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Abdominal midline wound closure with small bites versus large bites: a randomized comparative trial

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ABSTRACT

Background: The optimal strategy of abdominal wall closure after midline laparotomy has remained an issue of ongoing debate to minimize incidence of incisional hernia which occurs in 10 to 23% cases postoperatively. The main objective of the study was to evaluate the efficacy of small bites versus large bites suture technique in reduction of incidence of the complications like pain, wound infection, wound dehiscence, seroma formation and incisional hernia by using polydioxanone no.1.

Methods: The present study was conducted on 100 patients undergoing elective surgery who were randomly allocated into group A and B. Group A were the patients in which midline abdominal wound closure was done with small bites and group B were the patients in which midline abdominal wound closure was done with large bites. Then the patients were followed up for 6 months to observe any complications.

Results: A mean additional closure time of 9 minutes was seen with the small bites technique. The mean suture length was more in small bites group as compared to large bites technique. There was no difference in the visual analog scale score between the two groups. No significant difference was seen in the incidence of major and minor wound infection postoperatively in both the groups. Small bites technique reduced the incidence of suture sinus and incisional hernia compared to conventional large bites technique.

Conclusions: It can be concluded that the small bites suture technique is more effective than the traditional large bites technique for prevention of all post-operative complications.

Keywords: Large bite, Small bite, Midline laparotomy, Incisional hernia, Pain, Wound infection

INTRODUCTION

A midline incision is commonly used in exploratory laparotomy. It provides a relatively quick and wide access to the abdominal cavity and can be made with minimal damage to muscles, nerves and blood supply as these structures do not cross the midline.¹

Techniques for closure of the midline abdominal incision have varied over time with better understanding of the physiology and engineering of closure of the abdominal wall and improvement in materials of surgical suture. The ideal wound closure provides strength and barrier to infection. To achieve that goal, one should follow the principles of wound closure i.e. closure should be fast, efficient, performed without tension or ischaemia, technically easier to surgeon and anaesthesiologist.²

However, burst abdomen, wound infection, seroma formation, incisional hernia remains the complications after median laparotomy with reported incidences varying between 2% to 20%. The variation in reported incidence

is due to differences in patient population studied, length of follow up and method of hernia diagnosis. It is associated with high morbidity, decreased quality of life and high costs (direct and indirect) and can lead to emergency surgery for incarcerated hernia.³

Surgical site infection following abdominal closure is a common complication, affecting up to 15% of patients and is associated with an increased risk of incisional hernia and wound dehiscence, which can lead to negative outcomes such as increased reoperation rates.⁴

The risk of developing complications like burst abdomen, wound dehiscence, incisional hernia after midline laparotomy is related to patient factors i.e. male gender, local wound infection, obesity, the use of glucocorticoids, hypoalbuminemia, anaemia and emergency operations and operative factors like postoperative infection. Certain factors that can be controlled by the surgeon like choice of suture material and suture technique.⁵

Although certain populations of patients are more prone to developing complications after midline abdominal wall closure, it is clear that there are number of operative factors that are under the direct control of the surgeon and can have considerable impact on the outcome. Several techniques are beneficial to both postoperative incisional hernia and wound dehiscence rates, and are therefore strongly recommended by published guidelines.⁶

An association between the large bite technique and surgical site infection (SSI) has also been found and one study found that the rate of SSI could be halved when the small bite technique was employed. It has been suggested that the larger amount of surrounding tissue compressed in a large stitch bite may become necrotic, therefore predisposing to infection.⁷

It might be expected, the factors that reduce risk of incisional hernia are congruous with those that reduce risk of wound dehiscence. The most common mechanism is the cheese wiring of the suture through the tissue holding it and is due to excessive tension. Therefore, factors that may be expected to increase the strength of the wound and reduce the tension on the surrounding tissue have been found to reduce dehiscence rates. Principal among these factors is the suture to wound length ratio and in cases where the ratio is >4:1, dehiscence rates are very rare.^{7,8}

To achieve safe abdominal closure, it is advised to have a suture length (SL): wound length (WL) ratio of more than 4:1. The importance of a high SL:WL ratio led to standardise a safe abdominal closure technique.

