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Surgical outcome after using negative pressure therapy in infected leg wounds in coronary bypass grafting surgery

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Abstract

Background: Infection of leg wounds is a common complication following great saphenous vein harvesting (GSV) for coronary bypass grafting (CABG). This complication can result in increased risk of patient morbidity and mortality by causing septicemia, and gangrene, subjecting the patients to amputation. This study aimed to assess the efficacy of negative pressure wound therapy (NPWT) compared to conventional wound care in infected leg wounds following GSV harvesting for myocardial revascularization.

Results: The NPWT group had a significantly lower rate of deep vein thrombosis ($p = 0.013$), osteomyelitis ($p < 0.001$), bed sores ($p < 0.001$), shorter duration of tissue edema ($p < 0.001$), and lesser discharge ($p < 0.001$). Also, the length of hospital stay was significantly shorter in the NPWT group ($p < 0.001$). Multivariable analysis revealed that traditional wound care (without NPWT, $p < 0.001$) and wound stage IV ($p = 0.001$) significantly and independently prolonged the length of hospital stay.

Conclusions: The use of NPWT in advanced complicated infected leg wounds could improve patients' outcomes and satisfaction by decreasing the rate of complications and the length of hospital stay.

Keywords: Coronary artery bypass grafting, Negative pressure wound therapy, Saphenous vein grafting, Surgical site infection, Wound healing

Background

Complications following great saphenous vein (GSV) harvesting for coronary artery bypass graft (CABG) surgeries can result in increased morbidity and prolonged hospital stay, thus increasing healthcare expenditure [1]. Each case of complicated leg wound after CABG results in an increased cost per stay by $9,900 and prolongs hospital stay by an average of 12 days [2].

Negative pressure wound therapy (NPWT) is an alternative treatment that gained popularity for the care of surgical wounds, including chronic and infected wounds [3]. The therapeutic effects of NPWT are attributed to the enhancement of angiogenesis as well as stimulation of cellular proliferation and the formation of granulation tissue. In addition, NPWT can reduce local toxins and bacteria, enhance lymphatic drainage, and decrease interstitial edema [4, 5].

The NPWT consists of a closed system that applies intermittent or continuous negative pressure to the wound surface. The wound is covered with an open-cell foam or gauze dressing and sealed with an occlusive drape. The typically applied negative pressure rates are between − 50 mmHg and − 125 mmHg [6]. The vacuum-assisted closure (VAC) system (KCI, San Antonio, TX) is among the oldest devices that are still commonly used for NPWT [7]. Meanwhile, advances in technology produced new devices with additional advantages [8]. Currently, portable NPWT devices are available and

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used in community settings [9]. New NPWT for wounds with instillation (NPWTi) systems have been developed such as V.A.C. VeraFlo Therapy (KCI, San Antonio, TX), which enables the instillation of sterile water, saline, antiseptics, or antibiotics besides the NPWT [10, 11].

Previous studies showed controversial results regarding the superiority of NPWT for the care of surgical wounds compared to conventional wound care, whether as a prophylactic treatment immediately after surgery or as a treatment for complicated surgical wounds. Therefore, the current study was conducted to assess the efficacy of NPWT compared to conventional wound care in patients presenting with infected leg wounds following GSV harvesting for CABG.

Methods

A retrospective study was carried out in 2 tertiary centers from 2017 to 2021. The study included all severely infected leg wound cases who did CABG and saphenous veins were harvested as a conduit by open approach and they were followed for 2 years to observe the long-term outcome and satisfaction. One hundred twenty-seven cases (47 males and 80 females) were included in this study from a total number of 2085 patients who did CABG in this period and SV was harvested by the traditional open technique, as other techniques were not included in our cases. The study was approved by the hospitals' ethical committees, and consents were taken from the patients to use their data in this study.

We included any age group of patients, who underwent SVG harvesting in isolated CABG cases and acquired leg wound infection after removal of the conduit by the conventional technique. The Centers for Disease Control and Prevention created a surgical wound classification system (SWC: I, clean; II, clean/contaminated; III, contaminated; and IV, dirty) according to which the cases were selected in this study.

CABG cases associated with other cardiac heart diseases either acquired or congenital were excluded, also cases who underwent endoscopic vein harvesting (EVH) or through using interrupted techniques. Cases with leg wounds secondary to varicose veins or lower limb ischemia were excluded.

