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Comparative study on the outcome of primary skin closure versus delayed primary skin closure in case of emergency laparotomies

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***Abstract*---**Introduction: One of the most common complications that one can encounter is the surgical site infection (SSI) after any surgical procedures especially after exploratory laparotomy for perforative

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peritonitis. A surgical wound is considered as infected when there is purulent drainage from the wound. The purpose of the present study was to compare the primary wound closure technique and delayed primary wound closure technique with regard to the rate of wound infection and other complications which are usually associated with the infection like wound dehiscence, stitch sinuses, incisional hernias and duration of hospital stay. Materials and Methodology: 120 participants were randomly divided into two groups with 60 subjects each for primary wound closure and delayed primary wound closure. Data was coded and entered in Microsoft Excel sheet and the data analysis was done using SPSS-17. Association between qualitative variables will be analysed using Chi-square test. Associations between quantitative variables were analysed using independent sample t-test. Non parametric tests were if whenever necessary. When a p value of less than 0.05 is considered as statistically significant. Results: Major group (47.2%) of the study population were in the age range of 21-40 years of age and the mean age of the study population was 37.87 years with a standard deviation of 12.209 years. The mean age of the primary closure group was 38.66 years with a standard deviation of 11.822 years and that of delayed closure group was 37.09 years with a standard deviation of 12.607 years. This difference was not found to be statistically significant with a t-value of 0.692 at p value 0.557. 63.3% of the study subjects were males and 36.7% were females. Gender distribution was comparable between the two groups with a Chi-square value of 0.154 at p value 0.695. Among the study subjects the most common ideal indication for surgery was appendicular pathology. Matching was done with respect to indication for surgery between the groups. Among the primary wound closure group 13.3% 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 using Fisher's exact test at a p value of 0.027. Conclusion: To conclude, there was significant reduction in the rates of wound infection when delayed primary closure of contaminated wounds has been followed. Therefore, the strategy of delayed primary wound closure seems to be significantly better than the primary closure in decreasing the rate of SSI without increasing the duration of hospital stay for those patients who had undergone exploratory laparotomy.

***Keywords*---**delayed closure, infection, contamination, laparotomy.

Introduction

The infection occurring at the site of surgery which is collectively termed as "Surgical site infection (SSI)" is one of the main complications after any surgical procedures, especially after laparotomy for perforative peritonitis. SSI greatly encourages the associated morbidity, hospital stay, cost of treatment and reducing the patient satisfaction especially in a country like India where the resources are bound to be scarce. The closure of the abdominal wall in the

presence of sepsis is quite challenging to surgeon. When peritonitis is encountered, the gut mucosa is oedematous and due to sepsis in the peritoneal cavity, exudation is inevitable. After a lavish peritoneal cavity washing, compartment syndrome or wound dehiscence is inevitable if tight closure of abdominal wall is done which has been reported in a significant number of patients. Surgical Site Infections encountered as a result of contamination of the site with microorganisms which is mostly patient's flora (endogenous source) commonly seen in 5 to 6 days postoperatively when integrity of the skin and/or wall of a hollow viscus is overruled. Surgical wounds can be broadly classified into clean, clean-contaminated, contaminated and dirty. In case of perforative laparotomy, the surgical wound site of laparotomy falls under the category of clean contaminated wound, where the rate of infection of wound site is reported to be 5-8%.[1]

A surgical wound is considered infected when there is drainage of purulent materials from the wound, the wound spontaneously opens and drains exudate, the wound drains fluid which is culture positive or gram stain positive for bacteria or the surgeon observed erythema and drainage when the wound is determined to be infected. Acute wound failure (wound dehiscence or a burst abdomen) which is the most dreadful complication, refers to the postoperative separation of the abdominal musculoaponeurotic layers occurring in approximately 1% - 3% patients who are undergoing abdominal surgeries and had multiple predisposing factors in which intra-abdominal infection is also a major criterion. Primary closure could be done only in clean contaminated wounds after thorough peritoneal lavage. Another option is delayed primary suture in which the skin and subcutaneous tissue widely open before early primary closure. The wound has to be dressed with gauze soaked in normal saline every day and delayed suturing to be done usually after five days if the wound is observed healthy.[2]

