Efficacy of Vacuum-Assisted Closure (VAC) Therapy in the Treatment of Diabetic Foot Ulcer

Mafruha Nusrat Khan[1], Mohammad Mahbub Alam[2], Chaudary Nur-E-Tanzim[3], Hasina Alam[4]

1. Registrar
   Department of Surgery
   BIRDEM General Hospital
   Dhaka, Bangladesh
2. Deputy Chief Medical Officer
   Department of Surgery
   BIRDEM General Hospital
   Dhaka, Bangladesh
3. Registrar
   Department of Surgery
   US Bangla Medical College
   Narayanganj, Bangladesh
4. Assistant Professor
   Department of Surgery
   BIRDEM General Hospital
   Dhaka, Bangladesh

Correspondence to:
Mafruha Nusrat Khan
Registrar
Department of Surgery
BIRDEM General Hospital
Dhaka, Bangladesh
Email Id: mafruhanusratkhan@gmail.com
Orcid Id: https://orcid.org/0009-0000-4675-2070

Submission Date : 07 April 2025
Accepted Date : 21 May 2025
Published Date : 30 September 2025
DOI: https://doi.org/10.3329/jrpmc.v10i2.85611

Abstract

Introduction:
Diabetic foot ulcers (DFUs) are among the most serious and challenging complications of diabetes mellitus, frequently leading to infection, prolonged hospitalization, and lower-limb amputation.

Objective:
This study aimed to evaluate the rate of complete wound closure and complications of VAC therapy in treating diabetic foot ulcers.

Methods:
This prospective observational study was conducted at a specialized diabetic foot care centre in Dhaka over 18 months (April 2020 to October 2021) and included 90 patients with Wagner's grade 2 to grade 4 diabetic foot ulcers (DFUs).Vacuum-assisted closure (VAC) therapy was administered. Dressings were changed every 6–7 days, and each patient underwent 2–5 treatment cycles according to ulcer severity Data analysis was done by SPSS version 25.0.

Results:
Among 90 diabetic foot ulcer patients, male (80%) was predominant, with a mean age of 54.35 years. Most ulcers were Wagner grade 3(40%). Treatment outcomes showed that 21.6% achieved complete ulcer closure, while secondary closure and skin grafting accounted for 31.4% and 23.3%, respectively. Hospital stays ranged from 4 to 10 days, and healing time to granulation varied between 18 and 40 days. Complications were rare, affecting only 5.5% of patients, primarily due to minor bleeding or wound deterioration.

Conclusion:
VAC therapy is an effective and safe treatment for diabetic foot ulcers, significantly enhancing wound healing and reducing hospital stay. Its low complication rate and positive clinical outcomes support its use as a valuable modality in managing DFUs.

Keywords: Diabetic Foot Ulcers, Vacuum-Assisted Closure, Wound Deterioration, Wagner grade

Citation: Khan MN, Alam MM, Nur-E-Tanzim C, Alam H. Efficacy of Vacuum-Assisted Closure (VAC) Therapy in the Treatment of Diabetic Foot Ulcer. J Rang Med Col. 2025 Sep;10(2):43-48. doi: https://doi.org/10.3329/jrpmc.v10i2.85611

Introduction:

Diabetic foot ulcers (DFUs) represent a severe and common complication of diabetes mellitus, significantly increasing patient morbidity, risk of infection, and likelihood of lower-limb amputation. The management of DFUs remains a clinical challenge, with standard moist dressings often resulting in slow healing, recurrent infections, and extended hospital stays. Vacuum-assisted closure (VAC), a form of negative-pressure wound therapy (NPWT), has emerged as a potentially superior alternative, leveraging controlled sub atmospheric pressure to promote granulation tissue formation, reduce wound exudate, and accelerate healing. Emerging randomized controlled trials (RCTs) and meta-analyses offer compelling evidence regarding the efficacy of VAC therapy for DFUs. A landmark multicentre RCT demonstrated that patients receiving NPWT via the V.A.C.™ System

