

## Original Research Article

# Role of subcutaneous vacuum suction drain in prevention of abdominal wound complication in emergency laparotomy

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## ABSTRACT

**Background:** Some of the most common wound complications following laparotomy include hematoma formation, seroma formation, wound infection, burst abdomen and wound dehiscence. Closed-suction drains (CSDs) help to drain any wound collection and also reduce any dead space in the wound thereby promoting healing and preventing complication.

**Methods:** We conducted a prospective study and included patients presenting with acute abdomen in emergency department. Patients were selected as per inclusion and exclusion criteria. Two groups (group A and B) with equal number of patients were created based on closed envelope technique. CSD was placed in the wound of patients in group A. Wound healing and complications were compared between the two groups.

**Results:** 50 patients were included in the study with 25 in each group. Hematoma formation was found to be significantly more among group B (24.0%) compared to group A (4.0%). Seroma formation (p value =0.03917), SSI rate (p value =0.039) and wound dehiscence/burst abdomen (p value =0.0415) was more in group B than group A. The mean wound healing time (days) and mean hospital stay (days) was significantly more in group B.

**Conclusions:** Placing a subcutaneous vacuum suction drain at the time of abdominal wall closure during emergency laparotomy results in better wound healing and reduces postoperative wound complication, hospital stay time, morbidity and also decreases overall healthcare cost.

**Keywords:** Subcutaneous vacuum suction drains abdominal wound, Wound complication, Emergency laparotomy, Post laparotomy complication, Suction drain

## INTRODUCTION

The anterior abdominal wall consists of the following layers from inside out-peritoneum, extraperitoneal fascia (deep fascia), muscle, superficial fascia, subcutaneous tissue and skin.<sup>1</sup> It is of clinical importance to be aware of the various layers and level of tissue for abdominal wound closure. An abdominal wound may occur due to disruption in the anterior abdominal wall caused by either trauma or any surgical intervention in order to gain access to the peritoneal cavity. Vertical midline incision is the most common incision used for laparotomy.

Wound complication following emergency laparotomy can be divided into early and late complication. Early wound complications include: hematoma formation, seroma formation wound infection, burst abdomen (evisceration of bowel/abdominal contents) and wound dehiscence (fascial disruption without evisceration). Late complications include chronic wound pain, suture sinus, and incisional (ventral) hernia.<sup>2</sup>

Hematoma formation is one of the known complications after abdominal surgery. Hematoma formation makes wound prone for secondary infection.<sup>3</sup> Seroma formation

is another complication after abdominal surgery, it can lead to wound infection, wound dehiscence, calcification of the seroma, poor cosmetic result and unsatisfactory appearance of a surgical scar.<sup>4</sup> Surgical site infection (SSI) is one of the most common postoperative complications, occurring in at least 5% of all patients undergoing surgery and 30-40% of patients undergoing abdominal surgery, depending on the level of percentage between 5th and 10th postoperative days. Infectious complications are the main causes of postoperative morbidity in abdominal surgery. The most common form is superficial wound infection occurring within the first week of surgery.<sup>5</sup> SSI is significantly associated with longer hospital stay, which in turn results in higher health care costs.<sup>6-9</sup> Determining the strategies for its prevention could therefore improve patient care while lowering the duration and cost of hospital stay in patients at risk. Abdominal wound dehiscence and burst abdomen are also complications after abdominal surgery). Burst abdomen occurs in 1.03% operation, has a high mortality rate of 15-20%, and requires immediate reoperation

There are various patient and surgical factors affecting the outcome of laparotomy wound. Various interventions have been proposed with a view to reduce abdominal wound complication. A number of them are used in routine practice. Hand washing, minimizing shaving, skin preparation, and preoperative prophylactic antibiotics, type of incision, suture material used and method of closure, have all gained acceptance in the surgical community.<sup>11-14</sup> It has been shown that the placement of subcutaneous drain provide no advantage after cholecystectomies, hernia repair and various other type of elective surgery. However, there may be benefit of using subcutaneous vacuum suction drain in reducing abdominal wound complication in patient undergoing emergency laparotomy.<sup>15</sup>

The rationale of placement of subcutaneous drain is theoretical and is based on the premise that the removal of any collecting hematoma, seroma and elimination of dead space would perhaps result in lower rate of wound complication. Their use is effective in reducing the incisional SSI, not only because of continuous suction of seroma, hematoma and bacteria but also because of reduction of dead space of the wound area. In contrast to passive (open) drains, closed-suction drains (CSDs) establish a pressure gradient between the wound and the external environment and empty into a sealed reservoir, and are believed to reduce the risk of retrograde microbial contamination.<sup>16</sup> Thus negative suction in subcutaneous space has been shown to reduce the incidence of infection by evacuation of infected content, evacuation of collected hematoma/seroma in subcutaneous space and decreases dead space. Negative pressure also provide a moist and protected environment, reducing peripheral edema around the wound, stimulating circulation to the wound bed, decreasing bacterial colonization, increasing the rate of granulation tissue formation and epithelization leading to

improved healing capacity and decreased wound complication.<sup>17,18</sup>

### ***Aim of study***

The role of subcutaneous vacuum suction drain in preventing abdominal wound complication.