These cases with severe deep leg wound infection stages III and IV were divided into 2 groups. Group I: ($n = 67$, 52.8%) as NPWT suction was used in wound care. Group II: ($n = 60$, 42.2%) who were treated by the conventional wound care. All clinical, laboratory, and hospital course data were collected and analyzed to get more benefits in the management of these morbidities.

Cefazolin antibiotic was used as prophylaxis in all cases preoperative 30 min before skin incision and repeated after 4 h from the first dose administered. Doppler were not done for all cases either arterial doppler or venous duplex. for GSV harvesting the incision opened anterior and superior to medial malleolus then after dissection to the vein the skin was continuously opened using scalpel and scissors cutting the whole thickness till the adventitia over the vein any tributaries were ligated with silk ligature and double clipped for more hemostasis and adjusting the outflow caliber of the vein. the harvesting process stopped according to the length required according to the number of grafts. Our study is concerned with all cases that get deep gapped leg wound infection stage III and stage IV. They were diagnosed during the hospital stay or in outpatient clinic visits (Fig. 1A, B). In group I negative pressure suction was applied to their wound. In group II, classic wound care was applied. In both groups, cleaning and debridement of the infected areas were first performed. All pockets of collections within the wounds were evacuated either for pus or retained blood clots then were irrigated with saline and Bovidin iodine as antiseptic. Culture and sensitivity were done for all cases. The dressing was applied for all cases, till getting apparent clean wound.

NPWT (vacuum suction) were used in the first group as indicated. In this group of patients, the silver foam was used and tailored according to shape and wound length. An air-tight transparent Opsite pad was applied over, then a small opening was created within this pad to

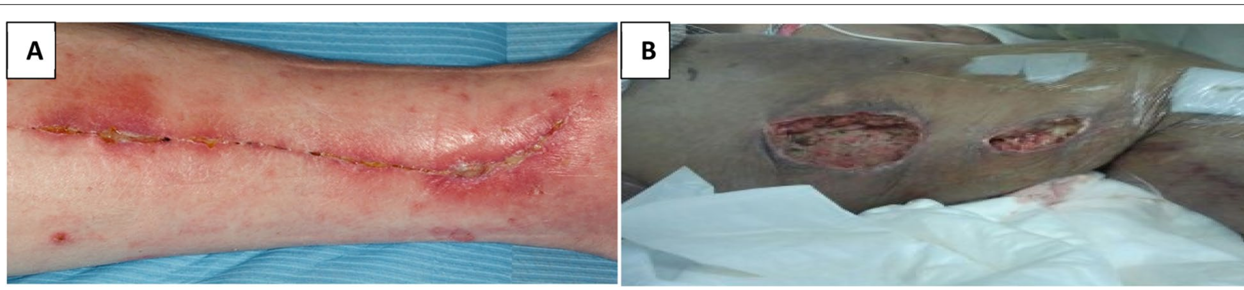

Fig. 1 Different presentations of leg wounds (**A**) erythema and superficial gapping (**B**) gapped wound in the thigh

communicate with the tubing system to suction apparatus. Negative pressure suction was adjusted on the negative (100–120 mmHg) continuous mode to be tolerated with the patients (Fig. 2A, B). The dressing was changed every 2–3 days unless there was bleeding or blockage of its system. The amount drained was calculated. Group II: underwent classic dressing with saline, antiseptic material and ointment containing B-sitosterol 0.25% to enhance granulation after debridement and cleaning. All wounds were followed till healthy granulation tissue grew up. The secondary suture was taken using prolene 0 interrupted sutures and then followed for at least 8 to 10 days to start removal of stitches (Fig. 3). In refractory complicated cases general surgery team was consulted either for amputation or to complete management using a skin graft.

All patients accepted the plan of management with the antibiotics coverage as ordered by the infectious disease team. Elevation of the limb was needed to decrease tissue oedema, and ambulation was started if possible. Deep vein thrombosis (DVT) prophylaxis was given to all cases. After the removal of stitches, patients were referred to physiotherapy. Those requiring amputations were referred to a plastic surgeon and psychiatrist for artificial limbs if applicable. Patient satisfaction was assessed before discharging home. Regular follow-up visits were arranged after discharge home.