achieved significantly higher complete wound closure rates 56% versus 39% in the standard therapy group (p=0.04).[1] Complementing this, a retrospective study of DFUs after partial foot amputation found that VAC therapy led to a higher proportion of wounds reaching ≥ 90% granulation compared to conventional moist dressing, suggesting more rapid progression toward healing.[2] Meta-analyses further substantiate these benefits. A comprehensive meta-analysis of nine RCTs, encompassing 943 patients, found that NPWT significantly increased healing rates (OR=3.60, 95% CI 2.38–5.45, p < 0.001) and reduced granulation tissue formation time (mean difference ≈ –8.95 days) as compared with standard wound care, with no significant increase in adverse events or amputations.[3] Similarly, another meta-analysis reported an improved risk ratio (RR=1.52; 95% CI=1.23–1.89; p < 0.001) for ulcer healing, faster reduction in ulcer area, and decreased major amputation rates (RR=0.14; 95% CI=0.04–0.51; p=0.003) when using NPWT.[4] More recent evidence includes the German DiaFu randomized controlled trial (RCT), which compared NPWT with standard moist wound care in real-life practice and confirmed favourable outcomes for NPWT in terms of healing rates and treatment efficiency.[5] An Egyptian RCT examining NPWT versus moist care found that although time to healing did not differ significantly between groups, NPWT reduced repeated surgical debridement, minor amputation rates, antibiotic duration, and hospital stay, underscoring practical advantages in clinical outcomes and resource utilization.[6] Exploring adjunctive therapies, a 2023 meta-analysis examined vacuum sealing drainage combined with autologous platelet-rich plasma (PRP) and found that this combined approach significantly shortened healing time (SMD=–0.87), increased healing rate (OR=4.01), and reduced hospital stays (MD ≈ –15 days) compared to VSD with or without standard dressings.[7] This synergy highlights the evolving strategies to optimize NPWT efficacy in DFU management. Quality of life and patient-centered outcomes also favor VAC therapy. A 2011 study noted quality-of-life improvements in DFU patients treated with VAC,[8] and other investigations have confirmed the short-term effectiveness and promising long-term outcomes of NPWT in chronic neuropathic noninfected DFUs.[9] Nonetheless, clinical judgment remains vital when applying NPWT. A systematic review cautioned that patients with severe peripheral vascular disease or poor tissue perfusion may not benefit optimally from NPWT, emphasizing the need for individualized assessment before therapy initiation.[10] This study aimed to evaluate the rate of complete wound closure and complications of VAC therapy in treating diabetic foot ulcers.

Methods:

This prospective observational study was conducted at a specialised diabetic foot care centre in Dhaka over 18 months (April 2020 to October 2021) and included 90 patients with Wagner's grade 2 to grade 4 diabetic foot ulcers (DFUs). Patients with untreated osteomyelitis, ischaemic ulcers requiring endovascular revascularisation, or clotting disorders were excluded. VAC therapy, also known as Negative Pressure Wound Therapy (NPWT), is a medical treatment used to promote the healing of acute, chronic, or complex wounds. It involves applying controlled negative pressure (suction) to the wound through a specialized dressing connected to a vacuum pump.[11] Vacuum-assisted closure (VAC) therapy was administered using a polyurethane foam dressing, a catheter, an adhesive drape, and continuous negative pressure of 70–125 mmHg generated by a single-chamber suction unit with a manometer. Before the VAC application, thorough debridement and excision of all infected and devitalized tissue with adequate haemostasis were performed. Dressings were changed every 6–7 days, with meticulous wound inspection and local debridement of necrotic edges or slough when indicated. Each patient underwent 2–5 treatment cycles according to ulcer severity. For all cases, glycaemic status, ulcer duration, location, and grade were recorded at baseline, and wound condition was assessed and documented at each visit. According to Wagner's grade.[12]

Grade 0: No open lesion, but the foot is at risk; may include deformities or bony prominences.

Grade 1: Superficial ulcer involving the full skin thickness but not underlying tissues.

Grade 2: Ulcer extends into tendon, bone, or joint capsule without abscess or osteomyelitis.

Grade 3: Deep ulcer with abscess, osteomyelitis, or joint sepsis.

Grade 4: Partial foot gangrene (e.g., toes or forefoot).

Grade 5: Extensive gangrene involving the entire foot.

Complete wound closure was defined as 100% re-epithelialization without drainage.Data analysis was done by SPSS version 26.0. Descriptive statistics were applied, with continuous variables such as age, hospital stay, and healing time expressed as mean, minimum, and maximum, while categorical variables including sex distribution, Wagner's grade, treatment outcomes, and complications were summarized as frequencies and percentages.

Results:

The largest proportion of patients was in the 46–60 year age group (41.0%), followed by 61–75 years (31.0%), and 25–45 years (28.0%) with mean age was 54.35 years. Male: female was 4:1 (Table-I).

