

A Comparative Study of Conventional Versus Mass Closure in Management of Generalized Peritonitis

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Abstract

Introduction: Many of the operations performed by the general surgeons take place within the abdomen and consequently incision and suturing of the abdominal layers are the most common exercises in operative surgery. The present study is taken up to evaluate the advantages of mass closure in comparison with the conventional layered closure on the basis of operative time, healing time, and post-operative morbidity such as wound infection, burst abdomen, and incisional hernia.

Aim and Objectives: The aim of the study was to compare the techniques of mass closure and conventional layered closure of laparotomy wounds.

Materials and Methods: This study includes 100 patients who were admitted to the Department of General Surgery, Mahatma Gandhi Memorial Hospital, Warangal, during the period of June 2015–October 2017, for acute abdominal surgical problems needing emergency surgery. Stratified randomized sampling was done. The patients were chosen randomly, irrespective of their age, sex, and nature of disease.

Results: The results of this study of 100 patients who underwent laparotomy for acute abdominal surgical problems at Mahatma Gandhi Memorial Hospital, Warangal.

Key words: Burst abdomen, Incisional hernia, Laparotomy wound, Wound infection

INTRODUCTION

Many of the operations performed by the general surgeons take place within the abdomen and consequently incision and suturing of the abdominal layers are the most common exercises in operative surgery. Abdominal closure is very important as regards to incision, technique of repair and use of newer suture material, and has created a great interest to surgeons.^[1,2]

Recent data suggests that technical factors are crucial and can be manipulated by the surgeon. Different suture techniques are used for closure of laparotomy wounds, and each has its strong proponents. However, the

ideal method of abdominal wound closure is modified frequently. Commonly followed methods of abdominal closure are conventional layered closure and single layer closure.^[3]

Since 1973, different workers have carried out comparative studies of these two methods with encouraging results and single layer closure was found to have definite advantages over conventional closure as regards to operating time, cost, feasibility, ease, and post-operative morbidity.^[4]

The present study is taken up to evaluate the advantages of mass closure in comparison with the conventional layered closure on the basis of operative time, healing time, and post-operative morbidity such as wound infection, burst abdomen, and incisional hernia.

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Objectives

The objectives of the study are as follows Table 1:

1. To compare the operative time and healing time for mass closure and conventional layered closure of laparotomy wounds Table 2.
2. To compare the post-operative complications after performing mass closure and conventional layered closure of laparotomy wounds such as seroma Table 3, wound infection, wound gaping, burst abdomen, and incisional hernia Table 4.

MATERIALS AND METHODS

Material

This study includes 100 patients who were admitted to the Department of General Surgery, Mahatma Gandhi Memorial Hospital, Warangal, during the period of June 2015–October 2017 Table 5, for acute abdominal surgical problems needing emergency surgery. Stratified randomized sampling was done. The patients were chosen randomly, irrespective of their age, sex, and nature of disease (cause of peritonitis).

Of these 100 patients, 50 were randomized to have the abdominal wall closed by mass closure technique and remaining 50 by the conventional layered closure, and they were grouped as Group 1 and Group 2, respectively Table 6.

Inclusion Criteria

The following criteria were included in this study:

1. Patients aged 15–75 years.
2. Patients posted for laparotomy, on an emergency basis.
3. Patients who underwent surgery with midline, paramedian, and subcostal incisions Table 7.

Exclusion Criteria

The following criteria were excluded from this study:

1. Patients with comorbid conditions such as diabetes mellitus, seropositive patients, patients on cancer chemotherapy, immunotherapy, and on long-term steroids.
2. Patients who died within 7 days after surgery.
3. Patients who underwent surgery by Grid-iron and Transverse abdominal incisions.
4. Patients who underwent second laparotomy or re-laparotomy.

RESULTS

The results of this study of 100 patients who underwent laparotomy for acute abdominal surgical problems at Mahatma Gandhi Memorial Hospital, Warangal, are as follows:

In our study, age of the patients ranged from 15 to 71 years in Group 1 and 23 to 73 years in Group 2, with a mean age of 49.9 years in Group 1 and 47.6 in Group 2.

Male:Female ratio in our study undergoing laparotomy was 3:1.

In our study, 50 patients underwent emergency surgery in Group 1 and 50 patients in Group 2.

