ISSN: 2457-0400

Impact Factor: 6.711

WORLD JOURNAL OF ADVANCE HEALTHCARE RESEARCH

www.wjahr.com

Volume: 9, Issue: 11

Page N. 177-184

Year: 2025

Review Article

Coden USA: WJAMA3

CLINICAL OUTCOMES & USE OF NEGATIVE-PRESSURE WOUND THERAPY (NPWT) IN CONTAMINATED SURGICAL WOUNDS-A REVIEW ARTICLE

Dr. Ansari Mohd. Danish Mohd. Nasim*[1], Dr. Huma Khatoon[2], Dr. Saiyad Shah Alam[3]

[1]Assistant Professor, Dept. of Ilm-ul-Jarahat (Surgery), Ahmad Garib Unani Medical College and As-Salam Hospital, Akkalkuwa, Nandurbar.

[2]Assistant Professor, Dept. of Ilmul-Qabalat wa Amraz-e-Niswan (Obstetrics and Gynaecology), Ahmad Garib Unani Medical College and As-Salam Hospital, Akkalkuwa, Nandurbar.

[3]Professor, Director of National Institute of Unani Medicine, Bangalore. Karnataka.

Article Received: 21 September 2025 **Article Revised:** 11 October 2025 **Article Published:** 01 November 2025

***Corresponding Author: Dr. Ansari Mohd. Danish Mohd. Nasim**

Assistant Professor, Dept of Ilm-ul-Jarahat (Surgery), Ahmad Garib Unani Medical College and As-Salam Hospital, Akkalkuwa, Nandurbar. **DOI:** https://doi.org/10.5281/zenodo.18093047

How to cite this Article: Dr. Ansari Mohd. Danish Mohd. Nasim*1, Dr. Huma Khatoon2, Dr. Saiyad Shah Alam3**.** (2025). CLINICAL OUTCOMES & USE OF NEGATIVE-PRESSURE WOUND THERAPY (NPWT) IN CONTAMINATED SURGICAL WOUNDS-A REVIEW ARTICLE. World Journal of Advance Healthcare Research, 9(11), 177–184.

ABSTRACT

Negative Pressure Wound Therapy has emerged as a pivotal advancement in the management of acute and chronic wounds, offering significant benefits in promoting granulation tissue formation, reducing edema, removing exudate, and decreasing bacterial burden. Originally inspired by ancient wound-suction practices and refined through centuries of invention, NPWT has evolved into a technologically advanced system widely used in modern surgical, traumatic, diabetic, and chronic wound care. The therapy utilizes controlled sub-atmospheric pressure delivered through foam dressings to accelerate healing and optimize the wound microenvironment. This review discusses the historical evolution, mechanism of action, clinical applications, advantages, and modern innovations of NPWT, emphasizing its effectiveness in contaminated and complex surgical wounds. Additionally, the paper highlights the integration of NPWT into long-term care settings, technological advancements, and factors influencing treatment success. NPWT continues to redefine wound care standards globally, making it an essential component of current clinical practice.

KEYWORDS: Negative Pressure Wound Therapy; Vacuum-Assisted Closure; Wound Healing; Diabetic Foot Ulcer; Surgical Wound Dehiscence; Granulation Tissue; Exudate Management; Chronic Wounds; Wound Infection; Modern Wound Care Technologies.

I. INTRODUCTION NEGATIVE PRESSURE WOUND THERAPY (NPWT)

Negative pressure wound therapy (NPWT) is a broad term used to describe a unique and versatile system that aids the optimization of wound healing through the application of sub-atmospheric pressure to help reduce inflammatory exudate and promote granulation tissue. It can be utilized to manage acute and chronic wounds, ranging from open fasciotomy wounds and diabetic foot ulcers to closed surgical incisions.

NPWT has undergone a significant evolution since the first modern-day recorded application of this concept in the 19 century.[1] The most recent iteration of NPWT is courtesy of Argenta and Moryk was, who demonstrated its efficacy in their paper published in 1997. This type of NPWT system comprises a porous foam dressing upon which continuous or intermittent suction is applied through an electronically powered suction device to achieve a sub-atmospheric pressure of 125mmHg below ambient pressure.[2]

The system has seen widespread uptake and is now implemented routinely for open wounds, such as open fractures, fasciotomies, ulcers, and infected wounds. Termed Vacuum-Assisted Closure, this system is only effective if applied correctly by trained individuals. It is usually performed in the operating room, given the fact

that the wounds usually require debridement and a washout in a sterile environment.

