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Comparative Study Between Simple Closure and Tension Suture Post Exploratory Laparotomy in High Risk Patients

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ABSTRACT

Background: Midline laparotomy incision is still the most common approach for many digestive, vascular [especially aortic] and abdominal trauma surgery procedures.

The aim of the work: This work aimed to compare the post-operative outcomes of simple closure and tension suture post exploratory laparotomy in high-risk patients regarding wound dehiscence, infection and late incisional hernia in 6 months follow up.

Patients and Methods: This prospective randomized study was conducted on 24 high-risk patients undergoing exploratory laparotomy regarding wound dehiscence, infection and late incisional hernia in 6 months follow up divided into two groups: Group [I]: with simple closure technique [12 patients] and Group [II]: with additional tension suture of midline closure technique [12 patients] in Surgery department at Damietta Faculty of Medicine, Al Azhar University.

Results: There was statistically significant difference between the studied cases as regard suture length while there was no statistically significant difference between the studied cases as regard complications, hospital stays, Closure time, indications of laparotomy and etiology.

Conclusion: The tension method of suturing also requires significantly more suture material than the conventional continuous method. Tension suture method of suturing is better than the conventional continuous method in the management of closure of emergency vertical midline laparotomy incision as the post-operative complications occurred less frequently in patients with tension sutures but without statistical significance.

Keywords: Exploratory; Laparotomy; Simple Closure; Tension Suture.

INTRODUCTION

Midline laparotomy incision is still the most common approach for many digestive, vascular [especially aortic] and abdominal trauma surgery procedures. This type of laparotomy can be performed quickly and can be extended proximally or distally according to requirements to provide a wide surgical field. On the downside, it is more exsanguinous than the transverse approach [1]. A midline laparotomy requires opening of the linea alba, which is a weak and tendinous zone. The weakness of the linea alba is enhanced when its fibers are vertically sectioned to access the peritoneal cavity. Thus, when repairing or closing the linea alba using sutures, these are subjected to the tension induced by the mechanical forces that act upon it [2].

Laparotomy wounds have been closed in various ways in terms of continuous versus interrupted closure, single layer versus mass closure, and absorbable versus non-absorbable sutures [2]. The continuous sutures have the advantage of evenly distributed tension across the suture line and being more expedient. It has the disadvantage of being a single suture holding the fascia together. The multiple interrupted suture method has been used successfully for many years, but it has the disadvantage of being time consuming to perform and of isolating the tension of each individual stitch [3].

The complications which may arise following fascial closure include wound dehiscence, wound infection, incisional hernia, and suture sinus formation. They may arise partly as a result of poor technique, faulty selection of suture material, and patient's factors; however, the most important causes are poor surgical technique, persistent intra-abdominal pressure, and local necrosis due to infection [4].

Elective patients with adequate nutritional status and otherwise free from risk factors related to dehiscence, type of closure may not be so important, but in emergency patients with multiple risk factors for developing dehiscence or burst abdomen, it may prove decisive [5].

A major surgical complication after emergency midline laparotomy is abdominal fascial dehiscence. It may appear either as an early [burst abdomen with evisceration and partial dehiscence] or a late [incisional hernia] complication. Post-operative complete wound dehiscence is an unfortunate condition and serious complication is associated with a high morbidity and mortality rate. These patients usually undergo multiple dressings, fecal fistula formation, and surgery for secondary fascial closure, which is associated with markedly increased morbidity, with high incidence of incisional hernia [6].

THE AIM OF THE WORK

The aim of the study was to compare the post-operative outcomes of simple closure and tension suture post exploratory laparotomy in high-risk patients regarding wound dehiscence, infection and late incisional hernia in 6 months follow up.

PATIENTS AND METHODS

This prospective randomized study was conducted on 24 high-risk patients undergoing exploratory laparotomy regarding wound dehiscence, infection and late incisional hernia in 6 months follow up divided into two groups:

Group [I]: with simple closure technique [12] patients and **Group [II]:** with additional tension suture of midline closure technique [12] patients in Surgery department at Damietta Faculty of Medicine, Al Azhar University.

Sample size:

The sample size was calculated using both G-Power and StatCalc, Epi-info version 7 [CDC] software's based on the following assumptions: t tests - Means: Difference between two independent means [two groups]. Analysis: A priori: Compute required sample size.

