

Effectiveness of Subcutaneous Negative Pressure Drain in Cases of Infective Laparotomies

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Abstract: Wound infection is most common complication in patients who underwent infective laparotomies leading to post-operative complications like pus discharge, prolonged hospitalization, increased cost of treatment etc. Even after sensitivity based antibiotic use and judicious intraoperative irrigation of wound with saline, it remained a major concern. **Aims & Objectives:** To evaluate the role of closed suction drainage in reduction of post-operative wound infection in cases of infective laparotomies as compared to laparotomy wounds without closed suction drainage. To evaluate whether closed suction drainage is effective in reducing the hospital stays and in reducing the cost of treatment. **Materials and Methods:** This study conducted on patients who underwent infective laparotomies by dividing into two groups, with and without subcutaneous negative pressure drain. **Conclusion:** closed suction drain prevented post op wound infection significantly. Also it reduced hospital stay, cost of treatment, thereby helping early wound healing and removal of sutures.

Keywords: wound infection/sepsis/drain/discharge/healing

1. Introduction

In humans, regeneration of tissues is limited. Only epithelium and the liver can actually regrow. Most tissues heal by repair with fibrosis, which results in scarring.^[1,2]

Infections which occur in the wound created by an invasive surgical procedure are generally known as surgical site infections (SSI).^[3,4] SSI previously termed as post operative wound infection is defined as that infection presenting up to 30 days after a surgical procedure if no prosthetic is implanted and up to 1 year if a prosthetic is implanted in the patient's body.^[5,6] The incidence of surgical site infection increases with the degree of abdominal contamination.

Surgical site infection is also one of the most common operative complication, occurring in about 5% of all patients who underwent surgery and this ratio is more upto 30-40% of those patients undergoing abdominal surgery, depending on the level of contamination.^[7]

Development of a surgical site infection has large impact on mortality, morbidity, healthcare costs, patient's inconvenience and dissatisfaction.^[8,9] The most common type is superficial wound infection occurring within the first week of surgery.^[10] Abdominal wall closure within the presence of infection presents a challenge.

Quite often, these patients present late, after many hours or days of perforation, resulting in the gut is edematous gut and presence of sepsis in the peritoneal cavity causes outpouring of fluid, pus. If after dealing, with pathology and abdominal cavity cleaning, tight closure of abdominal wall is done, then it may lead to bursting of abdominal wound, leading to wound dehiscence in a significant number of patients.^[12] It has been postulated that if there is presence of hematoma, serous fluid, and dead space in surgical wound, it can increase the risk of infection as this acts as a good culture medium.^[13,14] SSI can double the length of hospital stay,

thereby increasing the costs of health care. Seroma can lead to wound related complication, such as Abscess formation, Calcification of the seroma, poor cosmesis i.e. unsatisfactory appearance of a surgical scar.^[16] Surgeons have used various suture materials for closure varying from delayed absorbable to non-absorbable sutures.^[17] Negative suction in subcutaneous space has been shown to reduce the incidence of infection by evacuation of infected content, collected seroma in subcutaneous space. Negative suction improves the healing capacity of the wound by reducing its bacterial load.^[18,19,20]

2. Aim and Objectives

- To evaluate the role of closed suction drainage in reduction of post-operative wound infection in cases of infective laparotomies as compared to laparotomy wounds without closed suction drainage.
- To evaluate whether closed suction drainage is effective in reducing the hospital stay.
- To evaluate whether closed suction drainage is effective in reducing the cost of treatment.
- To evaluate that the closed suction drainage is beneficial in increasing patient's comfort & decreasing patient's morbidity.
- To study the epidemiology of wound infection.
- To evaluate type of healing primary or secondary.

3. Materials & Methods

Type of Study: Prospective RCT

Study Period of Study: January 2018 to June 2019

Place of Study: Department of General Surgery, Mahatma Gandhi Medical College & Hospital, Jaipur.

This study was conducted on 60 patients. Patients were chosen randomly irrespective of their age and sex. One controlled group included 30 cases and the other study group comprised of other 30 cases.

All details about the surgery/operation were being noted and operative wound were classified according to definition being given by the American College of Surgeons as :- 1. Clean 2. Clean contaminated 3. Contaminated 4. Dirty

At time to abdominal wall closure first of all the peritoneum was sutured/closed appropriately with absorbable suture material then rectus sheath were closed by non-absorbable suture material continuously like PDS loop⁽⁶⁶⁾

One or more intra-peritoneal drains were placed inside – in potential areas like pelvis/ subhepatic/ perisplenic. A tube with multiple holes small in size was positioned with its tip being lying extra peritonially over the rectus sheath, and it was brought out through area of healthy skin by a separate incision away from the wound site and fixed with skin with non absorbable suture material and connected with a closed suction drain and .Incision was then closed with non-absorbable suture and aseptic sterile dressing done.

