

Prospective Comparative Study of Conventional Continuous Method versus Modified Smead Jones Method of Fascial Closure in Midline Laparotomy Incision

Akkidas Suvarchala¹, S. Srinivasa Rao², Karuna Sudha Yarlagadda³, Kalyani Adiraju⁴, M. Samanth⁵, Kallepalli Vineel Sai Deepak⁶

¹Associate Professor, Department of Surgery, Government Medical College, Srikakulam, Andhra Pradesh

²Assistant Professor, King George Hospital, Andhra Medical College, Visakhapatnam

³Assistant Professor, Department of Surgery, Government Medical College, Srikakulam, Andhrapradesh

⁴Associate professor, Department of Surgery, Siddhartha Medical College, Vijayawada, Andhrapradesh

⁵Post Graduate, Department of Surgery, Government Medical College, Srikakulam, Andhrapradesh

⁶Senior Resident, Department of Surgery, MAMC, New Delhi

Received: 25-10-2023 / Revised: 23-11-2023 / Accepted: 26-12-2023

Corresponding Author: Dr. Akkidas Suvarchala

Conflict of interest: Nil

Abstract:

Background: The occurrence of sudden disruption of the abdominal laparotomy wound is a major disaster in the life of a patient who has undergone an abdominal operation and a major psychological blow to the patient as well as the surgeon.

Methods: 50 consecutively enrolled patients who underwent emergency midline laparotomies were enrolled in the study who were admitted in Department of Surgery, Government Medical College, Srikakulam. Intra-operatively randomized into two groups in 1:1 pattern.

Results: The total number of patients who underwent laparotomy for generalized peritonitis in 2 years was 50. The post-operative wound infection rate in Group A was 32.4% and in Group B was 12.3% (p = 0.03).

Conclusion: Present study concluded that the modified version of Smead-Jones techniques of laparotomy closure with prolene loop had very low incidence of early and may reduce the late complications. It was superior to other conventional methods of closure.

Keywords: Incisional Hernia, Laparotomy, Smead Jones, Wound Dehiscence.

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

Mid line laparotomy incision is simple and all quadrants are exposed satisfactorily and quickly with minimal or less blood loss. Wound dehiscence and burst abdomen are the common complications of midline laparotomy. When the intestine, omentum or other viscera are visible in the wound over the abdomen following a midline laparotomy it is considered a burst abdomen. It occurs following the separation of the musculoaponeurotic layer of the abdomen. It is an important postoperative complication leading to significant postoperative morbidity.

The method of closure is related to this complication apart from patient factors. [1,2] There should be minimal tissue damage and avoiding abdominal wall muscle in the closure would help in achieving it. The type of closure may not be so important in elective patients with good nutritional status but it may be decisive in emergency patients

with multiple risk factors to develop burst abdomen. There is no ideal method of wound closure suitable for all situations. Thus choosing the correct technique of suturing is vital. By using a correct technique of abdominal closure we can achieve a marked reduction in the incidence of burst abdomen and wound dehiscence.

The partial or complete postoperative separation of abdominal wound closure is known as wound dehiscence or acute wound failure. Acute wound failure is defined as postoperative separation of the abdominal musculoaponeurotic layers within 30 days after operation and requires some form of intervention, usually during the same hospitalization. Most bursts occur between the 6th and 9th postoperative day.

The integrity of the sutured abdominal wound rests on a balance between the suture holding capacity of tissues and tissue holding capacity of sutures.

Numerous clinical trials have compared layered to mass abdominal closure. This study aims to prospectively evaluate the modified version of Smead-Jones techniques of laparotomy closure with prolene loop with continuous sutures in the closure of midline laparotomy.

In developing countries such as India, most patients present in emergency setting with one or more risk factors such as prolonged intraperitoneal sepsis and malnutrition. Hence it is imperative for us to ascertain the safest method of closing the abdomen.