Input: Tail [s] = Two, Effect size d = 1.5415664, α err prob = 0.05, Power [1-β err prob] = 0.95, Allocation ratio N2/N1 = 1

Output: Non-centrality parameter δ = 3.7760511, Critical t = 2.0738731, Df = 22; Sample size group 1 = 12; Sample size group 2 = 12; Total sample size = 24; Actual power = 0.9501880; This was given a minimum sample size of 24.

Ethical considerations: Informed consent was taken from all participating subjects and confidentiality of information is assured.

Inclusion Criteria: Patient adult patients age ≥18 years, classified as American Society of Anesthesiology Physical Status Classification System [ASA] ≥ 3, undergoing exploratory midline laparotomy 10-cm surgical incision minimum.

Exclusion Criteria: Patients younger than 18 years and patients who have undergone previous laparotomies for any condition.

Preoperative assessment: Preoperative investigations essential for the pre-anesthetic evaluation and fitness for surgery. All patients were given pre-operative dose of antibiotics according to hospital antibiotic policy which was continued in the post-operative period also.

Surgical technique: Exploratory laparotomy was carried out through a midline vertical incision. The length of the incision was measured using a sterilized metallic scale. Peritoneal cavity was washed thoroughly with warm normal saline till the effluent was clear. Variable number of peritoneal drains was inserted as required. The required closure was performed accordingly.

The time taken for closure was noted. The total length of the suture material was noted. Suture length: wound length ratio was subsequently computed. The skin was left un-sutured in some cases the cases. The wound was primarily dressed with sterile surgical gauzes and covered with occlusive adherent bandage. The primary dressing was removed after 48 hours, and daily dressing was done. The wounds were inspected for signs of infection and dehiscence before each dressing. Swab cultures from the wound was sent for microbiological culture and antibiotic sensitivity on evidence of any signs of infection. Wounds were closed secondarily if there were no signs of infection or dehiscence and healthy granulation tissue appeared. In the first group, the fascia was closed in a continuous manner using continuous 1 prolene located 1 cm from the edge of the linea alba with 1-cm intervals. The continuous suture was locked intermittently every 5 cm to divide the long continuous suture into multiple smaller sections. Subcutaneous tissue was not sutured, and skin was closed using interrupted suture of 2-0 prolene. In the second group, the fascia was sutured using the same technique as the first group in addition, to it retention sutures were added using a1 prolene every 10 cm and contained 5 cm of the skin, subcutaneous tissue, rectus muscle, and abdominal fascia [except peritoneum] on each side. The first retention suture was placed 5 cm above the lower end of the incision and repeated every 5 cm toward the upper part of the incision.

Postoperative follow up: Regarding the follow-up, Patients were followed up and re-evaluated at 2, 4, 6 and 12 weeks and 6 months after surgery in outpatient department. The patients were examined for wound

infections or dehiscence. Closure time, suture length and length of hospital stay were compared between groups.

RESULTS

There was no statistically significant difference between the studied cases as regard personal data. Patient's age ranged between 18 and 74, and the majority of patients were males in both groups. The ASA grade III was the commonest [**Table 1**].

There was no statistically significant difference between the studied cases as regard indications of laparotomy. The commonest etiology in group I was intestinal obstruction [41.7%], and the same indication was the commonest in group II [33.3%]. Other causes include blunt trauma, penetrating trauma and intestinal perforation [**Table 2**].

There was no statistically significant difference between the studied cases as regard etiology [**Table 3**]. There was statistically significant difference between the studied cases as regard wound length. It was 15.5±1.93 in group I, compared to 20.5±3.97 in group II [**Table 4**].

There was no statistically significant difference between the studied cases as regard complications. The wound infection was the commonest complication in group I and II [66.7% vs 50.0%, respectively]. The second most common compilation was wound dehiscence in both groups **[Table 5]**.

Table [1]: Comparison between the studied cases according to history data

		Group [I] [n = 12]		Group [II] [n = 12]		Test of Sig.	p
Age	Range.	18 – 74		23 – 74		0.477	0.638
	Mean ± SD.	43.17 ± 18.92		39.92 ± 14.11			
		No.	%	No.	%		
Sex	Female	5	41.7	4	33.3	0.178	0.673
	Male	7	58.3	8	66.7		
ASA class	3	7	58.3	6	50.0	0.944	0.624
	4	2	16.7	4	33.3		
	5	3	25.0	2	16.7		

Data are presented as frequency [%] unless otherwise mentioned, SD: Standard deviation.

