Closure Methods for Midline Laparotomy Incisions Following Abdominal Surgery - A Comparative Study from Central India

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ABSTRACT

BACKGROUND

The method adopted for incision closure has an influence on the outcomes of wound healing. The study was conducted to compare the 'mass closure' method with the conventional layer closure, and to find out the suitable surgical closure method for midline laparotomy incision.

METHODS

A prospective comparative study was conducted at a tertiary care teaching institute over a period of 2 years. Patients > 14 years of age, who were operated on by midline laparotomy incision, were included in the study group (N = 60). Either a 'mass closure' or the conventional layer closure method was adopted as per the operating surgeon's choice. Based on the method used the cases were allocated into two groups, each with 30 patients. In the 'mass closure' group (Group A), continuous suturing was used in 22 patients and interrupted closure in 8 patients. In the 'layered closure' group (Group B), the abdomen was closed in layers using absorbable suture for the peritoneum (together with transversalis fascia) and non-absorbable for the linea alba. The patients were followed up post-operatively, and for 6 months after discharge from the hospital in follow-up for the detection of the wound complications.

RESULTS

The mean age of patients in Group A was 40.9 ± 15.48 years, and 41.03 ± 14.73 in Group B. There were 25 males and 5 females in Group A and 23 males and 7 females in Group B. Closure time of incision was significantly lower in the mass closure group ($P < 0.05$). The postoperative complications in Group A was 20 % (Seroma-1 patient, infection-3, partial wound dehiscence-1, and hernia-1). In Group B, the overall complication rate was 36 % (Seroma-3 patients, infection-5, burst abdomen- 1, hernia- 2).

CONCLUSIONS

Mass closure method is better than the conventional layer closure for the midline laparotomy incision.

KEYWORDS

Laparotomy, Layered Closure, Midline Incision, Mass Closure, Suture Technique

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BACKGROUND

Laparotomy is described as an incision that is made through the anterior abdominal wall to get access into the abdominal cavity.[1] Midline incisions during laparotomy have advantages i.e. it is quick and allows easy access to the abdominal cavity.[2] It is one of the common surgical procedures performed in any surgical centre. The surgical closure techniques, suture material used for closure, have a significant influence on the outcome of wound healing. During the period of the wound healing, sutures provides mechanical support for the closed wound. The sutures approximate the wound edges and help to maintain wound closure until the healing process provides sufficient strength for the wound to withstand stress and strain.[1,2]

Despite the advancement in surgical techniques, data regarding the best suture material and method of closure for the abdominal wall is scarce. The method of closure is very important following laparotomy as it is associated with higher rates of wound complications including wound dehiscence and incisional hernia. Early wound failure (wound infection and dehiscence of various grades) results in a return to the operating room and an increased length of hospital stay. Late wound failures (incisional hernia, sinus, and fistula formation) can lead to additional surgical procedures and significant morbidity and mortality.[3,4] Literature revealed that the risk of developing incisional hernia following laparotomy ranges between 5 to 20 %.[5,6]

Surgeons have several choices for closing the abdominal fascia, but there is currently scant consensus as to the best suture material or closure method. The best method of abdominal closure must be quick, easy, and with minimal early and late complications. Also, the closure of surgical wounds should be aesthetically acceptable to patients. There are various methods of abdominal closure such as continuous closure, interrupted closure, mass closure, and layered closure.[4,7,8] Until recently, layered closure of the abdominal wall has been considered as an ideal method. For the majority of surgeons, the choice of suture material in a given instance has mostly been directed by training exposure and local opinion, with many surgeons reluctant to attempt different techniques once their personal preferences have been established. How far the type of suture material or type of closure prevents these complications?

This study aims to compare the 'mass closure' method with the 'layered closure' method and the outcomes of wound healing in the repaired midline laparotomy incision.

METHODS

The present study was a prospective comparative study at the Department of Surgery, People's Medical College, and People's Hospital, Bhanpur Bhopal for the period of 18 months i.e. 1st December 2018 to 30th May 2020. All the patients undergoing laparotomy by midline incisions in the age group of 14 years and above were included. The patients with comorbidities such as diabetes, malignancy, immune-compromised patients, jaundice, on long term steroid therapy, chronic obstructive airway disease, autoimmune disease, collagen disorders, or previous laparotomy scar were excluded from the study.

After obtaining ethical clearance from the Institute's ethical committee, all the patients fulfilling inclusion criteria were selected and written consent was obtained from all the patients. A total of 60 eligible cases were enrolled in the study.

