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Knowledge of Using Vacuums in the Treatment of Resistance Diabetic Foot Ulcers among Medical Students at King Faisal University, Saudi Arabia

Mohammed Albarqi[1]*, Fatimah Ali Alnahwi[2]

[1] Department of Family Medicine and Community, College of Medicine, King Faisal University, Al-Ahsa, Saudi Arabia

[2] Medical Interns, College of Medicine, King Faisal University, Al-Ahsa, Saudi Arabia

Abstract: Negative pressure therapy is used in diabetic foot cases to be healing of diabetic foot wounds by suctioning and vacuuming negative partial air from the wound, which helps in the formation and promotion of new tissues that are healthy and rich in capillaries. The aim of the study is to assess medical students' knowledge about using negative pressure therapy in healing resistance diabetic foot wounds and ulcers. This is a cross-sectional study, depending on the online questionnaire that was used for data collection using social media platforms. 63.2% of participants answered "for 1-3 weeks" or "for 3-6 weeks" when they asked what is the duration of negative pressure wound therapy, while those who answered "for 6-9 weeks" were 29.4%, and about 7.5% answered "for 9-12 weeks." About 43.5% of the participants only heard about the vacuum treatment. Also, only 23.6% of the participants had seen the negative pressure wound therapy instrument, and the remaining 76.4% did not see it. when asked about thinking that negative pressure wound therapy impacted the quality of patient care, about 54.5% of the participants indicated that it impacted the better quality of care, and only 9.5% indicated that it is the same quality of care, while about 30.8% of them indicated that it impacted relative better but highly expensive, and only 5.2% indicated that it is the worse quality of care. Medical students need to be aware of negative pressure therapy to take care of the well-being of resistance wounds of diabetic patients.

Keywords: negative-pressure therapy, diabetic foot, diabetes mellitus, resistance wounds.

沙特阿拉伯费萨尔国王大学医学生使用吸尘器治疗抵抗性糖尿病足溃疡的知识

摘要：负压疗法用于糖尿病足病例，通过从伤口中抽吸和抽真空负压部分空气来治愈糖尿病足伤口，这有助于形成和促进健康且富含毛细血管的新组织。该研究的目的是评估医学生对使用负压疗法治疗抵抗性糖尿病足部伤口和溃疡的知识。这是一项横断面研究，取决于用于使用社交媒体平台收集数据的在线问卷。当被问及负压伤口治疗的持续时间是多长时，63.2%的参与者回答"1-3 周"或"3-6 周"，而回答"6-9 周"的为 29.4%，大约 7.5% 的人回答"9-12 周"。大约 43.5% 的参与者只听说过真空治疗。此外，只有 23.6%的参与者看过负压伤口治疗仪，其余 76.4%的人没有看过。当被问及认为负压伤口治疗会影响患者护理质量时，约 54.5% 的参与者表示它会影响更好的护理质量，只有 9.5%的参与者表示它是相同的护理质量，而约 30.8%他们中的人表示它的影响相对较好但费用很高，只有 5.2%的人表示它的护理质量较差。医学生需要了解负压疗法，以照顾糖尿病患者抵抗性伤口的健康。

关键词：负压治疗，糖尿病足，糖尿病，抵抗性伤口。

1. Introduction

Diabetic foot is a disease that affects patients with diabetes by manifesting pathologically in the foot in the form of swelling, ulcers, and wounds, to name a few

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About the authors: Mohammed Albarqi, Department of Family Medicine and Community, College of Medicine, King Faisal University, Al-Ahsa, Saudi Arabia; Fatimah Ali Alnahwi, Medical Interns, College of Medicine, King Faisal University, Al-Ahsa, Saudi Arabia

Corresponding author Mohammed Albarqi, dr.anma@hotmail.com

symptoms. It occurs due to neuropathy, lack of blood circulation, or bacterial infections. It can even occur after a long period of diabetes, in which case, it can be attributed to peripheral neuropathy and lack of blood circulation to the foot because of sugar [1, 2, 20]. In this regard, many treatment methods have been brought up and examined for treating this ailment.

