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Original Article

Surgery Section

Effect of Subcutaneous Closed-tube Drainage on Wound Complications following Elective Abdominal Surgery in Morbidly Obese Patients: A Prospective Interventional Study

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ABSTRACT

Introduction: Obesity is a recognised risk factor for complications in abdominal surgery wounds. The "dead space" formed by inadequately vascularised subcutaneous adipose tissue permits the accumulation of serous fluid and blood. Bacteria proliferate in this environment, heightening the risk of Surgical Site Infections (SSI) and wound dehiscence.

Aim: To determine the efficacy of prophylactic subcutaneous closed-tube drainage in reducing local wound complications following elective abdominal surgery in morbidly obese individuals.

Materials and Methods: This prospective interventional study was conducted in the Department of General Surgery, Dr. Vithalrao Vikhe Patil Medical College and Hospital, Maharashtra, India, between April 2025 and December 2025. The study included 200 patients with a Body Mass Index (BMI) exceeding 30 kg/m² and subcutaneous fat thickness greater than 3 cm. The study group (n=100) received a subcutaneous closed-tube suction drain, whereas the control group (n=100) underwent standard closure without drainage. The principal outcomes were seroma, haematoma, and SSI within 30 days postoperatively. The secondary outcomes encompassed the duration of hospital stay and the necessity for supplementary interventions.

Results: The baseline demographic and clinical characteristics, including mean age (p-value=0.34), BMI (p-value=0.58), and subcutaneous fat thickness (p-value=0.67), showed no statistically significant differences between the drain and no-drain groups. Use of subcutaneous suction drains significantly reduced wound complications. Seroma formation was 6% in the drain group and 24% in the control group (p-value <0.001). Also, there were fewer haematomas (2% vs 8%, p-value=0.048). Most significantly, the SSI rate was significantly lower in the study group (5% vs 18%, p-value=0.004). Consequently, the drain group had a markedly lower need for secondary interventions such as needle aspiration or re-suturing (4% vs 22%) and a shorter hospital stay (4.2±1.1 vs 6.8±2.5 days).

Conclusion: Prophylactic subcutaneous closed-tube suction drainage is an effective, low-risk intervention that reduces wound morbidity in morbidly obese individuals and optimises hospital resource utilisation by reducing fluid accumulation and bacterial proliferation.

Keywords: Abdominal wall, Morbid, Obesity, Seroma, Suction drainage, Surgical site infection

INTRODUCTION

Obesity has emerged as a global health crisis, and its increasing prevalence adversely affects surgical outcomes in nearly all medical specialties, including elective abdominal surgery [1]. Morbidly obese patients, characterised by elevated Body Mass Index (BMI) and significant subcutaneous fat thickness, are at an increased risk for adverse postoperative outcomes, particularly concerning wound healing [1]. The substantial amount of adipose tissue is relatively devoid of blood vessels and generates considerable dead space beneath the incision, which is susceptible to fluid accumulation [2].

This void invariably accumulates serous fluid and blood, resulting in the development of seroma and haematoma, respectively. These fluid accumulations hinder local tissue repair and provide an optimal environment for bacterial proliferation, significantly elevating the risk of SSI [3]. The elevated occurrence of local wound complications-specifically seroma, haematoma, and SSI-directly correlates with heightened patient morbidity, discomfort, the necessity for supplementary wound management procedures (such as aspiration or surgical drainage), and extended hospitalisations [4]. Preventing these complications is crucial for improving patient safety and reducing healthcare costs [5].

The implementation of a prophylactic subcutaneous drain, particularly a closed-tube suction drainage system, has been suggested as a straightforward and efficient approach to actively remove accumulating fluid, minimise dead space, and facilitate tissue approximation in high-risk patients [6]. The mechanical extraction of exudate is posited to diminish the likelihood of seroma and haematoma development, consequently reducing the rate of SSI [7]. Nonetheless, despite this rational framework, the habitual application of subcutaneous drainage in obese patients continues to be a significant source of contention in the literature [8]. It is observed, especially within gynaecological and abdominal surgery populations, that there is a substantial decrease in wound complications associated with drain utilisation [9]; however, other prospective trials have not evidenced a definitive advantage, resulting in inconsistent clinical practices [10].

