

Modified Midline Abdominal Wound Closure Technique in Complicated/High Risk Laparotomies

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ABSTRACT

Objective: To assess the local wound complications in complicated/ high risk laparotomies in terms of wound dehiscence and incisional hernia formation with a modified technique of midline abdominal wound closure.

Study Design: Quasi-experimental study.

Place and Duration of Study: Department of General Surgery, Combined Military Hospital, Bahawal Nagar Cantonment, May 2006 to June 2008.

Methodology: Cases of complicated/high risk abdominal conditions, which required laparotomy, were included in the study. A modified midline abdominal wound closure technique was used. Interrupted Smead-Jones sutures with prolene, a non-absorbable suture material for closure of linea alba was combined with mass closure involving all the layers (also with prolene) and drains were placed. Patients were followed-up for 3-23 months. The postoperative wound dehiscence and incisional hernia formation were noted. Other local wound complications were also recorded.

Results: Out of the 36 patients undergoing this surgical technique, 20 (55.55%) had inflammatory/intra-abdominal sepsis, 8 (22.22%) had trauma, 7 (19.44%) had neoplasia and 1 (2.77%) had vascular aetiology. Only 1 (2.77%) had partial wound dehiscence and 1 (2.77%) developed incisional hernia. Wound infection was noted in 12 (33.33%) cases; 4 (11.11%) experienced pain over the subcutaneous palpable knots and 3 (8.33%) developed sinus due to the knots. The average follow-up period was 12.47 ± 7.17 months.

Conclusion: Patients with extensive widespread generalized peritonitis and metastatic abdominal tumours need special attention regarding wound closure. This modified technique of midline abdominal wound closure is associated with low incidence of wound dehiscence and incisional hernia formation.

Key words: Complications. Midline wound closure. Wound dehiscence. Infection. High risk. Laparotomy. Smead-Jones sutures.

INTRODUCTION

Laparotomies whether elective or emergency, always remain commonly encountered surgical procedures in every surgical department. Pre-operative assessment is very essential in knowing the general condition of the patient but may prove inadequate in making a definitive diagnosis. Various incisions have been introduced but the most commonly performed by many surgeons, remains the midline one. It gives rapid access into the peritoneal cavity and the upper midline incision is almost bloodless. The success of any kind of surgery is not only dependent upon the procedure adopted but also on the method adopted for wound closure and its sequel.

The closure of the midline laparotomy wound aims at bringing the wound edges together with the least tissue damage so that adequate healing can occur. The material should cause minimum disturbance of the tissue but allow the wound to gain sufficient strength to avoid late herniation. A variety of midline abdominal wound repairs have been introduced and practiced all

over the world, but the cost of closing the abdominal wound ranges from 3.64 pounds to 20.40 pounds.¹ The main problem arises in dealing with complicated laparotomies like cases of extensive peritonitis or even in patients with metastatic tumours. In such cases, a modified technique for the closure of midline abdominal wounds is used employing Smead-Jones interrupted sutures to the linea alba alongwith mass (all-layer) closure with polypropylene. These cases are high risk ones and any re-do surgery for burst abdomen or incisional hernia, can prove not only difficult but also increases their morbidity and mortality. The incidence of wound disruption after 2030 median laparotomies was noted as 1.3%.² Postoperative complete wound dehiscence, being an unfortunate and also a very serious complication, is associated with high morbidity and mortality,³ despite the most sophisticated intensive care these patients receive today. The aim of this study was to analyze the local wound complications in terms of wound dehiscence and incisional hernia formation using this modified midline abdominal wound closure technique in complicated/high risk laparotomies.

METHODOLOGY

This study was conducted at the Combined Military Hospital, Bahawal Nagar Cantonment, from May 2006 to June 2008. Cases of complicated/high risk laparotomies, were included in the study. Only those cases were

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included which either had extensive generalized peritonitis (with extensive peritoneal contamination and soiling) or metastatic abdominal tumour. Cases with minimal peritoneal contamination, planned laparotomies for benign abdominal lesions/tumours and simple and straight forward laparotomies were excluded from this study.

