

A Prospective Comparative Study of Smead-Jones Technique and Conventional Continuous Closure of Abdominal Aponeurotic Sheath in Emergency Laparotomy Wounds.

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Abstract

Background: Laparotomy is invasive surgical procedure to examine the abdominal cavity. Ideal abdominal closure technique should be quick, simple and economical, and at the same time preventing both early and late complications. Early complications include surgical site infection (SSI) and wound dehiscence. Late complications include incisional hernia, suture sinus, and incision site pain. Aim of our study was to compare the Conventional Continuous Closure technique and Smead-Jones technique in terms of surgical site infection, wound dehiscence, incisional hernia and overall patient satisfaction. **Methods:** A total of 50 patients admitted for emergency laparotomy were included in this study. Random division of the patients was done into two groups A and B of 25 each. Patients assigned to Group A were treated with Smead Jones (SJ) Technique and those assigned to Group B were treated with Conventional Continuous (CC) Technique for the rectus sheath closure and were compared for the wound complications and patient satisfaction. **Results:** The relative risk of abdominal wound dehiscence is 0.80 and of burst abdomen is 0.33 in favor of Smead Jones Technique. Smead Jones Technique is better in comparison to Conventional Continuous Technique in terms of preventing occurrence of burst abdomen and is comparable with regards to post-operative complications like seroma, wound infection, wound dehiscence and length of hospital stay. Conventional Continuous Technique is better than Technique as it is faster, takes less suture material and there is less suture sinus formation. Overall, there were less complaints of post-operative pain and discomfort leading to more patient satisfaction in Smead Jones technique. **Conclusion:** Smead Jones Technique is the preferred method of sheath closure in emergency laparotomy wound closure, as there were less chances of burst abdomen, less complaint of post-operative pain and discomfort leading to more patient satisfaction. Both conventional continuous closure technique and Smead Jones technique were comparable in terms of seroma, surgical site infection, wound dehiscence and length of hospital stay.

Keywords: Smead-Jones Technique, Conventional Continuous Technique, Wound dehiscence, Burst abdomen, laparotomy, abdominal closure

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Introduction

Laparotomy is a type of invasive surgical procedure to examine the abdominal cavity. It can be carried out through different types of incisions. One of the most common incisions used is midline, whether elective or emergency, in surgery department because of its relative simplicity. Moreover, this type of laparotomy provides an adequate and quick exposure to all the quadrants of the abdomen with

minimal loss of blood [1]. Every surgeon aspires to close the abdominal incisions in such a way as to prevent post-operative complications like wound infection, dehiscence, incisional hernias, and suture sinuses [2]. The closure of abdominal aponeurotic sheath is done by several methods and each method have its own advantages and disadvantages.

The advantages and disadvantages of any abdominal fascia

closure technique can be measured by the incidence of early and late complications. Early complications comprise of wound dehiscence (at times coupled with evisceration) and surgical site infection, while late complications include incisional hernia, suture sinuses, and incision site pain. The best abdominal closure technique should be fast, easy, and cost-effective, while preventing both early and late complications [3].

There are very few prospective trials conducted to compare the Conventional Continuous Closure technique and Smead-Jones technique of interrupted suturing in Indian population especially in emergency laparotomy. In developing country like ours it is essential to ascertain the safer method of wound closure in laparotomy as most patients present with one or more risk factors such as malnutrition. The present study was conducted in search of a better method of closing abdominal sheath, especially in emergency settings.

Materials and Methods

Fifty patients admitted in surgical department of our tertiary care centre and posted for emergency laparotomy were taken into consideration for the study. All patients posted for laparotomy in emergency were considered for study. Patients with immunocompromised status such as those undergoing cancer chemotherapy or immunotherapy, patients with long-term steroid treatment and patients undergoing second laparotomy or re-laparotomy were not considered for the study. Patients were assigned into two groups, Group A and Group B of 25 each after simple randomization. Patients in Group A were treated with Smead Jones (SJ) Technique for the closure of the aponeurotic rectus sheath and while those in Group B were treated with Conventional Continuous (CC) Technique for the rectus sheath closure.