Table [2]: Comparison between the studied cases according to etiology

Indications of laparotomy	Group [I] [n = 12]		Group [II] [n = 12]		χ^2	p
	n.	%	n.	%		
Blunt trauma	2	16.7	3	25.0	0.253	0.615
Penetrating trauma	2	16.7	3	25.0	0.253	0.615
Intestinal perforation	3	25.0	2	16.7	0.253	0.615
Intestinal obstruction	5	41.7	4	33.3	0.178	0.673

Data are presented as frequency [%] unless otherwise mentioned.

Table [3]: Comparison between the studied cases according to etiology

	Group [I] [n = 12]		Group [II] [n = 12]		Test of Sig.	p
Etiology	No.	%	No.	%		
Adhesive	2	16.7	0	0.0	10.400	0.581
Appendicular mass	0	0.0	1	8.3		
Cancer colon	0	0.0	1	8.3		
Colonic mass	1	8.3	0	0.0		
D.U	1	8.3	1	8.3		
Diverticulosis	1	8.3	0	0.0		
Foreign body	0	0.0	1	8.3		
M.V.O	1	8.3	1	8.3		
Pelvic abscess	0	0.0	1	8.3		
Peptic ulcer	1	8.3	0	0.0		
RTA	2	16.7	3	25.0		
Stab	2	16.7	3	25.0		
Volvulus	1	8.3	0	0.0		

Data are presented as frequency [%] unless otherwise mentioned.

Table [4]: Comparison between the studied cases according to primary outcome

		Group [I] [n = 12]	Group [II] [n = 12]	Test of Sig.	p
Closure time [minutes]	Range.	28 – 60	30 – 50	1.011	0.323
	Mean ± SD.	42.83 ± 10.56	39.08 ± 7.33		
Suture length [cm]	Range.	13 – 18	15 – 28	3.927	0.001*
	Mean ± SD.	15.5 ± 1.93	20.5 ± 3.97		
Hospital stay [days]	Range.	4 – 12	5 – 12	t= 0.096	0.925
	Mean ± SD.	7.25 ± 2.18	7.17 ± 2.08		

Data are presented as frequency [%] unless otherwise mentioned, SD: Standard deviation.

Table [5]: Comparison between the studied cases according to satisfaction

Complications	Group [I] [n = 12]		Group [II] [n = 12]		χ^2	p
	No.	%	No.	%		
Wound infection	8	66.7	6	50.0	0.686	0.408
Wound dehiscence	6	50.0	5	41.7	0.168	0.682
Requirement of reoperation	3	25.0	2	16.7	0.253	0.615
Secondary suturing	1	8.3	0	0.0	1.053	0.591
Colostomy repair	2	16.7	2	16.7		

Data are presented as frequency [%] unless otherwise mentioned.

DISCUSSION

In this study we found that there was no statistically significant difference between the studied cases as regard demographic data. The male predominance was seen in both the groups and overall M: F ratio was found to be 1: 0.42.

In patients undergoing laparotomies male predominance has been consistently reported by various authors. **Ramneesh *et al.*** [7] conducted a prospective study on 50 patients who developed wound dehiscence [partial or complete] following laparotomy. There was a male predominance with a M: F ratio of 2.84: 1.

In contrast to above studies the authors such as **Singh *et al.*** [8] reported a female predominance [1:2] in patients undergoing non-traumatic emergency laparotomy.

In this study we found that there was statistically insignificant difference between the studied cases as regard closure time and hospital stay. **Roy *et al.*** [9] found that in continuous suturing, the mean hospital stay [Mean±S.D] of patients was 9.4324±4.8964. In tension suturing, the mean hospital stay [Mean±S.D] of patients was 8.0270±2.0479. Difference of mean hospital stay with both technique of suturing was not statistically significant [P=0.1116]. **Mohanad** [10] found that there were no statistically significant differences were observed between the two groups of patients [P > 0.05] according to hospital stay, closure time and length of incision.

In this study we found that There was statistically significant difference between the studied cases as regard suture length. **Shashikala *et al.*** [3] found that mean suture length used in closing rectus sheath in group A was 77.26±14.14 cm, and that in group B was 116.1±10.12 cm. Mean suture length used in continuous suturing was less compared to tension suturing, the difference being statistically significant [p<0.05].

