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Original Research Article

Primary versus delayed wound closure technique in laparotomy wound of perforation peritonitis

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ABSTRACT

Background: There is no consensus on the ideal techniques for wound closure of contaminated wounds. Multiple techniques have been proposed. The aim of the study is to compare the wound infection rates of laparotomy wounds in perforation peritonitis in primary and delayed primary wound closure. The purpose is comparison of primary wound closure and delayed primary wound closure with respect to rate of wound infection and other associated complications like wound dehiscence, stitch sinuses, incisional hernias and duration of hospital stay.
Methods: This study included 106 patients, divided into two groups, primary closure (A) in which wound was primarily closed and secondary closure (B) in which wound was left open without suturing and saline irrigation was given and were sutured once the wound is clean and culture sterile. The wound infection was assessed using Southampton scoring system.
Results: A total of 106 patients, 60 (56.6%) males and 46 (43.4%) females were included. Group A, 53 patients with 54.7% males and 45.3% females and in B, 53 patients with 58.5% males and 41.5% females. The mean age in A was 38.4±11.8while that in B 37.02±12.59. Group A had an infection rate of 77.4%whereas group B had only 34%. The duration of hospital stay for B was 9.72±2.57 and for group A, 11.74±2.87days.
Conclusions: The delayed primary closure is the optimal technique for wound closure in contaminated wounds like perforation peritonitis as it reduces wound infection rates and hospital stay.

Keywords: Primary closure, Delayed primary closure, Wound infection

INTRODUCTION

Most of the surgeries conducted in the emergency department are performed through midline laparotomy. It is a dilemma regarding the choice of technique of midline wound closure. The primary closure of wound is very simple and all is done in a single setting. Moreover the procedure is cost effective. Nonetheless, some of the surgeons prefer delayed wound closure because it has been proved with time that it is associated with decreased wound infection rates.

Despite the wide application of antibiotics and choosing meticulous surgical techniques, a surgical site infection continues to be a major nightmare in vast majority of emergency surgeries conducted for peritonitis. To have SSI and their complications like wound dehiscence, incisional hernias, stitch hernias, stitch abscesses, hypertrophic scars and keloid formation are discouraging for the surgeon and a great discomfort to the patient.[1-3] These complications increase the costs of treatment as well as prolong the hospital stay.[4,5] In majority of emergency surgeries conducted peritonitis, in order to control and reduce the rate of wound infections various

techniques of wound closure as well as prophylactic measures were used but all efforts had vague outcomes.[6-8]

There are mainly two types of wound closure techniques which are primary and delayed primary wound closure. In primary closure after the procedure, the wound edges are approximated on table with a wound drain if considered necessary.[9-11] Primary wound closure was widely practiced as it was simple and no further procedures were undertaken later on.[6-8] On the other hand delayed primary closure was preferred as it is associated with less wound infection rates thereby reducing costs as well as hospital stay.[12,13]

For a contaminated wound, many preferred the delayed wound closure technique. The thorough irrigation of wound is followed by closure of deeper layers up to skin with polypropylene. The skin is not approximated until after 3-5 days of dressing with saline. Regular dressings in delayed primary closure helps to decrease the anaerobic load at surgical site but indirectly increased the exposure to staphylococci.[14] The randomized controlled trials based on type of wound closure showed variable results. Some surgeons favor delayed primary closure while a few of them advocate primary closure technique after a thorough lavaging with saline.

Our study throws light on comparison between primary and delayed primary closure with respect to rate of wound infection and complications associated with it later on.

Objectives

The purpose of the present study was comparison of primary wound closure technique and delayed primary wound closure technique with respect to rate of wound infection and other complications associated with wound infection like wound dehiscence, stitch sinuses, incisional hernias and duration of hospital stay.

METHODS

This study was a prospective observational study on patients admitted in surgery emergency department of Government Medical College, Kottayam with perforation peritonitis and intra-abdominal collection who underwent exploratory laparotomy during 2017-2018 for a total of 18 months.

All patients admitted in surgery emergency dept. and underwent exploratory laparotomy for perforated and intra-abdominal collection mainly small intestine, vermiform appendix and large intestine were included. All cases of duodenal and pyloric perforation were excluded.