Patients were evaluated intra-operatively for time taken for closure, length of incision, suture material length and the ratio of length of suture material to length of incision. Thereafter patients were evaluated post-operatively for surgical site infection, burst abdomen, and wound dehiscence, length of hospital stay, incisional hernia and for any other complications. Patient follow up was done on 3rd post-op day, at 2nd week, 6th week and 3 months post-operatively on the same parameters evaluated before and along with post-operative pain or discomfort and were asked to grade their satisfaction. With the help of SPSS software the data collected in the study was statistically analyzed with mean, standard deviation, chi-square and t-test.

Techniques of Closure

Smead-Jones Closure Technique

The Smead-Jones is a technique of closure of the anterior abdominal wall using far-near-near-far interrupted sutures. It

were taken to include the complete abdominal wall structures with a margin of not less than 1.5-2 cm from the fascial edges in the far-far portion and only the fascia (with margin of not less than 0.8cm from the edges) on the near-near portion with successive bites taken not less than 1 cm apart. This allowed good healing without intervening fat or muscle.

Conventional Continuous Closure

Continuous closure was done using a No.1 Vicryl suture. The suture to wound length ratio of 4:1 was maintained. Each bite was placed on the Linea Alba with at least 1.5-2cm margin from the cut edge and each successive bite was taken 1 cm apart. Edges of Linea Alba were approximated while avoiding strangulation.

Results

Patients in groups A and B were comparable with no statistically significant difference (significance taken as $p < 0.05$) in age distribution (p -value was 0.78370), gender (p -value of 0.2337), hemoglobin (p -value of 0.925), TLC (p -value 0.451), blood urea (p -value 0.6174), serum creatinine (p -value 0.4391), serum Bilirubin (p -value 0.2189), Prothrombin Index (p -value 0.6321) and operative findings (p -value 0.6321).

Mean time taken for closure

The mean time taken to close the aponeurotic sheath in patients of group A by Smead Jones Technique was 23.36 minutes and those of group B by Conventional Continuous technique was 17.08 minutes. The difference in mean time taken for closure was statistically significant (p -value 0.0001).

Suture length

It was observed in the study that the mean length of suture material used in Group A (Smead Jones Technique) was 104.8 cm and in Group B (Conventional Continuous Technique) was 83.76 cm. Statistically this difference in suture length was highly significant with (p -value 0.0001).

Suture length: Incision length (SL: IL)

Suture material length used was divided by the length of incision to calculate SL: IL. The means of this ratio obtained was calculated and it was observed that SL: IL for group A was 5.49 and that of group B was 4.36. Statistically this difference in the means of SL: IL was highly significant (p -value 0.0001).

Surgical Site infection

It was found in the study that patients treated with Smead Jones Technique (Group A) had a lower rate of surgical site infection (20%) as compared to those treated with Conventional Continuous Technique, i.e. Group B (24%). Statistically this difference in the rate of wound infection

On follow up, it was found that surgical site infection persisted more in conventional continuous group in contrast to Smead Jones group. Maximum rate of infection was seen at the end of 2 weeks.

Wound dehiscence

Wound dehiscence was observed in 4 patients (16%) of group A and 5 patients (20%) of group B. Statistically this difference in the rate was not significant with p-value of 0.712. The calculated relative risk of wound dehiscence is 0.80.

In follow up of patients, the incidence was similar for both the groups at 2 weeks (16%) and at 6 weeks (12%). None of the patients presented with wound dehiscence at the end of 3 months.

Burst Abdomen

It was noted that the 1 patient (4%) treated with Smead Jones Technique (Group A) had burst abdomen while among those treated with Conventional Continuous Technique, 3 patients (12%) had burst abdomen at 2 weeks. However, statistically this difference was not significant with p-value 0.297. The calculated relative risk of burst abdomen is 0.33.

It was found on follow up of burst abdomen patients that patients treated with Conventional Continuous method had a more incidence (12%) of burst as compared to those with Smead Jones technique (4%). However, this difference was not statistically significant.

Suture Sinus

Suture sinus was defined as sinus formation due to projection

of suture material through the wound margin or nearby intact skin. No patient had incidence of suture sinus in the early post-operative period. On follow-up, sinus was found to be present in 12% patients in group A and 8% patients in group B, which further decreased to 4% in both the groups at 3 months of follow up.

Incisional Hernia

No patient in Group A i.e. Smead Jones Technique developed an incisional hernia whereas 1 patient out of 25 patients in Group B presented with incisional hernia after 6 weeks. This incidence remained the same (4%) at 3 months of follow up. However, statistically this difference of rate of incisional hernia was not significant (p-value of 0.3124).