Negative-pressure wound therapy (NPWT) is a treatment technique that uses a suction pump and tubing. The use of this technique in wound management increased dramatically during the 1990s [21]. Since then, many studies examining NPWT have been published, including areas like dried surgical wounds, diabetic foot ulcer (DFU), venous insufficiency, and laparotomy (management of the open abdomen) [2, 3].

NPWT promotes wound healing by applying a vacuum through a specially sealed bandage. Continuous vacuuming draws the fluid from the wound and increases blood flow to the area. This vacuum can be applied continuously or intermittently, depending on the type of wound being treated and the clinical goals. The dressing is usually changed twice to thrice a week. The dressings used for this technique include foam and gauze dressings, sealed with an occlusive dressing that is intended to contain the space at the site of the wound. When NPWT devices deliver fluids, such as saline or antibiotics, to irrigate the wound, the intermittent removal of the fluid helps clean and drain the wound bed well [4].

The general technique for NPWT is as follows: "'Ensure protection by applying a cutaneous barrier." A dressing or padding material is applied to the circumference of the wound and then foam or gauze–covered with a transparent film—is used to close the wound [1, 5].

The drainage tube is attached to the bandage through the opening of the transparent membrane of a vacuum pump. The tubes are connected through a hole in the film drape, to a case on the side of the vacuum pump. As an alternative, a vacuum source is used to transform an open wound into a closed wound, while removing excess fluid from the wound layer to promote blood circulation and remove the wound fluid. This creates a moist healing environment and reduces edema. The second step states "the vacuum tube needs to be an air-tight seal for this treatment to work." This vacuum technique is usually used for chronic wounds or wounds expected to cause difficulties during healing (such as those associated with diabetes) [6-10].

Four types of dressings are used on the wound surface: foam, gauze, a clear layer, and a non-adherent contact layer (woven or non-woven), if needed. Foam dressings or woven gauze are used to fill the open wounds. Foam can be cut to size to fit the wounds. Once the wound is filled, a clear layer is applied over the top to make a seal around the dressing. Following this, the tube is attached and connected to the pump [11, 12].

Once the dressing is sealed, the vacuum pump can be adjusted to deliver continuous or intermittent pressures, with pressure levels (ranging from −200 to −40 mmHg) depending on the device used, the material used, and the patient's tolerance. The compression can also be applied continuously or intermittently [11].

The type of dressing used depends on the type of wound, clinical goals, and the patient's requirements. For acute-pain patients with shallow or irregular cuts or wounds, gauze may be used. However, foam can be easily cut and used here, as it helps ensure a uniform contour and better performance, especially when aggressive granulation formation and wound contraction is the desired goal [13].

However, there are limitations to NPWT as well. Some of these include malignancy in the wound, dead tissue with a scar, and exposed blood vessels, contrast sites, organs, and nerves in the dew area (direct foam contact with these structures should be avoided) [14].

This study is based on the knowledge of NPWT among medical students, regarding the treatment of resistant diabetic foot ulcer. So, the main objectives of this cross-sectional study are as follows: 1) Assess students' knowledge about NPWT on healing diabetic foot ulcers; 2) assess students' knowledge on the quality of patient care in relation to diabetic foot wound, by having them use NPWT.

2. Methods

2.1. Study Design

This study is a cross-sectional study that assesses the knowledge of medical students on using vacuum devices for treating resistance diabetic foot ulcers. It includes a large sample size (n = 313) and was conducted in KFU in 2022.

2.2. Sample Population and Sample Size

The current study was conducted with 347 participants and included medical students, both male and female. The sample size was calculated for confidence level (which was shown to be 95%), margin of error (5%) and population proportion (50%). The total sample size was 1680, where z is the z score (1.96), p is the population proportion, and n is the sample size. The inclusion criteria included female and male medical students who were studying at KFU, Saudi Arabia. The exclusion criteria were people who were not studying at KFU, as well as non-medical school students.