In this study we found that There was no statistically significant difference between the studied cases as regard complications. **Roy *et al.*** [9] found that in continuous suturing, 15 [40.5%] patients had wound infection. In tension suturing, 12 [32.4%] patients had wound infection. Association of wound infection versus technique of suturing was not statistically significant [p=0.4687].

A recent study conducted by **Torfs et al.** [11], tension suturing did not significantly increase the likelihood of infection within the study population. **Agrawal *et al.*** [12] found that the study included 139 male and 35 female patients between the ages of 10 and 75 years. The incidence of wound infection [P=0.656], dehiscence [P=0.997], and incisional hernia [P=0.930] at 3 months and 4 years [P=0.910] was not statistically significant.

Randomized controlled trials in Iran by **Khorgami *et al*** [13] had compared Tension suture closure and simple closure in high risk cases for wound dehiscence. Trials revealed the frequency of wound dehiscence of 4% in TSC but the frequency increased to 13.3% when abdomen was closed by conventional SLC. The cases for this study were selected from high-risk patients [two or more risk factors, average greater than three risk factors], and the findings would suggest that this method, as a preventive strategy, benefits such a population. **Goligher *et al.*** [14] by applying three methods for closing abdominal laparotomies, suggested that reinforcing the routine methods of closure with retention sutures or application of a wire suture would result in fewer cases of dehiscence. However, we should note that the incidence of dehiscence in our study [41.7 %] was higher compared to others due to enrolling high-risk patients.

Penninckx *et al.* [15] in a study with a large sample size, reported a lower rate of incidence for Wound Dehiscence when extra prevention measures were utilized at the time of wound closure. They suggested that the selection of patients from the high-risk population is essential for raising the benefits against the costs of preventive approaches. **Hubbard and Rever** [16] concluded there were no advantages in applying wire retention sutures for the prevention of Wound Dehiscence. For closing the surgical site of incision, they randomized 203 subjects for wire retention sutures and 209 patients as the control; 3 patients in the retention group developed dehiscence compared to none of the controls. As these two different studies reveal, performing preventive retention sutures in an unselected population would be of no benefit in reducing the incidence of Wound Dehiscence.

Also, **Khorgami *et al.*** [13] showed that tension sutures have already been shown to reduce the rate of Wound Dehiscence after surgery, and their use has also been suggested as a treatment choice for managing fascial dehiscence; however, due to the subsequent pain, postoperative discomfort, and skin maceration, routine application of this technique has

not been well accepted. Considering the controversies involved in using this method for the prevention of abdominal WD, our study included only patients at a high risk for developing WD who would benefit the most from prophylactic retention sutures.

When risk factors of WD are in opposition to the complications of retention sutures, surgeons should determine which condition is more serious. Complications such as intestinal damage, skin maceration and cutting lesions, surgical site infections, and patient pain or discomfort prohibit the surgeons from performing this technique. However, in the presence of a high possibility for developing WD due to the accompanying conditions, the benefits of retention sutures may outweigh the disadvantages and the technique should be considered.

As our findings suggest, patient selection among the high risk population with multiple risk factors for WD is a prudent approach to apply tension sutures as a prophylactic routine for prevention of WD. With such a treatment approach, the risks of developing dehiscence would outweigh the complications. It should be mentioned that, although we included patients with at least two risk factors, the mean number of risk factors was greater than three in the total patient population. Therefore, we recommend the clinical application of prophylactic retention sutures for patients with three or more risk factors for WD, until further studies support the conclusion of this study.

Limitations:

Several limitations should be acknowledged. Firstly, the relatively small sample size limits the findings' generalizability. A randomized controlled trial with a larger sample size would provide more substantial evidence for comparing the two closure techniques. Secondly, the study was conducted at a single center, which may limit the generalizability of the findings. Multi-center studies involving diverse populations would enhance the external validity of the results. Additionally, the surgeon's discretion in selecting the closure technique introduces potential bias, and a randomized controlled trial would mitigate this bias.

Conclusion:

The tension method of suturing also requires significantly more suture material than the conventional continuous method. Tension suture method of suturing is better than the conventional continuous method in the management of closure of emergency vertical midline laparotomy incision as the post-operative complications occurred less frequently in patients with tension sutures but without statistical significance.

Conflict of Interest: None

Financial Disclosure: None

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