Study procedure

Equal number of patients with the diagnosis of perforated appendix, ileal perforation, colon perforation and traumatic viscera were chosen and was allotted to two groups. In the study group (Group A), primary closure technique was used and in group B, delayed primary closure was utilized. During surgery pus and abdominal secretions were taken for culture and sensitivity. Abdominal cavities were irrigated with 6 to 8 litres of normal saline. In group A, primary closure of musculoperitoneal and facial layer was done. Later thorough lavaging of wound was done. A subcutaneous drain was inserted in some cases followed by skin closure with staplers. Staples were removed on the 10th post-operative day. However in delayed primary wound closure (Group B) after closure of musculoperitoneal layers, fascia and skin were packed with saline soaked gauze piece. The wounds were dressed for 3 -5 days. Later, on the following days skin was closed with tightening sutures. The sutures were removed after 10 days. Both the groups were started empirically on third generation cephalosporin and metronidazole and were changed according to culture and sensitivity results. The surgical site infections were assessed using Southampton scoring system on day 3, day 5, day 7, day 10, 2nd week, 3rd week, 4th week as well as within six months of surgery. All patients were followed for early postoperative complications like wound infection and late complications like wound dehiscence, stitch abscess, stitch sinus, keloid or hypertrophic scar and incisional hernia over the period of six months after the surgery. Data related to causes of perforation and complications of contaminated surgery were collected in specific proforma.

Data management and analysis

Data was coded and entered in Microsoft Excel. Data analysis was done using SPSS-17. Association between qualitative variable will be analyzed using Chi-square test. Associations between quantitative variables were analyzed using independent sample t-test. Non parametric tests were utilized whenever necessary. Significance level will be fixed at a p value of <0.05.

RESULTS

This study was conducted among 106 patients. Study subjects were divided into two groups, with primary closure being done in 53 subjects and delayed wound closure in the remaining 53 subjects. Majority (47.2%) of the study population belonged to 21-40 years of age and the mean age of the study population was 37.73 years with a standard deviation of 12.171 years (Table 1).

The mean age of the primary closure group was 38.43 years with a standard deviation of 11.810 years and that of delayed closure group was 37.02 years with a standard deviation of 12.593 years. This difference was not found to be statistically significant with a t-value of 0.597 at p value 0.552. Hence the two groups were comparable with respect to age (Table 2).

Table 1: Distribution of study subjects based on age group and gender.

Distribution	Frequency	%
Age group (in years)		
Upto 20	11	10.4
21-40	50	47.2
> 40	45	42.5
Gender		
Male	60	56.6
Female	46	43.4

Table 2: Mean age of study subjects based on the study group.

Closure type	Mean	S.D.
Primary	38.43	11.810
Delayed	37.02	12.593
Total	37.73	12.171

T- value= 0.597, p= 0.552 (not significant).

56.6% of the study subjects were males and 43.4% were females. Gender distribution was comparable between the two groups with a Chi-square value of 0.154 at p value 0.695 (Table 1).

Among the study subjects the most common indication for surgery was appendicular pathology. Matching was done with respect to indication for surgery between the groups as shown in (Table 3).

Table 3: Distribution of the population based on indication for surgery.

Indication for surgery	Number	%
Traumatic	32	30.2
Illeal pathology	26	24.5
Appendicular pathology	40	37.7
Colon pathology	8	7.5
Total	106	100.0

Among the primary wound closure group 5.7% had wound infection on post-op day 3, whereas among those who underwent delayed primary closure only 1.9% had wound infection on post-op day 3. But this was not found to be statistically significant on Fisher's exact test at p value of 0.618 (Table 4).

Table 4: Distribution of the study population based on type of wound closure and presence of infection on post-op day 3, day 5, day 7 and day 10.