Fig. 01: Diabetic Foot Ulcer before and after NPWT.

More modern iterations of this system now offer advanced options to enhance the delivery of the NPWT, such as a range of pressure settings from -40mmHg to -200mmHg, which can be tailored for different types of wounds. The material from which the foam is derived is either polyurethane (black) or polyvinyl alcohol (white).[3] Additionally, disposable wound VACs, either battery operated or purely mechanic suction, are available for use and typically used for smaller wounds.

In more recent years, NPWT has also been adapted for the adjunctive treatment of closed wounds, such as closed surgical incisions and skin grafts.[4] This aims to reduce edema and seroma formation, prevents surgical dihisence in high-risk incision sites, and promote granulation to encourage healing. While the available evidence shows equivocal results for wound healing, this wound management system has seen a widespread implementation for closed wounds prone to dehiscence or infection secondary to exudate and localized inflammation.[5]

An emergent adaptation of NPWT is using fluid instillation in conjunction with NPWT to enhance the therapy delivered. This comprises the direct administration of saline or antibiotic-containing solution into the wound bed, followed by a period of time ranging from ten to twenty minutes to allow for the distribution of the solution throughout the wound. Negative pressure is then applied at 125mmHg below atmospheric pressure for a sustained duration of up to six hours, after which the fluid instillation recurs.[6]

NPWT provides an impactful and exciting development in wound care, with different clinical applications. This article explains the mechanism of NWPT along with the indications, contraindications, and practical approaches to this advanced wound care modality.

II. History and Background of Negative pressure wound therapy (NPWT)

Negative pressure wound therapy (NPWT) in its most current form has been used steadily to heal complex wounds since its initial development in the early 1990's.[1] This therapeutic modality aids in formation of granulation tissue to facilitate wound healing. Recently the use of negative pressure wound therapy (NPWT) has been advocated in traumatic injuries likes those sustained in combat situations.[2]

While this technology seems relatively recent to modern medicine, its roots go back to the earliest civilizations. The use of the human mouth predated the sponge, sealant, and tubing used today. These rudimentary applications are explored in this journey back through the history of NPWT. Modern medicine should not forget its past, and the knowledge gained from our predecessors. This historic review highlights the development of NPWT from ancient times to the modern era.

During the Roman era, medical personnel were attached to the various armies throughout the vast empire.[3] Deep wounds sustained in battle and possible "poisonous wounds" plagued those who cared for the injured. Individuals who were thought to have hereditary powers of healing were assigned to give direct suction by mouth to the wound.[3] This treatment proved so successful that they were considered in-dispensible to the Roman army, and even Cato had a group of these sucking healers in his African campaign. The historian Suetonius wrote that one of these healers was ordered to suck the wound of Cleopatra to attempt to revive her from the bite of the asp.[3] As history proves this was not a successful venture.

Along with direct mouth suction, the use of "cupping glasses" were utilized to draw fluid out of an open wound. These dome shaped cupping glasses were applied over the wound site and left in place for at least

an hour to draw out fluid. To activate the suction, heat was applied on the inside of the glass and placed against the patient's flesh, as cooling occurred the suction increased.[3] If these glass vessels were not readily available then the good old standby, oral suction was performed.

By the 18th century, this "lip service" approach to wound healing was seen as disgusting, but still effective. Dominique Anel, a French Surgeon, noted men attached to his regiment known as the "wound suckers" would successfully clear blood clots and foreign bodies from the injured soldiers wounds.[4]

This gruesome and risky act of "wound sucking" inspired Dr. Anel to invent a suction syringe with a triangular tip and wide cannula to replace the need for direct mouth contact.[5] This tool was then used to drain abscesses and hematomas. The syringe was a welcome alternative to the lip service normally paid in this era.

Cupping remained a predominate form of negative pressure therapy throughout the 19th century. In 1821 Dr. Francis Fox, a British physician, invented the "Glass Leech" which was a suction apparatus with a wide neck cup and clung to the skin affectively much like that of a leech.[6] Later in 1890, Dr. Gustav Bier developed a cupping system with glass cups in a variety of shapes and sizes along with tubing and a bulb.[6] This allowed for wound secretions to be extracted from various parts of the body.