Table-I: Age and sex distribution of participants (N=90)

Characteristics	no. (%)
Age group (years)	
25–45	25(28.0)
46–60	37(41.0)
61–75	28(31.0)
Mean age	54.35
Sex	
Male	72(80.0)
Female	18(20.0)

Most patients presented with Wagner's grade 3 ulcers (40.0%), followed by grade 4(32.0%) and grade 2(28.0%) (Figure-1).

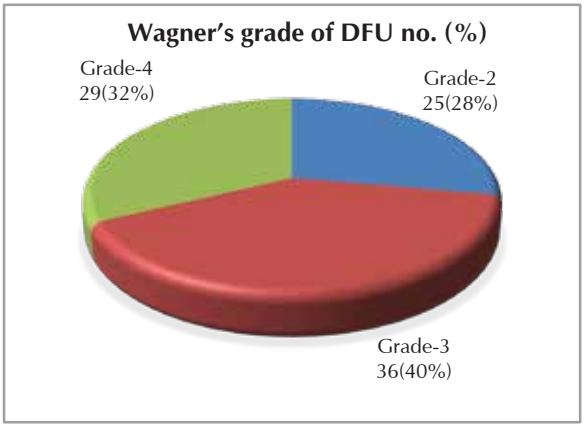

Figure-1: Distribution of patients according to Wagner's classification (N=90)

Secondary closure was the most common outcome (31.4%), followed by split-thickness skin grafting (23.3%) and complete ulcer closure (21.6%). Flap closure was required in 8.1% of cases, while 16.6% remained ongoing or had other outcomes (Figure-2).

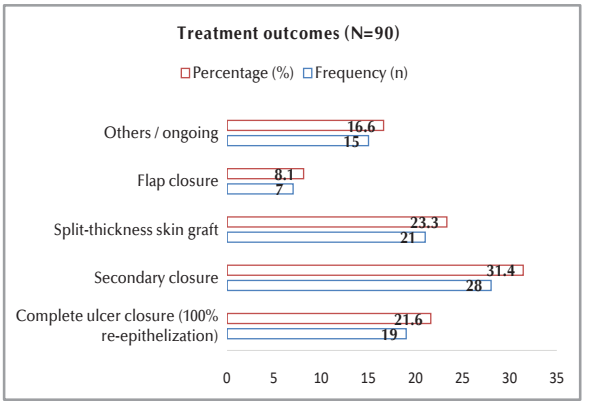

Figure-2: Treatment outcomes (N=90)

The duration of hospital stay ranged from 4 to 10 days. Time to granulation tissue formation varied between 18 and 40 days, with 4 to 7 clinic visits recorded.

Table-II: Hospital stays and healing time

Parameter	Minimum	Maximum
Hospital stays (days)	4	10
Healing time (granulation) (days)	18	40
Clinic visits (times)	4	7

Complications were infrequent, affecting 5.5% of patients, with the most common being bleeding and wound deterioration (each 2.2%). Financial issues led to discontinuation in 1.1% of cases (Figure-3).

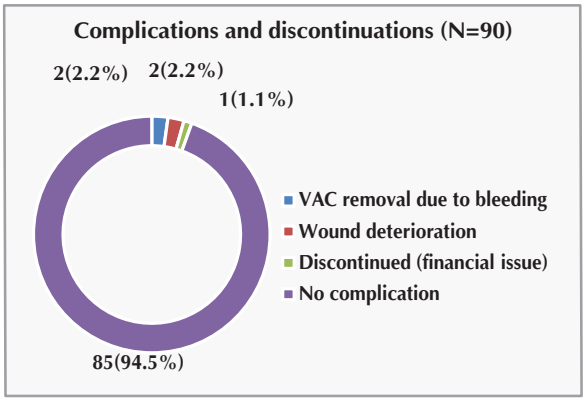

Figure-3: Complications and discontinuations (N=90)

Discussion:

