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A prospective study of single layer abdominal wall closure in the tertiary care hospital

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ABSTRACT

Background: Despite advances in surgical techniques and material, abdominal wound closure remains challenging. Most abdominal wall incisions are either midline or paramedian. The value of a particular method of closing is determined by the incidence of early and late wound complications. The best abdominal wound closure technique should be, fast, easy, safe and cost effective. It should also prevent or minimize the early and late complications. This study addresses the midline single-layer closure of the abdominal wound.

Methods: The purpose of this study is to evaluate the single layer midline abdominal wound closure. The early and late complications associated with this method are studied, and relevant literature reviewed. The study period is from May 2016 to May 2018, i.e. 24 months. The study group comprises of 52 patients, admitted in the department of surgery SBRKM Government medical college Jagdalpur. In all of them, the midline incisions closed in a single layer by a non-absorbable continuous suture. The skin closed separately. The mean age of the patient is 46.5 years. The male to female ratio is 3:1. Emergency laparotomy done in 35 cases and 17 (38.4%) underwent elective surgeries.

Results: In this series 20 (38.4%) patients had wound infection. 10 (19.2%) patients had wound gaping. There was no incisional hernia in six months follow-up.

Conclusions: Single layer abdominal wall closure has a definite advantage. It is fast, easy and cost-effective. Continuous running suture with non-absorbable material provides enough strength during healing and is better than interrupted sutures. The incidence of early and late complications is also significantly less. The results are comparable to many meta-analyses and RCT did in this field.

Keywords: Abdominal wall closure, Mass closure, Wound infection, Wound dehiscence, Sinus formation, Continuous closure, Incisional hernia

INTRODUCTION

Laparotomy is a major surgical procedure in surgical units. The type of incision and wound closure techniques remains the surgeon's choice; it depends upon his preferences and is backed by his experience, the prevailing culture, and scientific evidence. The integrity of sutured abdominal wound depends upon a balance between suture holding capacity of tissue and tissue holding capacity of sutures. From the perspective of the surgeon the ideal wound closure should be safe,

quick to perform, provide sufficient strength and acts as a barrier to infections. It should have low rates of wound dehiscence, hernia formation, and should be comfortable to patients and is aesthetic. There are so many clinical trials which compared mass closure of abdomen versus layered closure, absorbable vs. non-absorbable suture materials, continuous vs. interrupted sutures etc.

In the meta-analysis of mass closure of abdomen vs. layered closure, Weiland et al found that there is a significant increase in the incidence of incisional hernia

in the layered abdominal closure technique. In this metaanalysis, nine studies are included consisting of 3,321 patients. In the meta-analysis done by Rucinski et al also confirmed the superiority of mass closure over the layered closure. It can be concluded that a continuous mass closure is an optimal technique for the closure of abdominal wall incision after laparotomy.

The type of suture material used has also been, thoroughly investigated and the results are published in the various meta-analysis. Weiland et al compared continuous absorbable and non-absorbable sutures. The incidence of incisional hernia formation is significantly higher with absorbable continuous sutures. ⁴ Meta-analysis by Hodgson et al also confirmed that the non-absorbable, continuous suture have significantly less incidence of developing complications like an incisional hernia. ⁶

Objective

The objective of this study is to ascertain the usefulness of single layer abdominal wall closure. In fact single layer closure is a routine practice in our department. This study is an effort to evaluate its strength and weakness and to authenticate the procedure.

METHODS

The present study is undertaken in the department of surgery, SBRKM Government medical college, Jagdalpur to find out the pros and cons of mass closure of midline abdominal incision, by continuous non-absorbable suture material (Prolene®). The study period extended from May 2016 to May 2018. A written informed consent obtained from all the patients. The ethical committee approved to undertake the study. All the patients underwent standardized blood and urine test. The X-Ray. Ultra-Sound studies, and other investigations have done wherever indicated. It included both routine and emergency surgeries. The study design is a single-centric prospective study. The incisions other than midline are excluded from the study. Patients with co-morbidities like diabetes mellitus, Immuno-compromised, patients on chemo or radiotherapy, patients on long term steroids also were excluded.

The surgical procedure is carried out by all the consultants of the department of surgery. Abdominal wall closure is achieved by continuous non-absorbable No.1/0 Prolene® sutures. The suture-to-wound length ratio kept more than 4:1. The stitches given are one CM apart and bite taken 1 CM away from the midline. All sutures passed through the full thickness of the musculo-aponeurotic layer and included peritoneum, as well. The peritoneum is not closed separately. The suture tied with just enough strength to approximate the cut edges. After the closure of fascia, skin stitched either by silk or stapler device. During the operation, a record was kept regarding the time required for closure and the type of suture material used.

