Original Article

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Evaluation of Vacuum Assisted Wound Closure and Conventional Wound Closure In Contaminated Major Surgical Wound

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ABSTRACT

Background: *Surgical Site Infections (SSI) increase costs, hospital stay, morbidity, and mortality. Vacuum-Assisted Closures (VAC) system has been gaining popularity recently in managing wounds to reduce SSI. But the current guidelines do not recommend its routine use for surgical wounds. This study aimed to compare the effectiveness and safety of VAC with conventional wound closure techniques for preventing SSIs in the major contaminated surgical wound.*

Methods and materials: *Sixty patients with a contaminated surgical wound from the Department of Surgery and Department of Casualty of Chittagong Medical College Hospital were randomized in a 1:1 ratio to receive either VAC (Using Romovac device) or conventional wound closure. The primary endpoint was the rate of uncomplicated wound healing, defined as a Southampton wound score of <2 at 30 days postoperatively. Secondary outcomes include duration of hospital stay and other complications (Defined by the Clavien-Dindo Classification). The primary analysis was an intention-to-treat analysis performed with a Chi-square test.*

Results: *There were no significant differences in mean age, sex, body mass index, smoking history, wound class, indication for surgery and duration of surgery between the two groups. At 30 days postoperatively, 29 (96.3%) of 30 patients undergoing VAC had uncomplicated wound healing compared to 13 (43.6%) in the conventional closure group (p<0.001). Most patients (26/30, 86.6 %) in the VAC group experienced Clavien-Dindo grade I or II complications. In contrast, in the conventional closure group, 28 (93.3%) patients developed Clavien-Dindo Grade III or IV complications (p<0.001). The mean length of hospital stay was significantly shorter in the VAC group than in the conventional closure group (12.2±3.59 versus 29.07±10.36 days, p<0.001).*

Conclusion: *VAC resulted in favourable wound healing with less complication and shorter hospital stay than the conventional technique for the closure of the contaminated surgical wound.*

Key words: Contaminated wound; Negative pressure wound therapy; Vacuum-Assisted Closure (VAC); Wound healing; Wound complications.

Introduction

Postoperative wound infection is a common healthcare problem and postoperative wound complications are common after open abdominal surgery, including Surgical Site Infections (SSIs) seroma or hematoma formation and wound dehiscence. Wound infections account for high morbidity and mortality.[1] Current data indicates that SSIs account for over two million nosocomial infections in patients who have been hospitalized in the United States.[2] The net outcomes of SSIs include prolonged hospital stays, delay in adjuvant treatment, potential development of incisional hernias, and ultimately a decrease in patient quality of life.[3,4]

The cause of SSI is multifactorial, resulting from an interplay between patient-related, environmental, and surgical factors. Traditional care bundles aim to target these different components, including preoperative antibiotic prophylaxis and aseptic surgical technique, maintenance of intraoperative normothermia, and preoperative optimization of patient risk factors.[5,6] However, these measures have failed to alter the incidence of SSIs substantially.[6,7] Laparoscopic surgery has been demonstrated to result in a significantly lower incidence of SSI compared with open surgery.[8,9] However, not all patients are suited for this approach. Therefore, novel preventive measures are needed to abolish the development of SSI after open surgery.

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Negative Pressure Wound Therapy (NPWT) consists of the continuous delivery of negative pressure to the wound bed via a vacuum device, thereby removing excess tissue edema and promoting granulation tissue formation.[10] Although initially used solely in open wounds, use of NPWT has recently been extended to include closed surgical incisions.[10] Numerous studies in orthopedic, and cardiothoracic surgery have demonstrated decreased SSI rates with the use of NPWT in closed incisions.[11-13] Vacuum-Assisted Closure device (VAC) is a commercially available NPWT device. A recent meta-analysis showed that NPWT decreased wound infection rates and seroma formation compared with non-pressure, standard wound dressings.[14] However, few studies have evaluated the efficacy of the vacuum-assisted wound closure technique in general and colorectal surgeries.[15-17] Therefore, we aimed to evaluate the efficacy of vacuum-assisted wound closure in the surgical contaminated abdominal wound over conventional wound closure.

Methods and materials

The study was a parallel-group, open-level, single-centered randomized control trial conducted at the Department of Surgery and Department of Casualty of Chittagong Medical College Hospital from April 2020 to March 2021. Written informed consent were taken from all study subjects. Approval from Ethical Review Committee CMCH was also taken.