### **METHODS**

The study was conducted after clearance from board of studies and ethical committee of M.L.N. Medical College, Prayagraj during the period 2018-19. All the patients undergoing emergency laparotomy were entertained in the study. The total sample size was 50 and divided randomly in two groups of 25 each by closed envelop technique. By this sampling technique both groups are statistically similar in terms of various variables and thus comparable. Group A consists of patients in which subcutaneous vacuum suction drain placement done. Group B contain patient in which subcutaneous vacuum suction drain placement was not done.

### ***Inclusion criteria***

Inclusion criteria were patients of either sex or any age undergoing emergency laparotomy and are willing for investigations and treatment.

### ***Exclusion criteria***

Exclusion criteria were cases which underwent laparotomy for gynecological cause, accidental removal of subcutaneous vacuum suction drain, death of patient in postoperative period, patient not giving consent, and patient requiring re-exploration after first surgery.

### ***Study procedure***

A detailed history, complete physical examination and routine appropriate investigation were done for all patients undergoing laparotomy. Nasogastric suctioning, correction of fluid and electrolyte and appropriate antibiotic were given in all patients.

Preoperative antibiotic was given to all patients. Laparotomy was performed in both groups by vertical midline incision. Rectus was closed by simple continuous polypropylene suture in both groups. Use of appropriate vacuum suction drain was done in subcutaneous plane in group A during abdominal closure. In post-op period same antibiotic combination was given to both groups.

Surgical site incision was routinely examined post-operatively in terms of hematoma formation, seroma formation, surgical site infection, wound dehiscence/burst abdomen and hospital stay time and wound healing time.

Daily observation of drain quantity and content was also done. Drain removed when output nil or <5 ml in 24

hours. Results of both groups were compared and analyzed.

### Statistical analysis

The data was entered into the microsoft excel and the statistical analysis was performed by statistical software SPSS version 21.0. The quantitative (numerical variables) were present in the form of mean and SD and the qualitative (categorical variables) were present in the form of frequency and percentage. The student t-test was used for comparing the mean values (continuous data) between the 2 groups whereas chi-square test was applied for comparing the categorical data (frequency). The p value was considered to be significant when less than 0.05.

## RESULTS

Group A (drain group) and group B (non-drain group) are statistically similar in terms of various variables and thus comparable. As shown in (Table 1) there was no significant difference in the distribution of the patients

between gender and with ASA grade between drain and non-drain group.

**Table 1: Distribution of gender and ASA grade between both groups.**

| Parameter        |        | Drain group<br>N (%) | Non-drain<br>group N (%) |
|------------------|--------|----------------------|--------------------------|
| <b>Gender</b>    | Male   | 11 (44)              | 13 (52)                  |
|                  | Female | 14 (56)              | 12 (48)                  |
| <b>ASA grade</b> | I      | 11 (44)              | 10 (40)                  |
|                  | II     | 11 (44)              | 11 (44)                  |
|                  | III    | 3 (12)               | 4 (16)                   |

There was no significant difference in the distribution of patients with history of diabetes mellitus, steroid use and Smoking between drain and non-drain group. The mean hemoglobin, serum albumin and BMI (Kg/m<sup>2</sup>) was compared between drain and non-drain group using the unpaired t-test as shown in (Table 2). There was no significant difference in mean serum urea and serum creatinine as well as systolic and diastolic blood pressure between drain and non-drain group.