Objectives

The main objective of the study was to evaluate the efficacy of small bites versus large bites suture technique

in reduction of incidence of the postoperative complications.

METHODS

Study design

Interventional, single centric, prospective, randomised control trial was designed.

The present study was conducted in department of surgery at Sri Guru Ram Das Institute of Medical Sciences and Research, Amritsar on 100 patients undergoing elective surgery during the period from September 2017 till December 2019. They were randomly allocated into group A and B using block randomisation method.

Group A (50 patients) were the patients in which midline abdominal wound closure was done with small bites and group B (50 patients) were the patients in which midline abdominal wound closure was done with large bites.

Inclusion criteria

Patients with age more than 18 years, either sex, all elective laparotomies with a midline incision, signed informed consent were included.

Exclusion criteria

Patients with previous incisional hernia after midline incision, previous surgery through a midline incision within 3 months, pregnancy (in women), current immunosuppressive therapy (more than 40 mg of a corticosteroid per day or azathioprine), chemotherapy within 2 weeks before operation, all emergency laparotomies and refusal for consent were excluded.

Suture material used in both the groups was polydioxanone (PDS) no. 1 with length of thread 150 cm and half-moon shaped needle.

Small stitch technique

Continuous sutures of 5 mm bite taking distance of 5 mm from median wound incision to stitch site. SL to WL ratio being 5:1.

Large stitch technique

Continuous suture of 1 cm bite taking distance of 1 cm from median wound incision to stitch site. SL to WL ratio being 4:1.

During wound closure, the suture was held tight without tension. The wounds were closed as a continuous single layer, beginning at the top and bottom ends of the wound to complete the closure at the mid-point of the wound. Tissue bites 1 cm and 5 mm were taken on either side at 1

cm and 5 mm intervals. All knots consisted of 5 throws and SL and WL was measured.

In calculating SL

WL ratio, the SL for knotting and as free cut ends were subtracted from the overall SL used. The time for closure i.e. starting from 1st knot at the top till the knot at the bottom ends of the wound was also measured.

Post operatively, pain by visual analogue scale (VAS) score ranging from 0 to 10, zero (0), indicating no pain and ten (10) indicating severe pain. The pain score using VAS was measured in all patients at 24 hours, 48 hours, one week and compared.⁹

Then the patients were followed up for 6 months to observe any complications like pain, wound infection, wound dehiscence, seroma formation and incisional hernia.

The study was approved by the Institutional Ethics Committee and the data was analysed statistically using SPSS Version 26.

RESULTS

The present study was conducted to compare small bites versus large bites technique of wound closure in 100 patients undergoing elective midline laparotomy in the Department of Surgery at Sri Guru Ram Das Institute of Medical Sciences and Research, Amritsar. All the patients were observed for the complications postoperatively.

Table 1: Age distribution in groups A and B.

Age group (in years)	Group A (n=50)	%	Group B (n=50)	%
<20	4	8	4	8
21-40	16	32	14	28
41-60	18	36	21	42
>60	12	24	11	22
Total	50	100	50	100

Table 1 revealed that maximum number (36%) of the patients were in the age range of 48-60 years in group A whereas (42%) of the patients were in the age range of 48-60 years were in group B.

Table 2: Gender distribution in groups A and B.

Gender	Group A (n=50)	%	Group B (n=50)	%
Male	24	48	22	44
Female	26	52	28	56
Total	50	100	50	100

Table 2 shows a greater number of females than males in this study in both the groups A and B.

Table 3 shows that majority of surgeries were laparotomies (46%) (elective) in group A while in group B maximum (40%) surgeries were others.

Table 3: Comparison of types of surgeries in groups A and B.

Surgery	Group A (n=50)	%	Group B (n=50)	%
Laparotomy	23	46	12	24
Whipple's procedure	10	20	2	4
Hemicolectomy	5	10	10	20
Total abdominal hysterectomy with bilateral salpingo- oophorectomy	5	10	6	12
Others	7	14	20	40

Table 4: Comparison of mean time for closure in groups A and B.