Type of closure	Present	Absent	Total
	N (%)	N (%)	N (%)
Infection on post-op day 3			
Primary closure	3 (5.7)	50 (94.3)	53 (100)
Delayed primary closure	1 (1.9)	52 (98.1)	53 (100)
Infection on post-op day 5			
Primary closure	27 (50.9)	26 (49.1)	53 (100)
Delayed primary closure	11 (20.8)	42 (79.2)	53 (100)
Infection on post-op day 7			
Primary closure	26 (49.1)	27 (50.9)	53 (100)
Delayed primary closure	7 (13.2)	46 (86.8)	53 (100)
Infection on post-op day 10			
Primary closure	17 (32.1)	36 (67.9)	53 (100)
Delayed primary closure	1 (1.9)	52 (98.1)	53 (100)

Table 5: Distribution of the population based on type of wound closure and presence of infection on post-op week 2 and week 3.

Type of closure	Present	Absent	Total
	N (%)	N (%)	N (%)
Infection on post-op week 2			
Primary closure	6 (11.3)	47 (88.7)	53 (100)
Delayed primary closure	0 (0)	53 (100)	53 (100)
Infection on post-op week 3			
Primary closure	3 (5.7)	50 (94.3)	53 (100)
Delayed primary closure	0 (0)	53 (100)	53 (100)

Among the primary wound closure group 50.9% had wound infection on post-op day 5, whereas among those who underwent delayed primary closure only 20.8% had wound infection. This was found to be statistically significant with a Chi-square value of 10.502 at p value of 0.001 (Table 4).

Among the primary wound closure group 49.1% had wound infection on post-op day 7, whereas among those who underwent delayed primary closure only 13.2% had wound infection on post-op day 7. This was found to be statistically significant with a Chi-square value of 15.885 at p value of 0.001 (Table 4).

Among the primary wound closure group 32.1% had wound infection on post-op day 10, whereas among those who underwent delayed primary closure only 1.9% had wound infection on post-op day 10. This difference was found to be statistically significant on Fisher's exact test at p value of 0.001 (Table 4).

Among the primary wound closure group 11.3% had wound infection on post-op week 2, whereas among those who underwent delayed primary closure none had wound infection on post-op week 2. This difference was found to be statistically significant on Fisher's exact test at a p value of 0.027 (Table 5).

Among the primary wound closure group 5.7% had wound infection on post-op week 3, whereas among those who underwent delayed primary closure none had wound infection on post-op week 3. This difference was not found to be statistically significant on Fisher's exact test with a p value of 0.243.

On the other hand none of the study subjects in either of the two groups had wound infection at post op week 4. (Table 5).

On exploring the overall infection rates in both groups, among the primary wound closure group 77.4% had wound infection and in delayed primary closure only 34% had wound infection. This was found to be statistically significant with a Chi-square value of 20.221 at p value of 0.001 (Table 6).

Table 6: Distribution of study population based on type of wound closure and overall infection rate.

Type of closure	Present	Absent	Total
	N (%)	N (%)	N (%)
Infection			
Primary closure	41 (77.4)	12 (22.6)	53 (100)
Delayed primary closure	18 (34)	35 (66)	53 (100)
Incisional hernia			
Primary closure	4 (7.5)	49 (92.5)	53 (100)
Delayed primary closure	5 (9.4)	48 (90.6)	53 (100)
Wound dehiscence			
Primary closure	5 (9.4)	48 (90.6)	53 (100)
Delayed primary closure	2 (3.8)	51 (96.2)	53 (100)
Stitch abscess			
Primary closure	3 (5.7)	50 (94.3)	53 (100)
Delayed primary closure	0 (0)	53 (100)	53 (100)
Stitch sinus			
Primary closure	0 (0)	53 (100)	53 (100)
Delayed primary closure	1 (1.9)	52 (98.1)	53 (100)

On exploring the incisional hernia rates, among the primary wound closure group 7.5% had incisional hernia and in delayed primary closure 9.4% had incisional hernia. This difference was not found to be statistically significant on Fisher's exact test at a p value 0.727 (Table 6).

On exploring the rate of wound dehiscence in both groups, among the primary wound closure group 9.4% had wound dehiscence whereas and in delayed primary closure only 3.8% had wound dehiscence. This difference was not found to be statistically significant on Fisher's exact test at p value 0.437 (Table 6).

