

Interrupted Braided Sutures versus Running Monofilament Sutures in the Prevention of Abdominal Wound Dehiscence: A Prospective Nonrandomized Case-Control Trial

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ABSTRACT

Objective: To compare the impact of interrupted braided suture to continuous monofilament sutures on the development of abdominal wound dehiscence in high risk patients.

Methods: Clinical judgment and the Rotterdam risk score of abdominal wound dehiscence were used to identify 140 patients at high risk for abdominal wound dehiscence. Seventy high-risk patients who had their laparotomy wounds closed by interrupted braided suture (intervention group) were compared to a similar group of patients who had continuous monofilament suture closure (control group). Demographic, clinical and operative data of both groups were compared. The primary outcome was the occurrence of wound dehiscence either partial or complete. Secondary outcomes include development of wound infection and the 30-day mortality rate. The mean follow up period was 3 months (range 1-6 months).

Results: There were 78 males and 62 females with a mean age of 62.2 ± 13.0 years. Both groups were equivalent in terms of demographics, Rotterdam risk score, type of surgery and surgical incision. Wound dehiscence occurred equally in both groups (24.3 in control vs 22.9% in intervention group, p value 0.842) but evisceration was significantly reduced by the use of interrupted sutures (4.3 vs 14.3%, p value 0.042). The method of closure has no significant impact on infection and early mortality.

Conclusion: Although method of closure did not affect the overall incidence of wound dehiscence, interrupted braided sutures significantly reduced occurrence of evisceration. This reduced the need for urgent revisional surgery but did not affect the early mortality rate. A larger randomized control trial with a longer follow up period is advised.

Keywords: Burst abdomen, Evisceration , Wound dehiscence.

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Introduction

Abdominal wound dehiscence (AWD) is partial or complete disruption of fascial closure of laparotomy wounds with or without protrusion of abdominal viscera (evisceration or burst abdomen). It typically occurs on 5th-16th postoperative days ⁽¹⁾ and presents with increasing incisional pain and discharge when these should be decreasing, fever, signs of wound infection or frankly with burst abdomen. AWD remains a major problem after laparotomy with estimated incidence of 0.3-20% and associated mortality between 14% and 40 %. ⁽²⁾ It results in

prolongation of hospital stay, frequently leads to a second surgical procedure and is associated with the future development of incisional hernia.⁽³⁻⁴⁾ This invariably leads to tremendous escalation of the cost of care per patient. The multifactorial etiology of AWD and the incomplete understanding of its pathophysiology make prevention quite difficult. Multiple studies aimed at identification of preventable risk factors and various scoring systems to predict occurrence of AWD have been advocated ⁽⁵⁻⁸⁾. The Rotterdam abdominal wound dehiscence risk score Table I is one such score can identify patients with

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high risk for AWD and provides a numerical scale for comparison across study and control groups.⁽⁹⁻¹¹⁾ The Rotterdam risk score (RRS) consists of several preoperative criteria as well as two post-operative criteria namely postoperative coughing and development of wound infection. The score ranges from 0 to 10.6. Postoperative cough accounts for 1.4 and wound infection for 1.9 of the total score. As such the maximum calculated preoperative score is 7.3. The

score is translated into probability of dehiscence based on the formula $\text{Probability} = \frac{e^x}{1 + e^x} * 100\%$ where 'x' equals $-8.37 + (1.085 * \text{calculated total risk score})$. We conducted a prospective non-randomized case-control clinical trial comparing abdominal wound closure using either interrupted braided sutures or continuous running monofilament sutures and the impact on the incidence of wound dehiscence in high risk patients.

Table I: Rotterdam risk score for abdominal wound dehiscence

Criterion (mark x when present at last column)		X
Age category (years)	40-49	0.4
	50-59	0.9
	60-69	0.9
	>70	1.1
Gender	Male	0.7
	Female	0
COPD		0.7
Ascites		1.5
Jaundice		0.5
Anemia		0.7
Emergency surgery		0.6
Type of surgery	GB/biliary duct	0.7
	Esophagus	1.5
	Gastroduodenal	1.4
	Small bowel	0.9
	Large bowel	1.4
	Vascular	1.3
	Liver, spleen, pancreas, kidney, adrenal	0
Postoperative Coughing		1.4
Wound infection		1.9
Calculated risk score (Pre and Postoperative)		