Variable	Group A (n=50)	Group B (n=50)	P value
Time for closure (min)	23.78±8.41	14.58±5.08	0.000**

Data presented as mean \pm standard deviation, **p<0.001=highly significant.

Table 4 shows that longer mean time was taken in wound closure in small bites technique. Difference in mean time of closure between groups A and B was statistically significant.

Table 5: Comparison of mean SL in groups A and B.

(n=5)	$(0) \qquad (n=50)$	U)	
SL (cm) 115.	7±20.38 88.82	±17.44 0.0*	*

Data presented as mean \pm standard deviation, **p<0.001= highly significant

It is clear from Table 5 that mean SL was more in small bites group as compared to large bites group which is statistically significant.

The pain score using VAS was compared in all patients at 48 hours, 5, 7 and 9 days. In both the groups, mean difference in VAS scores at 48 hours, 5, 7 and 9 days postoperatively was statistically insignificant as shown in Table 6.

Table 7 depicted no statistical difference in the incidence of major wound infection postoperatively in both the groups. It can be inferred from Table 8 that there was no statistically significant difference in the incidence of minor wound infection postoperatively in both the groups.

Table 6: Mean VAS score at 48 hours, 5 days, 7 days and 9 days postoperatively.

Time	Group A (n=50)	Group B (n=50)	P value
48 hours	3.2±0.86	3.2±0.63	1.000
5 days	1.04 ± 0.81	1.14 ± 0.76	0.500
7 days	0.16±0.37	0.2 ± 0.4	0.600
9 days	0.0	0.0	-

Data presented as mean±standard deviation.

Table 7: Comparison of incidence of major infection at 48 hours, 5 days, 7 days and 9 days postoperatively.

Time		oup A 50)		oup B :50)	Chi square	P value	
	N	%	N	%	value		
48 hours	0	0	1	2		0.992	
5 days	0	0	0	0	0.000		
7 days	0	0	0	0	0.099	0.992	
9 days	2	4	6	12			

Table 8: Comparison of incidence of minor infection at 48 hours, 5 days, 7 days and 9 days postoperatively.

Time	Group A (n=50)			oup B :50)	Chi square	P value
	N	%	N	%	value	
48 hours	0	0	0	0	0.020	0.999
5 days	4	8	3	6		
7 days	7	14	6	12		
9 days	0	0	0	0		

Table 9: Comparison of incidence of wound dehiscence at 48 hours, 5 days, 7 days and 9 days postoperatively.

Time		Group A (n=50)		oup B :50)	Chi square	P value
	N	%	N	%	value	
48 hours	0	0.0	0	0.0		
5 days	0	0.0	0	0.0	0.000	1.000
7 days	0	0.0	0	0.0	0.000	1.000
9 days	4	8.0	5	10.0		

Although small bites suture technique showed decreased incidence of wound dehiscence but, the difference was statistically insignificant (p>0.05) between the two groups as depicted in Table 9.

Patients were followed up for 6 months to assess long term complications like suture sinus and incisional hernia. Table 10 and 11 showed that small bites technique

reduced the incidence of suture sinus and incisional hernia compared to conventional large bites technique, however the difference was statistically insignificant (p>0.05).

Table 10: Comparison of incidence of suture sinus at 1 month and 6 months postoperatively.

Time		=50)	Gro (n=		Chi square value	P value
	IN	%	IN	%	varue	
1 month	3	6.0	4	8.0	0.000	1.000
6 months	0	0.0	0	0.0	0.000	1.000

Table 11: Comparison of incidence of incisional hernia at 1 month and 6 months postoperatively.

Time		oup A :50)		oup B :50)	Chi square	P value
	N	%	N	%	value	varue
1 month	0	0.0	0	0.0	0.000	1 000
6 months	3	6.0	7	14.0	0.000	1.000

DISCUSSION

In this era of minimally invasive and robotic surgery, many patients with high-risk profiles still undergo major abdominal surgical procedures with midline incision. Closure of abdominal incision has been greatly simplified by realization that all incisions heal by forming a block of fibrous tissue.¹⁰ Wound infection and incisional hernia remain a frequent complication in the surgical population and should be monitored carefully. Therefore, the technique of laparotomy wound closure is an important factor in preventing the postoperative complications like wound infection, wound dehiscence, suture sinus formation, incisional hernia and scar complications. Elective midline exploratory laparotomy and its closure is a frequently performed procedure in any surgical unit worldwide and secure closure of a laparotomy incision remains an important aspect of any abdominal operation with the aim to avoid the postoperative morbidity and hasten the patient's recovery.11

In this study small bite suture technique versus large bite technique in closure of abdominal midline wound was observed.