2.3. Data Collection

The data were collected from 347 participants via an electronic self-administered questionnaire. The questionnaire was distributed via social media platforms, owing to the restrictions of the COVID-19 pandemic. The questionnaire was in the English

language and included three main parts: 1) three questions on demographic information (academic level, gender, name of medical school) and consent; 2) knowledge about vacuum treatment (NPWT), comprising one question about the duration of NPWT; 3) practices of NPWT. The questionnaire was designed to take approximately five to 10 min to complete.

2.4. Ethical Considerations

Informed consent was obtained from the university and participants before distributing the questionnaire. The confidentiality of the participant's personal information and data was ensured, with their names being kept anonymous. The information obtained from the study was used only for research purposes.

2.5. Data Analysis

The data were entered and statistically analyzed using the Statistical Package of Social Science Software (SPSS), version 25 (IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.).

3. Results

3.1. Demographic Information

A questionnaire was distributed among the medical students of the KFU medical school. The questions were intended to collect data for evaluating medical students' attitudes regarding the use of vacuum treatment resistant or intractable diabetic foot ulcer.

The sample size was 313 but there were 350 participants, of which, three declined to participate. Hence, the analysis of the questionnaire was based on a sample size of 347 participants. Among the participants, 67% were female while 33% were males. Regarding the academic level of the participants, 57.7% of them were from the fourth, fifth, and sixth years while 36.6% were from the first, second, and third years. The remaining 5.8% had just graduated.

3.2. Knowledge on Vacuum Treatment (Negative-Pressure Therapy)

About the duration of NPWT, about 63.2% answered "for 1–3 weeks" or "for 3–6 weeks," while those who answered "for 6–9 weeks" were 29.4%, and about 7.5% answered "for 9–12 weeks."

Table 1 The participants' replies about the negative-pressure wound therapy duration

What is the duration of Negative pressure wound therapy?	Frequency	Percent
1-3 weeks	131	37.8%
6-9 weeks	102	29.4%
3-6 weeks	88	25.4%
9-12 weeks	26	7.5%
Total	**347**	**100%**

Fig. 1 The participants' replies on the negative-pressure wound therapy duration

3.3. Practices of Negative-Pressure Wound Therapy

From the responses, it was observed that only about 43.5% of the participants had heard about the vacuum treatment.

Table 2 The participants' awareness of the vacuum treatment

Have you ever heard about Vacuums treatment?	Frequency	Percent
No	196	56.5%
Yes	151	43.5%
Total	**347**	**100%**

Moreover, only 23.6% of the participants had seen the NPWT instrument, with the remaining 76.4% stating that they had not seen it yet.

Table 3 The participants' experience of seeing the NPWT instrument

You see the Negative pressure wound therapy instrument	Frequency	Percent
No	265	76.4%
Yes	82	23.6%
Total	**347**	**100%**

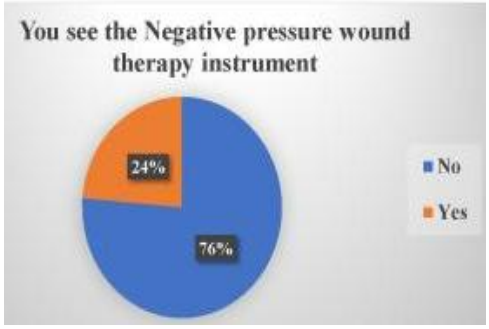

Fig. 2 The participants' experience of seeing the NPWT instrument

When asked about their opinion of the main advantages of NPWT, the main answers were that it will accelerate the healing, decrease the infection in the wounds, prevent amputation, regenerate the tissues and treat the wounds. Moreover, the responses also stated that it would be fast, easy and effective, be more cost-effective and lead to better outcomes. The participants also remarked that it would help increase the blood flow, decrease the size of the wounds, provide good information about wound healing, help drain the extra fluid, use pressure, decrease the duration of hospitalization. However, 37.2% of the participants

said that they do not know the main advantage behind this, while one participant said "Nothing," i.e., no advantage.

