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Tension Distribution Suture to minimize Burst Abdomen Post Contaminated Laparotomy

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Abstract

Background: *Burst abdomen, also known as abdominal dehiscence, is a severe postoperative complication that frequently necessitates immediate surgical intervention. Nevertheless, there is a lack of substantial evidence about surgical procedures to prevent burst abdomen recurrence (BAR).*

Aim and objectives: *To assess the efficacy of tension distribution suture (interrupted X technique) to minimize burst abdomen post-contaminated laparotomy.*

Subjects and methods: *This prospective interventional study was undertaken on a cohort of 50 patients who had contaminated laparotomy at Al-Azhar University Hospitals between April 2022 and October 2023.*

Results: *No statistically significant difference was observed within the study group regarding the link between anaemia and burst abdomen and the correlation between sepsis and burst abdomen. A notable disparity was observed within the examined group regarding the link between Hypoalbuminemia and burst abdomen, the correlation between wound infection and burst abdomen, the correlation between postoperative cough and burst abdomen, and the correlation between chronic renal failure and burst abdomen.*

Conclusion: *This study concluded that the distribution suture (interrupted X technique) effectively minimized burst abdomen post-contaminated laparotomy. However, older Age, Hypoalbuminemia, high BMI, wound infection, postoperative cough and chronic renal failure were significantly associated with the development of a burst abdomen.*

Keywords: Burst abdomen; Interrupted X suture; Abdominal wound dehiscence; laparotomy

1. Introduction

Abdominal wound dehiscence, also known as burst abdomen, is a significant and challenging postoperative complication that is encountered by several surgeons globally.¹

The death rate associated with wound dehiscence has varied between 9% and 43%, according to previous studies. However, a recent analysis found a fatality rate of 16%.²

Abdominal wound dehiscence refers to the partial or total separation of an abdominal wound, with or without the protrusion of internal organs. This condition necessitates rapid medical attention. Management ranges from simple dressing to further closure of the burst abdomen, followed by a period of critical care. This complication may result in lengthy hospitalization, frequent reopening of the incision, a high occurrence of incisional hernia, and the need for additional surgery.³

An infection related to the primary malignancy, intraoperative knot breaking, patient characteristics such as Age, Sex, and nutritional status, as well as preoperative medical conditions like anaemia, diabetes, hypoproteinemia, jaundice, and renal failure (uremia), have all been linked to the development of burst abdomen. Furthermore, prolonged steroid therapy (both before and after surgery), extended postoperative abdominal distension, coughing, and wound infection have also been linked to the development of a burst abdomen.⁴

Wound dehiscence is typically caused by a mix of causes rather than a single cause. The primary determinant is wound infection.⁵

Wound dehiscence is associated with the method of closing the abdomen and the type of sutures employed. Multiple studies have assessed different methods of closing wounds and various sutures.⁶

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It is generally accepted that a continuous suturing approach employing a non-absorbable or minimally absorbable suture material is the best way to close a midline incision. A 4:1 ratio between the suture and the wound's length is advised. Continuously flowing sutures ensure uniform tension distribution over every length of the wound.⁷

Although there have been improvements in perioperative care and suture materials, the incidence and death rates have remained unchanged in recent decades. This might be attributed to the fact that the risks faced by the patient population are more significant than the benefits provided by technological advancements.⁸

This study aimed to evaluate the effectiveness of the tension distribution suture (interrupted X technique) in reducing the occurrence of burst abdomen following a contaminated laparotomy.

2. Patients and methods

This prospective interventional study was undertaken on a cohort of 50 patients who had contaminated laparotomy at Al-Azhar University Hospitals between April 2022 and October 2023.

Inclusion Criteria: Patients above the Age of 14 who are planning to have contaminated laparotomy for acute abdomen and do not have any other risk factors that could compromise wound healing.

Exclusion Criteria: Patients below the Age of 14, individuals who have had previous laparotomies, incisional hernia, or burst abdomen, patients with uncontrolled chronic obstructive pulmonary disease (COPD), and patients with factors that hinder wound healing such as diabetes mellitus, steroid use, immunosuppressant therapy, or anticancer therapy.

Methods

Every patient underwent a comprehensive evaluation, which included a thorough medical history, complete physical examination, standard laboratory tests, and imaging analysis.