There are two major types of wound closure techniques which are primary and delayed primary wound closure. In primary closure after the surgical procedure, the edges of the wound are closely approximated on the surgical table with a wound drain if considered mandatory.[9-11] Primary wound closure was broadly in practice as it was considered simple and no further procedures were undertaken in the later stages.[6-8] Whereas delayed primary closure was considered as it is associated with less wound infection rates and thus eventually reducing expenses as well as hospital stay.[12,13]

For a contaminated wound, there are many who preferred the delayed wound closure technique. The thorough irrigation of wound is followed by closure of the deeper layers up to skin with polypropylene suture material. The skin is not approximated until after 3-5 days of dressing with saline. Regular dressings in delayed primary closure is primarily helpful to decrease the anaerobic bacterial load at the surgical site but indirectly increased the exposure of the site to staphylococci.[14] Some surgeons favour the delayed primary closure while a few of them instigated a primary wound closure technique after a thorough lavage with saline.

The purpose of the present study was to compare the primary wound closure technique and delayed primary wound closure technique with regard to the rate

of wound infection and other complications which are usually associated with the infection like wound dehiscence, stitch sinuses, incisional hernias and duration of hospital stay.

Materials and Methodology

This study was designed to be a prospective observational study on patients who are reported to the Department of General Surgery at Indira Gandhi Institute of Medical Sciences, Patna, Bihar with perforation peritonitis, intra-abdominal collection and intestinal obstruction who had undergone exploratory laparotomy. All patients who were diagnosed with perforative peritonitis or who had undergone the laparotomy for the same and intra-abdominal collection mainly small intestine, vermiform appendix and large intestine along with cases of Intestinal obstruction were included in the study. Whereas the exclusion criteria included pregnant women and immunocompromised individuals. Equal number of patients with the diagnosis of perforated appendix, ileal perforation, colon perforation, intestinal obstruction and traumatic viscera were selected and was separated into two groups. Group A - primary closure technique was used and in group B - delayed primary closure was performed. During surgery, when pus and abdominal secretions were encountered, it has to be taken and sent for culture and sensitivity tests. Abdominal cavities were irrigated lavishly with 6 to 8 litres of normal saline. In the study group where primary closure has been done, musculo-peritoneal and facial layer was done. Later thorough wound lavage was performed. A subcutaneous drain was inserted if needed in some cases followed by skin closure with staplers which are then removed on the 10th post-operative day. However, in delayed primary wound closure (Group B) after closure of musculo-peritoneal layers, fascia and skin were packed with gauze piece soaked in saline. The wounds were dressed continuously for 3 -5 days. And on the following days skin was closed with tightening sutures and the sutures were removed after 10 days. Third generation cephalosporin and metronidazole were administered in both the groups and were changed later according to culture and sensitivity results. The surgical site infections were assessed using on the day 3, day 5, day 7, day 10, 2nd week, 3rd week, 4th week and also six months after surgery. All patients were observed for the 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 was coded and entered in Microsoft Excel sheet and the data analysis was done using SPSS-17. Association between qualitative variables were analysed using Chi-square test. Associations between quantitative variables were analysed using independent sample t-test. Non parametric tests were if whenever necessary. When a p value of less than 0.05 is considered as statistically significant.

Results

This study was conducted among 120 patients. Study subjects were basically divided into two groups, with 60 subjects where primary closure has been done and delayed wound closure in the remaining 60 subjects. Major group (47.2%) of

the study population were in the age range of 21-40 years of age and the mean age of the study population was 37.87 years with a standard deviation of 12.209 years. The mean age of the primary closure group was 38.66 years with a standard deviation of 11.822 years and that of delayed closure group was 37.09 years with a standard deviation of 12.607 years. This difference was not found to be statistically significant with a t-value of 0.692 at p value 0.557. Hence the two groups were comparable with respect to age which is shown in Table – 1, 2. 63.3% of the study subjects were males and 36.7% 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 ideal indication for surgery was appendicular pathology. Matching was done with respect to indication for surgery between the groups as shown in Table 3.

Among subjects observed with the primary wound closure group 51.6% had wound infection on day-5 post-operatively, whereas only 23.3% of those underwent delayed primary closure reported with wound infection considerably. This was observed to be statistically significant with a Chi-square value of 10.502 at p value of 0.001 which is shown in Table-4. Among the primary wound closure group 48.4% had wound infection on post-op day 7, whereas among those who underwent delayed primary closure only 15% 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). Subjects in the primary wound closure group 31.6% had wound infection on post-op day 10, whereas among those who underwent delayed primary closure only 3.3% had wound infection on post-op day 10. This difference was noted to be statistically significant on Fisher's exact test at p value of 0.001 (Table 4).