All the cases were initially received in the general out doors/emergency and later referred for surgical consultation. A detailed history and clinical examination was conducted by two general surgeons. The data was noted on a proforma. Baseline investigations like complete blood count, urinalysis, serum urea/creatinine, serum electrolytes, chest radiograph, electrocardiograph and blood sugar (random) were noted in all the cases. Abdominal radiographs and ultrasonography was also done in a few cases. Blood was also sent for grouping and cross matching. All the patients had an acute presentation and required immediate intervention. Initially intravenous fluid resuscitation was carried out with Ringer's lactate solution alongwith Foley catheterization and nasogastric intubation. All the patients were assessed by one anaesthetist, written and informed consent was taken after counseling regarding the condition of the patient and the possible outcomes.

Under general anaesthesia, the operative field was prepared with povidone iodine and all the patients were opened through a midline abdominal incision with a size 20 blade and the surgical procedure was conducted according to the requirement of the underlying disease. After dealing with the primary pathology, a thorough peritoneal lavage was performed in all the cases with 12 litres of normal saline. Two drains were placed in the peritoneal cavity using a 28Fr Foley catheter and were brought out through separate stab incisions. The drains were placed in both the paracolic gutters extending into the pelvis, except in the cases of perforated duodenal ulcers where one drain was placed in the Rutherford Morrison's Pouch and the other in the pelvis. A modified repair of the midline abdominal wound was performed in

all the cases. Interrupted Smead-Jones sutures were applied to the linea alba using No. 1 prolene suture. In between two/ three interrupted sutures, mass (all layer) suture was applied with No. 1 prolene (polypropylene). The Smead-Jones sutures were double far-near, near-far sutures applied to the linea alba. However, the mass sutures were passed through all the layers from the skin to the peritoneum about 3-4 cm from one margin, then brought out from the edge of the linea alba on the ipsilateral side, followed by pushing it inwards from the margin of the linea alba on the contralateral side. Lastly, the suture was brought out from the peritoneum passing through all the layers to the skin on the contralateral side about 3-4 cm from the margin (Figure 1). The skin was not closed primarily and was left open in a majority of cases. All the patients were started on injectable cefoperazone/salbactam 2 grams 12 hourly, combined with injectable metronidazole 500 mg 8 hourly. The wound was managed by daily antiseptic dressings. The injectable antibiotics were continued for 5 days and this was later followed by oral sparflaxacin 200 mg 12 hourly for another 5 days. The patients who developed wound infection were also given injectable amoxicillin/clavulanate 1.2 gram 8 hourly intravenously alongwith twice daily change in dressings. The patients were discharged from the 5th to 9th postoperative day, except in 3 cases who were discharged from the 17th to 25th postoperative day. All layer sutures were removed after 2 weeks of surgery. All the patients made a satisfactory recovery except one case which had a fatal outcome. Postoperatively the patients were followed-up regularly, initially weekly for one month and later three monthly. The total follow-up period was variable and had been continued for 3-23 months (mean 12.47 ± 7.17).

Data was entered in SPSS version 16.0 and statistical analysis was done. Mean was calculated for descriptive variables like age, sex, follow-up period while frequency was determined for different diagnoses (complicated/high risk) of cases undergoing emergency laparotomies along with wound dehiscence and incisional hernia formation.



Figure 1: Modified midline abdominal wound closure technique.

RESULTS

Out of the 36 cases studied, 25 (69.4%) were males and 11 (30.6%) were females. Their age ranged between 17-70 years (mean 42.28±14.80). This study included 20 (55.55%) inflammatory (intra-abdominal sepsis), 8 (22.22%) traumatic, 7 (19.44%) neoplastic and 1 (2.77%) case of vascular aetiology. The different diagnoses of the abdominal conditions requiring emergency laparotomy are mentioned in (Table I).

Table I: Diagnosis of exploratory laparotomies.

Aetiology	Diagnosis	No.	Percentage
Inflammatory (n 20)	Acute perforated appendicitis	7	19.44%
	Perforated duodenal ulcer	6	16.66%
	Tuberculous peritonitis	3	8.33%
	Enteric perforation	1	2.77%
	Primary peritonitis	1	2.77%
	Perforated acute acalculous cholecystitis	1	2.77%
Traumatic (n 8)	Post c section peritonitis/ wound infection	1	2.77%
	Sigmoid perforation/ faecal peritonitis	3	8.33%
	Traumatic ileal perforation	2	5.55%
	Traumatic jejunal perforation	1	2.77%
	Gun shot wound abdomen/ rectal injury	1	2.77%
Neoplastic (n 7)	Uterine rupture/ induced abortion	1	2.77%
	Metastatic carcinoma colon	4	11.11%
	Metastatic granulosa cell tumour ovary	1	2.77%
	Ruptured mucinous adenoma ovary	1	2.77%
Vascular (n 1)	Ruptured benign cystic teratoma ovary	1	2.77%
	Mesenteric vascular occlusion with acute peritonitis	1	2.77%