Statistical analysis

The Statistical Package for Social Science (SPSS) was used to analyze the results (version 28). Means and standard deviations (SD) were used to describe quantitative numerical data. Frequencies and percentages were used to describe qualitative data. The *t* test was used to compare quantitative data, chi-square test was used to compare qualitative data. The significant variables in the univariate analysis were subjected to linear regression using the forward likelihood ratio. A *p* value equal to or less than 0.05 was considered significant.

Fig. 3 The wound after closure

Results

In this retrospective study, we reviewed a total number of 2085 patients who underwent CABG surgery in two tertiary centers. After applying the inclusion criteria of the study, we enrolled 127 cases of post-saphenous vein harvest patients, with severely infected leg wound stages III and IV. They were classified into 2 groups group I: (n = 67, 52.8 %) as NPWT suction was used in wound care. Group II: (n = 60, 42.2%) who were treated by the conventional wound care

Table 1 shows the demographic data of the patients and the most prominent risk factors for developing a wound infection. The female-to-male ratio was 1.71:1 in all cases. The patients' mean age were in group I and II respectively 56.7 $\pm$ 8.28 and 56.78 $\pm$ 7.8 years. The mean BMI were (30.14 $\pm$ 3.25 and 30.62 $\pm$ 3.30) kg/m^2 in group I and II respectively. The most frequently found risk factors in the studied patients included diabetes mellitus (G I 62.7% and G II 66.7%), female gender (G I 65.7% and G II 60%), peripheral limb ischemia (G I 65.7% and G II 63.3%), coagulopathy (G I 74.6% and G II 78.3%), and high lipid profile (G I 77.6% and G II 71.7%). There were no significant differences between the two groups regarding patient characteristics and risk factors (all P values > 0.05).

The clinical presentation of the cases and their related signs and symptoms are documented in Table 2. All patients in both groups complained of pain 100%. High-grade fever (defined as 38.5 c and above) was

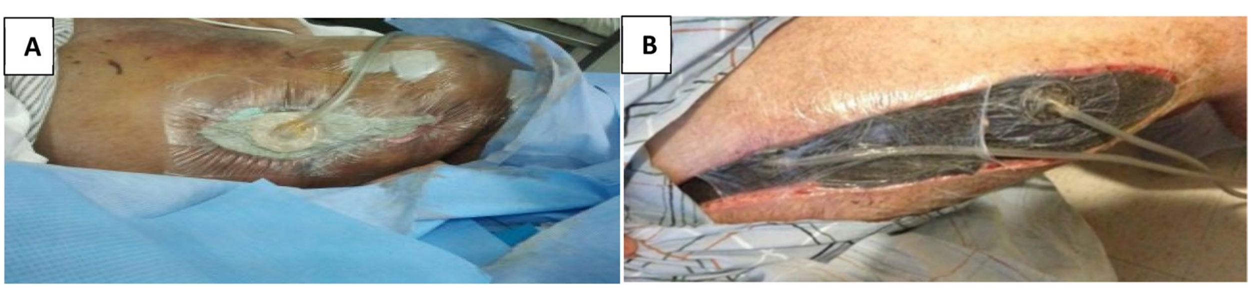

Fig. 2 **A** One vacuum suction device applied to thigh wound stage III **B** two vacuum suction devices applied to a deep long wound in the thigh

Table 1 Baseline characteristics of the participants

		Group I (67 cases)	Group II (60 cases)	*P* value
Age	Mean ± SD	56.65 ± 8.28	56.78 ± 7.80	1.000
Body mass index	Mean ± SD	30.14 ± 3.25	30.62 ± 3.30	0.986
Age groups, year, *n* (%)	˂ 50	8 (11.9)	9 (15	
	50–65	51 (76.2)	43 (71.7)	
	˃ 65	8 (11.9)	8 (13.3)	0.831
Sex, *n* (%)	Female	44 (65.7)	36 (60)	
	Male	23 (34.3)	24 (40)	0.509
Body mass index, *n* (%)	Normal	3 (4.5)	4 (6.7)	
	Overweight	29 (43.3)	18 (30)	
	Obese	30 (44.8)	32 (53.3)	
	Morbid obesity	5 (7.4)	6 (10)	0.479
Diabetes mellitus, *n* (%)		42 (62.7)	40 (66.7)	0.640
Chronic kidney disease, *n* (%)		3 (4.5)	5 (8.3)	0.475
Smoking, *n* (%)		22 (32.8)	27 (40)	0.160
Peripheral ischemia, *n* (%)		44 (65.7)	38 (63.3)	0.783
Hypercholesterolemia, *n* (%)		52 (77.6)	43 (71.7)	0.441
Coagulopathy or use of anticoagulation, *n* (%)		50 (74.6)	47 (78.3)	0.623
Serum albumin level (low) ˂ 30 mmol/l, *n* (%)		30 (44.8)	28 (46.7)	0.831

