Role of Closed Suction Drain in Prevention of Suture Line Infection in Elective Laparotomy Wounds.

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ABSTRACT

INTRODUCTION: Wound infection continues to represent a major problem, both in terms of how they affect the outcome of surgical procedure, and for their impact on length of hospital stay and cost of treatment. Moreover, post-operative wound infection or surgical site infection (SSI) delays return to gainful employment and prolong hospital stay. The objective of closed suction drainage of an established surgical site wound collection is to facilitate treatment of such collection with the aim of increasing patient’s comfort, decreasing patient morbidity and decreasing the length of hospitalization.

AIMS/OBJECTIVES:
1. To evaluate the role of closed suction drainage in reduction of surgical site infection in elective laparotomy wounds as compared to laparotomy wounds closed without suction drainage.
2. To study the effect of closed suction drainage in reducing the hospital stay.

METHODS: Study group consists of patients with suction drain in wound closure, while controls were patients with simple abdominal closure.
Sample size:
Group A – Patients with suction drain in wound closure – 50 cases
Group B – Patients with simple abdominal closure – 50 cases

A Prospective study was conducted at Dr. D.Y.Patil Medical College & Hospital and Research Centre Pimpri, Pune, for a period of 3 years from 2013 to 2016.

RESULT:
Closed suction drainage prevents post-operative surgical site (Incision) infection, reduces hospital stay and the wound healing time is also less when closed suction drain is used in patients undergone elective laparotomies in comparison to simple abdominal closure.

CONCLUSION:
1. Closed suction drainage prevents post-operative surgical site (Incision) infection significantly.
2. Closed suction drainage reduces hospital stay in a patient undergone elective laparotomy, which is significantly more where closed suction drain is not used.
3. Obese patients with subcutaneous fat are more likely to develop Surgical site infection.

INTRODUCTION

Infections that occur in the wound created by an invasive surgical procedure are generally referred to as surgical site infections (SSIs).

Wound infection continues to represent a major problem; both in terms of how they affect the outcome of surgical procedure, and for their impact on length of hospital stay. Infection can weaken an abdominal closure and result in wound dehiscence and incisional hernia.

Surgical site infections have been shown to compose up to 20% of all of healthcare-associated infections. At least 5% of patients undergoing a surgical procedure develop a surgical site infection.

A surgical site infection may range from a spontaneously limited wound discharge within 7–10 days of an operation to a life-threatening postoperative complication. Most surgical site infections are caused by contamination of an incision with microorganisms from the patient’s own body during surgery. Infection caused by microorganisms from an outside source following surgery is less common. The majority of surgical site infections are preventable by taking different measures, applied at pre-operative, intra operative and post-operative period such as sterilization.
methods, surgical technique, antibiotic prophylaxis, oxygen supply, fluid management, and skin disinfection. (1)

Despite, the amazing advances made by medical sciences, post-operative wound infection linger as a potential killer. Moreover post-operative wound infection or surgical site infection (SSI) delays return to gainful employment and prolong hospital stay. Therefore, control of infection is a major consideration before, during and after operation; which can be achieved by reducing the microbial inoculums and treating established infection.

However hard we try to treat it; there are always some factors which may enhance morbidity such as age, general condition of the patient, nutritional status, malignancy and co-existing co-morbid conditions such as diabetes.

CLOSED SUCTION DRAIN

The use of closed suction drains in medicine dates back to the third century BC when Hippocrates utilized hollow tubes to treat empyema (4-5). The first portable enclosed wound suction unit was unveiled in Paris in 1954 and twenty years later, Dr. Stanley Kalish developed the TLS drain.(6)

Closed suction irrigation method is a modification of the VAC technique. (7)

Vacuum assisted closure (VAC) is a well-described technology with applications in a variety of “difficult to manage” acute and chronic wounds. Since Cruse et al. published their prospective study of 23,659 surgical wounds in 1973, which showed a lower wound infection rate (1.8% vs 2.4%) with a closed suction drain system than a Penrose wound drain closed suction drain systems have been preferred to open systems. Thereafter, in almost all studies, subcutaneous wound drain refers to a closed suction drain system. (8,9)

The Mini-VAC Drainage System has two characteristics: pressure is a maximum of 60 mmHg so that the drainage is not excessive, and obstruction of the drainage tube is improbable because the Silicon Drain is designed with 4 slits, so that if one slit is obstructed, suction can continue from the other openings. (10) In contrary to the VAC technique, there is no need to use a special foam dressing.