Operative details: The procedure of interrupted closure was carried out utilizing a No.1 proline suture. A substantial portion was removed from the outside side, two cm away from the incision margin of the linea alba. The needle protruded through the opposite side, starting two cm from the edges and moving from the inside out. Then, the needle emerged diagonally, starting two cm from the edges and three cm away from the initial penetration. The needle protruded from the opposite side, two cm from the edge and three cm from the second stitch. The two ends were securely fastened, with just enough tension, to align with the edges of the linea alba, ensuring that no bowel or omentum was trapped between

the edges. This resulted in X cross-like markings on the surface of the linea alba. The subsequent X suture was positioned one cm apart from the preceding one. In each case, three sutures were applied subcutaneously and extraperitoneally in an eleven cm long incision. Additionally, a subcutaneous drain with suction was inserted.

Follow-up: Patients underwent examinations for burst abdomen on postoperative days 1, 2, 3, 4, 5, 6, 7, and 15. After 15 days following the surgery, when there were no indications of a burst abdomen, the laparotomy wound was determined to be negative for such a condition. Weekly follow-ups were conducted for four weeks after the surgery.

Ethical approval: The approval was obtained from the ethical committee of the Faculty of Medicine Al-Azhar University. Written and conscious agreement was obtained from each patient following a comprehensive explanation of all aspects of the procedure, including its benefits, potential intraoperative and postoperative risks, realistic expectations, and the possibility of other complications.

Statistical Analysis: SPSS 26.0 for Windows (SPSS Inc., Chicago, IL, USA) was used to gather, arrange, and statistically analyze the data. In order to depict quantitative data, percentages and numerical values were used. The mean, standard deviation, median, and range—the lowest and most significant values—were used to characterize the quantitative data. A two-tailed test with a significance threshold of P-value ≤ 0.05 indicating a significant distinction, $P < 0.001$ showing a highly significant difference, and $P > 0.05$ indicating a non-significant difference was used for all statistical comparisons.

3. Results

Table 1: Demographics characteristics among the study population.

STUDY POPULATION (N = 50)	
AGE DISTRIBUTION	
- 14 - 30 YEARS	13 (26%)
- 31 - 45 YEARS	20 (40%)
- 46 - 60 YEARS	15 (30%)
- 61 - 75 YEARS	2 (4%)
Study population (n = 50)	
GENDER	
- MALE	32 (64%)
- FEMALE	18 (36%)

The study population consisted of 13 patients (26%) in the age group of 14-30 years, 20 patients (40%) in the age group of 31-45 years, 15 patients (30%) in the age group of 46-60 years, and 2 patients (4%) in the age group of 61-75 years. The study population consisted of 32 male patients, accounting for 64% of the total, and 18 female patients, accounting for 36%.

Table 2. Correlation between BMI and burst abdomen among the study population.

BURST ABDOMEN	BMI > 30	BMI < 30	TEST OF SIG.	P
	GROUP (N = 20)	GROUP (N = 30)		
- YES	3 (15%)	0 (0%)	X2 = 4.787	0.029
- NO	17 (85%)	30 (100%)		

x2 refers to the Chi-Square test, while p represents the p-value used to compare the groups being investigated. A p-value more than 0.05 indicates non-significance, while a p-value less than 0.05 indicates significance. A p-value less than 0.001 indicates high significance

Regarding correlation between BMI and burst abdomen, there was a significant difference among the two studied groups (p= 0.029).

Table 3. Correlation between Anemia and burst abdomen among the study population.

BURST ABDOMEN	ANEMIA	NO ANEMIA	TEST OF SIG.	P
	GROUP (N = 23)	GROUP (N = 27)		
- YES	2 (8.70%)	1 (3.70%)	X2 = 0.549	0.459
- NO	21 (91.30%)	26 (96.30%)		

x2 refers to the Chi-Square test, while p represents the p-value used to compare the groups being investigated. A p-value more than 0.05 indicates non-significance, while a p-value less than 0.05 indicates significance. A p-value less than 0.001 indicates high significance

There was no statistical significant difference between the two studied groups (p= 0.459) as regard burst abdomen.

Table 4. Correlation between Hypoalbuminemia and burst abdomen among the study population

BURST ABDOMEN	HYPOALBUMINEMIA	NO HYPOALBUMINEMIA	TEST OF SIG.	P
	GROUP (N = 20)	GROUP (N = 30)		
- YES	3 (15%)	0 (0%)	X2 = 4.787	0.029
- NO	17 (85%)	30 (100%)		

x2 refers to the Chi-Square test, while p represents the p-value used to compare the groups being investigated. A p-value more than 0.05 indicates non-significance, while a p-value less than 0.05 indicates significance. A p-value less than 0.001 indicates high significance

Regarding correlation between Hypoalbuminemia and burst abdomen, there was a significant difference between the two studied groups (p= 0.029).