SD standard deviation, *Group I* used NPWT, *Group II* conventional wound care

Table 2 Cclinical presentations of the patients

Manifestations		Group I (67 cases), *n* (%)	Group II (60 cases), *n* (%)	*P* value
Movement difficulty		64 (95.5)	60 (100)	0.121
Wound discharge		42 (62.7)	37 (61.7)	0.906
Swelling		64 (95.5)	49 (81.7)	0.013*
Pain		67 (100)	60 (100)	-----
Gangrene		4 (5.9)	5 (8.3)	0.604
Skin necrosis		17 (25.4)	15 (25)	0.961
Fever		25 (37.3)	28 (46.7)	0.215
Wound stage III		59 (88.1)	49 (81.7)	0.313
Wound stage IV		8 (11.9)	11 (18.3)	0.203
Site of infected wound	Above knee	32 (47.8)	32 (53.3)	
	Below knee	25 (37.3)	16 (26.7)	
	Whole length	10 (14.9)	12 (20)	0.411

Group I used NPWT, *Group II* conventional wound care

*Statistical significance at $p < 0.05$

documented in 37.3% of group I and 46.7% of group II. Skin necrosis and gangrene were detected in group I in 25.4% and 5.9%, respectively, while their corresponding frequencies in group II were 25% and 8.3%. Wounds were in grades III and IV in both groups. The majority of cases had deep infected wound stage III (G I 88.1% and G II 81.7%). The remaining cases in both groups had stage IV wound infections. Regarding the site of the infection, the most frequent site was above the knee (G I 47.5% and G II 52.8%). No significant differences were observed between the patients of both groups in terms of clinical presentation, wound stage, and the site of infection (all *P* values > 0.05).

Evaluation of both the operative and postoperative risk factors revealed no significant differences between both groups. The use of IABP was nearly the same in both groups (G I 37.3% and G II 38.3%). Long bypass time (defined as more than 120 min) was observed in 70.1% of group I and 66.7% of group II. There was no significant difference in the method of closure, either single or double layers, the use of creep bandage post operative, suction drain insertion, and excessive use of diathermy for hemostasis. Also, no significant differences in both groups were found regarding the need for high inotropic support infusion and the need for reopening for bleeding and hematoma evacuation (Table 3).

The postoperative course and the incidence of complications were followed to determine the outcome in both groups. The Overall rate of complications was significantly higher in group II than in the group I (90% vs. 23.9%, $p < 0.001$). Deep vein thrombosis was diagnosed in 25% of group II compared to 5.9% of group I patients ($p = 0.003$). Likewise, the incidence of pulmonary embolism (PE) was higher in group II (n=3, 5%) compared to group I ($n = 2$, 2.9%) but did not reach statistical significance ($p = 0.66$). The rate of osteomyelitis was significantly higher in group II than in group I (53.3% vs. 4.4%,

Table 3 Intraoperative and postoperative factors

	Group I (67 cases), *n* (%)	Group II (60 cases), *n* (%)	*P* value
IABP	25 (37.3)	23 (38.3)	0.906
Inotrope	40 (59.7)	39 (65)	0.539
Diathermy	15 (22.4)	13 (21.7)	0.922
Single layer closure	19 (28.4)	12 (20)	0.386
Double layer closure	48 (71.6)	47 (78.3)	0.902
Use of creep bandage	12 (17.9)	13 (21.7)	0.595
Suction drain use	17 (25.4)	11 (18.3)	0.339
Reopening	28 (41.8)	21 (35)	0.433
Bypass time (long) ˃ 120 min	47 (70.1)	40 (66.7)	0.673

IABP: intra-aortic balloon pump, Group I: (used NPWT), Group II: (conventional wound care)