The target population consisted of consecutive patients with emergency laparotomy, contaminated surgical wounds, and patients with routine contaminated colorectal surgeries. Exclusion criteria were steroid drugs, residual malignant cells in the wound, radiotherapy, deep fistulas, sepsis, active bleeding, patients younger than 18 years, and psychiatric patients.

Previously, Lozano-Balderas et al. reported an SSI rate of 0% and 37%, respectively, in the VAC and conventional groups.[15] However, owing to the pragmatic design of the present study, it was assumed a rate of 37% in the conventional group and 5% in the VAC group. With these assumptions, a two-sided type I error of 5% and 90% power, a sample size of 30 patients per group was needed. Patients were randomly allocated to the experimental group (n=30), where Romovac for Vacuum-assisted wound Closure was used, and the control group (n=30), where the wound was closed by conventional wound suture closure without using the Romova device.

Postoperatively patient's surgical wound was assessed at 72 hours, seven days, and one-month intervals. The Southampton wound grading system scored SSIs, and Uncomplicated wound healing, defined as a Southampton wound score of <2 at 30 days postoperatively.[18] Surgical complications were graded by the Clavien-Dindo International Classification Surgical complication Scale.[19]

Data were analyzed using Statistical Packages for Social Sciences (SPSS-23, IBM). Quantitative variables were presented as means standard deviations and tested by the Student t-test. Frequencies and percentages indicated the quantitative observation and Chi-Square (or Fisher's exact test) test was done and showed with cross-tabulation. $p<0.05$ was considered a statistically significant difference.

Results

There was no loss to follow-up in the present study. All the patients were available for all outcome assessment and included in the analysis. The baseline demographic and clinical characteristics in the two treatment groups were showed in Talbe I. There were no relevant differences in age, sex, BMI, smoking characteristics and wound grade between the two groups. Males were predominated in both groups, the most frequent surgical indication was perforation of GC HV, repair of perforation was the most common surgical procedure done in both groups.

Table I Distributions of the study subjects according to age (n=60)

Characteristics	VAC Group (n=30)	Conventional Group (n=30)	p value
Age, Years	38.73±14.27	38.17±10.9	0.866†
Sex			
Male	23 (76.7)	25 (83.3)	0.519*
Female	7 (23.3)	5 (16.7)	
Body mass index, kg/m^2	23.37±4.27	22.23±3.18	0.124†
Obesity			
Present	23 (76.7)	21 (70.0)	0.559*
Absent	7 (23.3)	9 (30.0)	
Smoker	14 (46.7)	12 (40.0)	0.602*
Underlying condition			
Perforation of GC HV	21 (70.0)	23 (76.7)	0.559*
Others	9 (30.0)	7 (23.3)	
Surgery performed			
Repair of perforation	21 (70.0)	23 (76.7)	0.559*
Others	9 (30.0)	7 (23.3)	
Wound class			
Grade II	12 (40.0)	16 (55.3)	0.301*
Grade III	18 (60.0)	14 (46.7)	
Duration of surgery, hours			
< One hour	29 (96.7)	29 (96.7)	1.0**
> One hour	1 (3.3)	1 (3.3)	

Data were expressed as either Mean±SD or frequency (%), GC HV: Gas Containing Hollow Viscus, †Student t test, *Chi-square test, **Fisher's exact test.

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The distribution of the study of the patients by surveillance of surgical wound was showed in Table II. It was observed that the wound healing was better in 72 hours, seven days, and one-month postoperative period in the VAC group than the conventional wound closure group. After one month of surgery, wound healing was uncomplicated in 96.7% and 43.3% of the patients, respectively in the VAC group and conventional closure group.

Table II Distributions of the study subjects by surveillance of surgical wound

Grade of SSIs*	VAC Group (n=30)		Conventional Group (n=30)		p value**
	n	%	n	%	
Follow up at 72 Hours					
Grade 1 & below	12	40.0	1	3.3	<0.001
Grade II & above	18	60.0	29	96.7	
Follow up at 7 days					
Grade 1 & below	13	43.3	1	3.3	<0.001
Grade II & above	17	56.7	29	96.7	
Follow up at 1 month					
Grade 1 & below	29	96.7	13	43.3	<0.001
Grade II & above	1	3.3	17	56.7	

*By Southampton wound grading system, **Fisher's exact test.