Table 5. Correlation between Wound infection and burst abdomen among the study population

BURST ABDOMEN	WOUND INFECTION	NO WOUND INFECTION	TEST OF SIG.	P
	GROUP (N = 18)	GROUP (N = 32)		
- YES	3 (16.67%)	0 (0%)	X2 = 4.986	0.0416
- NO	15 (83.33%)	32 (100%)		

x2 refers to the Chi-Square test, while p

represents the p-value used to compare the groups being investigated. A p-value more than 0.05 indicates non-significance, while a p-value less than 0.05 indicates significance. A p-value less than 0.001 indicates high significance

Regarding association between Wound infection and burst abdomen, there was a statistical significant difference between the two studied groups (p = 0.0416).

Table 6. Correlation between Sepsis and burst abdomen among the study population.

BURST ABDOMEN	SEPSIS	NO SEPSIS	TEST OF SIG.	P
	GROUP (N = 34)	GROUP (N = 16)		
- YES	2 (5.88%)	1 (6.25%)	X2 = 0.003	0.959
- NO	32 (94.12%)	15 (93.75%)		

x2 refers to the Chi-Square test, while p represents the p-value used to compare the groups being investigated. A p-value more than 0.05 indicates non-significance, while a p-value less than 0.05 indicates significance. A p-value less than 0.001 indicates high significance

Regarding burst abdomen, there was no statistical significant difference between the two studied groups (p = 0.959).

Table 7. Relationship between the research population's surgical cough and burst abdomen.

BURST ABDOMEN	POSTOPERATIVE COUGH	NO POSTOPERATIVE COUGH	TEST OF SIG.	P
	GROUP (N = 15)	GROUP (N = 35)		
- YES	3 (20%)	0 (0%)	X2 = 7.447	0.006
- NO	12 (80%)	35 (100%)		

x2 refers to the Chi-Square test, while p represents the p-value used to compare the groups being investigated. A p-value more than 0.05 indicates non-significance, while a p-value less than 0.05 indicates significance. A p-value less than 0.001 indicates high significance

Regarding burst abdomen, there was a significant distinction (p=0.006) between the two groups under study.

Table 8. Relationship among the research population's chronic renal failure and ruptured abdomen.

BURST ABDOMEN	CHRONIC RENAL FAILURE	NO CHRONIC RENAL FAILURE	TEST OF SIG.	P
	GROUP (N = 1)	GROUP (N = 49)		
- YES	1 (100%)	2 (4.08%)	15.986	< 0.001
- NO	0 (0%)	47 (95.92%)		

x2 refers to the Chi-Square test, while p represents the p-value used to compare the groups being investigated. A p-value more than 0.05 indicates non-significance, while a p-value less than 0.05 indicates significance. A p-value less than 0.001 indicates high significance

Table 7 revealed Relationship among the research population's chronic renal failure and ruptured abdomen, 1(100%) of Chronic renal failure group had Burst abdomen, and 2(4.08 %) of no Chronic renal failure had Burst abdomen. There was a highly significant difference between the two studied groups ($p < 0.001$).

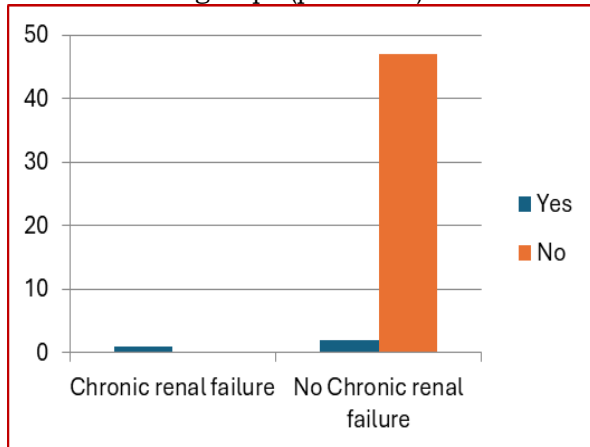


Figure 1. Bar chart showing comparison between chronic renal failure and burst abdomen among the study population.

4. Discussion

The study sample comprised 13 patients (26%) aged between 14 and 30 years, 20 patients (40%) aged between 31 and 45 years, 15 patients (30%) in the age group of 46-60 years, and two patients (4%) in the age group of 61-75 years. The study population comprised 32 male patients, accounting for 64% of the total, and 18 female patients, accounting for 36%. The findings of our study revealed that 20 patients (40%) in the study population had a BMI less than 30, while 30 patients (60%) had a BMI greater than or equal to 30. As for the correlation between BMI and burst abdomen. A notable disparity was seen between the two examined groups ($p = 0.029$).

