Section: General Surgery

Original Research Article

# EFFECTIVENESS OF SUBCUTANEOUS NEGATIVE PRESSURE DRAIN IN REDUCING SURGICAL SITE INFECTION AFTER EMERGENCY LAPAROTOMIES

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## Abstract

**Background:** Surgical site infections (SSIs) following abdominal surgery result in higher morbidity, mortality, healthcare costs, prolonged hospital stay, patient discomfort, delayed wound healing and an increased risk of incisional hernia. This study is aimed to assess the effectiveness of subcutaneous negative pressure drain using a syringe to reduce surgical site infections after emergency laparotomy. **Materials and Methods:** This randomised controlled trial was conducted on 100 patients who underwent emergency laparotomy at the Government Thiruvarur Medical College from 2022 to 2023. Patients were categorised into group A (study group) and group B (control). Both groups were evaluated for subcutaneous tissue thickness, intraoperative contamination, type of wounds and SSIs using the Southampton scoring system to compare the indicators of postoperative wound infection. **Result:** Wound discharge rates were significantly lower in Group A. Among patients with subcutaneous thickness <2.5 cm, 0% in the drain group had discharge compared to 32% in the non-drain group (p=0.001). For thickness >2.5 cm, 39% with drains experienced discharge versus 50% without drain. In terms of intraperitoneal contamination, 21% in <250 ml and 29% in >250 ml contamination in drain group. 22% in 250 ml and 47% in >250 ml contamination in non-drain group. Southampton scoring indicated that 30% of patients without drain had severe grading compared to 8% with drains (p=0.028). **Conclusion:** The use of subcutaneous drains during emergency laparotomy significantly reduces the incidence and severity of SSIs, particularly in patients with lower subcutaneous tissue thickness and intraperitoneal contamination. This technique should be considered as part of a comprehensive strategy to minimize SSIs in surgical practice.

## INTRODUCTION

Infections that occur in wounds created by invasive surgical procedures are generally referred to as surgical site infections. Surgical site infections (SSIs) are a significant concern in the domain of abdominal surgery and are associated with increased morbidity and mortality rates, increased healthcare costs, increased hospital stay, delayed wound healing, discomfort to the patient and increased risk of incisional hernia.[1] SSIs are the third most frequently reported nosocomial infections accounting for 14-16% of all nosocomial infections among hospitalised patients. SSI cases are diagnosed within 30 postoperative days according to the Centre for Disease Control and Prevention (CDC) criteria.

The term 'acute wound failure' refers to the partial or complete separation of laparotomy wound closure that occurs after surgery. This phenomenon involves the disconnection of the abdominal musculoaponeurotic layers within the first month following the procedure. It typically necessitates some form of intervention, often occurring within the same hospitalisation period. SSIs have been demonstrated to account for as much as 20% of hospital-acquired infections, occurring in 5% of all invasive surgical procedures and ranging from 30-40% of major abdominal surgeries contingent on the degree of contamination.[2]

SSIs can be categorised into two types: incisional and organ/space. Within incisional SSIs, there are distinctions between those affecting solely the skin and subcutaneous tissue (referred to as superficial incisional SSI) and those affecting the deeper soft tissues of the incision (known as deep incisional SSI). In contrast, organ/space SSIs encompass any area of


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the body's anatomy such as organs or spaces that extend beyond the incised layers of the body wall.[3] Routine measures such as hand washing, minimising shaving preoperatively, skin preparation and antibiotic prophylaxis are known to reduce the risk of SSI.[2] The hypothesis proposes that the presence of hematoma, serous fluid and vacant spaces within a surgical wound could increase the likelihood of infection as they create an environment conducive to microbial growth.[4] Non-primary closure techniques require additional wound care and more time and effort than primary wound closure.[5] Various techniques can be used to reduce surgical site infections. Subcutaneous negative suction helps lower the incidence of surgical site infections and wound dehiscence. This approach involves the removal of the seroma through evacuation with negative pressure thereby promoting wound healing and reducing dehiscence.

**Aim and Objective**

This study aims to assess the effectiveness of subcutaneous negative pressure using a drain to reduce surgical site infections after emergency laparotomy and to reduce the incidence of surgical site infections using subcutaneous suction drains intraoperatively.