$p < 0.001$) respectively. One of the documented catastrophic events was septicemia secondary to the hematogenous spread of the infection in 20% of group II and 4.4% of group I. Amputations were performed in severely infected limbs with gangrene and secondary septicemia in 16.7% of group II and 2.9% of group I. In one female case with a severely infected lower limb, amputation was cancelled after the use of VAC and the limb was saved. Bed sores were encountered in a significantly higher percentage of group II patients than in group I (36.7% vs. 5.9%, $p < 0.001$). Tissue oedema subsided dramatically within a significantly shorter period of time in the group I (mean duration 5 ± 0.9 days). The amount of drainage was 115.05 ± 9.77 ml/day then decreased gradually to 10–20 ml/day until NPWT devices were removed. On the other hand, the tissue oedema in group II remained for a longer duration (mean 21 ± 2.9 days) with a higher drainage, the mean amount of drainage was (170.52 ± 29.60 ml/day), putting in consideration the frequent daily dressing because of the soaked wound ($p < 0.001$). Group I had a significant reduction in their hospital stay length compared to group II (14.9 ± 3.3 vs. 44.7 ± 9.7 days, $p < 0.001$). Patients in group I reported excellent satisfaction in 49.3% of cases compared to 15% in group II ($p < 0.001$). Mortality occurred in 5% of patients in group II (Table 4).

For hospital stay the significant variables in the univariate analysis were subjected to linear regression using the forward likelihood ratio as Table 5 demonstrated the significant $P < 0.001$ regarding the group of cases and the presence of complications. Multivariable analysis regarding the risk factors affecting the hospital stay proved that the group of patients who were managed with conventional wound care protocol (without NPWT) had longer duration than those in group I (B 29.517; $p < 0.001$) 95% confidence interval for B (27.048–31.987) and CKD (B: 5.466; $p = 0.035$), 95% CI (0.391–10.541) significantly prolonged the length of hospital stay (Tables 5 and 6).

Discussion

Many studies assessed the prophylactic effect of NPWT in reducing the incidence of SSI [2, 12] in wounds after different surgical procedures. However, few studies

Table 4 Postoperative complications

	Group I (67 cases), *n* (%)	Group II (60 cases), *n* (%)	*P* value
Overall complications	16 (23.9)	54 (90.0)	< 0.001*
Skin graft (partial thickness)	2 (2.9)	15 (25)	< 0.001*
Skin graft (full thickness)	3 (4.4)	20 (33.3)	< 0.001*
Deep vein thrombosis	4 (5.9)	15 (25)	0.003*
Pulmonary embolism	2 (2.9)	3 (5)	0.666
Bed sores	4 (5.9)	22 (36.7)	< 0.001*
Osteomyelitis	3 (4.4)	32 (53.3)	< 0.001*
Septicaemia	3 (4.4)	12 (20)	0.007*
Amputation	2 (2.9)	10 (16.7)	0.004*
Mortality	0 (0)	3 (5)	0.103
Drainage/ml, mean ± SD	115.05 ± 9.77	170.52 ± 29.60	< 0.001*
Hospital stays/days, mean ± SD	14.9 ± 3.3	44.7 ± 9.7	< 0.001*
Satisfaction			
Excellent	33 (49.3)	9 (15)	
Good	27 (40.3)	19 (31.7)	
Poor	7 (10.4)	32 (53.3)	< 0.001*

One person may have more than one complication, *SD* standard deviation

*Statistical significance at $p < 0.05$, *Group I* used NPWT, *Group II* conventional wound care

Table 5 Univariable analysis for factors affecting hospital stay length

		Hospital stay	*P* value
Groups	Group I (NPWT)	14.9 ± 3.3	
	Group II (conventional wound care)	44.7 ± 9.7	< 0.001*
Age groups, year	˂ 50	16.9 ± 4.1	
	50–65	16.8 ± 1.7	
	˃ 65	15.2 ± 3.5	0.961
Sex	Female	28.6 ± 16.63	
	Male	29.7 ± 16.4	0.745
Body mass index	Normal	30.4 ± 15.9	
	Overweight	26.5 ± 16.1	
	Obese	30.0 ± 16.2	
	Morbid obesity	33 ± 20.5	0.674
Diabetes mellitus	No	27.5 ± 15.8	
	Yes	29.8 ± 16.8	0.443
Chronic kidney disease	No	28.4 ± 16.3	
	Yes	38.6 ± 18.1	0.057
Smoking	No	27.2 ± 16.3	
	Yes	31.8 ± 16.4	0.068
Peripheral ischemia	No	29.9 ± 16.3	
	Yes	28.5 ± 16.7	0.482
Hypercholesterolemia	No	32.3 ± 16.9	
	Yes	27.9 ± 16.3	0.192
Coagulopathy or use of anticoagulation	No	28.9 ± 16.4	
	Yes	29.4 ± 16.6	
Serum albumin level (low) ˂ 30 mmol/l	No	28.9 ± 16.4	0.957
	Yes	29.1 ± 16.7	
Complications	No	18.5 ± 11.7	
	Yes	37.5 ± 14.8	< 0.001*