On exploring the rate of stitch abscess, the primary wound closure group 5.7% had stitch abscess whereas in delayed primary closure none had stitch abscess. This difference was not found to be statistically significant on Fisher's exact test at a p value 0.243 (Table 6).

On exploring the rate of stitch sinus in both groups, among the primary wound closure group none had stitch sinus whereas among those who underwent delayed primary closure 1.9% had stitch sinus. This difference was not found to be statistically significant on Fisher's exact test at a p value 0.931.

Keloid or hypertrophic scar was seen in 1.9% of those who underwent primary wound closure whereas none of those who had delayed primary wound closure had keloid or hypertrophic scar as a delayed complication.

Most common organism isolated from the surgical site was seen in *E. coli* in 11.8% of the infected followed by polymicrobial infection (8.47%).

E. coli infection was predominantly more in primary closure whereas staphylococcal infection was more in delayed primary closure.

Table 7: Mean duration of hospital stay of study subjects based on the closure type.

Closure type	Mean	S.D.
Primary	38.43	11.810
Delayed	37.02	12.593

T- value= 3.807; p= 0.001 (significant).

The mean duration of hospital stay of the primary closure group was 11.74 days with a standard deviation of 2.877 days and that of delayed closure group was 9.72 days with a standard deviation of 2.575 days. This difference was found to be statistically significant with a t value of 3.807 at p value 0.001 (Table 7).

DISCUSSION

The current study was conducted among 106 patients who underwent exploratory laparotomy for perforated and intra-abdominal collection, of whom 53 subjects had undergone primary wound closure and 53 underwent delayed primary wound closure. The two groups were comparable with respect to age, gender as well as indication for surgery (Table 1-3). 47.2% of the study population belonged to 21-40 years of age and the mean age of the study population was 37.73±12.171 years. There was a slight male preponderance (56.6%) in the study population.

The overall infection rate in the study population was 55.7%. On comparing primary wound closure and delayed wound closure with respect to rate of wound infection, it was seen that there was a significantly higher rate of infection after primary wound closure as compared to delayed primary wound closure (77.4 vs 34%, p value=0.001) (Table 6).

On analysing the trend of infection rate over the postoperative period, significantly higher wound infection rates was noted on post-operative day 5 (50.9 vs. 20.8%, p value=0.001) (Table 6), on day 7 (49.1 vs 13.2%, p value=0.001) (Table 7), on day 10 (32.1 vs 1.9%, p value=0.001) (Table 8) as well as during post-operative week 2 (11.3 vs 0%, p value=0.027) (Table 4).

Similar to the results of the current study, Nasib et al in a randomized controlled trial comprising 70 patients showed that the frequency of wound infection was significantly lower with delayed primary wound closure technique as compared to primary closure technique (25.72 vs 51.43%).[15] In another study, comparing the two different closure techniques, Aziz et al showed an overall infection rate of 40% in delayed closure group as compared to 68% in the primary closure group. Similar findings were also reported by Singh et al (42.5% vs 17.5%) as well as Brown et al (23.2% vs. 2.1%).[16-18]

Cohn and Giannotti in a prospective randomized trial conducted to compare two wound management strategies for dirty abdominal wounds, concluded that delayed primary wound closure produced a decreased surgical site infection rate compared with primary wound closure if carried out for dirty wounds 4 days after surgery.[19] A meta-analysis of abdominal trauma patients undergoing damage control laparotomy concluded that technique of primary closure resulted in higher rate of wound infections when compared with delayed primary closure.[20]

On the other hand, Ussiri et al as well as Siribumrungwong et al demonstrated a higher incidence of wound infection among delayed primary suture group when compared to primary suture group.[21,22]

This difference in the rate of wound infection between the two may be explained by the fact that, in the patients undergoing primary wound closure, the bacteria are trapped in the subcutaneous tissue. This space has poor vascularity, and the collection of exudates, blood clots, and other surgical debris in this space provide an excellent culture medium, allowing bacteria to grow and multiply rapidly leading to increased incidence of wound infection. On the other hand delayed primary wound closure prevents the formation of seroma and anaerobic environment in the wound, thus avoiding bacterial proliferation.[23] Another postulate in favour of delayed primary wound closure is that, leaving open the wounds, as in delayed primary wound closure, prevent infection as repeated dressing change accomplishes adequate drainage.[15]