This study evaluated the demographic characteristics, ulcer severity, treatment outcomes, and complications among diabetic foot ulcer (DFU) patients undergoing VAC therapy. The mean patient age was 54.35 years, with a majority (41%) aged 46–60 years and predominantly male patients (80%). These demographic patterns are consistent with earlier studies reporting that DFU commonly affects middle-aged to older adults with a male predominance, possibly related to occupational and behavioral factors increasing risk.[11,12] Wagner's classification showed most ulcers were grade 3(40%), indicating moderate severity with deep ulcers and possible abscess formation. This distribution aligns with findings by Malik et al and Lavery et al, who noted that many DFU patients present with advanced grades at initial care, underscoring the chronicity and delayed presentation in diabetic populations.[13,14] Regarding treatment outcomes, 21.6% achieved complete ulcer closure with VAC therapy, while secondary closure and split-thickness skin grafting accounted for 31.4% and 23.3%, respectively. These results corroborate the efficacy of NPWT in promoting wound healing, consistent with Andros et al, who demonstrated that VAC therapy significantly improved healing rates and reduced time to closure compared to conventional moist dressings.[15] Additionally, a meta-analysis by Liu et al. confirmed higher closure rates and reduced amputation risk with VAC therapy in DFU patients.[16] The observed hospital stay range of 4–10 days and healing time of 18–40 days are comparable to other clinical trials reporting shorter hospitalization and faster granulation with NPWT. For instance, Blume et al reported a median healing time of approximately 38 days with VAC therapy, indicating our findings fall within established ranges.[1] The frequency of clinic visits (4–7) also reflects typical follow-up in DFU management protocols employing NPWT.[17] Complication rates in this study were low (5.5%), with minor bleeding and wound deterioration as the main issues, aligning with safety profiles reported in previous literature. Lavery et al found VAC therapy to be generally well tolerated, with adverse events occurring in less than 10% of cases, supporting the safety of this modality when applied appropriately.[14] Financial constraints leading to therapy discontinuation (1.1%) highlight real-world challenges in low-resource settings, as noted by Jais et al., emphasizing the need for cost-effective wound care solutions.[18] Overall, the study confirms that VAC therapy is an effective and safe modality for DFU treatment, facilitating wound closure, reducing hospitalization, and minimizing complications. These findings reinforce international guidelines advocating NPWT as a valuable adjunct in managing complex diabetic foot wounds.[11]

Limitations:

Lack of comparative control was the biggest limitation. The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

Conclusion:

Vacuum-assisted closure (VAC) therapy is an effective and safe modality for managing diabetic foot ulcers, demonstrating promising outcomes in terms of ulcer closure, reduced healing time, and minimal complications. The majority of patients showed significant improvement with secondary closure or grafting, and hospital stays were relatively short. Despite occasional complications and financial challenges, VAC therapy remains a valuable tool in improving wound healing and potentially reducing the burden of diabetic foot complications.VAC therapy should be considered a preferred treatment option for diabetic foot ulcers due to its demonstrated efficacy in promoting wound healing and reducing hospital stay. Healthcare providers are encouraged to integrate VAC therapy into standard DFU management protocols, while also addressing financial and access barriers to maximize patient outcomes. Further studies on long-term benefits and cost-effectiveness in diverse settings are warranted.

Funding: No funding sources

Conflict of interest: None declared

References:

1. Blume PA, Walters J, Payne W, Ayala J, Lantis J. Comparison of negative pressure wound therapy using vacuum-assisted closure with advanced moist wound therapy in the treatment of diabetic foot ulcers: a multicenter randomized controlled trial. Diabetes care. 2008 Apr 1;31(4):631-6. doi: 10.2337/dc 07-2196