**Table 2: Distribution of patients based on status of medical history and pre-operative blood investigation values.**

| Pathology                         | Drain group  | Non-drain group | P value |
|-----------------------------------|--------------|-----------------|---------|
| <b>Diabetes mellitus N (%)</b>    | 6 (24)       | 5 (20)          | 0.733   |
| <b>Steroid use N (%)</b>          | 3 (12)       | 4 (16)          | 0.684   |
| <b>Smoking N (%)</b>              | 10 (40)      | 9 (36)          | 0.77    |
| <b>Hemoglobin (mean±SD)</b>       | 11.80±1.57   | 11.73±1.77      | 0.127   |
| <b>Serum albumin (mean±SD)</b>    | 4.07±1.74    | 4±2.07          | 0.352   |
| <b>BMI (mean±SD)</b>              | 24.07±1.27   | 23.46±2.57      | 0.294   |
| <b>Serum urea (mean±SD)</b>       | 51.25±32.95  | 53.51±30.34     | 0.101   |
| <b>Serum creatinine (mean±SD)</b> | 1.97±1.15    | 1.94±1.26       | 0.609   |
| <b>Systolic BP (mean±SD)</b>      | 113.88±13.38 | 111.8±8.69      | 0.38    |
| <b>Diastolic BP (mean±SD)</b>     | 74.12±6.08   | 74.96±4.81      | 0.9     |

**Table 3: Distribution of underlying cause of acute abdomen.**

| Pathology                       | Drain group<br>N (%) | Non-drain<br>group N (%) |
|---------------------------------|----------------------|--------------------------|
| <b>Appendicular perforation</b> | 5 (20)               | 6 (24)                   |
| <b>Duodenal perforation</b>     | 4 (16)               | 4 (16)                   |
| <b>Ileal perforation</b>        | 2 (8)                | 3 (12)                   |
| <b>Jejunal perforation</b>      | 3 (12)               | 2 (8)                    |
| <b>Gastric perforation</b>      | 2 (8)                | 3 (12)                   |
| <b>Ruptured liver abscess</b>   | 4 (16)               | 3 (12)                   |
| <b>Intestinal obstruction</b>   | 4 (16)               | 2 (8)                    |
| <b>Blunt trauma abdomen</b>     | 1 (4)                | 2 (8)                    |

**Table 4: Distribution of post-operative wound complications.**

| Complication                          | Drain group<br>N (%) | Non-drain<br>group N (%) | P value |
|---------------------------------------|----------------------|--------------------------|---------|
| <b>Hematoma formation</b>             | 1 (4)                | 6 (24)                   | 0.041   |
| <b>Seroma formation</b>               | 2 (8)                | 8 (32)                   | 0.039   |
| <b>Wound infection/SSI</b>            | 2 (8)                | 8 (32)                   | 0.039   |
| <b>Wound dehiscence/burst abdomen</b> | 1 (4)                | 6 (24)                   | 0.0415  |
| <b>Mean wound healing time</b>        | 6.04 days            | 10.32 days               | <0.0001 |
| <b>Duration of hospital stay</b>      | 6.52 days            | 8.96 days                | 0.004   |

In Table 3, compares the two groups based on the underlying cause of acute abdomen and such comparison was found to be statistically non-significant.

In Table 4, studied the distribution of various post-operative wound complications like hematoma, seroma, wound infection, wound dehiscence, mean wound healing time and hospital stay among the two groups and these factors were found to be significant statistically. Average duration for which the drain was kept in drain group was 3.48 days with SD being 1.08.

## DISCUSSION

SSI is one of the most common complications of abdominal wound following emergency laparotomy. This study consideration is to remove the blood and serous fluids from the wound by drains before fluids can get infected.<sup>19</sup>

SSI cases were diagnosed within 30 postoperative day by ICT (information and communications technology) according to the centers for disease control and prevention (CDC) criteria: purulent drainage with or without laboratory confirmation from the superficial incision; organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision; at least one of the following signs or symptoms of infection: pain or tenderness, localized swelling, redness, or heat and superficial incision were deliberately opened by surgeon, unless the incision was culture negative; and diagnosis of s-SSI by the surgeon or ICT.

It is generally thought that the incidence of s-SSI is related to amount of bacterium of the wound, formation of hematoma, pool of serous effusion, potential subcutaneous dead space, disturbance of the local circulation, and the amount of bacterium in the surgical organ.<sup>20</sup> A subcutaneous drain reduces the amount of bacterium around the wound and removes residual effusion and blood from the wound that serves as a medium for bacterial growth. A closed drain is an active drain that employs the power of suction.<sup>21</sup> Negative suction drain also provide moist and protected environment, reduces edema around wound, increases circulation around wound that results in better healing of wound.