Over all incidence of incisional hernia in the present study population was 8.5%, with 7.5% in primary suture group and a slightly higher- 9.4% in the delayed primary suture group, though not statistically significant (Table 12). But Ashraf et al showed 12% incidence of incisional hernia in primary closure group and 9% in delayed primary closure group.[24] Similarly Aziz et al also showed higher incidence of incisional hernia in primary closure group (25% vs 8%), contrary to the current study.[16] These discrepancies in the results might be due to heterogeneous patients with different types of operation.

As per the current study, post op complications like wound dehiscence, stitch abscess, keloid or hypertrophic scar were higher among primary closure group but stitch site sinus was more in delayed primary closure group (Table 13-15). Duttaroy et al, Ahmed et al as well as Aziz et al reported a similar lower incidence of wound dehiscence among delayed primary suture group, whereas Riou et al while assessing factors influencing wound dehiscence could not find any association with type of closure.[16,25-27] The higher incidence of delayed complications like stitch abcess and keloid or hypertrophic scar in primary closure group is supported by the findings of Aziz et al.[16]

Current study demonstrated a significantly lower duration of hospital stay for patients undergoing delayed closure (9.72±2.575 days) when compared to those undergoing primary wound closure (11.74±2.877 days). Jadesh et al in his study reported a mean post-operative stay of 16.5±5 days in delayed primary closure group and 19.4±5 days in primary closure group.[28] Similar findings were reported by Nasib et al, Ahmed et al as well as Duttaroy et al.[15,25,26] This may be attributed to the lesser post-operative wound infection associated with delayed primary closure as demonstrated in this study.

Bacterial contamination of the wound during surgery is said to be a major factor responsible for the development of a subsequent wound infection. The offending organisms are predominantly bacteria from the colonic flora.[29] In the current study from the culture report of pus from the surgical site infection, the most common organism isolated was *E. coli* (11.8%) followed by polymicrobial infection (8.47%) (Table 8). Similar pattern of organism were seen in a study conducted by Agrawal et al who reported that most common organism isolated from pus culture as *Escherichia coli* in 35 % followed by mixed growth in 8.8% and *Klebsiella* 4.4% and *Staph aureus*, *Enterobacter*, and *Pseudomonas* in 1.4% and 7.3%.[23] Jadesh et al who compared primary closure and delayed primary closure demonstrated the most common organism cultured from the wounds as *E. coli* 13%, *Klebsiella* 17%, *Pseudomonas* 21%, *Staphylococcus aureus* 9%, coagulase negative staphylococci 4%, enterococci 4% and sterile 36%.[28]

Table 8: Wound infection rates as reported by studies from around the globe.

Study done by	Wound infection rate in	
	Primary wound closure (%)	Delayed primary wound closure (%)
Nasib et al[15]	51.43	25.72
Aziz et al[16]	68	40
Singh et al[17]	42.5	17.5
Brown et al[18]	23.2	2.1
Cohn and Giannotti[19]	48	21
Ussiri et al[21]	2.1	30.2
Siribumrungwong et al[22]	7.7	27.8
Current study	77.4	34

The method of delayed primary wound closure has the advantage of reducing the numbers of colonic bacteria, particularly anaerobes, contaminating the wound.[30] However, literature does report the disadvantage of allowing exogenous bacteria such as Staphylococci to contaminate the wounds in the ward before closure has been recognized.[31] The current study also evidences higher staphylococcal infection rate in delayed primary wound closure.

Thus the current study strengthens the view that delayed wound closure is associated with significantly less wound infection rates and post-operative wound complications like wound dehiscence, stitch sinuses as well as lesser duration of hospital stay as compared to primary wound closure in laparotomy wound of perforation peritonitis.

CONCLUSION

There was significant reduction in wound infection rates after delayed primary closure of contaminated wounds. Hence, the strategy of delayed primary wound closure seems to be better than primary closure in decreasing the rate of SSI without increasing the length of hospital stay.

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