2. Sukur E, Akar A, Uyar A3, Cicekli O, Kochai A, Turker M, et al. Vacuum-assisted closure versus moist dressings in the treatment of diabetic wound ulcers after partial foot amputation: A retrospective analysis in 65 patients. Journal of Orthopaedic Surgery. 2018 Sep 19;26(3):2309499018799769. doi: 10.1177/2309499018799769
3. Chen L, Zhang S, Da J, Wu W, Ma F, Tang C, et al. A systematic review and meta-analysis of the efficacy and safety of negative pressure wound therapy in the treatment of diabetic foot ulcer. Annals of Palliative Medicine. 2021 Oct;10(10):108300839-10839. doi: 10.21037/apm-21-2476
4. Zhang J, Hu ZC, Chen D, Guo D, Zhu JY, Tang B. Effectiveness and safety of negative pressure wound therapy for diabetic foot ulcers: a meta-analysis. Plastic and reconstructive surgery. 2014 Jul 1;134(1): 141- 51. doi: 10.1097/PRS.0000000000000275
5. Seidel D, Storck M, Lawall H, Wozniak G, Mauckner P, Hochlenert D, et al.Negative pressure wound therapy compared with standard moist wound care on diabetic foot ulcers in real-life clinical practice: results of the German DiaFu-RCT. BMJ Open. 2020 Mar 1;10(3):e026345. doi: 10.1136/bmjopen-2018-026345
6. Adel EE, Mubarak SA, Elyamany MM, Kamel MM. Comparative Study of Negative Pressure Wound Therapy Using Vacuum-Assisted Closure and Standard Moist Care in Management of Diabetic Foot Ulcer. Suez Canal University Medical Journal. 2024 Nov 1;27(11):8-16. doi: 10.21608/SCUMJ. 2024. 427806
7. Yin XL, Hu L, Li T, Zou Y, Li HL. A meta-analysis on the efficacy of vacuum sealing drainage combined with autologous platelet rich plasma in the treatment of Grade 2 and Grade 3 diabetic foot ulcers. International Wound Journal. 2023 Apr;20(4): 1033-41. DOI: 10.1111/iwj.13956
8. Karatepe O, Eken I, Acet E, Unal O, Mert M, Koc B, et al.Vacuum-assisted closure improves the quality of life in patients with diabetic foot. Acta Chirurgica Belgica. 2011 Jan 1;111(5): 298-302. doi: 10.1080/00015458.2011.11680757
9. Borys S, Hohendorff J, Koblik T, Witek P, Ludwig-Slomczynska AH, Frankfurter C, et al. Negative-pressure wound therapy for management of chronic neuropathic noninfected diabetic foot ulcerations–short-term efficacy and long-term outcomes. Endocrine. 2018 Dec;62(3):611-6. doi: 10.1007/s12020-018-1707-0
10. Chiang N, Rodda OA, Sleigh J, Vasudevan T. Effects of topical negative pressure therapy on tissue oxygenation and wound healing in vascular foot wounds. Journal of Vascular Surgery. 2017 Aug 1;66(2):564-71. doi: 10.1016/j.jvs.2017.02.050
11. Eneroth M, van Houtum WH. The value of debridement and vacuum-assisted closure (VAC) therapy in diabetic foot ulcers. Diabetes/Metabolism Research and Reviews. 2008 May;24(S1):S76-80.doi: 10.1002/ dmrr. 852
12. Raja JM, Maturana MA, Kayali S, Khouzam A, Efeovbokhan N. Diabetic foot ulcer: A comprehensive review of pathophysiology and management modalities. World journal of clinical cases. 2023 Mar 16;11(8):1684. doi: 10.12998/wjcc.v11.i8.1684.
13. Armstrong DG, Boulton AJ, Bus SA. Diabetic foot ulcers and their recurrence. New England Journal of Medicine. 2017 Jun 15;376(24): 2367-75. doi: 10.1056/NEJMra1615439
14. Yazdanpanah L, Nasiri M, Adarvishi S. Literature review on the management of diabetic foot ulcer. World journal of diabetes. 2015 Feb 15;6(1):37. doi: 10.4239/wjd.v6.i1.37
15. Malik A, Mohammad Z, Ahmad J. The diabetic foot infections: biofilms and antimicrobial resistance. Diabetes & Metabolic Syndrome: Clinical Research & Reviews. 2013 Apr 1;7(2):101-7. doi: 10.1016/j.dsx.2013.02.006
16. Lavery LA, Armstrong DG, Wunderlich RP, Mohler MJ, Wendel CS, Lipsky BA. Risk factors for foot infections in individuals with diabetes. Diabetes care. 2006 Jun 1;29(6):1288-93.doi: 10.2337/dc05-2425
17. Andros G, Armstrong DG, Attinger CE, Boulton AJ, Frykberg RG, Joseph WS, Lavery LA, Morbach S, Niezgoda JA, Toursarkissian B. Consensus statement on negative pressure wound therapy (VAC® Therapy) for the management of diabetic foot wounds. Wounds. 2006 Jun 1;18(6). https://www.researchgate.net/profile/David-Armstrong-14/publication/224882315_Consensus_statemen

t_on_negative_pressure_wound_therapy_VAC_Therapy_for_the_management_of_diabetic_foot_wounds/links/02e7e525826c6aa3f7000000/Consensus-statement-on-negative-pressure-wound-therapy-VAC-Therapy-for-the-management-of-diabetic-foot-wounds.pdf

18. Liu Z, Dumville JC, Hinchliffe RJ, Cullum N, Game F, Stubbs N, et al. Negative pressure wound therapy for treating foot wounds in people with diabetes mellitus. Cochrane Database of Systematic Reviews. 2018(10). doi: 10.1002/14651858.cd 010318. pub3