Aims and Objectives:

1. To compare post-operative pain in the modified version of Smead-Jones techniques with the continuous technique
2. To estimate the incidence of wound dehiscence in the modified version of Smead-Jones technique of midline laparotomy wound closure and the continuous technique
3. To estimate the incidence of burst abdomen in the modified version of Smead-Jones technique of wound closure and the continuous technique
4. To estimate the incidence of surgical site infection in the modified version of Smead-Jones technique of wound closure and the continuous technique.
5. To estimate the incidence of post-operative incisional hernia in the modified version of Smead-Jones technique of midline laparotomy wound closure and the continuous technique

Methods & Materials:

100 consecutively enrolled patients who underwent emergency midline laparotomies were enrolled in the study who were admitted in Department of Surgery, Government Medical College, Srikakulam & KGH and intra-operatively randomized into two groups in 1:1 pattern. Ethical clearance obtained from the Institutional Ethical Committee. Study design was prospective Comparative study.

Inclusion criteria: 1. Age group more than 13 years 2. Emergency laparotomies

Exclusion criteria: 1. Other than midline laparotomy incision 2. Patients died before 10th post-operative day 3. Age group less than 13 years 4. Previous laparotomy incision present

Methods

The present prospective comparative study was conducted between July 2019 to November 2022 in the Department of Surgery Government Medical College SRIKAKULAM & KGH, Andhrapradesh, India.

A total of 100 patients were randomized in two groups of 50 each who underwent midline

laparotomy with two different methods of linea alba closure. Group A: Abdominal closure was done using Modified Smead Jones technique. Group B: Abdominal closure was done using Conventional continuous technique.

Suture: Polypropylene (prolene) no.1 loop was used in both techniques.

Patients were included in two groups: Group 'A' and Group 'B'.

Group A includes those patients who underwent conventional closure with polypropylene number 1 size loop suture. Conventional closure included closure of rectus fascia first in a continuous fashion. The sutures were placed 2 cm from the edge of the linea alba on both sides and 1 cm was maintained between two adjacent sutures. Following this skin was closed with interrupted ethilon 2-0 sutures.

Group B includes those patients who underwent modified Smead Jones "far-near-near-far" technique of abdominal wall closure.

Suture techniques:

Modified Smead Jones technique: By this method a far bite starting at 2 cm on the edge of linea from outside-in and then taking a near bite of 0.5 cm on the other side inside-out- a near bite on the same side outside-in and then a far bite on the other side inside-out. The suture was next converted to a horizontal mattress by taking a far bite 1 cm above or below the previous bite on the other side- near bite on the same side, near bite on the other side, and finally a far bite on the same side. The two ends of the suture were tied to approximate the edges of the linea alba. The skin was sutured separately. Primary outcome measures the incidence of wound infection and abdominal wall dehiscence at the end of 15 days by the evaluating surgeon. Suture removal on 10th postoperative day and were followed on 15th day and then monthly up to 6months & One year.

Continuous closure: It was done using number 1 polypropylene suture care being taken to place each bite 1-1.5 cm from the cut edge of linea alba and successive bites being taken 1cm away from each other. The edges of linea alba were gently approximated without strangulation with an attempt to keep a suture to wound length ratio of 4:1.

Statistical analysis:

The Statistical Package for Social Sciences (SPSS) software for windows was used for statistical analysis by using Chi square test, calculation of Relative risk, Confidence interval and p value. The results were considered statistically significant at $p < 0.05$

Observation and Results:

This study deals with the observation, analysis, and interpretation of the data. 100 participants who fulfilled the inclusion criteria were included in this study. In order to determine the association between the suturing technique and post-operative

complications descriptive statistics were used. A Chi-square test was used to assess the association between postoperative complications and clinical and demographic variables. In this study Males (82%) whereas females comprised (18%) of the subjects.