## MATERIALS AND METHODS

This randomized controlled trial included 100 patients who underwent emergency laparotomy in the Department of General Surgery at Govt. Thiruvarur Medical College, between October 2022 and October 2023. This study was approved by the Institutional Ethics Committee before initiation and informed consent was obtained from all patients.

**Inclusion Criteria**

Patients of both gender and adults between 14 years and 80 years of age were included in this study.

**Exclusion Criteria**

Patients aged < 14 years and > 80 years, with immunocompromised status such as HIV infection, prior radiotherapy or chemotherapy and re-performed laparotomy surgeries were excluded from this study.

**Methods**

The patients were allocated into two groups, patients with a drain tube (group A) and those without a drain tube (group B). Patients in the emergency ward who underwent laparotomy were studied. Surgery was performed with strict adherence to the preoperative and intraoperative sterile techniques. There were no differences in the surgical procedures between Group A and Group B except that a syringe suction drain was inserted along the entire length of the surgical incision and placed in the subcutaneous tissue in Group A. The skin incision was made with a scalpel and subcutaneous fat was dissected using electrocautery. All intraoperative precautions were taken and the rectus sheath was closed with 1 prolene as continuous sutures. The wound was irrigated with 2000 ml of saline solution. In group A patients a blunt tip 10 F infant feeding tube was taken, the length of the midline incision was measured using the same and additional lateral openings were made in the tube using scissors such that all the openings were within the incision, ensuring that no lateral opening was kept outside of the incision.

The exit of the drain was separated from the incision and fixed to the skin using 1-0 silk. The subcutaneous drain was kept in the entire length; subcutaneous tissue was closed intermittently using 2-0 vicryl with inverted sutures and the skin was closed with skin staplers. A 10 ml syringe was connected to the infant feeding tube and the piston was withdrawn; negative pressure was created. Negative pressure (suction) was maintained using a piston from another smaller syringe (5 ml). These two pistons were maintained in position using plasters. The syringes were changed three times daily for five days.

The first dressing was changed at 48 h. Features suggestive of SSI were noted and the incision site was closely monitored for pain, tenderness, induration, redness, discharge, swelling and increased local warmth. Daily dressing was performed with povidone-iodine and normal saline with sterile aseptic precautions.

Intraoperative subcutaneous thickness, intraperitoneal contamination and type of wound were assessed. Postoperative pain or tenderness, localised swelling, induration, discharge (Southampton's scoring) and suture removal (≤ 10 days or > 10 days) were assessed.

**Statistical Analysis**

Data analysis was performed using MS Excel and differences were evaluated using the chi-square test and statistical significance was set at $p<0.001$.

## RESULTS

**Table 1: Demographic and clinical characteristics of both groups.**

| | | Drain Tube (DT) | |
|---|---|---|---|
| | | Yes (Group A-with DT) (%) | No (Group B-without DT) (%) |
| Age group in years | < 20 | 1 (2%) | 0% |
| | 20-29 | 3 (6%) | 6 (12%) |
| | 30-39 | 0% | 3 (6%) |
| | 40-49 | 9 (18%) | 7 (14%) |
| | 50-60 | 28 (56%) | 21 (42%) |
| | > 60 | 9 (18%) | 13 (26%) |
| | Mean | 53.64±13.169 | 52.64±14.447 |
| Gender | Male | 33 (66%) | 37 (74%) |
| | Female | 17 (34%) | 13 (26%) |


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| | | | |
|---|---|---|---|
| Type of wounds | Clean contaminated | 17 (34%) | 17 (34%) |
| | Contaminated | 11 (22%) | 7 (14%) |
| | Dirty | 22 (44%) | 26 (52%) |
| Subcutaneous thickness (cm) | < 2.5 | 19 (38%) | 34 (68%) |
| | > 2.5 | 31 (62%) | 16 (32%) |
| Intra-peritoneal contamination (ml) | < 250 | 33 (66%) | 18 (36%) |
| | > 250 | 17 (34%) | 32 (64%) |