The type of closure either a 'mass closure' or the conventional 'layer closure' method was adopted as per the operating surgeon's choice. Based on the method used, the cases were allocated into two groups, each with 30 patients. In the 'mass closure' group, continuous suturing was used in 22 patients and interrupted closure in 8 patients. In the 'layered closure' group, the abdomen was closed in layers using absorbable suture for the peritoneum (together with transversalis fascia) and non-absorbable for the linea alba. The patients were followed up post-operatively, and for 6 months after discharge from the hospital in follow-up for the detection of the wound complications.

A validated questionnaire was used to collect the data from all the patients. Data regarding socio-demographic profile such as age, gender, level of education, occupation, socio-economic status were noted. Detailed history regarding their presenting complaints was obtained from all the patients. Further, all patients were subjected to detailed clinical and systemic examination, and findings were noted in the questionnaire.

Routine blood investigations such as haemoglobin, complete blood picture, blood sugar, renal function test were collected. Indication of surgery, diagnosis, nature of surgery elective or emergency, nature of wound (clean or contaminated), technique of closure, suture material used, and suturing technique used was documented in the pretested questionnaire.

Post-operatively, all patients were followed up at 7 days, then every 2 weeks till 2 months, then at 3 months intervals till 6 months for detection of wound complications. Based on the methods used the cases were allocated in two groups, each with 30 patients.

One group for 'mass closure' and the other with conventional 'layered closure'. At each follow-up, wound healing, infection and development of complications if any were noted.

Statistical Analysis

Data was compiled using Microsoft excel and analyzed using SPSS version 20.0 for Windows (IBM Corporation Armonk, NY, USA. Frequency and percentage were calculated and chi square test was applied to assess the difference in proportions between two groups. $P < 0.05$ was considered as statically significant.

RESULTS

The present study was conducted on a total of 60 patients who underwent laparotomy by midline incisions. Based upon

the technique of closure of midline laparotomy incision, participants were categorized into two groups.
Group A- Mass closure group
Group B- Layered closure group

Baseline Variables		Mass (N = 30)		Layered (N = 30)	
		n	%	n	%
Age (years)	≤ 20	3	10	4	13.3
	21 - 30	7	23.3	4	13.3
	31 - 40	5	16.7	6	20.0
	41 - 50	6	20.0	7	23.3
	> 50	9	30.0	9	30.0
Gender	Male	23	76.7	25	83.3
	Female	7	23.3	5	16.7
BMI	< 18.5	1	3.3	4	13.3
	18.5 - 22.9	14	46.7	16	53.3
	23 - 24.9	6	20.0	3	10.0
	> 25	9	30.0	7	23.3
Diagnosis	Abdominal tuberculosis	0	0.0	4	13.3
	Acute intestinal obstruction	4	13.3	2	6.7
	Appendicular lump	0	0.0	1	3.3
	Appendicular perforation	0	0.0	2	6.7
	Blunt trauma abdomen	1	3.3	0	0.0
	Chronic obstruction	1	3.3	1	3.3
	Duodenal perforation	1	3.3	0	0.0
	F/C/ with wound dehiscence	1	3.3	0	0.0
	FB rectum	0	0.0	1	3.3
	Gall bladder lump	1	3.3	0	0.0
	Gastric outlet obstruction	0	0.0	1	3.3
	Idiopathic peritoneal fibrosis	1	3.3	0	0.0
	Ileocaecal mass	0	0.0	1	3.3
	Intestinal perforation	1	3.3	0	0.0
	Obstructed incisional hernia	1	3.3	0	0.0
	Obstructed umbilical hernia	0	0.0	1	3.3
	Perforation peritonitis	14	46.7	13	43.3
	Rectal prolapse	0	0.0	1	3.3
	SAIO	4	13.3	2	6.7

Table 1. Study Variables

The mean age of patients of the mass closure group was 40.9 ± 15.49 years whereas the mean age of patients of the layered closure group was 41.03 ± 14.73 years. (Table 1)

Surgery		Mass (N = 30)		Layered (N = 30)		P Value
		n	%	n	%	
Type of surgery	Elective	0	0.0	9	30.0	0.01
	Emergency	30	100.0	21	70.0	
Position of incision	Lower midline	2	6.7	13	43.3	0.04
	Mid midline	19	63.3	10	33.3	
	Upper midline	9	30.0	7	23.3	
Nature of wound	Clean	2	6.7	6	20.0	0.199
	Clean Contaminated	5	16.7	7	23.3	
	Contaminated	23	76.7	17	56.7	
Incisional Length		14.5	1.3	14.7	1.4	0.5
Closure time		26.9	5.6	44.3	5.1	0.001

Table 2. Study Variables

In mass closure group all patient were operated in Emergency, where in layered closure group 70% were operated in Emergency.The observed difference in type of surgery between two groups was statistically highly significant (P < 0.01). Mass closure was conducted in maximum cases with mid midline incisions (63.3 %) whereas layered closure was done in 43.3 % cases with lower midline incision and the observed difference between two groups was statistically highly significant (P < 0.01).