Among the primary wound closure group 13.3% 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 using Fisher's exact test at a p value of 0.027 as shown in Table 5. Among the primary wound closure group 10% had wound infection on post-op week 3, whereas among those who underwent delayed primary closure no one 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 exploring the incisional hernia rates, among the primary wound closure group 10% had incisional hernia and in delayed primary closure 11.7% had incisional hernia. This difference was not found to be statistically significant on Fisher's exact test at a p value 0.727 as tabulated in Table 6. On exploring the rate of wound dehiscence in both groups, among the primary wound closure group 11.6% had wound dehiscence whereas and in delayed primary closure only 8.3% 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 10% 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 3.3% had stitch sinus. This difference was not found to be statistically significant on Fisher's exact test at a p value 0.931.

The mean duration of hospital stay of the primary closure group was 11.822 days with a standard deviation of 2.89 days and that of delayed closure group was 9.72 days with a standard deviation of 2.63 days. This difference was found to be statistically significant with a t value of 3.807 at p value 0.001 (Table 7)

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

Distribution	Frequency	Percentage
Age (years)		
Upto 20 years	12	10.4
21 – 40 years	57	47.2
>40 years	51	42.5
Gender		
Male	76	63.3
Female	44	36.7

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

Wound closure type	Mean	S.D
Primary	38.66	11.822
Delayed	37.09	12.607
Total	37.87	12.209

T- value= 0.602, p= 0.557 (not significant).

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

Surgery indication	Number	%
Traumatic	37	30.8
Ileal pathology	31	25.8
Appendicular pathology	42	35
Colon pathology	10	8.4
Total	120	100.0

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.

Closure type	Present N (%)	Absent N (%)	Total N (%)
Infection on day 3 of post-op			
Primary closure	4 (6.7)	56 (93.3)	60 (100)
Delayed closure	2 (3.3)	58 (96.7)	60 (100)
Infection on day 5 of post-op			
Primary closure	31 (51.6)	29 (48.4)	60 (100)
Delayed closure	14 (23.3)	46 (76.7)	60 (100)
Infection on day 7 of post-op			
Primary closure	29 (48.4)	31 (51.6)	60 (100)
Delayed closure	9 (15)	51 (85)	60 (100)
Infection on day 10 of post-op	19 (31.6)	41 (68.3)	60 (100)

Primary closure **Delayed closure**	2 (3.3)	58 (96.7)	60 (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.

Closure type	Present N (%)	Absent N (%)	Total N (%)
Infection on week - 2 of post-op **Primary closure** **Delayed closure**	8 (13.3) 0 (0)	52 (86.6) 60 (100)	60 (100) 60 (100)
Infection on week - 3 of post-op **Primary closure** **Delayed closure**	6 (10) 0 (0)	54 (90) 60 (100)	60 (100) 60 (100)

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

Closure type	Present N (%)	Absent N (%)	Total N (%)
Infection Primary closure Delayed closure	46 (76.6) 20 (33.3)	14 (23.3) 40 (66.7)	60 (100) 60 (100)
Incisional hernia Primary closure Delayed closure	6 (10) 7 (11.7)	54 (90) 53 (88.3)	60 (100) 60 (100)
Wound dehiscence Primary closure Delayed closure	7 (11.6) 5 (8.3)	53 (88.3) 55 (91.7)	60 (100) 60 (100)
Stitch abscess Primary closure Delayed closure	6 (10) 0 (0)	54 (90) 60 (100)	60 (100) 60 (100)
Stitch sinus Primary closure Delayed closure	0 (0) 2 (3.3)	60 (100) 58 (96.6)	60 (100) 60 (100)

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

Wound closure type	Mean	S.D
Primary	38.66	11.822
Delayed	37.09	12.607

T- value= 3.823; p= 0.001 (significant).

Discussion

The present study was undertaken to be conducted among 120 patients who had undergone exploratory laparotomy for perforation peritonitis, intestinal obstruction and intra-abdominal collection. From these 120 subjects, 60 subjects

had undergone primary wound closure and 60 subjects underwent delayed primary wound closure. And these two groups were comparable with respect to age, gender as well as indication for surgery as tabulated in Table 1-3. A total of 47.2% of the study population belonged to 21-40 years of age and the mean age of the study population was 37.87 years with a standard deviation of 12.209 years. 63.3% of the study subjects were males and 36.7% were females which showed a slight male preponderance in the study subjects. 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 (76.6 vs 33.3%, p value=0.001) (Table 6).