In our study, 65% of patients had midline abdominal incision and 33% had a right paramedian incision. 84% of patients in mass closure technique had midline incision and 12% had right paramedian. Whereas only 46% of patients had midline incision and 54% had right paramedian incision in conventional layered closure group.

In our study, 28% of patients had surgery done for intestinal obstruction, and 14% of patients had surgery done for enteric perforation, and 45% of patients underwent surgery for gastroduodenal perforation. Other surgeries included splenectomies, drainage of intraabdominal abscesses, gallbladder perforation, and hemoperitoneum.

In our study, the mean time taken for the closure of laparotomy wounds, by single layer closure technique was 19.6 min, and by conventional layered closure, technique was 27.9 min. There was a difference of about 8 min in the mean time between the two techniques used which was statistically significant ($P = 0.001$), indicating that the time needed for mass closure technique was significantly less than that needed for conventional layered technique.

In our study, 53% of patients undergoing laparotomy had suture removal done on the 7th post-operative day and 25% on the 8th post-operative day. The mean time taken was 7.74 days for mass closure method and 7.75 days for conventional layered closure method. There was no significant difference in the time taken for suture removal between the mass closure technique and the conventional layered technique.

DISCUSSION

The present study aimed at comparing the techniques of laparotomy wound closure. The technique of laparotomy wound closure is one of the important factors in preventing post-operative complications such as wound infection, burst abdomen, and incisional hernia. Prevention of herniation of abdominal contents through the incisional wound, resulting in burst abdomen or herniation through a weak scar resulting in an incisional hernia is the main aims of a surgeon closing laparotomy wounds.

Although different closure techniques exist for the closure of laparotomy wounds, the ideal method of closure is yet to be finalized. Hence, the present study was taken up by us at Mahatma Gandhi Memorial Hospital, Warangal, to compare the mass closure and the conventional layered closure of laparotomy wounds on the basis of operative time and post-operative complications.

The ideal fascial closure should maintain tensile strength throughout the healing process. The dynamic process of wound healing can be divided into three phases. The first exudative phase (days 1–4) does not provide any holding strength to the wound. It is followed by the proliferative phase (days 5–20), in which the tissue regains approximately 15–30% while up to 80% of its original tensile strength is regained in the third or remodeling phase (days 21 onward). It was demonstrated in the early 1950s that the healing process of abdominal fascia after surgical incision continues for 9–12 months. Abdominal fascia regains only 51%–59% of its original tensile strength at 42 days, 70%–80% at 120 days, and 73%–93% by 140 days. It has been shown experimentally by Jenkins that the length of a midline laparotomy incision can increase up to 30% in the post-operative period in association with several factors that increase the intra-abdominal pressure and determined that a suture length to wound length ratio should be 4:1.

The term wound dehiscence includes partial or total separation of layers of wound closure. Evisceration indicates protrusion of bowel through the separate edges of abdominal wound closure, an emergency situation. Despite the arguments for and against different suture materials, the sitting of incisions and the insistence on meticulous surgical techniques in the closure of wound, better pre-operative and post-operative care, control of infection with antibiotics, the cases of wound disruption still occur.

Many clinical studies have attested to a continuing steady incidence of wound disruption to be 1%–3% regardless of the type of suture used. It is the dreaded complication that increases the hospital stay and cost wound disruption is associated with a mortality rate of 10%–20% despite the most sophisticated intensive care these patients receive today. The problem remains accordingly a real one, although individual “runs” have been reported in which disruption has never occurred. Wound disruption has been known to occur following the used of every type of suture material, whether natural or synthetic. This is understandable.

The surgeon is upset because of an unfortunate occurrence, and an inanimate piece of suture material has the advantage that is cannot answer back. Although a number of systemic and local factors have been associated with an increased

incidence of burst abdomen, attention to the technique and materials for closure is associated with low rates of wound complications. It was found that the cause of wound dehiscence is not the poor tissues but the poor technique, too small bites, suture placed too far apart or tied too tightly predispose to disruption.

A maximum zone inflammatory reaction with edema and a resultant weak area was recognized to lie in the 0.5 cm adjacent to the wound edge. From the review of literature, no difference in dehiscence has been noted between various absorbable sutures or the various monofilament sutures, be absorbable or nonabsorbable, In the opinion of inflammatory reaction with edema and a resultant weak area was recognized to lie in the 0.5cm adjacent to the wound edge.