First dressing was changed after 48 hours and incision site closely monitored for pain, tenderness, induration, redness, discharge, swelling, raised local temperature and suture under tension or cut through.

Discharge collected and was sent for culture and sensitivity. Criteria of wound infection - Wound infection is being described as:

- A. Incisional surgical wound infection - When the infection is located above the fascial layer.
- B. Deep surgical wound infection - When the infection is located below the fascial layer.

Types of discharges through the wound are:

- A. Serous B. Sero purulent C. Purulent D. Fecopurulent

Drain was removed when it stopped draining or the output was 5 ml or less whichever comes earlier. The sutures were removed before or after discharge of the patient atleast after 8 days depending upon the wound site condition. Patient was followed up in hospital Out Patient Department or through correspondence by phone/email/messages/social media for upto 30 days post operatively. Statistical Analysis were made to find significant association.

4. Observation & Results

The study was conducted on 60 patients -30 with negative pressure subcutaneous drain and 30 without drain. Relevant findings that we noted in the study were highlighted here.

Operative Procedure

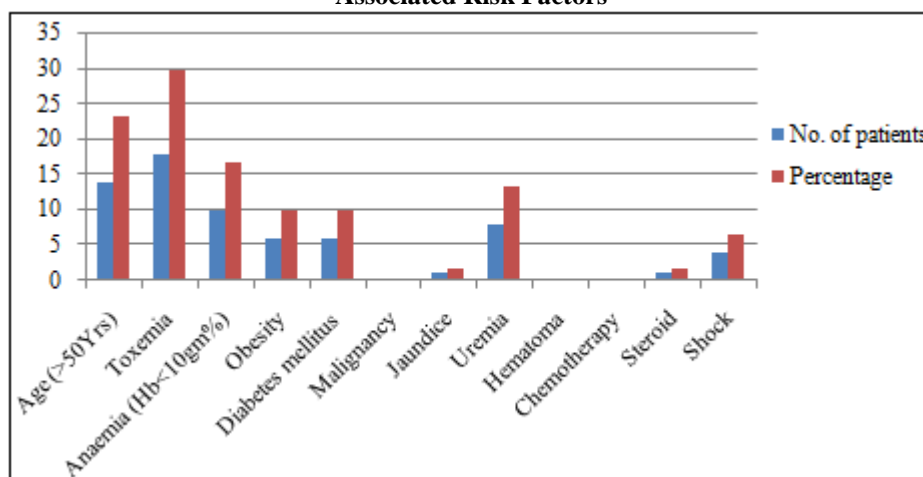
Most common operative procedure was primary repair (65%) followed by Resection Anastomosis (15%), Ileostomy (13.33%), Appendectomy in 5% and Colostomy (1.66%) respectively.

Table: Surgical Wound Infection Sign and Symptoms

Features	Control Group	Study Group	Total
Pain	13	7	20
Tenderness	12	7	19
Redness	8	5	13
Discharge	18	9	27
Raised Local Temperature	8	4	12
Suture under tension/cut through	5	3	8

The comparison in our study between groups i.e. control without closed suction drain and study group with closed suction drain, gave result that **discharge** from wound in the study group compared to discharge from the wound in control group is statistically highly significant with **P-Value 0.0195**.

Associated Risk Factors



Post Operative Day of Detection of Wound Infection & Discharge from Stitch Line

Control Vs Study

Duration	Control	Study	Total	P Value
<= 4 Days	13	4	17	0.0099
>4 Days	17	26	43	
Total	30	30	60	

The comparison in our study between groups i.e. control without closed suction drain and study group with closed suction drain, gave result that post operative day of detection of wound infection and discharge from the stitch line among the group that used closed suction drain as compared to the group without closed suction drain is statistically highly significant with **P Value 0.0099**. It clarifies that closed suction drain is very effective in preventing the wound infection especially in much prone first four post-operative days.

Removal of Drain: Control Vs Study

Removal of drain	Control	Study	Total	P Value
<=4 Days	4	12	16	0.0023
>4 Days	26	18	44	
Total	30	30	60	

In this study, we found that in patients of study group, also have decreased abdominal collection and their abdominal drain was removed early as compared to control group. The data is statistically highly significant with **P Value of 0.0023**.

Removal of Sutures: Control Vs Study

Removal of Sutures	Control	Study	Total	P Value
<=10 Days	13	27	40	0.0001
>10 Days	17	3	20	
Total	30	30	60	

In this study we found that in patients in whom closed suction drain was used, have a very early wound healing as compared to the control group in whom closed suction drain was not used.