When the trend of infection rate compared over the postoperative period, reportedly higher wound infection rates were observed on post-operative day 5 (51.6 vs. 23.3%, p value=0.001) (Table - 4), on day 7 (48.4 vs 15%, p value=0.001) (Table 4), on day 10 (31.6 vs 3.3%, p value=0.001) (Table 4) as well as during postoperative week 2 (13.3 vs 0%, p value=0.027) (Table 4). Similar results were observed in the study conducted by *Nasib* et al in a randomized controlled trial comprising 70 patients showed that the frequency of wound infection was reportedly lower than those with the delayed primary wound closure technique as compared to primary closure technique (25.72 vs 51.43%).[9]

While in a parallel study, when comparing the two different closure techniques, *Aziz* et al observed an overall infection rate of 40% in delayed closure group as compared to 68% in the primary closure group. Identical findings were also reported by *Singh* et al (42.5% vs 17.5%) as well as *Brown* et al (23.2% vs. 2.1%).[10-12] *Cohn* and *Giannotti* in a prospective randomized trial performed in comparing the two wound closure techniques The strategies for dirty abdominal wounds concluded that delayed primary wound closure significantly produced a reduction in the surgical site infection rate when compared with primary wound closure when carried out in dirty contaminated wounds 4 days after surgery.[13] In a meta-analysis of abdominal trauma, patients who are all undergoing damage control laparotomy revealed that technique of primary closure resulted in a higher rate of wound infections when compared with delayed primary closure.[14] *Ussiri* et al as well as *Siribumrungwong* et al displayed a greater incidence of wound infection among delayed primary closure group when compared to primary closure group.[15,16] This difference in the rate of wound infection between the two may be briefly explained by the hypothesis that 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 are ought to provide an excellent culture medium, hence allowing bacteria to grow and multiply rapidly and leading to increased incidence of wound infection. Also, the delayed primary wound closure prevents the formation of seroma and anaerobic environment in the wound thus avoiding bacterial proliferation to a greater extent.[17] Another point which is in favour of delayed primary wound closure is that, leaving the wounds open, as in delayed primary wound closure, prevent the infection since the repeated dressing change might accomplishes adequate drainage that is necessary for the wound to get healthy.[9]

The present study revealed a significantly lesser duration of hospital stay for patients undergoing delayed closure (9.72±2.575 days) when compared to those undergoing primary wound closure (11.82±2.877 days). *Jadesh* et al in his study observed a mean post-operative stay of 16.5±5 days in delayed primary closure group and 19.4±5 days in primary closure group.[18] Similar figures were obtained in the study conducted by *Nasib* et al, *Ahmed* et al as well as *Duttaroy* et al.[19,20] This may be attributed to the lesser post-operative wound infection associated with delayed primary closure as reported in this study. The contamination of the wound by bacterial during surgery is thought to be the major factor which plays a main role in the development of a subsequent wound infection. The offending organisms are predominantly bacteria from the colonic microbiota.[21] 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%). Similar group of organisms were seen in a study conducted by *Agrawal* et al in which they 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 are E. coli 13%, Klebsiella 17%, Pseudomonas 21%, Staphylococcus aureus 9%, coagulase negative staphylococci 4%, enterococci 4% and sterile 36%.[18]

The method of practising delayed primary wound closure has the added advantage of reducing the colonic bacteria load, especially those anaerobes which are common in contaminating the wound.[22] But, literature does report the disadvantage of allowing exogenous bacteria such as Staphylococci which contaminate the wounds in the outpatient ward before closure has been identified.[23] The current study also supports that higher staphylococcal infection rate has been reported in delayed primary wound closure. Thus, the present study strengthens the idea that delayed wound closure is associated with reportedly less wound infection rates and post-operative wound complications like wound dehiscence, stitch sinuses and lesser duration of hospital stay when compared to primary wound closure in laparotomy wound of perforation peritonitis.

Conclusion

To conclude, there was significant reduction in the rates of wound infection when delayed primary closure of contaminated wounds has been followed. Therefore, the strategy of delayed primary wound closure seems to be significantly better than the primary closure in decreasing the rate of SSI without increasing the duration of hospital stay for those patients who had undergone exploratory laparotomy.

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