In our study, SSI was found to be significantly more among non-drain group (32.0%) compared to drain group (8.0%). This was in accordance with the study by Gupta and Kumar, 50% and 24% patients developed surgical site infection in non-drain and drain group respectively, Razavi et al, where they found 139 patients among 802 (17.40%) suffered from SSI, Renvall et al, in which SSI rate in acute surgery was 12.4%, Tanzania (15.6%), Pakistan (13.5%) and Vietnam (14.9%).<sup>20,22-26</sup> Vaghani et al, study showed surgical site infection rate of 25% in study group and 57.7% in non-drain group.<sup>27</sup>

In the study by Patel et al, a total of 31 patient in study group (with drain) who had undergone surgery for perforation peritonitis only 2 patients (6.45%) had wound infection as compared to non-drain group where 16 patient (51.61%) had wound infection.<sup>30</sup> This was lower than the incidence of infections in the study by Adejumo et al, SSI was observed to be present in 85 patients, giving an incidence rate of 38.1%.<sup>28</sup> Fujii et al, included high risk patients, including emergency laparotomies, and patients with thick subcutaneous fat and the risk ratio showed a reduction in the SSI rate in the drain group (RR 0.37) (0.15-0.9).<sup>29</sup>

In our study, Seroma formation was found to be significantly more in group B compared to group A (32% in non-drain group and 8% in drain group). This was similar to the study by Chowdri et al.<sup>31</sup> In our study, mean hospital stay time is more in non-drain group than drain group. In the study by Vaghani et al, the average hospital stay for group A was 12±1.5 days and for group B (standard simple closure without any drain) was 18±1.5 days.<sup>27</sup> In our study average wound healing time significantly more in non-drain group (10.32±2.19 days) than drain group (6.04±1.95 days). In Vashist et al, (2013) in which average duration of wound healing time was 10 days in drain group and 14 days in non-drain group.<sup>32</sup>

## CONCLUSION

Patients undergoing emergency laparotomy suffer from local wound complication such as hematoma formation seroma formation pain at wound site, surgical site infection, wound dehiscence and burst abdomen. These complications occur because of patient related factors, poorly controlled bleeding points in the subcutaneous plane, poorly maintained aseptic condition and improper surgical techniques. This will lead to increased morbidity, prolonged wound healing and prolonged hospital stay.

These complications can be reduced by the use of subcutaneous vacuum suction drain toilet out the collection in the wound. The result from present study shows that insertion of subcutaneous vacuum suction drain during abdominal wall closure during emergency laparotomy provide effective drainage of wound collection which in turn reduces the incidence of hematoma formation, seroma formation, SSI and wound dehiscence. Negative suction also enhances healing process by decreasing bacterial colonization, reducing edema around the wound, stimulating circulation of wound bed and by increasing the rate of granulation tissue formation and epithelization.

Placing a subcutaneous vacuum suction drain at the time of abdominal wall closure during emergency laparotomy results in better wound healing and reduces postoperative wound complication, hospital stay time, morbidity and also decreases overall healthcare cost.