As a result of this in Study group, in 27 out of 30 patients wound healed so sutures were removed early within 10 days compared to control group in whom only 13 out of 30 patients showed wound healing signs and only sutures were taken out. This comparison gave a very highly significant statistical data with **P Value of 0.0001**.

Average duration of Hospital Stay (In Days) Control Vs Study

Removal of Sutures	Control	Study	Total	P Value
<=10 Days	4	17	21	0.0004
>10 Days	26	13	39	
Total	30	30	60	

In this study we found that in patients in whom closed suction drain was used, have a early recovery as compared to the control group in whom closed suction drain was not used. As a result of this, in Study group, 17 out of 30 patients recovered well without signs of infection and were discharged early within 10 days compared to control group

in whom only 4 out of 30 patients showed recovery signs and were discharged within first 10 post operative days. This comparison gave a very highly significant statistical data with **P Value of 0.0004**.

Healing by Primary/ Secondary Intention:- Control vs Study

Healing	Control	Study	Total	P Value
Primary Intention	19	27	46	0.0146
Secondary Intention	11	3	14	
Total	30	30	60	

In this study we found that in patients in whom closed suction drain was used, have significant more number of patients with healing by primary intention/closure as compared to the patients of control group in whom closed suction drain was not used. As a result of this, in Study group, in 27 out of 30 patients healing happened by primary intention/ closure compared to control group in whom only 19 out of 30 patients showed healing by primary intention. This comparison gave a very highly significant statistical data with **P Value of 0.0146**.

We were able to reduce wound infection rate by using closed suction drain in infective laparotomies. By reducing the wound infection rate we were also able to help wound healing by primary intention in about 90% of patients in study group as compared to 63.33% in control group of infective laparotomies.

5. Discussion

Surgical wound infection continues to be a major cause of morbidity and mortality in surgical practice despite peri-operative broad spectrum antibiotic coverage. Even though complete elimination of wound infection is not possible, a reduction of the wound infection rate to a minimum level could have marked benefits in terms of both patients comfort and resources used .

Healing is divided into the following phases for descriptive purposes; inflammatory phase; proliferative phase and maturation phase. Negative pressure wound therapy does several things to stimulate wound healing, the five major benefits of this therapy is as follows -

- 1) **Protection** - By closing the wound primarily a closed wound environment is produced. This beneficial in that it protects the wound from external contaminations.
- 2) **Blood flow** -Both clinically and experimentally, the application of sub atmospheric pressure removes third space fluid from the area immediately adjacent to the wound .Removal of this fluid results in a decrease in tissue turgor and a decrease in capillary after load , which promotes better capillary circulation and better inflow .Adequate blood flow supports a moist wound environment. Additionally, the removal of excess fluid is thought to remove inhibitory factors present in the fluid.
- 3) **Decrease in Bacterial load** -Concomitant with the rise in blood flow and removal of stagnant wound fluid, which is a fantastic medium for microorganisms, bacterial load is reduced. This is evidenced by a decrease in superficial purulence, slime production and odour. Any increase in circulation and oxygenation to compromised or damaged

tissue enhances the resistance to infection (*Bunt TK, 1998*).

- 4) **Increased granulation tissue proliferation** - The increase in rate of granulation tissue formation of wounds treated with negative pressure application is significantly higher than the rates reported for human growth factors and saline dressings treated wounds (*Morykuwas MJ 1997*). This highly significant increase in the rate is postulated to be due to transmission of the uniformly applied force to the tissue on the periphery of the wound. Application of negative pressure changes the external forces and perturbs the integrin bridges and cytoskeleton, causing the release of intracellular second messengers (prostaglandins, inositol phosphates, protein kinase C and intracellular calcium) (*Ingber D, 1991*). Controlled negative pressure actually helps the wound get smaller faster. Research has proven that mechanically stretching cells encourages them to proliferate at an increased rate. Continued irritation, via negative pressure, can increase the rate of tissue regrowth dramatically.
- 5) **Wound contraction** - When negative pressure is applied to the wound, it contracts. The suction drain applies a pressure of approximately 100 to 200mm hg below atmospheric pressure. Oedema fluid is removed from the extravascular space, thus eliminating an extrinsic cause of microcirculatory embarrassment and improving blood supply, local oxygenation and promoting angiogenesis. In addition, the mechanical tension from the vacuum directly stimulates cellular proliferation of reparative granulation tissue. It also exerts a mechanical force on the tissues and attracts the wound edges centripetally.

6. Conclusion

This study concludes that placement of a subcutaneous negative pressure drain in infective laparotomies, reduces wound infection, helps in early post operative recovery, better wound healing, decreases financial burden on patient by decreasing hospital stay and infection.

Therefore, this method of closed suction drainage is very strongly recommended for the prevention of wound infection in infective laparotomies.

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