Table 4 The participants' replies about the main advantages of NPWT

In your opinion, what is the main advantage of Negative pressure wound therapy?	Frequency	Percent
I Don't Know	129	37.2%
Accelerate the healing	114	32.9%
Decrease infection level of the wounds	35	10.1%
Fast, Easy, and Effective	18	5.2%
Prevent amputation	8	2.3%
Tissue regeneration	6	1.7%
Treat wound	6	1.7%
Cost effective and better outcome	6	1.7%
Increase blood flow	6	1.7%
Decrease the size of wounds	4	1.2%

When asked about their opinion on the main disadvantages of NPWT, the main answers were that it will be expensive and unavailable in all hospitals, difficult to use and maintain, and require special care. Some opined that it would not be effective for all patients and would be a painful process that can increase skin irritation, restrict patient movement, and increase bleeding and infection. Moreover, they stated that it would take a long time to heal and cause swelling or ulcers to surround the skin. Moreover, about 56.8% of the participants said that they do not know of the main disadvantages, while 3.5% said "Others," i.e., there are other disadvantages than indicated.

Table 5 The participants' replies about the main disadvantages of NPWT

In your opinion, what is the main disadvantage of Negative pressure wound therapy?	Frequency	Percent
I Don't Know	197	56.8%
Expensive and not available in all hospitals	46	13.3%
Difficult in use and maintain, Need special care	29	8.4%
Not effective for all patients	17	4.9%
Painful process	12	3.5%
Others	12	3.5%
Skin irritation	11	3.2%
Restriction of patient movement when connect	5	1.4%
the risk of bleeding in patients	5	1.4%
Risk of infection	4	1.2%
Takes long time to heal	4	1.2%
Cause Swelling	3	0.9%
Ulcers to surround skin	2	0.6%
Total	**347**	**100%**

When asked about whether NPWT should be made available in every hospital and wound healthcare centers in KSA, about 44.4% of the participants indicated that it is an advantage, while 40.6% agreed that it should indeed be implemented. Only 15% disagreed with this.

Table 6 The participants' replies whether NPWT should be made available in every hospital and wound healthcare centers in KSA

Do you think the Negative pressure wound therapy should be found in every hospital and wound healthcare centers in KSA?	Frequency	Percent
It's an Advantage	154	44.4%
Yes	141	40.6%
No	52	15.0%
Total	**347**	**100%**

When asked about whether NPWT has impacted the quality of patient care, about 54.5% of the participants indicated that it led to a better quality of care, while only 9.5% indicated that the quality of care was as it was before. Meanwhile, 30.8% of them indicated that while it did relatively improve the care, it was highly expensive. Only 5.2% indicated that it provided a poor quality of care.

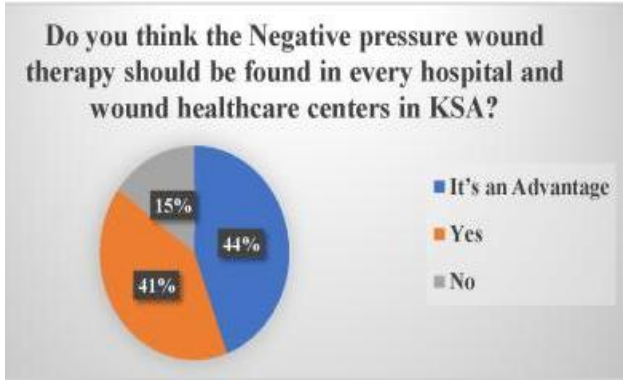

Fig. 3 The participants' replies whether NPWT should be made available in every hospital and wound healthcare centers in KSA

Table 7 The participants' replies about the impact of NPWT on the patient care quality

How do you think the Negative pressure wound therapy impacted the quality of patient care?	Frequency	Percent
Better quality of care.	189	54.5%
Same quality of care.	33	9.5%