*Statistical significance at $p < 0.05$

Table 6 Multivariable analysis of factors affecting hospital stay

Variables	Hospital stay				
	B	95% confidence interval for B	Standard error	*t*	*P* value
Grouping	29.517	27.048–31.987	1.248	23.655	< 0.001*
CKD	5.466	0.391–10.541	2.564	2.132	0.035*

B regression coefficient, *CKD* chronic kidney disease, *Group I* used NPWT, *Group II* conventional wound dressing

*Statistical significance at $p < 0.05$

assessed the therapeutic effect of NPWT in patients who already developed SSI.

This study reviewed 127 cases with severely infected leg wounds (stages III and IV) after GSV harvesting. Patients managed using NPT had better results and less complications if compared to those who did not use VAC therapy. The rates of pulmonary oedema, septicemia, leg amputation, and amputation tended to be lower in the group that received NPWT compared to those treated with conventional wound care, though the differences did not reach statistical significance. The association of NPWT with a lower rate of complications can be attributed to the improved healing of wounds that leads to early mobility of the patients and a shortening of the hospital stay compared to those receiving standard wound care.

The length of hospital stay was significantly shorter in patients receiving NPWT than in the other group (15.27 ± 3.44 vs. 45.05 ± 8.81 days, $p < 0.001$). We performed linear regression analysis to assess the effect of NPWT on the length of hospital stay. The analysis revealed that both traditional wound care (without NPWT) (B 0.905; $p < 0.001$) and wound stage IV (B: 0.180; p 0.001) significantly and independently prolonged the length of hospital stay. This reduction in the length of hospital stay with the use of NPWT can be explained by the enhancement of wound healing in those patients. Several studies confirmed that contracture of wound area and reduction of the healing with the use of NPWT [13–16]. The decreased length of stay found in the present study can significantly contribute to cutting down on healthcare costs [17].

The decreased length of hospital stay has been reported also by previous studies that evaluated NPWT for infected surgical wounds. Simek et al. [18] assessed NPWT as a treatment for SSI in 25 patients who underwent cardiac surgery, out of whom four patients (16%) had severe leg wound infections, and the remainder had sternal wound infections. In all patients, the infected wounds successfully healed. The overall length of hospitalization in their study was longer than that in our study, ranging from 11 to 62 days, and the duration of NPWT treatment until surgical closure ranged from 6 to 24 days. These differences may be related to the severity of infected wounds as well as the general condition of the patients and the protocol of the institution where the study was conducted. In addition, most patients in their study had deep sternal SSIs, which may predispose the patients to more morbidity and require a longer time for healing.

Moreover, two studies compared the use of the pectoralis major muscle flap with NPWT to the flap without NPWT in patients with deep sternal SSI after cardiac surgery. The studies reported that the NPWT had a significantly shorter ICU stay [19, 20] and tended to have a shorter overall length of hospital stay [20].

A meta-analysis by Gao et al. [21] compared the efficacy of NPWT with the conventional treatment of SSI. The authors included 13 eligible clinical trials and 11 cohort studies. Wound healing time was shorter in the NPWT group than in the control group (mean difference − 7.51 days, 95% CI − 11.31 to − 3.71, $p = 0.0001$). However, the length of hospital stay was found to be longer in the NPWT group, which could be explained by the inclusion of studies in which patients underwent orthopaedic operations. This explanation is justified by the longer duration of hospital stay detected in those studies compared to non-orthopaedic procedures on performing subgroup analysis (mean difference − 4.73 days, 95% CI − 6.93 to − 2.54, $p < 0.0001$).