Table 1: Risk factors Distributions of various clinical variables among the patients included in this study

S.No.	Clinical variables	Percentage (%)
1	Diabetes mellitus	23
2	Jaundice	14
3	Pulmonary disease	28
4	Anemia	24
5	Smoking	30
6	Hypoalbuminemia	42
7	Hypertension	15
8	Alcoholism	28
9	SICU admission	35
10	Mechanical Ventilation	30

Most of the subjects in this study comprised of BMI<35 (91%) while 9% of the subjects in this study were morbidly obese with BMI>35. 23% of the subjects developed wound infection or surgical site infection. 14% of the subjects developed wound dehiscence. 7% of the subjects in this study developed burst abdomen, 10% of the subjects developed an incisional hernia.

Table 2: Suturing techniques and their association with postoperative wound complications

S.No	Postoperative complications of the wound		Interrupted figure of eight technique		Continuous technique		Chi-square test
			Number	%	Number	%	
1.	Wound infection/surgical site infection	Yes	10	20	13	26	0.51*
		No	40	80	37	74	-
2.	Wound dehiscence	Yes	5	10	9	18	1.33*
		No	45	90	41	82	-
3.	Burst abdomen	Yes	1	2	6	12	3.84*
		No	49	98	44	88	-
4.	Incision alhernia	Yes	4	8	6	12	0.44*
		no	46	92	44	88	-

The p value is not significant if $p < 0.05$. From the above table it is evident that complications observed in the continuous technique of rectus closure are higher than those with the interrupted technique of closure.

Table 3: Postoperative complications and their association with various demographic variables

S.No.	Demographic variables	Post-Operative wound complications							
		Surgical site infection		Wound dehiscence		Burst abdomen		Incisional hernia	
		+	-	+	-	+	-	+	-
1.	Age In years: 18-30	4	15	6	13	1	18	3	16
	31- 45	10	21	4	27	1	31	3	29
	46 - 60	7	30	6	31	3	33	3	33
	61- 70	3	10	2	11	1	12	1	12
	p-value by hi-square test	0.62		0.38		0.83		0.82	
2.	Gender:	23	59	13	67	6	76	6	76
	Female	1	17	1	17	1	17	4	14
	Chi-square test (p-value)	0.04		0.18		0.79		0.06	

From the above table it is concluded that no statistical significance was found between the increases in the age of the patient with the incidence of various complications of the wound.

Table 4 (A): The postoperative complications of the wound and their association with various clinical variables which are considered in this study

S.No.	Clinical Variables Considered		Complications of the wound							
			Surgical site infection		Wound dehiscence		Burst abdomen		Incisional hernia	
			Yes	No	Yes	No	Yes	No	Yes	no
1.	Diabetes mellitus	Yes	6	17	9	14	5	18	4	19
		No	17	60	5	72	2	75	6	71
	Chi-square test	0.16		0.0075		0.0015		0.17		
2.	Hyper-bilirubinemia	yes	3	11	1	13	1	13	2	12
		No	20	66	13	73	6	80	8	78
	Chi-square test	0.88		0.43		0.98		0.56		
3.	Hypo-albuminuria	Yes	15	27	12	30	6	36	8	34
		No	8	50	2	56	1	57	2	56
	Chi-square test	0.01		0.0003		0.02		0.01		
4.	smoking	Yes	3	27	5	25	1	29	1	29
		No	20	50	9	61	6	64	9	61
	Chi-square test	0.04		0.61		0.34		0.14		
5.	Anaemia	Yes	1	23	5	19	3	21	4	72
		No	22	54	9	67	4	72	9	67
	Chi-square test	0.01		0.27		0.23		0.26		
6.	hypertension	Yes	3	12	2	13	2	13	1	14
		No	20	65	12	73	5	80	9	76
	Chi-square test	0.76		0.93		0.82		0.64		

Table 4(B):

S No.	Clinical variables considered		Complications of the wound							
			Surgical site infection		Wound dehiscence		Burst abdomen		Incisional hernia	
			Yes	No	Yes	No	Yes	No	Yes	no
7.	Pulmonary disease	Yes	7	21	7	21	4	24	5	23
		No	16	56	7	65	3	69	5	67
	Chi-square test	0.77		0.048		0.07		0.1		
8.	Alcoholism	yes	5	23	5	23	1	27	1	27
		No	18	54	9	63	6	66	9	63
	Chi-square test	0.45		0.49		0.4		0.18		
9.	SICU care	Yes	6	29	8	27	3	32	6	29
		No	17	48	6	59	4	61	4	61
	Chi-square test	0.3		0.06		0.65		0.08		
10.	Mechanical ventilation	Yes	5	25	7	23	2	28	5	25
		No	8	62	7	63	5	65	5	65
	Chi-square test	0.48		0.07		0.93		0.15		