The study group comprises 70 patients, admitted in the Department of Surgery, SBRKM Government Medical College Jagdalpur. Out of 70 patients, we have lost follow-up of 10 patients and 8 patients expired due to various conditions and co-morbidities, thus a total of 52 patients of either sex are studied. The age ranges from 15 to 75 years. 46.5 years is the mean age of the patients. The wound inspected on third, fifth and tenth P.O. day.

In the postoperative period, wound inspected for the presence or absence of seroma, wound infection, & wound dehiscence. They were also examined for abdominal distension, vomiting, hiccup, chest infection etc. If the wound healing found satisfactory, the patient discharged after removal of stitches and with the instruction to come for follow-up after one week, then after one month. The patients are asked to come for a follow-up in three and six month's time. We were able to follow-up 30 cases up-to one month, 15 cases up-to three months and 7 cases for 4-6 months.

During the follow-up, the complications were noted. Immediate complications included wound infection, wound dehiscence and late complications were sinus formation and incisional hernia.

RESULTS

The study group comprises of a total of 52 patients. The age of patients ranged from 18 years to 75 years, the mean age being 46.5 years. The male to female ratio is 3:1. Emergency surgery was undertaken in 35 cases and elective surgery in 17 cases.

Wound infection

It is the infection at the operative site and the discharge of pus. Surgical wound infections are the most common healthcare-associated complications. They are responsible for secondary mortality and morbidity and also for significant escalation in the cost of treatment. In our study a total number of 20 (38.4%) patients had wound infection. This wound infection may be due to infective nature of the primary disease and emergency laparotomy. In the series by Elkheir et al, the rate of wound infection was 29.6%, Togert et al reported it as 17% and 22.5% by Choudhary et al. 9-11

Wound gaping/burst abdomen

Complete wound dehiscence/burst abdomen is a serious complication and the etiology is multifactorial. ¹² It is also associated with high mortality and morbidity. A burst abdomen is defined as a separation of all the layers of the abdominal wound with or without protrusion of viscera. In the postoperative period abdominal distension and wound oedema are known, and here comes the importance of the ratio of suture length to wound length. As recommended by Jenkins et al and other authors the suture length should be kept at least four times to wound

length (SL: WL = 4:1). This principle was kept in mind while closing the wound in our series. As a result, no burst abdomen was noted in our study.

Wound dehiscence and wound gaping were noted in our patients. Wound dehiscence is considered when the infection reaches the muscles and there is a separation of wound edges.¹³ Ten patients (19.2%) in our series have wound gaping. High percentage of wound gaping in our series may be attributed to more number of surgery associated with infective pathology and emergency surgery. They are treated with control of infection, wound care and secondary suturing where-ever indicated.

Sinus formation

Sinus formation can occur where the sutures have knot i.e. at the beginning and at the end. To minimize the possibilities of sinus formation the knots at either end should be buried in the fascia. Alternatively, the loop suture material is used, so that there is only one knot at the end of suturing, this knot is buried in the fascial layer. If this precaution is observed the sinus formation due to knot can be completely avoided. In our series, there was no sinus formation.

Table 1: The study design and data collection.

SN	Item	Data/ description				
1	Place of study	SBRKM Government medical college, Jagdalpur.				
2	Period of study	From May 2016 to may 2018				
	Inclusion criteria	Midline laparotomy incision.				
		Anterior abdominal wall incisions, other than midline.				
	Exclusion criteria	Patients with co-morbidities like Diabetes mellitus, patients on chemo or radiotherapy, patients on long term steroids.				
	Suture	Continuous non-absorbable suture.				
_		Prolene® (1/0).				
3	Number of patients	52				
4	Mean Age	46.4 years.				
5	Male :female ratio	3:1				
6	Type of surgery	Disease	No. of patients			
		Hollow viscous perforation	25			
		Intestinal obstruction	10			
		Hydatid disease	3			
		Gastric outlet obstruction	3			
		Abdominal Tuberculosis	4			
		Liver Abscess	7			
		Total number of patients	52			
		Emergency Surgery	35			
		Routine Surgery	17			
	Follow-up	<1 month: 30 cases.				
7		1-3 months: 15 cases.				
		4-6 months: 07 cases.				
8	Wound infection	38.4%				
9	Wound gaping/dehiscence	19.2%				
10	Sinus formation	Nil				
11	Incisional hernia	Nil				

Table 2: Comparison of post operative complications with earlier and present study.