The highest percentage of patients in both groups were in the 50-60 years age group with 56% in group A and 42% in group B. In patients with drain tube (group A), 33 were males and 17 were females. In patients without drain tube (group B), 37 were males and 13 were females. The most common type of wound in both groups was dirty, with 44% in group A and 52% in group B. An equal percentage of patients (34%) in both groups had clean contaminated wounds. In group A (with DT), the majority of patients (62%) had a subcutaneous thickness > 2.5 cm; whereas in group B (without DT), the majority of patients (68%) had a subcutaneous thickness < 2.5 cm. The majority of patients with < 250 ml of intra-peritoneal contamination were in group A (with DT) 66%, compared to 36% in group B (without DT). In group B (without DT), 64% of patients had > 250 ml of intra-peritoneal contamination; while in group A (with DT), 34% of patients had > 250 ml of contamination [Table 1].

**Table 2: Comparison of wound discharge in both groups with type of wound, subcutaneous thickness and intraperitoneal contamination**

| | | Wound discharge | | P-value |
|---|---|---|---|---|
| | | Yes (Group A-with DT) | No (Group B-without DT) | |
| Type of wound | Clean contaminated | 0 | 4 | 0.165 |
| | Contaminated | 5 | 4 | |
| | Dirty | 7 | 11 | |
| Subcutaneous thickness (cm) | < 2.5 | 0 | 11 | 0.001 |
| | > 2.5 | 12 | 8 | |
| Intraperitoneal contamination (ml) | < 250 | 7 | 4 | 0.034 |
| | > 250 | 5 | 15 | |

Out of 17 patients with clean contaminated wound with drain tube, no patient had wound discharge and out of 17 patients without drain tube, 4 patients had wound discharge. Out of 11 patients with contaminated wound with drain tube, 5 patients had wound discharge and out of 7 patients without drain tube, 4 patients had wound discharge. Out of 22 patients with dirty wound with drain tube, 7 patients had wound discharge and out of 26 patients without drain tube, 11 patients had wound discharge. with p=0.165 which is statistically not significant.

In < 2.5 cm subcutaneous thickness, out of 19 patients with DT, no patient had wound discharge and out of 34 patients without DT, 11 patients had wound discharge. In > 2.5 cm subcutaneous thickness, out of 31 patients with DT, 12 patients had wound discharge and out of 16 patients without DT, 8 patients had wound discharge with p= 0.001 which is statistically significant.

In < 250 ml intra peritoneal contamination, out of 33 patients with DT, wound discharge was present in 7 patients and out of 18 patients without DT, wound discharge was present in 4 patients. In > 250 ml intra peritoneal contamination, out of 17 patients with DT, wound discharge was present in 5 patients and out of 32 patients without DT, wound discharge was present in 15 patients with a p=0.034 which is statistically significant [Table 2].

**Table 3: Comparison of drain tube with wound discharge, suture removal, and Southampton scoring between groups**

| | | Drain Tube (DT) | | P value |
|---|---|---|---|---|
| | | Yes (Group A-with DT) (%) | No (Group B-without DT) (%) | |
| Wound discharge | Yes | 12 (24%) | 19 (38%) | 0.13 |
| | No | 38 (76%) | 31 (62%) | |
| Suture removal (days) | < 10 | 38 (76%) | 30 (60%) | 0.08 |
| | > 10 | 12 (24%) | 20 (40%) | |
| Southampton scoring | No discharge (1A ,1B, 1C, 2A, 2C, 2D, 3A) | 39 (78%) | 32 (64%) | 0.028 |
| | Mild (3A) | 3 (6%) | 2 (4%) | |
| | Moderate (3B) | 4 (8%) | 1 (2%) | |
| | Severe (3C, 3D, 4A) | 4 (8%) | 15 (30%) | |

In Group A, 12 patients had wound discharge, 38 patients had no wound discharge. In Group B, 19 patients had wound discharge, 31 patients had no wound discharge with a p=0.13 which is not significant.

In Group A, suture removal was done in < 10 days in 38 patients and in > 10 days in 12 patients. In Group B, suture removal was done in < 10 days in 30 patients and in >10 days in 20 patients with p=0.08 which is statistically not significant.

In Group A, no discharge was present in 39, mild in 3, moderate in 4 and severe in 4 patients. In Group B, no discharge was present in 32 patients, mild in 2 patients, moderate in 1 patient and severe in 15


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patients with a p=0.028 which is statistically significant [Table 3].