Patient Satisfaction

Patients were asked about their well-being in terms of post-operative pain or discomfort and were asked to grade their satisfaction as "satisfied" or "not satisfied" on 3rd post-operative day and after 2nd week, 6th week and 3 months. 96% of the patients treated with Smead Jones Technique reported only a minimal post-operative pain or discomfort and regarded the overall period as "satisfied" whereas 88% of the patients treated with Conventional Continuous Technique reported their overall experience as "satisfied". Statistically the difference in overall satisfaction was not significant (p-value 0.2971).

Discussion

An ideal abdominal sheath closure technique is the one that

Table 1: Surgical Site infection

| Surgical Site Infection | GROUP A (SJ) | GROUP B (CC) | TOTAL |
|-------------------------|--------------|--------------|----------|
| PRESENT | 5 (20%) | 6 (24%) | 11 (22%) |
| ABSENT | 20 (80%) | 19 (76%) | 39 (78%) |
| TOTAL | 25 | 25 | 50 |

The chi-square statistic is 0.1166. The p-value is 0.732807.

Table 2: Wound dehiscence

| Wound Dehiscence | Group A (SJ) | Group B (CC) | Total |
|------------------|--------------|--------------|----------|
| PRESENT | 4 (16%) | 5 (20%) | 9 (18%) |
| ABSENT | 21 (84%) | 20 (80%) | 41 (82%) |
| TOTAL | 25 | 25 | 50 |

The chi-square statistic is 0.1355 (p-value of 0.712795). Relative risk of wound dehiscence=0.80 in favour of Group A (SJ).

Table 3. Burst Abdomen

| Burst Abdomen | Group A (SJ) | Group B (CC) | Total |
|---------------|--------------|--------------|----------|
| PRESENT | 1 (4%) | 3 (12%) | 4 (8%) |
| ABSENT | 24 (96%) | 22 (88%) | 46 (92%) |
| TOTAL | 25 | 25 | 50 |

The chi-square statistic is 1.087 (p-value is 0.2971). Relative risk of burst abdomen=0.33 in favour of Group A (SJ).

Table 4: Patient Satisfaction

| Patient satisfaction | Group A (SJ) | Group B (CC) |
|-----------------------------|--------------|--------------|
| 3 rd POST-OP DAY | 24 (96%) | 22 (88%) |
| 2 WEEKS | 24 (96%) | 22 (88%) |
| 6 WEEKS | 24 (96%) | 22 (88%) |
| 3 MONTHS | 24 (96%) | 22 (88%) |

preserves the endurance strength of the wound throughout the process of healing along with good adherence of wound edges, is devoid of wound infection, has a good patient satisfaction postoperatively and is technically simple maneuver with no long-term complications. In search of an ideal abdominal fascial closure technique, this prospective, comparative study was done to compare Smead Jones technique and Conventional Continuous Closure Technique in emergency laparotomy wounds of patients admitted in surgical emergency [4,5].

In our study, a total of 42 out of 50 patients suffered from perforation peritonitis. Other diagnoses were ruptured gall bladder, ruptured liver abscess, blunt trauma abdomen and hemoperitoneum. Both the group had a similar profile of patients in terms of operative diagnosis. Mean time taken to close the rectus sheath was found to be 23.36±1.95 minutes in Smead Jones and 17.08±1.63 minutes in Conventional Continuous. This difference in the meantime taken for closure was statistically significant and can be explained by the less time taken for a continuous running suturing technique which involves tying a knot on both the ends and not multiple knots as in Smead Jones Technique. Also, Smead Jones technique involves a double loop of sutures at every interval which takes more time than taking a single loop in case of continuous suturing. Stone et al. [6] in their study on emergency laparotomies concluded that the operating time was prolonged by 10 minutes by use of an interrupted suture.

It was observed in our study that the average length of the suture material used in Smead Jones technique and Conventional Continuous technique was 104.8 cm and 83.76 cm respectively. This difference in mean length was statistically highly significant ($p < 0.001$). Moreover, incision length was comparable in both the groups, so the ratio of suture length: incision length was a better way to assess and compare the suture length in either of the groups. Mean SL:IL was found to be 5.49 and 4.36 respectively. This difference in mean was statistically highly significant ($p < 0.001$). The more length of suture material used in Smead Jones technique may be explained by the double loop of suture at every interval. However, Israelsson and Jonsson [7] suggested that the ratio of suture length to wound length may not be a critical parameter to assess.