Due to the elevated occurrence of wound-related complications in morbidly obese patients undergoing elective abdominal surgeries (such as ventral hernia repair, hysterectomy, or colorectal resections), a robust evidence foundation is imperative.

Although theoretically effective, the routine use of prophylactic subcutaneous closed-tube suction drainage remains debated in surgical literature [11]. Due to the significant economic and clinical impact of wound morbidity in this population, there is an urgent necessity for a solid evidence base to guide the standardisation of care for morbidly obese patients undergoing elective abdominal surgeries. This study aimed to prospectively and comparatively assess the effects of subcutaneous closed-tube drainage on local wound complications, specifically seroma, haematoma, and SSI, along with the necessity for intervention and duration of hospital stay after elective abdominal surgery in morbidly obese patients. Despite the well-established association between obesity and increased postoperative wound complications, the routine use of prophylactic subcutaneous drainage remains controversial due to inconsistent and conflicting evidence in existing literature. While some studies have demonstrated a reduction in wound morbidity, others have failed to show significant benefit, particularly in heterogeneous surgical populations. Furthermore, there is a lack of focused, high-quality prospective data specifically addressing morbidly obese patients with increased subcutaneous fat thickness, who represent a distinctly high-risk group.

Therefore, this study was undertaken to address this existing research gap and provide clearer evidence regarding the effectiveness of subcutaneous closed-tube drainage in reducing wound complications and improving postoperative outcomes in this vulnerable population.

MATERIALS AND METHODS

This prospective interventional study was conducted in the Department of General Surgery at Dr. Vithalrao Vikhe Patil Medical College and Hospital, Ahmednagar, Maharashtra, India, between April 2025 and December 2025. The study protocol was approved by the Institutional Ethics Committee (IEC Approval No.: VIMS/IEC/C/2025/106). Written informed consent was obtained from all participants prior to enrollment in the study.

Patient population and eligibility: The study population consisted of patients undergoing elective abdominal surgeries, including ventral hernia repair, gastric surgery, and colorectal procedures. The study population comprised a heterogeneous mix of elective abdominal procedures, including ventral hernia repairs, gastric surgeries, and colorectal surgeries. The distribution of cases included ventral hernia repair, gastric surgeries, and colorectal surgeries, ensuring representation across common abdominal surgical interventions.

Inclusion criteria:

- Patients with obesity defined as BMI ≥40 kg/m², with subgroup focus on morbid obesity (BMI ≥35 kg/m²) as per World Health Organisation (WHO) classification [12].
- Subcutaneous fat thickness >3 cm at the incision site (assessed intraoperatively).

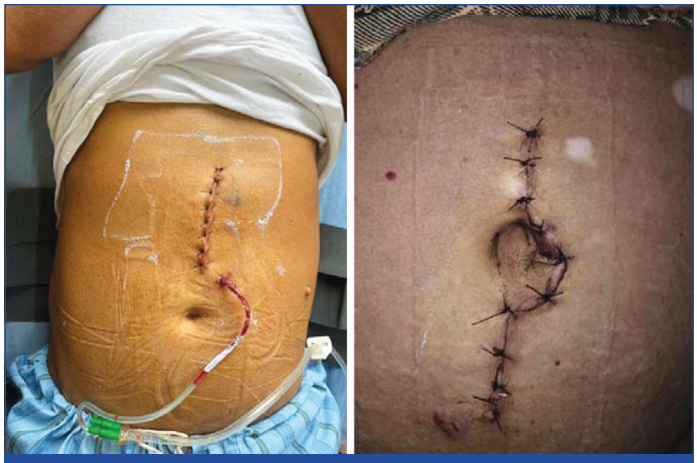
Exclusion criteria:

- Patients undergoing emergency surgery;
- Severe co-morbidities affecting wound healing (e.g., uncontrolled diabetes, coagulopathy);
- Patients unwilling to participate or not providing consent.

Sample size and allocation: The sample size of 200 patients (100 per group) was calculated based on an expected reduction in SSI rates from 20% in the control group to 8% in the intervention group, with 80% power and 5% alpha error.

Randomisation and group allocation: A total of 200 eligible patients were randomly allocated into two groups (1:1 ratio) using computer-generated randomisation:

- **Drain group (n=100):** Received prophylactic subcutaneous closed-tube suction drainage [Table/Fig-1a].
- **No-drain group (n=100):** Underwent standard wound closure without drainage [Table/Fig-1b].