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## REFERENCES

1. Harmon LA, Husen VR, Roberts EK. Abdominal closure. Medscape. 2017. Available at: <https://emedicine.medscape.com/article/1961789-overview>. Accessed on 18 October 2018.
2. Bruce J, Russell EM, Millinson J, Krukowski ZH. The measurement and monitoring of surgical adverse events. Health Tech Assess. 2001;5:1-194.
3. Shikhman A, Tuma F. Abdominal Hematoma. Last Updated 16 June 2019. Available at: <https://www.ncbi.nlm.nih.gov/books/NBK519551/>. Accessed on 18 October 2019.
4. Coello R, Charlett AJ, Wilson V, Pearson WA, Borriello P. Adverse impact of surgical site infections in English hospitals. J Hospital Infection. 2005;60(2):93-103.
5. Kujath P, Kujath C. Complicated skin, skin structure and soft tissue infections - are we threatened by multi-resistant pathogens. European J Med Res. 2010;15:544-53.
6. Olson MM, Lee JT. Continuous, 10 years wound infection surveillance. Results, advantages, and unanswered questions. Arch Surg. 1990;125:794-803.
7. Cruse PJ, Foord R. The epidemiology of wound infection. A 10 years prospective study of 62,939 wounds. Surg Clin North Am. 1980;60:27-40.
8. Mahmoud NN, Turpin RS, Yang G, Saunders WB. Impact of surgical site infections on length of stay and costs in selected colorectal procedures. Surg Infect. 2009;10:539-44.
9. Reilly J, Twaddle S, McIntosh J, Kean L. An economic analysis of surgical Bibliography 47 wound infection. J Hosp Infect. 2001;49:245-9.
10. Sahu SK, Shergill JS, Sachan PK, Gupta P. Superficial Incisional Surgical Site Infection in Elective Abdominal Surgeries - A Prospective Study. Internet J Surg. 2011;26:1.
11. Diana M, Hubner M, Eisenring MC, Zanetti G, Troillet N, Demartines N. Measures to prevent surgical site infections: what surgeons (should) do. World J Surg. 2011;35(2):280-8.
12. Darouiche RO, Wall MJ, Itani KMF. Chlorhexidine-alcohol versus povidone-iodine for surgical site antisepsis. New England J Med. 2010;362(1):18-26.
13. Alexander JW, Fischer JE, Boyajian M, Palmquist J, Morris MJ. The influence of hair-removal methods on wound infections. Archives Surg. 1983;118(3):347-52.
14. Murray BW, Huerta S, Dineen S, Anthony T. Surgical site infection in colorectal surgery: a review of the nonpharmacologic tools of prevention. J Am College Surg. 2010;211(6):812-22.
15. Manzoor B, Heywood N, Sharma A. Review of subcutaneous wound drainage in reducing surgical site infections after laparotomy. Surg Res Pract. 2015:1-6.
16. Dougherty SH, Simmons RL. The biology and practice of surgical drains. Part 1. Curr Probl Surg. 1992;29:559-623.
17. Sadoshima J, Izumo S. Mechanical stretch rapidly activates multiple signal transduction pathways in cardiac myocytes: potential involvement of an autocrine/paracrine mechanism. EMBO J. 1993;12:1681-92.
18. Subramonia S, Pankhurst S, Rowlands BJ, Lobo DN. Vacuum assisted closure of postoperative abdominal wounds: a prospective study. World J Surg. 2009;33:931-7.
19. Baier PK, Gluck NC, Baumgartner U, Adam U, Fischer A, Hopt UT. Subcutaneous Redon drains do not reduce the incidence of surgical site infections Bibliography 51 after laparotomy. A randomized controlled trial on 200 patients. Int J Colorectal Dis. 2010;25:639-43.
20. Numata M, Tanabe H, Numata K, Suzuki Y, Tani K, Shiraishi R, et al. The efficacy of subcutaneous penrose drains for the prevention of superficial surgical site infections. Jpn J Gastroenterol Surg. 2010;43:221-8.
21. Gupta P, Kumar R. Role of subcutaneous suction drain in reducing surgical site infections after emergency laparotomy. Int Surg J. 2017;4:2717-20.
22. Razavi SM, Ibrahimpoor M, Sabouri A, Jafarian KA. Abdominal surgical site infections: incidence and risk factors at an Iranian teaching hospital. BMC surgery. 2005;5(2):3-5.
23. Renvall S, Aho NAJ. Wound infection in abdominal surgery: a prospective study on 696 operations. Acta Chir Scand. 1980;146(1):25-30.
24. Ussiri EV, Mkony CA, Aziz MR. Surgical wound infection in clean-contaminated and contaminated laparotomy wounds at Muhimbili National Hospital. East Cent Afr J S. 2005;10:19-23.
25. Khan M, Khalil J, Muqim R. Rate and risk factors for surgical site infection at a tertiary care facility in Peshawar, Pakistan. J Ayub Med Coll Abbottabad. 2011;23:1-4.
26. Nguyen D, Leod MB, Phung DC. Incidence and predictors of surgical site Bibliography 52 infections in Vietnam. Infect Control Hosp Epidemiol. 2001;22:485-92.
27. Vaghani YL, Chaudhari J, Navadiya S. A Study of subcutaneous negative pressure closure versus closure in laparotomy wound of Ileal perforation. Int J Med Sci Public Health. 2014;3:24-6.
28. Adejumo AA, Nuhu M, Afolaranmi T. Incidence of and risk factors for abdominal surgical site infection in a Nigerian tertiary care centre. Int J Infect Control. 2015;11:4.
29. Fujii T, Tabe Y, Yajima R, Yamaguchi S, Tsutsumi S, Asao T, et al. Effects of subcutaneous drain for the prevention of incisional SSI in high-risk patients

undergoing colorectal surgery. Int J Colorectal Dis. 2011;26(9):1151-5.

30. Patel BJ, Patel KH, Kharadi A, Panchal B. Role of subcutaneous corrugated drain in class IV surgical wound. Int Surg J. 2015;2:252-5.
31. Chowdri NA, Qadri SA, Parray FQ, Gagloo MA. Role of subcutaneous drains in obese patients undergoing elective cholecystectomy: A cohort study. Int J Surg. 2007;5:404-7.
32. Vashist M, Singla A, Malik V, Verma M. Abdominal Wall Closure in The Presence of Sepsis:

Role of Negative Suction. Internet J Surg. 2013;29(1):407-12.

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