Types of Drains

Drains can be classified based on the mechanism of action either passive or active. (11) Passive drains work in the absence of any electrical or mechanical means. They depend on the higher pressure inside the wound, gravity, and capillary action to evacuate fluid from a wound into the surrounding dressing. The classic example of a passive drain is a Penrose drain. Active drains are attached to a vacuum device that works through negative pressure to draw the fluid from the wound while atmospheric pressure provides compression.

Closed suction drainage, as reported in the literature, withdraws pools of blood and air pockets from a wound, obliterating dead space from surgical sites. It minimizes the inflammatory process by providing conditions conducive to optimal wound healing. In 1981, Miller described four principles of closed suction drainage: Haemostasis, external drainage, negative pressure, and airtight wound. We have undertaken this study to analyse the role of closed suction drainage in reducing surgical site infection & hospital stay.

MATERIAL AND METHOD

This prospective study was carried out at Dr. D.Y.Patil Medical Hospital, Pune for a period of 3 years from July 2013 to September 2015. A total of 100 patients undergoing elective laparotomy aged 18-65 years were included and distributed in Group A & B consisting of 50 patients with subcutaneous closed suction drain and 50 cases without drain. Immunosuppressive, emergency laparotomies, malignancy and patients diagnosed as Diabetes mellitus were excluded from the study.

Body weight and height were used to calculate the body mass index (BMI). According to the criteria suggested by the World Health Organisation for the Asian population, overweight and obesity were defined as $23 \leq \text{BMI} < 27.5 \text{kg/m}^2$ and $\geq 27.5 \text{kg/m}^2$, respectively.

Informed written consent was obtained. Appropriate incision to open abdomen was made.

A suction drain (Mini-vac 8F) was positioned with its tip lying over the subcutaneous tissue; it was brought out through healthy skin by a separate stab incision away from the wound and connected to a close suction drain. Incision line was then closed using ethilon 2.0 mattress sutures and dressed.

First dressing was changed after POD-2 and subsequent dressings on POD 3,5,7 .incision site closely monitored for (1) local warmth (2) tenderness (3) redness (4) swelling (5) nature of discharge.

Quantity of Drainage from Mini-vac 8F drain was noted every 24 hourly.

If collection is there on surgical site, it was evaluated for culture/sensitivity and accordingly antibiotics were started.
Amount of drainage was recorded daily. Drain was removed when the output came to less than 5 ml/day (24 hourly).

Postoperatively, all patients were given Inj. Cefotaxime 1 gm 12 hourly. Antibiotics was continued in case of discharge from wound site or drainage system until culture and sensitivity report was available and modified according to culture-sensitivity report.

The sutures were removed (alternate on 8th & rest on 10th day) before discharge from hospital. All cases were followed up at an interval of 30days in OPD Post operatively for various complications like hematoma, wound infection, wound dehiscence, incisional hernia and any other complications.

Chi-square test was applied to detect the statistical significance between the variables and the level of significance was set at 5%.

DISCUSSION

Surgical wound infection continues to be a major cause of morbidity and mortality in surgical practice despite pre and post-operative broad-spectrum antibiotic coverage. (12)

For wound healing to progress methodically, the local environment of the wound should be healthy. Evidence indicates that if a wound is not allowed to drain freely, blood, body fluids, pus and necrotic material will collect in the wound, providing a growth medium for microorganism. Surgical wound drainage is recognized as a key element in facilitating the healing process.

In our study, Demographic data matched for both groups in terms of age and gender. Among the 100 patients undergoing various surgical procedures were assessed and the age of the patients ranged from 18 to 65 years. Extremes of age have been reported to have a higher incidence of wound infections, perhaps owing to decreased immune-competence. (13)

The mean age of patient’s in group I was 42.78 years, whereas it was 39.92 years in group II. Sohn et al. reported an average of 39 years in a study group of 280 cases. (14)

In group I M:F was 1:2(M<F) & in group II 3:2(M>F).