[Table/Fig-1]: a) Placement of subcutaneous drain in ventral hernioplasty; and b) Closure done in layers without placing drain in ventral hernioplasty.

Surgical and postoperative protocol: All patients received standardised perioperative care, including antibiotic prophylaxis and a uniform layered abdominal closure technique. In the drain group, a closed suction drain was placed in the subcutaneous plane and exteriorised through a separate stab incision.

- **Drain removal criteria:** Output <30 mL/day for two consecutive days.

Outcome assessment: Outcomes were assessed by an independent surgical team member not involved in the procedure.

Primary outcomes:

- Seroma: Clinically detectable fluid collection confirmed by aspiration or ultrasound when required.
- Haematoma: Localised blood collection requiring evacuation or aspiration.
- Surgical Site Infection (SSI): Defined according to Centers for Disease Control and Prevention (CDC) criteria within 30 days [13].

Secondary outcomes:

- Need for intervention (aspiration, drainage, re-suturing);
- Duration of hospital stay;
- Postoperative pain (VAS score);

Patients were followed-up for a period of 30 days postoperatively to assess early wound-related outcomes.

STATISTICAL ANALYSIS

Continuous variables (BMI, hospital stay, fat thickness) were expressed as mean±SD and Categorical variables (complication rates, intervention requirement) as frequencies and percentages. Intergroup comparisons were performed using the Chi-square test or Fisher's exact test for categorical variables and an independent t-test for continuous variables. A p-value <0.05 was considered statistically significant. For the analysis of data, Statistical Package for the Social Sciences (SPSS) software version 20.0 was used.

RESULTS

Both groups were comparable regarding age (p-value=0.34), BMI (p-value=0.58), subcutaneous fat thickness (p-value=0.67), and co-morbidities, including diabetes (p-value=0.75), hypertension (p-value=0.77), and smoking status (p-value=0.72) [Table/Fig-2].

The primary outcomes demonstrated in [Table/Fig-3] showed a significant reduction in wound morbidity within the prophylactic drain group compared to the control group. Seroma formation was significantly lower in the drain group at 6% compared to 24% in the

Parameter	Drain Group (n=100)	No-Drain Group (n=100)	p-value
Mean age (years)	45.2±10.5	46.8±11.2	0.34
Mean BMI (kg/m²)	42.1±3.5	41.8±3.8	0.58
Mean SFT (mm)	42.5±8.2	41.9±7.9	0.67
Diabetes mellitus (%)	28%	30%	0.75
Hypertension (%)	34%	36%	0.77
Smoking (%)	18%	20%	0.72

[Table/Fig-2]: Baseline demographics and clinical characteristics.

Outcome variable	Drain Group (n=100)	No-Drain Group (n=100)	p-value
Seroma (Yes)	6 (6%)	24 (24%)	<0.001
Haematoma (Yes)	2 (2%)	8(8%)	0.048
SSI (Yes)	5 (5%)	18 (18%)	0.004
Overall complication rate	11%	40%	<0.001

[Table/Fig-3]: Primary outcomes.

control group (p-value <0.001). Overall, total wound complications were significantly lower for patients receiving a prophylactic drain, with a morbidity rate of 11% compared to 40% in those without drainage (p-value <0.001).

As shown in [Table/Fig-4]; postoperative outcomes showed a significant reduction in morbidity in the drain group. The mean hospital stay was significantly shorter in the drain group compared to the no-drain group (4.2±1.1 vs 6.8±2.5 days, p-value <0.001). The need for secondary interventions was also markedly lower in the drain group (4% vs 22%, p-value <0.001).

Parameter	Drain group (n=100)	No-Drain group (n=100)	p-value
Mean hospital stay (days)	4.2±1.1	6.8±2.5	<0.001
Need for intervention	4 (4%)	22 (22%)	<0.001
Mean Pain Score (VAS) (POD3)	3.1±0.8	4.5±1.2	<0.001
Drain duration (days)	3.6±1.2	–	–
Mean operation duration (mins)	92.5±18.4	90.8±17.9	0.48

[Table/Fig-4]: secondary outcomes.