Table III shows the distribution of the study of the patients by surgical complication (the Clavien-Dindo classification). It was observed that three fourth (73.3%) patients had grade I in group A and 22(73.3%) patients had grade III in group B. The difference was statistically significant ($p<0.05$) between two groups.

Table III Distributions of the study subjects according to surgical complication (The Clavien-Dindo classification)

Surgical Complication*	VAC Group (n=30)		Conventional Group (n=30)		p value
	n	%	n	%	
Grade I	22	73.3	1	3.3	
Grade II	4	13.3	1	3.3	0.001**
Grade III	3	10.0	22	73.3	
Grade IV	1	3.3	6	20.0	

*The clavien-Dindo Classification, **Chi-square test.

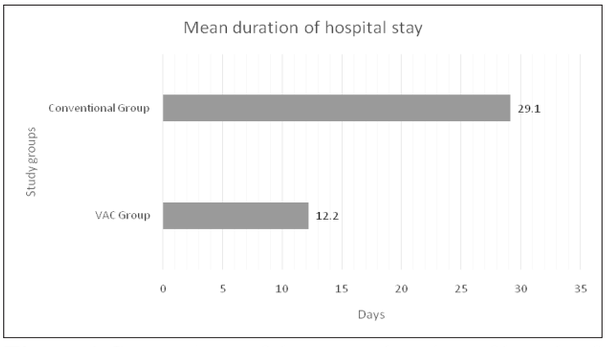

Figure 1 Comparison of the mean duration of length of hospital stay between two groups

The mean length of hospital stay was 12.2±3.59 days in VAC group and 29.07±10.36 days in conventional closure group (Figure 1). The difference was statistically significant ($p<0.001$, Student's t test).

Discussion

In the current study, the VAC device demonstrated its superiority concerning uncomplicated wound healing, less surgical complications, less length of hospital stay compared to the conventional wound closure. The present study findings agreed to the observation of James et al where the authors concluded that, VAC therapy significantly decreases the time to complete wound healing, hastens granulation tissue formation and reduces the ulcer area compared to conventional dressing.[20] There was no significant increase in the bleeding and infection in the VAC therapy group. Experimental evidence suggests that NPWT may assist wound healing by increasing local blood flow and the production of granulation tissue and may encourage other changes to the microenvironment of the wound by reducing bacterial contamination, oedema, and exudate.[21]

Wound complications remain common after laparotomy incisions, especially after emergency surgery.[22] Various methods of wound closure techniques (eg, delayed primary closure) have been described in an attempt to decrease SSI rates.[23] However, healing by secondary intention is labor intensive and costly. Present study confirmed that, prophylactic NPWT by VAC had a positive association in contaminated surgical wound.

The mean length of hospital stay in the present study, was significantly shorter in VAC group than the conventionally closure group. Jimenez et al reported that the length of hospital stay in the NPWT group was 8 days versus 12 days in the non-NPWT group.[24] Cheema et al. stated that VAC therapy appears to be an effective modality for management of variety of wounds, achieving faster recovery along with comparatively minimal hospital stay decreasing morbidity and hospital cost when compared with the conventional dressing.[25] Moreover, it has been widely demonstrated that reductions in hospital stay associated with a decrease in the SSI rate entail a significant savings in healthcare resources and patient suffering.[26]

Limitation

The study had several limitations. Relatively small sample size was one of the main limitations. Moreover, surveillance was carried out in one centre among selected population which might not be considered as a real reflection of the population of this country as whole.

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Conclusion

The current study results show that vacuum-assisted closure therapy was more effective for providing uncomplicated wound healing in patients with contaminated surgical wound, than the conventional wound closure method. Moreover, VAC may reduce the risk and complications of contaminated major surgical wounds, and likewise may reduce the length of postoperative hospital stay.

Recommendation

Based on the study findings VAC could be recommended for the contaminated surgical wound to prevent surgical site infection. Nevertheless, considering the limitations of the study, further multicenter study with large sample size is needed to explore the optimal methodology of using VAC and to determine its cost effectiveness, perspectives, quality of scar, functional and cosmetic outcomes.

Disclosure

The authors declared no conflicts of interest.

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