The sutured laparotomy wound was assessed for any signs of pockets of fluid collection i.e. seroma, surgical site infection

like pain, redness, swelling or discharge from the wound in the early post-operative period till discharge and then followed up till 3 months. It was observed that surgical site infection was present in 5 out of 25 patients (20%) in Smead Jones and 6 out of 25 (24%) patients in Continuous Conventional patients in the early post-operative period. During follow-up, the rate of surgical site infection at 3rd post-operative day was 20% and 24% in Smead Jones and Continuous Conventional respectively which remained the same till 2 weeks.

It was found that the incidence of wound dehiscence was 16% in Smead Jones and 20% in Continuous Conventional. On further follow up the rate of wound dehiscence was same in both the groups at 16% which further decreased to 12% in both the groups at 6 weeks. Thus, statistically there was no significant difference in the rate of wound dehiscence among patients treated with either of the technique. High incidence of wound dehiscence may be explained by high prevalence of malnourishment and presence of extensive intra-abdominal infections with other co-morbid conditions.

Burst abdomen occurred in 12% patients in Conventional Continuous Group at 2 weeks which remained same at 6 weeks. There was one incident (4%) of burst abdomen in patients treated with Smead Jones Technique, at 2 and 6 weeks post-operatively. All the patients of burst abdomen were treated aggressively with one or the other means of management of burst abdomen and none of the patients in either of the groups had burst abdomen at the end of 3 months. Larsen et al [8] in their retrospective study on midline laparotomy wounds, concluded that 45 out of 3768 patients had burst abdomen within 30 days of surgery. On an average the burst abdomen occurred after 8 days.

In our study, no incidence of suture sinus was seen in the immediate post-operative period. During follow up of patients, it was found to be present in 12% of cases in Smead Jones and 8% of cases in Continuous Conventional, which further decreased to 4% in both the groups at 3 months of follow up time. The more incidence of suture sinus in patients treated with Smead Jones Technique may be explained by a higher SL:IL in this group, which meant longer suture material present in the wound that could be the reason for higher suture sinus formation as explained by Rucinski et al. [9] in their meta-analysis. LoCicero J et al. [10] studied and recommended minor precaution in using monofilament in

suture in thin patients with minimal fat to prevent suture sinus formation.

None of the patients in Smead Jones Technique developed an incisional hernia whereas 1 patient out of 25 patients in Continuous Technique had incisional hernia at 6 weeks check-up. This incidence of incisional hernia remained the same (4%) at 3 months of follow up. This case may have been because of technical error. However, there was no statistically significant difference in the rate of incisional hernia in both the groups. This finding has been validated in most of the studies which have concluded an incidence of 2-16% irrespective of the sheath closure technique or type of suture material used. Richards et al [11]. had shown an incidence of 1.3% for incisional hernia irrespective of method of closure.

It was concluded that 96% of the patients treated with Smead Jones Technique reported only a minimal post-operative pain or discomfort and regarded the overall period as “satisfied” whereas 88% of the patients treated with Conventional Continuous Technique reported their overall experience as “satisfied”. A few of the patients (12%) in Conventional Continuous Technique reported moderate to severe post-operative pain which on further follow up remained the same. Thus, in our study, patients treated with Smead Jones Technique had less wound pain and were more satisfied than those treated with Conventional Continuous Technique which is comparable in conclusion to other studies done [12-15].

Conclusion

Smead Jones Technique seems to be better method of sheath closure in emergency laparotomy wounds, although it is time consuming, took more suture material and more chances of suture sinus formation but there were less chances of burst abdomen, less complaint of post-operative pain and discomfort leading to more patient satisfaction. Both techniques were comparable with regard to post-operative complications like seroma formation, surgical site infection, wound dehiscence and period of hospital admission.

Authors' Contribution

Singh A K- Helped in drafting discussion and review of literature. *Singh J*- Helped in drafting discussion and review of literature. *Singh B*- Reviewed the article and made appropriate changes in introduction and results. *Khalsa MS*- Critically reviewed the article, made the corrections in introduction, discussion and conclusion. *Singh TP*- Collected the data references and wrote the initial write-up and statistical analysis. *Singh S*- Helped in writing introduction, discussion and statistical analysis.

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