Study	Wound infection (%)	Wound gaping/dehiscence (%)	Sinus formation (%)	Incisional hernia (%)
Ibrahim ⁹	29.6	-	-	-
Togart ¹¹	17	0.87	-	-
Choudhary & Choudhary 10	22.5	-	-	-
Shukla et al ¹⁵	0.5	2	-	-
Singh et al ¹⁶	6.6	0	-	0
Bucknall et al ¹⁹	-	0.76	0.8	-
Present study	38.4	19.2	0	0

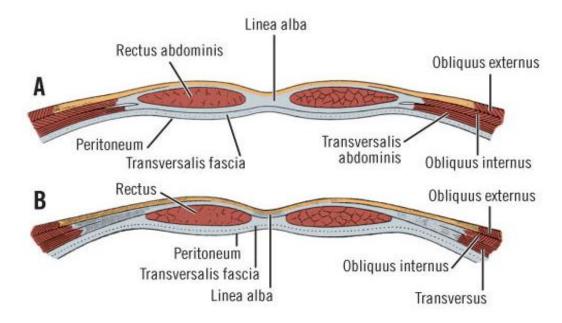


Figure 1: Anterior abdominal wall anatomy.⁷

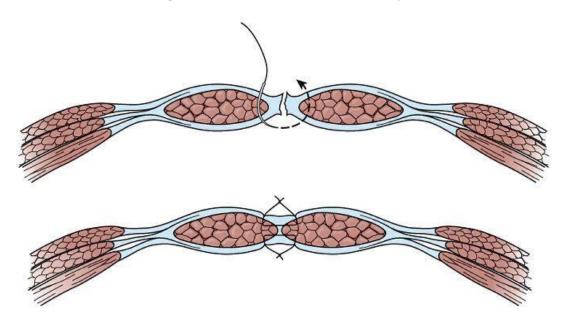


Figure 2: Single layer closure of anterior abdominal wall.⁷

Incisional hernia

An incisional hernia is said to be present when there is protruding swelling on the scar tissue, and there is a palpable fascial defect. The swelling becomes obvious on asking the patient to cough and leg or head raising test. An incisional hernia is closely related to the suture technique. Ellis reported a decreased incidence of incisional hernia with mass closure. If In single-layer closure, the incidence of postoperative complications like seroma formation, wound infection and wound gaping is less and thus they also contribute towards fewer chances of incisional hernia.

Incisional hernia is a known complication in the layered abdominal wall closure. The overall incidence varies from 5% to 15% in a one-year follow-up. ⁵ These two meta-analyses have confirmed a significant reduction in hernia formation and wound dehiscence with mass closure. Continuous closure minimizes the number of knots and very low incisional hernia incidence. Shukla and Singh et al reported an incidence of incisional hernia as 3% and 6.6% respectively in layered closure while there is no incidence of incisional hernia in single layer closure. ^{15,16} In our study also, there is no incisional hernia reported in six months follow-up.

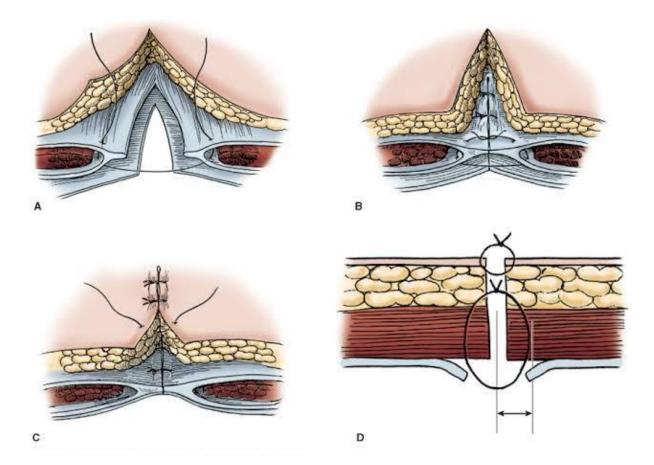


Figure 3: Abdominal wall closure. (A) single layer abdominal wall closure, containing rectus sheath and peritoneum; (B) Mass closure in progress; (C) skin closed as separate layer; (D) the sutures are inserted one CM apart and kept one CM away from the edge of incision.⁷

DISCUSSION

In any abdominal operation, the aim of the surgeon is to restore the structural integrity of the anterior abdominal wall as near to normal as possible. This restoration of structural integrity helps in proper wound healing and avoids future complications like wound dehiscence, sinus formation or incisional hernia. The present study is focussed on midline incisions only.