A higher incidence of infection was found in males (47%) as compared with females (31%) in our study. Similarly, a study conducted in a Peruvian Hospital in 2005 by Hernandez et al. reported 65.6% males and 34.4% females among the SSI patients. (15)

Among the risk factors for wound complications obesity is the most well-known and widely studied risk factor for wound complications. (16,17)

In our study, there was no significant difference between patients with and without closed suction drain in terms of BMI. The mean in group I was 25.55±1.63 whereas it was 24.94±1.43 in group II.

The most common associated risk factor in the patients with SSI in our study was Obesity. According to the criteria suggested by WHO for the Asian population, overweight and obesity were defined as 23≤ BMI < 27.5 kg/m² and BMI ≥ 27.5 kg/m², respectively. The mean BMI in patients with SSI was 29.4± 1.2 kg/m² and without SSI was 28.9±0.94 kg/m² (18).

In our study, lower BMI was related with better wound healing, however the difference was insignificant. This was in contrast with a study conducted in 1976 by Pitkin et al he observed a 29% wound complication rate in obese patients in comparison to 4% in non-obese patients. In another study by Gallup et al a wound complication rate of 42.2% was reported in obese gynaecological patients compared to 0.9% in non-obese patients. (16)

The mean subcutaneous fat thickness in patients with and without SSI was 35.4±2.3 mm and 28.9±0.84 mm. The difference was significant.

Wound complication was reported only in patients with a depth of subcutaneous tissue of >3 cm, and none with a depth of <3 cm. This was in agreement with a study conducted by Chowdri et al and Soper et al has demonstrated significant association between the depth of adipose tissue and subsequent wound complication (19,20).

Although obesity has traditionally been considered a major risk factor for wound infection, it was demonstrated by logistic regression analysis that weight and BMI were not significantly associated with wound complications. Wound complication was reported only in patients with a depth of subcutaneous tissue of >3 cm, and none with a depth of <3 cm. We found a significant increase in the rate of seroma formation with the increase in the subcutaneous fat thickness. The patients were evenly distributed in both the groups.

The patients selected underwent various elective abdominal surgical procedures like Cholecystectomy (54%), appendectomy (40%), total abdominal splenectomy (3%) & mesenteric cyst excision (3%).owing to the fact that Cholecystectomy is the second most commonly performed operation in GI surgery after appendectomy. (21)
The kocher’s right sub-costal incision was the most common incision taken.

In our study, the overall infection rate was 13%. The incidence of suture site infection was more when subcutaneous CSD was not used (20%) in comparison to when CSD was used (6%). It was in agreement to a study conducted by Panci et al. They demonstrated that a subcutaneous drain was associated with a significant decrease in the wound complication rate (6% vs 42%; p=0.003). (22)

In a study by Chowdri et al reported no infection in the drain group compared to 8% infection in no drain group (19). Kim et al reported 2.8% infection in drain group and 7.8% in group without drain. (21) However, it was in contrast with a study conducted by Gallup et al they reported no statistical differences (20% vs. 31% ; p = 0.09) in the wound complication rate between the wound drain group and controls. Similarly, according to an RCT conducted by Cardosi et al. use of a subcutaneous wound drain showed no significant change (17.9% vs. 15.6%; p = 0.70) in the incidence of wound complication rates compared with the control group.

In the current study, E. coli (10%) was the most common organism isolated from discharge in group I & II patients followed by Enterobacteria (2%), klebsiella (1%). Similar observation was made in a study conducted by Sahu et al and Fadnis et al. (23,24)

Length of hospitalization and duration of stay was significantly associated with surgical site infection. Longer post-operative stay also results in prolonged exposure to the potentially infective hospital environment, and consequently higher infection rate.

The mean postoperative hospital stay in the patients in which closed suction drain used was 8.91+1.14 days; whereas the mean postoperative hospital stay in patients in which CSD was not used was 12.88 + 2.97 days for t value 6.97 & P value <0.0001. Thus the postoperative hospital stay was significantly more in group II patients than in group I. This was in agreement with a study conducted by Kim et al which concluded that the application of a subcutaneous negative pressure wound drain resulted in shorter hospital stay (median 8 vs 11 days; p = 0.021). (21) Similarly, Zhen et al obtained encouraging results with the use of the closed suction irrigation method for laparotomy wounds. (24)

The closed suction irrigation method decreased hospital stay (mean ± SD, 9.2 ± 0.1 vs. 20.5 ± 0.6 days, P < 0.001) and allowed early rehabilitation.