The mean postoperative pain score (VAS) was significantly lower in the drain group (3.1±0.8) compared to the no-drain group (4.5±1.2, p-value <0.001). The average duration of drain placement was 3.6±1.2 days. In cases of infection, drains were retained longer based on clinical judgment. There was no statistically significant difference between the groups in terms of mean operative duration or smoking status, indicating baseline comparability.

DISCUSSION

The current study demonstrated that postoperative wound complications in morbidly obese patients who undergo elective abdominal surgery are significantly diminished by prophylactic subcutaneous closed-tube suction drainage. Specifically, the use of drainage was associated with a marked reduction in the incidence of seroma (6% vs 24%), haematoma (2% vs 8%), and SSI (5% vs 18%), as well as a reduction in the necessity for secondary interventions and shorter hospital stays. The primary objective of the study is directly supported by these findings, which suggest that subcutaneous drainage has a clinical advantage in this high-risk population.

The pathophysiological characteristics of morbid obesity can account for the decrease in seroma and haematoma formation that was observed in the present study. A dead space that is poorly vascularised is the result of excess subcutaneous adipose tissue, which is prone to fluid accumulation. Continuous suction drainage promotes tissue approximation, reduces wound tension, and actively removes accumulated fluid.

Recent evidence supports a specific advantage of subcutaneous drainage in high-risk patients. Fujii T et al., [14] evaluated strategies to reduce SSI in abdominal wall surgery. The study found that interventions that target dead space, such as drainage, may reduce wound complications in specific high-risk populations. Subcutaneous drains have been shown to reduce seroma formation in high-risk abdominal surgeries, as demonstrated by Gupta P and Kumar R [15]. However, the routine use of these drains is still uncertain due to conflicting evidence regarding their effectiveness across different patient populations and surgical contexts.

Additionally, Pang K et al., conducted a meta-analysis to evaluate prophylactic drainage in abdominal surgery [16]. Although routine drainage did not benefit all patients, subgroup analysis revealed improved outcomes specifically in obese patients and those with increased subcutaneous fat thickness. This finding supports the targeted use observed in the present study. In a systematic review, Ishinuki T et al., have recently underscored the importance of patient selection, particularly obesity and wound depth, in determining the efficacy of subcutaneous drainage [17]. Additionally, Tagar E et al., reported that the customised use of subcutaneous drainage in high-risk surgical patients led to a decrease in SSI and seroma rates without an increase in complications [18].

In obese individuals, SSI continues to be a significant contributor to postoperative morbidity. The hypothesis that the removal of fluid collections reduces bacterial proliferation is corroborated by the lower SSI rate observed in this study.

The discrepancy between studies that demonstrate a benefit and those that do not demonstrate a clear advantage can be attributed to variations in study design, patient selection, and outcome definitions. Numerous studies involve populations that are heterogeneous and lack stratification based on the severity of obesity or the thickness of subcutaneous fat. The current study focused on a high-risk subgroup, which may explain the more pronounced benefit observed. These results indicate that subcutaneous drainage should not be implemented universally but rather selectively in patients who are at an elevated risk of wound complications [16,17]. The use of drainage in this study was associated with shorter hospital stays and a reduced need for secondary interventions, in addition to reducing complications. This indicates that targeted drainage may enhance recovery and potentially reduce the healthcare burden.

This study's prospective design and emphasis on a well-defined high-risk population are important strengths that increase the findings' clinical relevance. The results' validity is further reinforced by the application of standardised surgical and postoperative procedures.

Limitation(s)

Nevertheless, it is imperative to recognise specific constraints. The study was conducted at a single tertiary care centre, which may restrict its generalisability. Additionally, lack of blinding may introduce observer bias, particularly for subjective outcomes like pain assessment. Furthermore, the follow-up period was restricted to 30 days; therefore, long-term complications, such as chronic seroma or delayed wound healing, were not assessed.

CONCLUSION(S)

In conclusion, prophylactic subcutaneous closed-tube suction drainage appears to reduce wound morbidity in morbidly obese patients undergoing elective abdominal surgery. It was associated with lower rates of seroma, haematoma, and SSIs, along with shorter hospital stay and reduced need for secondary interventions. However, given the single-centre design, limited sample size, and lack of blinding, these findings should be interpreted with caution. Further large-scale, multicentric randomised studies are warranted to validate these results and establish definitive clinical recommendations.

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