Methods

Over a study period of 4 years, clinical judgment and the RRS were used to identify 140 patients at high-risk for AWD. Patients with a preoperative score higher than 3.5 were considered at high risk of AWD and were included in the study. Patients undergoing repair of incisional hernia were excluded since these patients require mesh as part of closure of their abdominal wound. Several surgeons in different teams have participated in the study in order to include as many patients as possible to increase the power of statistical analysis. This study was nonrandomized so the choice

of wound closure was left to the operating surgeon. Interrupted braided sutures (polyglactin 0, 1 or 2) were used to close the fascia in 70 patients (intervention group). All sutures were placed 2 cm apart and 2 cm from the edge of the fascia. After insertion of all the sutures they were tied successively without tension starting from the ends of the incision until the middle Fig.1 Continuous running monofilament sutures (Polypropylene or polydioxanone 0, 1 or 2) were used in the remaining cohort. The routine method employed by most surgeons at our institute was continuous running mass closure using a monofilament suture;

this group was therefore the control group against which the intervention group was compared. The demographic & clinical data of the 140 patients were collected on a proforma. Perioperative data including the type of incision, surgery as classified by RSS (Table I), complications and mortality were also recorded. The primary end point of the study was the development of wound dehiscence and evisceration. Diagnosis of wound dehiscence was made clinically by a specialist surgeon and was classified as either concealed (facial separation felt by specialist surgeon but without evisceration) or complete with evisceration necessitating emergency revision of abdominal closure. Secondary end points include wound infection and 30-day mortality rates. The follow up period ranged from 4 weeks to 6 months with a mean of 3 months



Fig: 1. The method of interrupted braided-suture closure of laparotomy wounds.

Statistical analysis:

All statistical analysis were performed using IBM Statistical Package for the Social Sciences software 21 (SPSS 21). Chi-square test, independent t-test and Mann-Whitney U tests were used as appropriate. A P-

value of less than 0.05 was considered statistically significant. Approval by our institution ethical committee was obtained for the study and publication.

Results

There were 78 males and 62 females with a mean age of 62.2 ± 13.0 years (range 20-94 years). The average preoperative Rotterdam risk score for the whole group was 4.57 ± 0.82 (range 3.5-7) equivalent to a probability of AWD of $4.72 \pm 5.45\%$ (range 1.0-31.5%). As shown in Fig. 2, there was significant positive correlation between RRS and development of dehiscence (Kendall's tau-b correlation coefficient of 0.49, p-value < 0.001). Both groups were similar in age, gender, RSS, incision and type and setting of surgery (elective or emergency) as shown in Table II and III.

Wound dehiscence was diagnosed in 33 patient of the whole study group (23.6%), 17 in the control group and 16 in the intervention group (24.3 vs 22.9%, p value 0.842). The method of closure had no significant impact on the overall incidence of wound dehiscence Table V. Evisceration developed in 13 patients, 10 in the control group and 3 in the intervention group (14.3 vs 4.3%, p value 0.042, Odd ratio 0.269, 95% confidence interval 0.071-1.022). Although interrupted suture closure of laparotomy wounds did not affect the occurrence of abdominal wound dehiscence in high risk patients it did reduce the occurrence of evisceration and emergency revision of wound closure that was associated with a high mortality rate. Infection occurred in 35 patients (25%) and it was not significantly affected by the method of closure (p-value 0.845, Odd ratio 1.079, 95% confidence interval 0.502-2.320). Conversely, development of infection was significantly associated with occurrence of AWD (relative risk 2.2105, 95% confidence interval 1.2443 to 3.9271 and p value 0.008) the 30-day mortality rate was 9.29% and was similar among the study and control group Table VI. This high preoperative mortality rate reflects the high-risk patients studied. On subset analysis of mortality as shown in Table V, the occurrences of AWD and particularly of evisceration led to a significant increase in the mortality rate. Although interrupted braided-suture closure resulted in significant reduction of evisceration, this was not translated into reduction of mortality.

Table II: Demographic and clinical data in the control and study group.

Criterion	Control group	Intervention group	p-value
Age (mean±SD)	63.1±13.8	61.3±12.1	0.418
Gender			0.496
Male %	58.6	52.9	
Female %	41.4	47.1	
Calculated preoperative RRS			

Mean±SD	4.62±0.81	4.52±0.83	0.535
Range	3.5-7.0	3.6-6.8	
Estimated probability of AWD (%)	4.8±5.2	4.6±5.7	0.535
Mean±SD	1.0-31.5	1.1-27.1	
Range			

*p-value<0.05 is significant

Table III: Type of surgery and surgical incision in the control and study group.

	Control	Intervention	p-value
Type of Surgery (%)			0.830
Biliary	8.6	5.7	
Gastroduodenal	21.4	20.0	
Small intestine	4.3	8.6	
Large bowel	40.0	41.4	
Liver, spleen, pancreas and retroperitoneal	25.7	24.3	
Type of incision (%)			0.430
Longitudinal	72.9	72.9	
Transverse	11.4	17.1	
Combined	15.7	10.0	
Emergency Surgery (%)	31.4	18.6	.079

*p-value<0.05 is significant

Table IV: Comparison of occurrence of wound dehiscence, evisceration, infection and 30-day mortality rate in the study and control groups.