From the above tables it is evident that patients who had diabetes mellitus, hypoalbuminemia, pulmonary disease, peri-operative SICU care, post-op mechanical ventilation had high incidence of wound complications [3]

Postoperative pain: The mean pain score in the first three postoperative days obtained by numeric pain rating scale is 5.25. The mean pain score in the group of patients closed by interrupted technique is 5.8. The mean pain score in the other group is 4.7. The postoperative pain score was higher in the patients closed by interrupted technique compared to the other group.

Discussion

The main aim of this study is to compare the efficiency of two techniques of suturing in reducing early and late wound complications post-operatively among patients who underwent midline laparotomy in the emergency setting. The study was conducted among the patients who presented to Government medical college Srikakulam & KGH and underwent midline laparotomy in the emergency setting. This study contains a sample size of 100 patients who were operated by midline laparotomy in the emergency setting. The patients who left the hospital against medical advice and the patients who died within 1 year post-operatively were excluded from this study. All the patients included in this study followed the inclusion criteria and exclu-

sion criteria. The average duration of hospital stay for the patients who underwent closure by the continuous technique was 11.5 days.

The average duration of hospital stay for the patients who underwent closure by the modified version of Smead-Jones techniques was 12.2 days. Post-operatively the follow-up of patients was done in the out-patient department and the patients were examined for any complications of the abdominal wound. The range of period of follow-up was from 10 days to 12 months in the postoperative period. All the subjects included in this study were followed up to 365 days post-operatively at intervals of 10 days, 1 month, 3 months, 6 months, and 1 year. This time was considered adequate in order to detect both the early and late postoperative complications of the wound. The most common surgical emergency among the patients included in this study who underwent emergency midline laparotomy was generalized peritonitis due to hollow viscus perforation followed by blunt trauma to the abdomen. Most of the cases of generalized peritonitis in this study had duodenal perforation (60%). The type of surgical technique of midline laparotomy closure was chosen equally among the patients

included in this study.

The continuous technique of closure was chosen half of the patients (50%) and in the remaining half (50%) of the patients midline rectus closure was done by the modified version of Smead-Jones techniques.⁴In spite of having more risk factors the individuals in whom rectus closure was done by the interrupted technique did better compared to those individuals in whom rectus closure was done by the continuous technique in all the postoperative complications of the wound studied.

Surgical site infection was found in 23% of the cases. That implies almost a quarter of the individuals in the study had surgical site infections.

This is significantly greater than the 9.8% surgical site infection rate reported by Krukowski et al. In comparison of the two approaches 20% of the participants closed with the modified version of Smead-Jones technique had post-operative surgical site infection compared to 26% of the subjects closed with the continuous technique.

Comparison with Other Studies:

Table 5:

Study	Incidence of surgical site infection	
	Continuous technique	Interrupted technique
Odiya S et al	34%	10%
Balaji C et al	32%	32%
Badkur M et al	28.3%	21.6%
Sharma G et al	30%	25%
This study	26%	20%

This study is comparable to the studies done by Odiya Setal, Badkur Metal, Sharma Getal which showed similar results. Whereas Balaji Cetal documented an equal incidence of surgical site infection in both the suturing techniques. [5] 23% of the patients who had diabetes mellitus developed surgical site infection. 21% of the patients who had hyperbilirubinemia developed SSI which was clinically significant. 10% of the patients who had a history of smoking developed SSI. 35.7% of the patients who had hypoalbuminemia developed wound infection. 20% of hypertensive patients developed SSI which was not statistically significant.