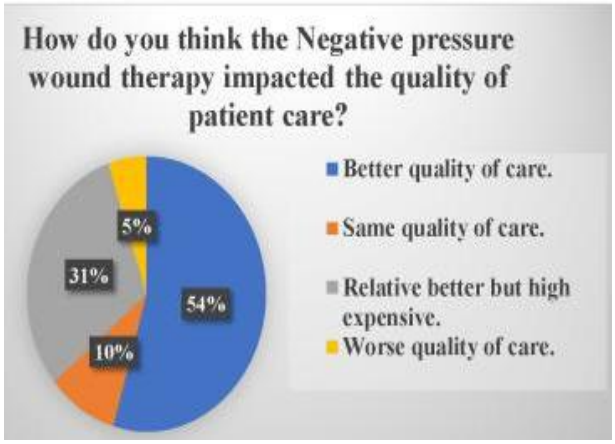

Fig. 4 The participants' replies about the impact of NPWT on the patient care quality

4. Discussion

NPWT is widely used in several hospitals and wound care centers worldwide. Hence, there have been several studies and published articles that have highlighted this technique. This study was conducted to assess the knowledge of medical students regarding the

use of vacuum treatment for resistance diabetic foot ulcer.

The study showed 43.5% of the participants only heard about the vacuum's treatment. Also, only 23.6% of the participants had seen the negative pressure wound therapy instrument, and the remaining 76.4% did not see it. About 54.5% of the participants indicated that it provided a better quality of care, and only 9.5% indicated that it is the same quality of care, while about 30.8% of them indicated that it provided a relatively better but highly expensive service, and only 5.2% indicated that it is a worse quality of care. Finally, the medical students at King Faisal University have a poor knowledge about the negative pressure therapy.

There were no studies or articles based on the knowledge of medical students regarding NPWT, making this study the first of its kind. However, we will discuss our results in view of the articles that assessed the knowledge of medical students regarding the other recent techniques.

The study by Jeffrey et al. [15] assessed the knowledge of medical students regarding electroconvulsive therapy. The authors focused on second-year medical students of the University of Arkansas for Medical Sciences, with the sample size including 40% of the total student population. The results showed poor knowledge as well as wrong beliefs about electroconvulsive therapy among second-year medical students.

Prezzia, Vorona, and Greenspan [16] found that 137 of the total 444 fourth-year medical students at US medical schools are aware of the importance of radiology. However, they have poor knowledge about the radiation safety criteria and the ACR Appropriateness Criteria.

Oskvarek et al. [17] assessed the knowledge of 105 US medical students regarding oncology and related disciplines. The results showed that the students had poor knowledge of oncology, especially about palliative care, pain management, radiation, and survivor care.

Whiles et al. [18] investigated the knowledge of medical students regarding urologic surgery. The study included 114 medical students studying at the University of Kansas School of Medicine, USA. Similar to other studies, it was seen that these students had poor knowledge of the subject, although it stated that this can be rectified through proper medical school training.

All of these studies are compatible with our results, showing the poor knowledge of medical students regarding several therapy sciences and practices. However, there are exceptions: Brittany [19] assessed the knowledge of medical students in the USA regarding the operating room sterile techniques. The study was conducted among 220 medical students, and the results found the knowledge assessment score to be 74% (good).

5. Conclusion

NPWT is a novel technique approved by several committees, such as the FDA and DAI. It is considered a safe mode of therapy that can be used in treating the complicated, resistant, and critical wound and ulcer cases. Additionally, the use of NPWT could reduce the risk of amputation among patients with diabetes mellitus disease, as well as prevent several complications of these wounds and ulcers, posing resistance to the bacterial and/or viral infection state. Therefore, given the low level of knowledge among medical students regarding NPWT, a targeted educational program is needed to promote more awareness about it. In the end, we recommended assessing the knowledge of medical students regarding NPWT in other medical schools. We also recommend holding conferences and training programs to ensure more adequate support and training.

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