Wound was contaminated in 76.7 % cases of mass closure group as compared to 56.7 % cases of layered closure group. However, the wound was clean contaminated in 16.7 % and 23.3 % cases of mass and layered closure groups respectively. The present study observed no statistically significant difference in nature of wound between patients of two groups (P > 0.05). (Table 2)

Though mean incisional length between two groups was statistically similar (P > 0.05), mean closure time was significantly higher in the layered closure group (44.3 ± 5.1 minutes) as compared to 26.9 ± 5.6 minutes in mass closure group (P < 0.001). (Table 2)

Post-Operative Complications	Mass (N = 30)		Layered (N = 30)		P Value
	n	%	n	%	
Wound haematoma	0	0	0	0	NA
Wound infection	3	10	4	12	0.69
Wound seroma	1	3.3	3	10	0.301
Wound dehiscence (partial)	1	3.3	0	0	0.31
Wound dehiscence (complete)	0	0	1	3.3	0.31
Hypertrophic scar	0	0	0	0	NA
Wound sinus	0	0	1	3.3	0.31
Stitch granuloma	0	0	0	0	NA
Wound fistula	0	0	0	0	NA
Incisional hernia	1	3.3	2	6.6	0.554
Overall complication rate	6	20	11	36.7	0.015

Table 3. Postoperative Complications

Wound infection was noted in 10 % cases of mass closure and 12 % cases of layered closure. However, wound seroma, wound dehiscence (partial) and incisional hernia was observed in 3.3 % cases each in mass closure groups. In the layered closure group seroma was noted in 10 % cases, incisional hernia was observed in 6.6 % cases and complete wound dehiscence and wound sinus was noted in 3.3 % cases. Wound hematoma, hypertrophic scar, stitch granuloma and wound fistula was observed in none of patients in any group.

Overall, among patients with mass closure, primary healing with complications was noted in 20 % cases. Similarly, in the layered closure group, healing with complications was noted in 36.7 % cases. The present study observed that the overall difference in the post-operative complication in the compared groups was statistically significant at (P < 0.05).

LOS (Days)	Mass (N = 30)		Layered (N =30)		Total (N =60)	
	Frequency	%	Frequency	%	Frequency	%
< 7	1	3.3	2	6.7	3	5.0
8 - 14	21	70.0	20	66.7	41	68.3
15 - 21	7	23.3	6	20.0	13	21.7
> 21	1	3.3	2	6.7	3	5.0
Mean LOS (days)	13.17 ± 4.6		12.1 5 ± 4.65		12.78 ± 4.63	
P - value			0.857			

Table 4. Length of Hospital Stay (LOS)

(Table 4): The mean length of hospital stay (LOS) was 2.27 ± 0.58 and 2.27 ± 0.69 days in mass closure and layered closure group respectively. The length of stay ranged between 8 to 14 days for maximum patients in both the groups and the observed difference in length of stay between patients of two groups was statistically not significant (P > 0.05).

DISCUSSION

Laparotomy is the most common surgical procedure and the ultimate aim of a surgeon is to restore the structural integrity of the tissues to as normal as possible.[9] Constantly, the

research is being conducted to identify the best suture technique that would minimize the wound failure rate. Laparotomy was performed for various indications in present study. Though laparotomy can be conducted in any age, the outcomes are documented to be poor in elderly population following abdominal surgeries.[10] However, the majority of patients who underwent laparotomy belonged to more than 50 years of age in both the groups. The mean age of patients of mass closure group and layered closure group was 40.9 ± 15.49 years and 41.03 ± 14.73 years respectively. The findings of present study were supported by findings of Kumar et al. in which mean age of patients was 42.8 years in mass closure group and 41.6 years in layered closure group.[11] The present study documented male predominance in both the groups i.e. about 76.7 % and 83.3 % cases in mass closure and layered closure group respectively were males. This could be due to the fact that certain clinical conditions requiring laparotomy are commonly observed in males as compared to females. The findings of present study were in concordance to finding of Chhabra et al. where the authors documented male dominance in both single layer (67.5 %) as well as conventional layer group (75 %).[12] Khan et al. also observed that maximum patients i.e. 64 % and 70 % in mass closure and layered closure group respectively were males.[13]