## DISCUSSION

Various methods have been used to reduce the rate of surgical site infection; there has been a need to identify simpler and more cost-effective ways to reduce the rate of surgical site infection.[6]

In our study group A, ages were distributed as follows: 1 patient aged < 20 years, 3 patients 20-29 years, 0 patients 30-39 years, 9 patients 40-49 years, 28 patients 50-60 years and 9 patients aged > 60 years. In group B, the ages were 0 patients < 20 years, 6 patients 20-29 years, 3 patients 30-39 years, 7 patients 40-49 years, 21 patients 50-60 years and 13 patients > 60 years old and emergency laparotomies were more commonly performed in the 50–60 years group.[7,8]

In our study, group A included 33 males and 17 females, whereas group B included 37 males and 13 females; indicating that males were more frequently admitted to the general surgery department for emergency laparotomies.[9]

In our study, based on the type of wound, there were 17 clean-contaminated cases, 11 were contaminated and 22 were dirty. In group B, there were 17 clean-contaminated cases, 7 contaminated cases and 26 dirty wounds. Hence, this study shows that the most common wound encountered in emergency laparotomies is dirty. In group A, no clean-contaminated wounds had wound discharge compared to 4 in group B. In group A, 5 contaminated wounds had discharge compared to 4 in group B. Among the 7 dirty wounds in group A compared to group B, it was 11 patients and was statistically not significant (p=0.165).[10]

In our study of the 50 patients in group A, 19 patients had < 2.5 cm subcutaneous thickness and 31 had > 2.5 cm. In group B, 34 had < 2.5 cm subcutaneous thickness and 16 had >2.5 cm. In group A, none of the patients with a subcutaneous thickness of < 2.5 cm had discharge while in group B, it was 11. In group A, 12 patients with a subcutaneous thickness of > 2.5 cm had a wound discharge compared to 8 patients in group B. The p-value is 0.001 which is statistically significant, indicating that keeping DT in patients with subcutaneous thickness < 2.5 cm is better in reducing surgical site infection than keeping DT in patients with subcutaneous thickness > 2.5 cm.[11]

In our study, intraperitoneal contamination in group A, 33 patients had < 250 ml and 17 had >250 ml. In group B, 18 patients had <250 ml and 32 patients had >250 ml. In the < 250 ml intraperitoneal contamination group, 7 patients in group A and group B comprised 4 patients had a wound discharge. For > 250 ml contamination, discharge occurred in group A for 5 patients and in group B for 15 patients. The p-value was 0.034, which was statistically significant, indicating that maintaining DT in patients with intraperitoneal contamination of < 250 ml is better in reducing surgical site infection than maintaining DT in patients with intraperitoneal contamination of > 250 ml.[12]

In our study, sutures were removed within < 10 days in 38 patients in group A, 30 patients in group B, > 10 days in 12 patients in group A and 20 patients in group B (p=0.08).

In our study, Southampton scoring showed that group A had 39 patients with no discharge, 3 with mild, 4 with moderate and 4 with severe discharge while group B had 32 with no discharge, 2 with mild, 1 with moderate and 15 with severe discharge (p = 0.028). In patients with subcutaneous DT, Grade 3C, 3D, 4C (severe) was noted in 8% of cases and in patients without subcutaneous DT Grade 3C, 3D, 4C (severe) was noted in around 30% of cases. Which indicates keeping subcutaneous DT in emergency laparotomies reduces the severity of wound discharge and surgical site infection than in patients without subcutaneous DT.

## CONCLUSION

Surgical site infection is one of the most common postoperative complications, hence we are trying to reduce the incidence of surgical site infection by inserting subcutaneous syringe drain tube intraoperatively in addition to preoperative, intraoperative and postoperative steps in reducing surgical site infection. Subcutaneous syringe DT is better in reducing surgical site infection in patients with subcutaneous thickness <2.5 cm and <250 ml intraperitoneal contamination. Placing a subcutaneous syringe DT in emergency laparotomies reduces the grading of Southampton scoring of wound discharge and surgical site infection than in patients without subcutaneous DT.

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