The main complications encountered in these patients was wound infection. It was seen in 12 (33.33%) cases. Out of these, 01 (2.77%) patient developed partial wound dehiscence. This was a case of sigmoid perforation with faecal peritonitis. Apart from the wound infection she also developed prolonged paralytic ileus, which had a fatal outcome. One (2.77%) patient had an incisional hernia formation. He was a case of gun shot wound in the abdomen with rectal injury. He had an extensive deep wound infection which took about 3 weeks to recover. In 4 (11.11%) cases, the patients had pain over the palpable knots and out of these, 3 (8.33%) developed sinus due to the knots (Table II). The pain subsided with analgesics. However, 2 cases of sinus formation required removal of the underlying stitch.

Table II: Local (wound) complications.

Complications	Number	Percentage
Wound sepsis	12	33.33%
Wound dehiscence	1	2.77%
Incisional hernia	1	2.77%
Painful knots	4	11.11%
Knot sinus formation	3	8.33%

The general complications which were not the scope of this study, however, showed some interesting findings. Most of the patients had deranged renal functions but two had established acute renal failure (serum creatinine > 500 umol/L), which recovered after surgery and did not require haemodialysis. One patient developed a duodenal fistula due to which he was transferred to a tertiary care hospital and he responded

to total parenteral nutrition. Three had disseminated intravascular coagulation, out of which one expired and the rest improved. Hypoproteinaemia was noted in 5 cases as well. We had 1 (2.77%) mortality. She was a case of sigmoid perforation with faecal peritonitis, who not only developed wound dehiscence but also went into multi-organ failure and could not recover.

DISCUSSION

A variety of abdominal wound closure techniques have evolved over many years. However, wound dehiscence remains a serious complication. Penninckx *et al.*³ documented a 2.58% wound dehiscence in 4538 patients treated with gastrointestinal operations. An interesting observation was that the group of patients with diseases pre-disposing to wound dehiscence had a significantly higher incidence of wound dehiscence (4.45%) in contrast to a group of patients presenting with so-called non-predisposing diseases (0.43%). They also noted that complicated neoplasms and complicated inflammatory diseases had an extremely high frequency of wound dehiscence; 15.07% and 22.73% respectively, with routine continuous suture closure technique. The frequency of wound dehiscence after emergency laparotomy was 6.7% as compared to 1.5% in elective cases. Rahman recorded abdominal wound dehiscence in 7 (23.23%) cases, among the 33 patients of spontaneous ileal perforation with acute peritonitis and an incidence of wound infection in 30.3%.⁴ This study also had a small number of patients, but all were emergency laparotomies with complicated and high risk cases (neoplasms and intra-abdominal sepsis). There was only a single case of partial wound dehiscence with the modified midline abdominal wound closure technique. Wound dehiscence is associated with a mortality of above 25%.^{5,6}

van t Riet *et al.*⁷ noted that out of 168 patients with wound dehiscence, 42 (25%) died within 60 days of surgery and 55 of the remaining 126 developed an incisional hernia.⁷ The rate of incisional hernia is higher after emergency midline laparotomies. It has been noted to be upto 18.1% as well.⁸ In this study, there was only patient who developed an incisional hernia later. Apart from the surgical technique, better preparation of the operative field and scrupulous sterility throughout the procedure can decrease the incidence of postoperative wound infection and subsequent dehiscence and incisional hernia formation. However, patient variables like age, obesity, co-morbid conditions like diabetes mellitus, hypoproteinemia, immunocompromised states and personal cleanliness can also affect the outcome as well.