25% of the patients who had a documented pulmonary disease developed SSI. This association was clinically significant. 17.9% of the patients who were alcoholics developed SSI which was not clinically and statistically significant. 17.1% of the patients requiring SICU care peri-operatively acquired SSI. 16.7% of the patients requiring mechanical ventilation postoperatively acquired SSI which was not clinically and statistically significant. Wound dehiscence was found to be 14% of the patients included in this study. This is significantly greater than the 1% to 3% observed by Campbell et al [1] and McFadden and Peacock.[6,7,8]

Table 6: Comparison of this study with other studies showing incidence of wound dehiscence among the two suturing techniques:

Study	Incidence of wound dehiscence	
	Continuous	Interrupted
Badkur M et al	21.6%	3.33%
Richards et al	2%	0.9%
Sudarshanodiya et al	30%	6%
Balaji C et al	22%	6%
This study	18%	10%

The burst abdomen was observed at a rate of 2% in patients who underwent closure by the interrupted technique. After closure with the continuous method 12% of the patients develop burst abdomen.

Table 7: Comparison of this study with other studies showing incidence of burst abdomen among the two suturing techniques:

Study	Type of closure	
	Continuous	Interrupted
Nisith ranjanmallik et al	14.8%	2.17%
Khan AA et al	16%	4%
Srivastava et al	14.8%	2.2%
Choudary IM et al	10%	2.5%
This study	12%	2%

Age has been proven in studies to be an independent risk factor in the development of a burst abdomen. 21.7% previous wound infection was found in 42.85% of the participants who developed burst abdomen in this study. The association between diabetes and burst abdomen was found to be statistically significant ($p=0.0015$). 16.6% of the subjects who were chronic smokers developed burst abdomen. 28.6% of the patients who had low serum albumin developed burst abdomen. The results obtained were clinically significant. The statistical association was found to be significant between low serum albumin and the development of burst abdomen. ($p=0.02$). 12.5% of the patients who were anemic developed burst abdomen.

24.3% of the patients who had previous pulmonary disease developed burst abdomen. There was a Burst abdomen has been linked to diabetes, pulmonary illness and low serum albumin. The pathophysiology of these diseases has already been established. The foregoing findings are predicted because wound dehiscence and burst abdomen are both parts of the same wound disruption spectrum. [9,10] Incisional hernia occurred in 10% of the patients after surgery, according to the study Irvin Cameron and Leaper indicated a range of 3 % to 9% as the highest limit in the incidence of incisional hernia. In their studies, Pollock et al and Bucknall et al found an incidence of roughly 11% which is comparable to this study. [11,12]

The high rate of post-operative wound infection may be to blame for the high incidence of incisional hernia. Previous wound infection was discovered in 70% of participants who developed an incisional hernia. Wound sepsis plays a significant role because it is the most preventable cause of wound failure. Patients who had a history of diabetes mellitus developed an incisional hernia. 14.2% of the subjects who had raised bilirubin in this study developed an incisional hernia.

The statistical association was found to be significant between low serum albumin and the development of an incisional hernia. ($p=0.01$). 17.8% of the patients who had previous pulmonary disease developed an incisional hernia [13,14]. There was a significant clinical association between the development of incisional hernia and pulmonary disease.

A higher frequency of incisional hernia was linked

to low serum albumin, pulmonary illness, and peri-operative mechanical ventilation (Table 4). This highlights the importance of addressing and correcting peri-operative pulmonary problems as soon as possible. Other demographic and clinical characteristics were shown to have no statistical relationship with the development of incisional hernia (Tables 3,4). According to Ausobsky et al., the main causes of incisional hernia are technical insufficiency and wound infection. Incisional hernia mainly develops as a result of pulmonary complications. This is supported by the findings of this investigation. As a result of this research, we can conclude that the post-operative challenge to wound strength is mostly determined by suture technique, wound infection, and other risk factors.