Mass closure versus layered closure

Since the beginning of abdominal surgery, most of the surgeons have advocated meticulous layer by layer closure of the incision. Layered closure consists of separate closure of individual components of the abdominal wall especially the peritoneum and musculo-aponeurotic layer. The mass closure is the closure of all layers of the abdominal wall including peritoneum en masse. The skin is closed separately. The mass closure was first described and advocated by Smead in 1900 and then by Jones in 1941, so it is popularly known as Smead-Jones technique. To Dudley et al in 1970 showed that the mass closure is superior to the layered closure using stainless steel wire. Bucknall et al, in his

prospective study on 1129 patients, demonstrated that layered closure was associated with a significantly higher dehiscence rate as compared to mass closure (3.81% vs. 0.76%). ¹⁹

In many of the published meta-analysis, it is confirmed that there is a statistically significant reduction in hernia formation and dehiscence rate in mass closure technique.²⁰ Mass closure methods not only reduce the time taken for the closure of abdominal wall incision but also reduce the incidence of wound dehiscence and hernia formation.²¹ It may be due to even tension distribution across the entire length of the suture and minimization of tissue strangulation.^{22,23}

In our series, there is there is no burst abdomen. Wound gaping does reported in our series and it is attributed to the infective nature of the primary disease. They are treated by control of infection and wound care.

Continuous versus interrupted sutures

The incidence of incisional hernia has been studied by comparing continuous vs. interrupted sutures in many meta-analyses. The meta-analysis by Hodgson et al in 2000 concluded that continuous sutures resulted in significant reduction of IH as compared to interrupted sutures (OR 0.73, 95% CI 0.55-0.99).¹⁷

Several randomized trials and meta-analysis have examined continuous vs. interrupted sutures wound closure. ²⁴ Continuous sutures are faster to apply and less costly. Dehiscence, wound complication rate and incisional hernia rates are similar in both the methods. There is an advantage of even distribution of tension throughout the wound in case of continuous sutures. Very rarely slipping of knot may be responsible for wound dehiscence. ^{25,26} In our series we have used continuous suture of abdominal wound closure.

Suture to wound length ratio

The suture length to wound length ratio involves a geometric approach that aims to avoid wound dehiscence and hernia formation. The length of midline laparotomy incision can increase up to 30% in the post-operative period, as shown by Jenkin et al experimentally. This increase in length is associated with increased intraabdominal pressure. It is important to use an adequate length of suture and to take enough bites to accommodate the potential increase in the length of the wound; in the post-operative period. Israelsson et al have reported that a 4:1 ratio for suture-to-wound length and smaller facial bites (<1 cm) result in less hernia formation. Respectively. Page 10.30 larger bites may contain and compress more soft tissues.

The ideal amount of tension that should be used to close the wound remains unknown due to the lack of clinical research. Greater tension on suture lines may cause ischemia of soft tissue caught in the tight stitches and are responsible for increasing the risk of wound infection, weakening of scar and future hernia formation. Jenkins studied the relationship of the bites of tissue taken in suturing to the amount of suture material used by the surgeons. In his study, it was determined that a suture-length-to-wound length ratio of 4:1 is ideal. In the present study the wound to suture length is kept more than 4:1 in all the laparotomy closures.

Two other aspects of abdominal wound closure need some elaboration. They are the pulling tension on the suture during abdominal wall closure and the impact of the knot on the complications like sinus formation and wound infection. Excessive pulling tension during suture causes tissue ischemia. This, in turn, is responsible for impaired wound healing, small fascial tears, and formation of fascial defects in the healing wound. The placing of the knot also needs some consideration. In continuous suturing, the knot at the beginning and end should be buried in the fascia. Knot failure has been implicated as the cause of a burst abdomen in four percent of the patients.³⁴

As far as the suture material is concerned slowly absorbable and non-absorbable suture were favoured over rapidly absorbable suture materials in all the studies. The suture material needs to provide adequate elastic strength, support, and tension during wound healing. After the wound healing, they should continue supporting the scar until the regenerated fascia is strong enough, which may take a few months time. It means suture should retain all these properties long enough to avoid the incidence of incisional hernia. The monofilament polypropylene suture (Prolene®) has stood the test of time. In our series, all the abdominal wound closure is done by this suture material. The suture length to wound length (WL: SL) ratio was kept 4:1. In the study of Israelsson et al WL: SL of 4:1 and more is found ideal. 35,36

CONCLUSION

It is a persisting challenge to the surgeon, to reduce the local wound complication and formation of an incisional hernia. Yet there is considerable evidence regarding optimal wound closure technique. The present study concludes the followings.

- The single layer closure technique offers a certain definite advantage over layered closure technique with regards to time taken for the closure of incision, local wound complications, and incisional hernia formation.
- A simple running suture as compared to interrupted sutures is preferred and is supported by many prospective studies as well as 4 meta-analyses.
- Non-absorbable sutures perform better than absorbable sutures.
- Suture length to wound length ratio of 4:1 is found ideal and is supported by prospective experimental and clinical studies.

The present study contributes to the best method of anterior abdominal wall wound closure. It unequivocally proves that single layer abdominal wall closure with non-absorbable, continuous suture has least complications and it has stood the test of time.

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 $Institutional\ Ethics\ Committee$

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