehiscence.

CONCLUSION

Interrupted-X closure technique is good surgical technique advocated for closure of rectus sheath in midline laparotomy, which can be learnt fast and followed. In patients with delayed presentation of perforation peritonitis and more amount of pyoperitoneum, the rectus sheath should preferably be closed with interrupted-X closure technique to prevent post-operative wound dehiscence and reduction in the period of hospital stay.

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