Therefore, it seems logical that the use of nonabsorbable sutures in laparotomy closure is a better choice and is favored in most of the resent studies. Wound dehiscence usually occurs within 2 weeks postoperatively, often following local serosanguinous discharge. At this time, most of the wound strength is provided by sutures and not by wound healing; it seems logical that the type of closure has an important role in fascial disruption. Burst abdomen or post-operative evisceration may be partial or complete, depending on whether all the layers of the abdominal wall have separated or either skin or peritoneum remain intact. It may occur up to 3% of laparotomy wounds, with mortality as high as 49%. It was pointed out that about 50% of dehisced wound healed primarily, finish with a late incisional hernia, a serosanguineous (pink) discharge from wound is a forerunner or disruption in burst abdomen.

The hernia may occur through a small portion of scar. Most cases of an incisional hernia are asymptomatic and broad necked and do not need treatment. Late incisional hernia is not always innocent. It can lead to potentially fatal complication of intestinal obstruction and strangulation. It has been found that incidence of an incisional hernia continues to rise with the passage of time; thus long-term (10–12 years) follow-up is required to determine its true incidence. The reported incidence of a such hernia varies from 1.6 to 10.8%.

A midline incision is regularly used for exploratory laparotomy in patients with abdominal trauma and does not endanger the abdominal muscle, blood supply or nerve supply or damage aponeurosis. In mesogastric and hypogastric incisions a greater portion of wound dehiscence occurred after paramedian incision than midline incisions. However, low incidence of wound dehiscence and incisional hernia with paramedian incision has been reported.

Table 1: Age distribution of patients undergoing laparotomy

Age group	Type of closure		Total
	Mass closure	Conventional layered	
<20	4	0	4
20–30	3	9	12
30–40	7	7	14
40–50	8	13	21
50–60	16	11	27
60–70	10	8	18
>70	2	2	4
Total	50	50	100

Table 2: Sex distribution of patients undergoing laparotomy

Sex	Type of closure		Total
	Mass closure	Conventional	
Male	38	34	72
Female	12	16	28
Total	50	50	100

Table 3: Type of surgery in patients undergoing laparotomy

Type of surgery	Type of closure		Total
	Mass closure	Conventional	
Emergency	50	50	100

Table 4: Type of abdominal incision used in patients undergoing laparotomy

Type incision	Type of closure		Total
	Mass closure	Conventional	
Midline	42	23	65
Right paramedian	6	27	33
Right Kocher's	2	0	2
Total	50	50	100

Asymptomatic bulge develop in up to 10% of abdominal incisions and requires surgical intervention. Incisional hernia occurs after 3–5% of all abdominal operations. The management is by two techniques. One is an anatomical approach (Keel method). The other is implantation of prosthetic materials such as marlex or mersilene. Incisional hernia although a less serious complication than acute disruption, but is not always innocent. Full-length incisional hernia probably represents covert dehiscence and usually starts as a symptomless partial disruption of the deep layer of abdominal wound, while the superficial layers remain intact, and skin is only to heal.

Consequently, the hernia appears immediately, although it may not be recognized until some month. These large

Table 5: Nature of abdominal surgeries performed in patients undergoing laparotomy

Nature of surgery	Type of closure		Total
	Mass closure	Conventional	
Intestinal obstruction	16	12	28
Enteric perforation	7	7	14
Gastro duodenal perforation	19	26	45
Others	8	5	13
Total	50	50	100

Table 6: Time taken for closure of laparotomy wounds

Time taken (min)	Type of closure		Total
	Mass closure	Conventional layered	
10–15	7	0	7
15–20	26	1	27
20–25	16	10	26
25–30	1	26	27
30–35	0	11	11
35–40	0	2	2
Total	50	50	100

Table 7: Time taken for suture removal after laparotomy

Time taken for suture removal (days)	Type of closure		Total
	Mass closure	Conventional	
7	27	26	53
8	12	13	25
9	8	7	15
10	3	4	7
Total	50	50	100

incisional hernias are caused by the failure of technique (broken sutures, knot slippage, or a suture cutting out of the tissues following an inadequate bite). The smaller incisional hernia probably results from wound sepsis or may follow the placement of a drain through the wound.

The majority of incisional hernias develops in the 1st year after the operation and is the result of the interaction of a number of factors including the method of closure. The early hernia is attributable to mechanical wound failure. The combined strength of the healing wound, a function of the extrinsic strength dependent on the mechanical aspect of wound closure, and the slowly increasing intrinsic strength is inadequate to withstand the forces applied and a diffuse hernia results.