CONCLUSION

- Closed suction drainage prevents post-operative surgical site infection significantly in elective laparotomy.
- Closed suction drainage reduces hospital stay in a patient undergone elective laparotomy, which is significantly more where closed suction drain is not used.
- Obese patients with thick subcutaneous fat are more likely to develop SSI.

**Conflict of Interest Statement**

The authors have no conflict of interest

**Ethical Approval**

"All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards."

**Informed Consent**

Informed consent was obtained from all individual participants included in the study.

REFERENCES


OBSERVATION & RESULTS:

Table 1: Age distribution amongst group I and group II patients

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Group I (n=50)</th>
<th>Group II (n=50)</th>
<th>t Value</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Age (Years)</td>
<td>42.78 ± 11.51</td>
<td>39.92 ± 11.94</td>
<td>1.22</td>
<td>&gt;0.05</td>
</tr>
</tbody>
</table>

- The mean age of patient’s in group I was 42.78 years, whereas it was 39.92 years in group II.

Table 2: SSI with respect to Obesity

<table>
<thead>
<tr>
<th>Associated factors</th>
<th>Surgical Site Infection</th>
<th>Z Value</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obesity (BMI ≥ 27.5kg/m²)</td>
<td>29.4 ± 1.2kg/m²</td>
<td>28.9 ± 0.94 kg/m²</td>
<td>0.04</td>
</tr>
</tbody>
</table>
• The mean obesity in patients with SSI was more.
• The difference was insignificant.

Table 3: SSI development with respect to subcutaneous fat thickness

<table>
<thead>
<tr>
<th>Subcutaneous fat thickness</th>
<th>Surgical Site Infection</th>
<th>Z Value</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present (n=13)</td>
<td>35.4±2.3 mm</td>
<td>4.71</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Absent (n=87)</td>
<td>28.9±0.84 mm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- SSI was more in patients with subcutaneous fat thickness >3cm.

Table 4: Operative procedure distribution of patients in group I and group II

<table>
<thead>
<tr>
<th>Operative procedure</th>
<th>Group I</th>
<th>Group II</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Cholecystectomy</td>
<td>28</td>
<td>26</td>
<td>54</td>
</tr>
<tr>
<td>Interval Appendectomy</td>
<td>18</td>
<td>22</td>
<td>40</td>
</tr>
<tr>
<td>Splenectomy</td>
<td>3</td>
<td>0</td>
<td>03</td>
</tr>
<tr>
<td>Mesenteric cyst excision</td>
<td>1</td>
<td>2</td>
<td>03</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
</tbody>
</table>

- Open cholecystectomy (54%) was the most common surgical procedure followed by interval appendectomy (40%), splenectomy & mesenteric cyst excision (3%).

Table 5: Patients in group I and group II

<table>
<thead>
<tr>
<th>Surgical site infection evident on Post-operative day</th>
<th>Group I</th>
<th>Group II</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>≥8</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Nil</td>
<td>47</td>
<td>40</td>
<td>87</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
</tbody>
</table>

- The incidence of SSI was more when subcutaneous drain was not used (20%) in comparison to when closed suction drain was used (6%).

Table 6: Comparison of hospital stay in group I and group II

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Group I (n=50)</th>
<th>Group II (n=50)</th>
<th>t Value</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>8.92</td>
<td>12.88</td>
<td>6.59</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>SD</td>
<td>1.14</td>
<td>2.97</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Group II (without CSD) patients had a longer Hospital stay (12.88+2.97) Days than Group I (CSD) patients (8.92+1.14) Days.
- The difference between the groups was significant.
- P value was significant.
Figure 1. Drain placed in subcutaneous plane intra-operatively.

Figure 2. Closed suction drain placed intra-operatively.
Figure 3 Clean wound on Post-operative day 3.

Figure 4 Post-operative pus collections in closed suction drain.