Criterion	Control	Intervention	p-value	Odd ratio (95% confidence interval)
Dehiscence (%)				
Overall	24.3	22.9	0.842	0.924(0.423-2.017)
Evisceration	14.3	4.3	0.042*	0.269(0.071-1.022)
Infection (%)	24.3	25.7	0.845	1.079(0.502-2.320)
30-day Mortality rate(%)	10	8.6	0.771	0.844(0.269-2.650)

*p-value<0.05 is significant

Table V: Subset analysis of 30-day mortality rate.

Criterion	30-day Mortality (%)	p-value	Relative risk (95% confidence interval)
No AWD	5.6		
AWD	21.2	0.0104	3.7828 (1.3665 to 10.4718)
Evisceration	38.5	0.0002	6.1058 (2.3364 to 15.9561)

*p-value<0.05 is significant

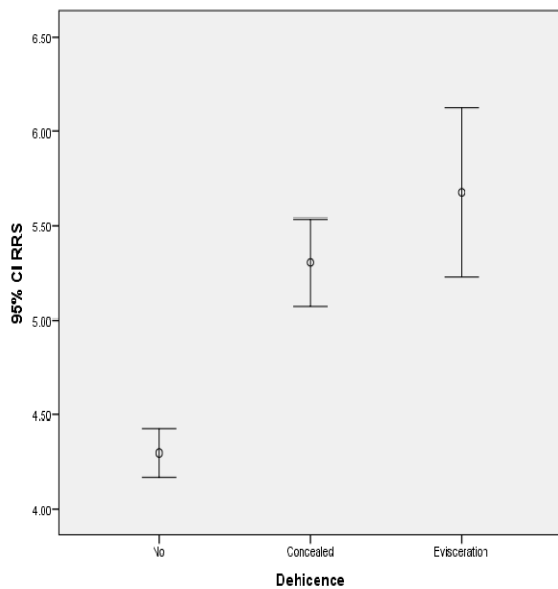


Fig.2: The positive correlation between Rotterdam risk score and abdominal wound dehiscence (p-value<0.001).

Discussion

Abdominal wound dehiscence continues to be a major health problem. Despite advances in surgical techniques including suture materials the incidence of AWD seems static or even increasing as older patients with more co-morbidity are undergoing more complex surgical procedures. (12)

As many of the associated risk factors are uncorrectable (e.g. age, gender, type of surgery, etc.), sound surgical wound closure remains the only potentially modifiable factor to prevent wound dehiscence. Many methods have been advocated to prevent AWD including the use of different type of suture material, different techniques of suturing including tension sutures, use of relaxing incisions and even use of absorbable mesh. (13-18) The hypothesis of our study was partly based on the intraoperative findings at the time of revision of dehisced wounds. A common finding was sutures cutting through the fascia leading to loosening of the whole repair in cases of continuous wound closure. Loss of tension on the edge (19). With the use of interrupted braided sutures we aimed to distribute the tension on multiple isolated sutures evenly across the wound. Also braided sutures have less cutting effect when compared to monofilament sutures. In cases sutures cut out, the remainder will keep the tension on the fascia and can prevent the occurrence of evisceration. of the fascia even if temporary has been found in an animal study to delay fibroblast proliferation and orientation and impair collagen contraction function Although patients may end up with incisional hernia in the future, management of this is less morbid and not urgent unlike the management of evisceration. We have used the Rotterdam risk score for identification of patients

at high risk for AWD and for comparison between the control and intervention groups. Although there was a good correlation between RRS and occurrence of dehiscence, this score does not include factors such as obesity, malnutrition, hypoalbuminemia and previous treatment with radiotherapy or chemotherapy, risk factors that have been found to increase AWD in various studies. (20-26) we found that the method of wound closure did not significantly affect the overall development of neither wound dehiscence nor wound infection. Our result was in concordance with other similar studies. (27-28) However, interrupted braided sutures resulted in a significant reduction in wound evisceration. This could lead to a reduction of the 30-day mortality rate but this was not found in our study. This is most likely explained by the risk factors that wound dehiscence and mortality share in common which are not likely to be altered by the method of closure. One limitation in this study is the lack of analysis of the impact of method of wound closure on future development of incisional hernia as a result of relatively short follow up period. Also the patients were not randomized to the method of closure and the choice was left to the operating surgeon. A larger randomized control trial with longer follow up is thus advised. In conclusion, interrupted braided-suture closure of laparotomy wound decreases the occurrence of evisceration in high risk patients without affecting the overall occurrence of wound dehiscence. This did not translate into a reduction of early mortality but resulted in significantly less revisional surgery. Any future development of incisional hernias can be managed on elective basis.

Conclusion

Although method of closure did not affect the overall incidence of wound dehiscence, interrupted braided sutures significantly reduced occurrence of evisceration. This reduced the need for urgent revisional surgery but did not affect the early mortality rate. A larger randomized control trial with a longer follow up period is advised.

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