Several mechanisms were proposed for explaining the therapeutic effects of NPWT. Experimental studies showed that the use of NPWT was associated with arteriolar dilatation, increased local blood flow, and the formation of granulation tissue [22], besides reducing bacterial colonization, oedema, and exudate [23]. However, a study on healthy volunteers reported that increasing the suction pressure resulted in decreased local blood flow [24]. A study on a porcine model [25] reported that the effect of suction pressure on wound perfusion was minimal, with a slightly reduced blood flow in superficial tissue. In addition, NPWT can remove pus and stimulate local tissue repair via local negative pressure simultaneously, an advantage which cannot be achieved with the other alternatives for wound care including standard debridement, dressings, continuous and closed irrigation suction systems, or advanced antimicrobial dressings.

In the current study, no 30-day deaths were recorded in the NPWT group, while 5% of the cases in the standard wound care group died, but the difference was not statistically significant. Similarly, Simek et al. [18] reported that none of the patients receiving NPWT died during the hospital stay or within 30 days after the initiation of treatment. However, the study by Morisaki et al. [26] on 73 patients with deep sternal SSI after cardiac surgery stated that patients treated with NPWT, and primary closure had an in-hospital mortality rate of 33%. Meanwhile, the same study found that the rate was 0 with NPWT plus tissue flaps and on multivariable analysis that NPWT was independently and significantly associated with reduced in-hospital mortality (odds ratio 0.062; 95% confidence interval 0.004–0.897, $p = 0.041$). the relatively high mortality rate in patients receiving NPWT in their study is explained by the severity of the infection and the site which exposes the patients to higher morbidity.

The rate of patients reporting excellent satisfaction was significantly higher in the NPWT group compared to the standard wound care group (82.5% vs. 61.1%, $p = 0.037$). This excellent rating of NPWT is supported by earlier studies that found enhanced patient comfort due to decreased daily wound handling [27–29]. Early recovery and shortening of the length of hospital stay can also contribute to increased patient satisfaction.

The present study possessed several points of strength, being one of the few studies that compared the use of NPWT to conventional wound care in patients with SSI following GSV harvesting for CABG. In addition, our study included a larger sample size than comparable studies, allowing for the conduction of multivariable analysis regarding the hospital stay and the shorter the duration in group I who used NPWT compared to group II. However, the results of the current study were limited by not including other patients who underwent GSV harvesting by interrupted or endoscopic techniques. Infection of leg wounds following harvesting by other approaches warrants further research.

Another point that should be cautiously considered is the cost-effectiveness of NPWT as the technique uses relatively expensive devices, but some studies argue that the shortening of hospital stay, the decreased prescription of antimicrobials, and the decreased patient morbidity can result in decreased healthcare expenditure [2].

In conclusion, the early use of NPWT in advanced complicated infected leg wounds improves postoperative outcomes. The World Health Organization recommends NPWT only as a prophylactic measure to prevent SSI in high-risk surgical incisions [30]. However, NPWT is commonly used in clinical practice to treat cases with SSI. The launching of future randomized clinical trials with larger sample sizes is recommended to confirm or refute the efficacy of NPWT for the treatment of infected leg wounds following GSV harvesting.

This study did not include other patients who underwent SV harvesting by interrupted or endoscopic techniques. Infection post harvesting by other approaches need further research. Number of cases seen in outpatient clinic with infection sometimes underestimated. Lack of resources makes it difficult to apply EVH in many of cardiac centers.

Conclusions

The use of NPWT in advanced complicated infected leg wounds at the GS vein harvesting site in CABG surgery, could improve patients' outcomes and satisfaction by decreasing the rate of complications and the length of hospital stay.

Abbreviations

CABG: Coronary artery bypass grafting surgery; DVT: Deep venous thrombosis; EVH: Endoscopic vein harvesting; GSV: Great saphenous vein grafting; NPWT: Negative pressure wound therapy; CKD: Chronic kidney disease; SSI: Surgical site infection; VAC: Vacuum assisted closure; SWC: Surgical wound classification.

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Authors' contributions

AS and AA designed the study. EE, KS, and AA conducted literature search, AS, EE, and KS acquired and analyzed data. All authors performed the experimental part, read, and approved the final manuscript.

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This study was approved by the Ethics Committees of the Cardiac Center, Dallah and King Abd Al Aziz Hospitals, Riyadh, Saudi Arabia (10-12-2017). We obtained informed consent from all participants.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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