100 patients who underwent explorative laparotomy through midline incision were studied. The following observations were made from the above study.

The demographic characteristics like age, height and gender distribution was similar in both the groups. The types of surgeries and therefore the mean incision length was also similar in both the groups.

The mean time for closure was 9.2 minutes more in small bites groups than the large bites group. The mean SL used in small bites group was 26.88 cm more in the small bites group than the large bites group which reduces the tension on the suture and thus the complications.

The SL to WL ratio is an important parameter for healing of midline incisions closed with a continuous suture technique. This is because the excessive tension leads to cheese wiring of the suture through the tissue holding it and thus increases the chances of wound dehiscence. Therefore, it is advised to have a SL:WL ratio of more than 4:1.^{7,8} In this study the SL:WL was more than 4:1 in both the groups.

Post operative complications

Pain

Deerenberg et al in their study, reported that both the techniques i.e. small bites as well as conventional large bites technique were not associated with significant postoperative pain. Similarly, in present study both the groups had similar VAS scores postoperatively and patients were pain free at 48 hour, 5, 7 and 9 days postoperatively.

Wound infection

The part played by wound sepsis is important, as this is the major avoidable cause of wound failure.

In the study done by de Vries et al the incidence of wound infection was 42% in small bite technique, whereas in the conventional large bites suture technique it was 58%. Therefore, the implementation of small bites wound closure of abdominal midline incisions in clinical practice was correlated with a reduction in surgical site infections in this study.¹³

In the study performed by Gokani et al on the economic evaluation of small bite sutures versus large bite sutures in the closure of midline laparotomies in the United Kingdom National Health Service it was concluded that small bites technique reduced the incidence of SSI by 15%.¹⁴

This study also depicted increased incidence of SSI in large bite group. This is because the larger bites contain and compress more soft tissue, thus leading to tissue necrosis and thus wound infection.¹⁵

Wound dehiscence

Israelson et al reported that in their study the total incidence of wound dehiscence requiring reoperation occurred in three patients (0.7 per cent) when the SL to WL ratio was \geq 4 in their study. ¹⁶

Milbourn et al reported that wound dehiscence occurred in one patient whose wound was closed with a long stitch length.¹⁷

Present study showed parallel results among the two groups. Wound dehiscence increases due to increase in the incidence of SSI in large bite group.

Incisional hernia

Incisional hernia is a frequent complication of midline laparotomy and is associated with high morbidity and decreased quality of life. ¹²

Milbourn et al reported that incisional hernia was present in 49 out of 272 patients (18.0%) in the long stitch group and in 14 out of 250 (5.6%) in the short stitch group.¹⁷

Deerenberg et al who reported that at 1-year follow-up, 57 (21%) of 277 patients in the large bites group and 35 (13%) of 268 patients in the small bites group had incisional hernia.¹²

In present study more incidence of incisional hernia was observed in large bites group due to increased rate of wound dehiscence in them.

Our study has some limitations. Previous studies have shown that incidence of incisional hernia increases during longer follow-up. Therefore, a longer period of follow up is required to diagnose incisional hernia.

Another limitation might be that our study did not differentiate between the effects of the smaller bites on the use of different suture material. Therefore, analysis of whether the small bites or the thinner needle and suture material reduces the incisional hernias in the small bites group needs further studies. We included only patients undergoing elective surgery. Whether results obtained by studies for elective laparotomies can be extrapolated to emergency laparotomies remains a topic of discussion.

CONCLUSION

Therefore, our findings showed that the small bites suture technique is more effective than the traditional large bites technique for prevention of all post-operative complications. We highly recommend the use of continuous small bite technique with PDS no. 1 for closure of midline abdominal wound.

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