Our study can be supported by Mehdorn et al.⁹ who aimed to study Interrupted sutures to prevent recurrent abdominal fascial dehiscence. The study reported that Age in years was 62.18 (± 14.76), Sex: male/female (%) was 58.9 /41.1, and BMI in kg/m² was 25.75 (IQR 48.3) in total patients while Age was 63.59 (± 14.58), Sex: male/female (%) was 69.4/30.6 and BMI in kg/m² was 26.35 (IQR 7.6) in burst abdomen patients suggesting that advanced Age (however being insignificant), male Sex and higher BMI ($p < 0.05$) are risk factors for developing burst abdomen.

The results of our study indicated an association between anaemia and a burst abdomen. The two analyzed groups showed no statistically significant difference ($p = 0.459$).

Vijay Ganesh et al.¹⁰ support our study. The

individual's objective was to investigate abdominal wound dehiscence and its treatment at Government Rajaji Hospital in Madurai. The study findings indicated that 34 out of the total cases (68%) exhibited an Hb% level below 10, while 16 instances showed an Hb% level above 10. This suggests that anaemia was present in 34 (68%) cases included in the study, all of which had abdominal wound dehiscence.

The results of our study demonstrated an association between Hypoalbuminemia and a ruptured abdomen. Regarding the burst abdomen, there was an essential distinction between the investigated groups ($p = 0.029$).

Our study is consistent with Hegazy et al.¹¹ The person aimed to examine the occurrence of abdominal wall dehiscence in emergency midline laparotomy. The study reported that 20 (64.5%) of the studied cases with Serum albumin (g/dl) < 3.5 had burst abdomen, indicating a high prevalence of burst abdomen in hypoalbuminemia patients ($p < 0.001$).

Our study demonstrated an association between Wound infection and a burst abdomen. A statistically significant difference was observed between the two groups under study ($p = 0.0416$).

Ram et al.¹² can bolster the validity of our findings. The study found that 59.45% of patients (22 out of 37) with preventive retention sutures had wound infections, compared to 48.83% of patients (21 out of 43) who did not have prophylactic sutures. However, There was no statistically significant change ($p = 0.342$).

In line with our study, Ahi et al.¹³ We aimed to investigate the occurrence and comparative risk of burst abdomen in patients who underwent post midline laparotomy, comparing continuous suture, interrupted X suture, and Hughes technique. The Far-and-Near method is a technique used for sheath closure. Out of the 90 patients in the study group, 29 acquired wound infection during the postoperative period, as stated by the study. Among the 29 patients, 19 (65.5%) experienced a burst abdomen, with a statistically significant p-value of less than 0.0001. Out of the total number of patients, ten individuals (34.5%) experienced wound healing without a burst abdomen. Of the 90 patients in the trial group, 61 experienced routine wound healing without any infection. There were no patients who experienced a burst abdomen without having a wound infection.

Our study disagrees with Agrawal et al.¹⁴ The objective was to compare Interrupted-X and Conventional Continuous Closures in Surgical and Gynecological Patients. The investigation indicated that intraperitoneal sepsis was detected in 100 instances, accounting for 28.73%. Seventeen percent (17%) of these individuals experienced ruptured abdomens. Conversely,

among the remaining 248 instances (71.21%), Just 12 (4.84%) of these instances had an abdominal rupture when there was no evidence of peritoneal cavity contamination. With a 95% confidence interval (CI) ranging from 1.74 to 7.08, the relative risk (RR) of septic for burst was 3.51. 0.0005 was the p-value.

The results of our study indicate a significant difference in the correlation between postoperative cough and ruptured abdomen between the two groups that were examined ($p = 0.006$).

Our study agrees with Ahi et al.¹³ The study found that out of the 17 patients who had cough and lung infection, 12 (70.6%) experienced burst abdomen. In comparison, only 7 out of the 73 patients who did not have a cough or pulmonary difficulties suffered a burst abdomen (9.6%). The statistical analysis showed a significant difference between the two groups, with a p-value of less than 0.001.

Our study revealed a strong association between Chronic renal failure and a ruptured abdomen, with a significant difference observed between the two groups under investigation ($p < 0.001$).

4. Conclusion

This study concluded that the distribution suture (interrupted X technique) effectively minimized burst abdomen post-contaminated laparotomy. However, older Age, Hypoalbuminemia, high BMI, wound infection and postoperative cough were significantly associated with the development of a burst abdomen.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

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