Summary

The optimal wound closure method is one that maintains tensile strength with adequate tissue approximation throughout the healing process, does not encourage wound infection or inflammation, is quite well tolerated by patients, and is technically easy and quick. In the short term, the number of wound infections, wound dehiscence rates, and the frequency of burst abdomen are used to evaluate any abdominal wall closure procedure. The rate of incisional hernia formation can be used to determine the long-term complication. The goal of the study was to document wound complications following a midline laparotomy in the emergency setting, as well as current trends in the rectus abdominis midline laparotomy closure technique selection. The study was a cross-sectional study. The goal of the study was to compare and document the post-operative problems that occurred when two suturing procedures (continuous suturing and interrupted figure of eight suturing) were used. A total of 100 people were included in the study. A questionnaire was used to acquire objective data from the individuals and thorough examination of the patients was done in the post-operative period. Following that, the data was evaluated using statistical techniques.

Conclusion

The best way to close an abdominal wound is yet to be established. The ideal approach should be technically simple enough that the trainee can achieve the same results as the master surgeon, it should be

devoid of post-operative wound issues, it should be comfortable for the patient and it should leave a tolerable aesthetic scar. Although this study sheds light on the proper abdominal closure technique, the abdomen still holds a lot of mysteries.

References

1. Odiya S Hedau S, Raghuwanshi RK, et al. Comparative study between continuous suture and interrupted suture in laparotomy wound repair J. EvolutionMed.Dent.Sci.2017;6(65): 47204723.
2. Richard-s PC, BalchCM, & Aldrete JS. Abdominal wound closure. A randomized prospective study of 571 patients comparing continuousvs. Interrupted suture techniques. Ann Surg.1983 Feb; 197(2):238-43.
3. Bucknall TE. Factors influencing wound complications. A clinical and experimental study. Ann R CollSurg Engl.1983Mar; 65(2):71-7.
4. Weiland DE, Bay RC, & Del Sordi S. Choosing the best abdominal closure bymeta-analysis. AmJ Surg. 1998; 176: 666-70.
5. Anderson DJ, Podgorny K, Berríos-Torres SI, Bratzler DW, Dellinger EP, Greene L, Strategies to prevent surgical site infections in acute care hospitals: 2014 update Infect Control Hosp Epidemiol 2014 35(6):605-27.
6. Higgins GA Jr, Antkowiak JG, & Esterkyn SH. Aclinical and abdominal wound closure and dehiscence. Arch Surg1969;98:4214
7. Reitamo J, & Moller C. Abdominal wound dehiscence. Acta Chir Sca.1972; 138:1706-5.
8. Ramneesh G, Sheerin S, Surinder S, Bir S, A prospective study of predictors for postlaparotomyabdominal wound dehiscence J Clin Diagn Res 2014 8(1):80-83.
9. Srivastava A, Roy S, Sahay KB, Seenu V, Kumar A, Chumber S et al. Prevention of burst abdominal wound by a new technique: a randomized trial comparing continuousversusinterrupted X-suture. Indian J Surg. 2004; 66:19.
10. Play forth MJ, Sauven P, Evans M, & Pollock AV. The prediction of incision al hernias by radio-opaque markers. Ann R CollSurgEngl.1986; 68:82-4.
11. Fischer JD &Turner FW. Abdominal incisional hernias. A ten year review. Can J Surg. 1974; 17:2024.
12. Gislason H, Viste A. Closure of burst abdomen after major gastrointestinal operations: comparisonof different surgical techniques and later development of incisional hernia. Eur J Surg. 1999; 165:958.
13. Wong SY, Kingsnorth AN. Abdominal wound dehiscence and incisional hernia. Surg. 2002; 20:100-3
14. Van t Riet M, de vos van Steenwijk PJ, Bonjer HJ. Incisional hernia after repair of wound dehiscence: Incidence and risk factors. Am Surg. 2004; 70:281-6.
15. Mingoli A, Puggioni A, Sgarzini G, Luciani G, Corzani F, Ciccarone F, et al. Incidence of incisional herniafol-lowing emergency abdominal surgery. Ital J Gastroenterol Hepatol. 1999; 31:449- 53.