Nutritional status of an individual is an important determinant of outcome of surgery. Both over nutrition i.e. obesity as well as undernutrition i.e. malnutrition are significantly associated with poor surgical outcome in terms of poor wound healing and wound complications.[14] In present study, majority of patients in both the groups had BMI in normal range whereas 30 % in mass closure group and 23.3 % patients in layered closure group were obese (with BMI more than 25 kg/m^2). Obesity as well as malnutrition were risk factor significantly associated with higher risk of wound related complications following laparotomy in a study by Kumar et al.[11]

Type of surgery i.e. elective or emergency may be considered as an important determinant of wound healing and wound related complications. Emergency laparotomy is considered as a high risk procedure and complication rates are documented to be higher in emergency laparotomy as compared to elective laparotomy.[15] In present study, mass closure of midline incision was done in all the cases of emergency laparotomy whereas in layered closure group, 70 % patients underwent emergency laparotomy and 30 % underwent elective laparotomy. However, Kumar et al. performed mass and layered closure in 44 % and 48 % cases of emergency laparotomy.[11]

Most common approach for laparotomy is via midline incisions, however, the location of incision may vary depending upon clinical diagnosis. For example, upper midline incision is preferred in upper gastrointestinal pathology.[16] Upper and lower midline incisions were most commonly performed for laparotomy in a study by Deshmukh et al.[8] In our study, mid midline incisions were most commonly performed in mass closure group and lower midline incision were most common in layered closure group.

Clean wound is one in which no signs of inflammation are observed and when respiratory, abdominal and genitourinary tract are not entered. However, clean contaminated wound is one in which respiratory, alimentary and genitourinary tracts are entered but no signs of inflammation are observed. However, contaminated wound is one in which there is a major break in sterile technique due to gross spillage of infective material from gastrointestinal tract, or when non-purulent inflammation is observed.[17] In present study, nature of wound was contaminated in 76.7 % cases of mass closure group as compared to 56.7 % cases of layered closure group. Wound was clean and contaminated i.e. abdomen was entered but sterility was maintained in 16.7 % and 23.3 % cases of mass and layered closure group respectively. The importance of nature of wound helps in predicting the likelihood of surgical site infection, risk of complication post-operatively as well as need for reoperation.[18]

In present study, post-operative complication noted were wound infection (10 %), wound seroma (3.3 %), partial wound dehiscence (3.3 %) and incisional hernia (3.3 %) in mass closure group. Similarly, in the layered closure group, post-operative complications were wound infection (12 %), wound seroma (10 %), incisional hernia (6.6 %), complete wound dehiscence (3.3 %) and wound sinus (3.3 %). The present study observed that the overall difference in the post-operative complication in the compared groups was statistically significant at ($P < 0.05$). However, in the study of Patel et al. in which closure method i.e. mass versus layered closure had no influence on the development of incisional hernia (RR 1.92, 95 % CI 0.58 to 6.35). [7] For secondary outcomes, mass versus layered closure was not associated with reduced risk of wound infection with RR 0.93, 95 % CI 0.67 to 1.30. Similarly, none of the interventions reduced the risk of wound dehiscence (mass versus layered, RR 0.69, 95 % CI 0.31 to 1.52,).[7] Deshmukh et al. documented incidence of complications both early and late to be higher in layered closure group but were statistically not significant.[8] However, Bhavikatti et al. observed significantly higher incidence of wound infection (36.66 %) in layered closure group as compared to mass closure group (13.33 %).[19] The observed difference in rate of wound infection between two studies could be due to associated confounding factor i.e. contaminated nature of wound in reference study which was not considered in the reference study. Also, the use of newer antibiotics has probably decreased the rate of wound infection.

The patients were discharged once they showed complete healing, however length of stay was higher for patients with associated complications. In our study, the mean length of hospital stay was 2.27 ± 0.58 and 2.27 ± 0.69 days in mass closure and layered closure group respectively and the difference was statistically insignificant ($P > 0.05$). Poor wound healing, wound infection, and wound dehiscence of various grades is associated with longer duration of hospital stay and in some cases requirement of second surgery.[3,4] Overall, mass and layered closure both were associated with good clinical outcome and satisfactory healing, but mass closure group was observed

to be superior to layered technique in terms of mean closure time.

CONCLUSIONS

The incidence of post-operative complication was higher in the layered closure group as compared to the mass closure group, and the difference was statistically significant. Closure time was significantly lower in mass closure groups as all the layers of abdominal wall are sutured in one layer providing greater strength to wound closure. Thus, mass closure technique may be preferred for closure of anterior abdominal wall following laparotomy.

Limitations of the Study

The small sample size and the duration of study were limitations of our study.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.
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