A majority of the studies recommend the use of continuous suture closure of the linea alba over the interrupted suture closure technique. This is firstly

because of the fact that the former can be accomplished more rapidly and secondly, the latter usually has tight tying and this can result in the lower wound strength.⁹⁻¹² while continuous suturing usually distributes tension equally over a continuous line.¹³ Whipple and Elliott⁹ indicated that tying sutures too tightly caused strangulation of the tissue with ischemic necrosis and was the most common error in abdominal wound closure. Investigators reported that tight tying of interrupted sutures resulted in a lower wound strength than sutures tied when the wound edges were approximated.¹⁰⁻¹²

In an intact animal model, Poole and co-workers demonstrated that the continuous suture technique was associated with greater wound bursting pressure than the simple interrupted suture or figure of eight mattress suture.¹⁴ Richard and colleagues found no difference in the wound dehiscence rate or incidence of incisional hernia between continuous and interrupted (Smead-Jones) suturing.¹⁵ In addition, Stone and associates showed that continuous suturing resulted in a comparable incidence of dehiscence to interrupted suture and had the average saving of 26 minutes anaesthesia time.¹⁶ Apart from continuous suturing, the use of absorbable suture materials is also being promoted over the non-absorbable ones. Absorbable monofilament suture material (polydioxanone PDS) is considered superior to both absorbable braided and non-absorbable suture for abdominal fascial closure as it is associated with lesser incision pain and suture sinus formation.¹⁷⁻²⁰ But the main issue associated with PDS is the cost constraints. This is much more expensive than the routinely used non-absorbable suture materials. Lastly, the selection of a wound closure technique must also take into account the dynamic changes in wound length during distention.²¹ The continuous suture usually distributes its tension throughout the wound, while with an interrupted closure, the tension remains isolated to each suture loop.

Despite of all these strong recommendations for a continuous suture technique, we decided to combine the interrupted suture technique with mass (all-layer) sutures as a primary surgical method for the closure of midline abdominal wounds using non-absorbable suture material, polypropylene. Those patients were considered who had extensive generalized peritonitis or metastatic/widespread abdominal tumour.

Weiland and co-workers conducted a meta-analysis that continuous closure with non-absorbable should be used to close most abdominal wounds. However, if infection or distension is anticipated, interrupted (absorbable) sutures are preferred and mass closures are superior to layered closures.²²

In this study, 12 (33.33%) cases developed wound infection and this was noted in patients with generalized

peritonitis. Among these, ten showed satisfactory wound healing but one developed partial wound dehiscence and one had a late sequel of incisional hernia. The former was a patient with sigmoid perforation with faecal peritonitis and had a fatal outcome, while the latter was a case of gun shot wound in the abdomen with rectal injury with extensive deep wound infection. The antibiotics used in this study may appear to be unnecessary, but working at a peripheral station and managing such critically ill patients with no culture facilities and lack of intensive care units, such as an antibiotics regimen may prove essential.

Another interesting problem encountered in this technique was due to the multiple knots (Smead-Jones sutures) of the non-absorbable suture material, specially in those that are thin and lean. It was not seen in the cases that had adequate subcutaneous fat over the linea alba. These knots caused pain and suture sinus formation. The interrupted sutures were combined with mass (all layers) closure. The technique of the mass closure was also modified as it helped in avoiding any chance of the gut getting trapped in the inner portion of the suture.

In cases of wound dehiscence between the 6th and 8th day after operation, the abdominal wound bursts open and the viscera are extruded.^{23,24} The disruption of the wound tends to occur a few days before and when the sutures apposing the deep layers (peritoneum, posterior rectus sheath) tear through or even become untied. At the completion of the operation, any violent coughing set off by the removal of the endotracheal tube and suction of the laryngopharynx strains the sutures. Likewise cough, vomiting and distension (e.g. due to the ileus) in the early postoperative period can contribute to wound dehiscence. Incisional hernias after abdominal surgery are common but with a varied reported incidence (2-20%), depending upon the type of case.^{23,24} There are several factors that contribute to the etiology of incisional hernias, the most important being adequacy of abdominal wound closure in the first instance and the occurrence of wound infection and subclinical wound dehiscence in the postoperative period. Smith and Enquist found that a standardized staphylococcal wound infection produced a significantly weaker fascial wound than the controls.²⁵ Other factors like obesity, chronic obstructive airway disease, steroid dependence, jaundice, hypoproteinaemia, malnutrition, drainage through the wound and formation of stoma also contribute to its etiology. An incisional hernia usually starts as a symptomless partial disruption of the deeper layers during the immediate or early postoperative period, the event passing un-noticed if the skin wound remains intact after the skin sutures have been removed.

CONCLUSION

The modified technique used in managing the patients with generalized peritonitis and metastatic abdominal tumours (complicated/high risk laparotomies) is associated with a low incidence of serious complications like wound dehiscence and incisional hernia formation comparable to internationally recommended techniques. However, the local problems of the knots are the main reservation and should not be considered as the only reason for not adopting this technique in moribund patients.

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