In our study, the mean age of patients taken up for the study was 49.9 years in mass closure group and 47.6 years in conventional layered closure group, showing no significant difference between the two groups.

In our study, 65% of patients had midline abdominal incision and 33% had right paramedian abdominal incision, for the approach into the abdomen. 65.63% of midline incisions were closed by mass closure technique, and 82% of paramedian incisions were closed by conventional layered technique, showing that mass closure technique was used significantly more in midline incisions and significantly less in paramedian incisions and preferring conventional layered closure for paramedian incisions.

This was due to the fact that we found in paramedian incisions, closing the peritoneum separately and then suturing the anterior rectus sheath only was more technically easier than taking a single bite through the peritoneum, posterior rectus sheath, rectus muscle, and anterior rectus sheath, which was bulkier and had high chance of injuring the bowel at the end of the closure.

A meta-analysis on 23 randomized trials showed that odds of the burst are reduced to half with the interrupted method of closure compared to the continuous method. In emergency surgery, interrupted sutures are better than continuous method as they have “Gigli saw” or “hacksaw” effect. In conventional abdominal closure, the primary advantage of layered closure is that as the individual fascial layer is sequentially closed, the multiple strands exist,

so that if a break, the incision is held intact by the remaining sutures. Whereas, continuous fascial mass closure with a single closure allows the even tension distribution across the entire length of the suture which results in minimization of tissue strangulation.

However, excessive tension if applied in layered closure, leads to tissue necrosis and resultant failure of closure. Agrawak *et al.* have concluded that interrupted abdominal wall closure prevents burst abdomen, in his randomized controlled trial comparing interrupted X and conventional continuous closures in surgical and gynecological patients.

Many larger earlier studies, and Weiland *et al.*^[1] study advocated the use of monofilament nonabsorbable suture material for closure of laparotomy wounds. Weiland *et al.*, from their meta-analysis study suggested that continuous closure with nonabsorbable suture should be used to close most abdominal wounds; however, if infection or distension is anticipated, interrupted absorbable sutures are preferred. Rucinski *et al.*^[2] in their meta-analysis of an optimal technique for closure of abdominal midline fascia compared absorbable and nonabsorbable sutures. They found no statistically significant difference

between nonabsorbable and monofilament absorbable sutures with regard to post-operative wound infection, dehiscence, and incisional hernia. There was, however, a higher incidence of wound infection and incisional hernia formation when braided absorbable suture material was used. There was a higher incidence of incision area pain and suture sinus formation when nonabsorbable suture material was used. They advocated a continuous mass closure with absorbable monofilament suture material for laparotomy wounds. However, results of larger studies showing the advantages of absorbable sutures over nonabsorbable sutures are still awaited. Hence, in our study, we used monofilament, nonabsorbable continuous interlocking sutures (Prolene No.1) for the closure of laparotomy wounds.

In our study, the mean time taken for the closure of laparotomy wounds by mass closure was 19.6 min and by conventional layered closure was 27.9 min. Mass closure took about 8 min lesser time than conventional layered closure. In Banerjee and Chatterjee^[3] study, mass closure took about 10 min lesser time than conventional layered closure. Our study was inconsistent with the study of Banerjee and Chatterjee. Reduction in operative time prevents anesthetic hazards, reduces the cost of anesthetic agent and saves the time of the surgeon.

Different studies have reported post-operative complication rates which are definitely less in mass closure than in conventional layered closure. Irvin *et al.*^[4] found that wound infection was responsible for ten-fold rise in the incidence of burst abdomen and incisional hernia. Tearing through the weak infected tissues with intact suture is the main cause for wound dehiscence.

The incidence of post-operative seroma formation in our study was 6% in single layer closure group and 10% in conventional layered closure group, showing a higher incidence in conventional layered closure group.

CONCLUSION

In our study, mass closure of laparotomy wounds took less operative time than conventional layered closure. Furthermore, the incidence of post-operative complications such as seroma, wound infection, wound gaping, burst abdomen, and incisional hernia was less in mass closure. Hence, we conclude that mass closure technique is better than the conventional layered closure of laparotomy wounds in terms of operative time and post-operative complications. However, longer study period is required to know the exact incidence of an incisional hernia.

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