In the 20th century, the Russians were innovators in the area of negative pressure treatments. The Soviet-Afghanistan War drove this need for advancements in both surgical technique and wound care.[7] Dr. Nail Bagaoutdinov, a Soviet Surgeon, began using a negative pressure unit with foam dressings to treat infected wounds in 1985.[7] The modern NPWT systems came into being in the 1990's with the use of polyurethane foam and a mechanical vacuum pioneered by Drs. Louis Argenta and Michael Morykwas of Wake Forest University School of Medicine.[8]

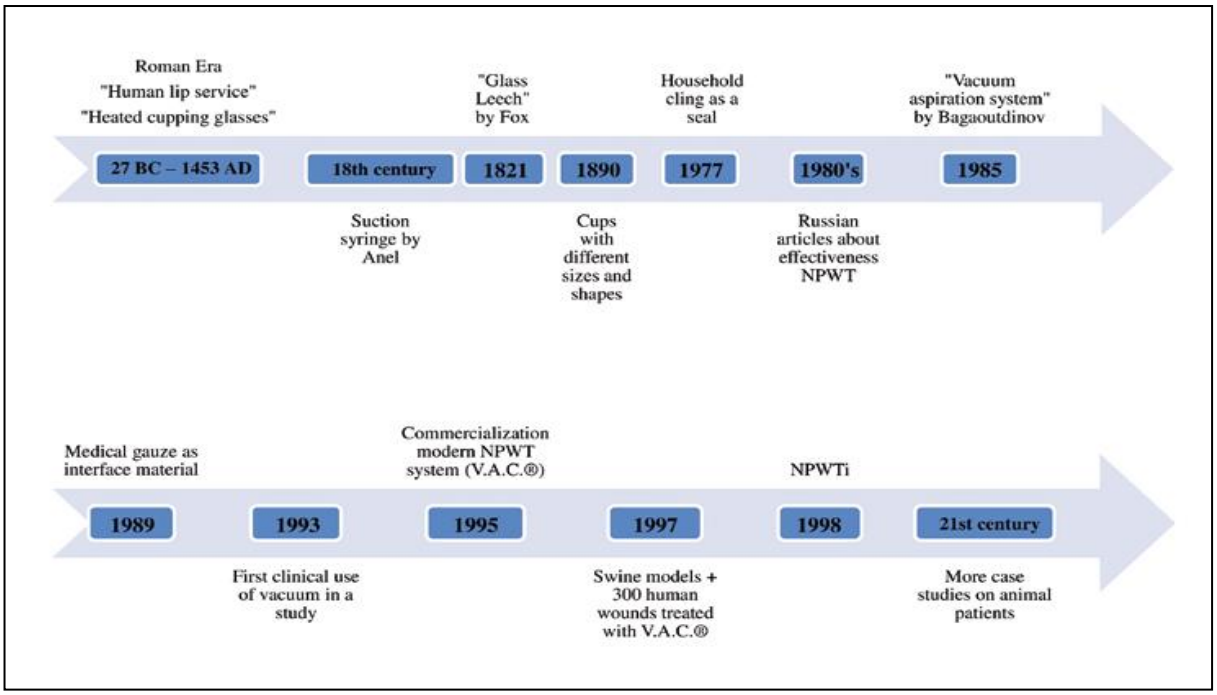

Fig. 02: Timeline History of NPWT.

III. Negative Pressure Wound Therapy Meaning and Definition

Negative pressure wound therapy helps a wound heal faster by removing fluid and bacteria with suction. It also protects your wound from harmful things in the air, creating a good environment for healing. This works for soft tissue wounds on many different areas of your body.

Negative pressure wound therapy is a treatment that pulls fluid and bacteria out of a wound to help it heal better. Some healthcare providers call it vacuum-assisted therapy. It works by creating suction. A provider can use this treatment to heal soft tissue on many different parts of your body. Less fluid leads to less edema (swelling). Negative pressure wound therapy allows the wound to compress down, making it smaller. It also encourages new healthy tissue to form in a clean, moist environment. A provider may use negative pressure wound therapy in the operating room after cleaning a wound and closing it. After that, a provider can visit your hospital room to change the dressings and ensure a tight seal on your wound. If you use this therapy at home, you can visit a clinic for dressing changes. Negative pressure wound therapy is a very common treatment providers use for wounds. Millions of people around the world have used it since doctors invented it in the 1990s.

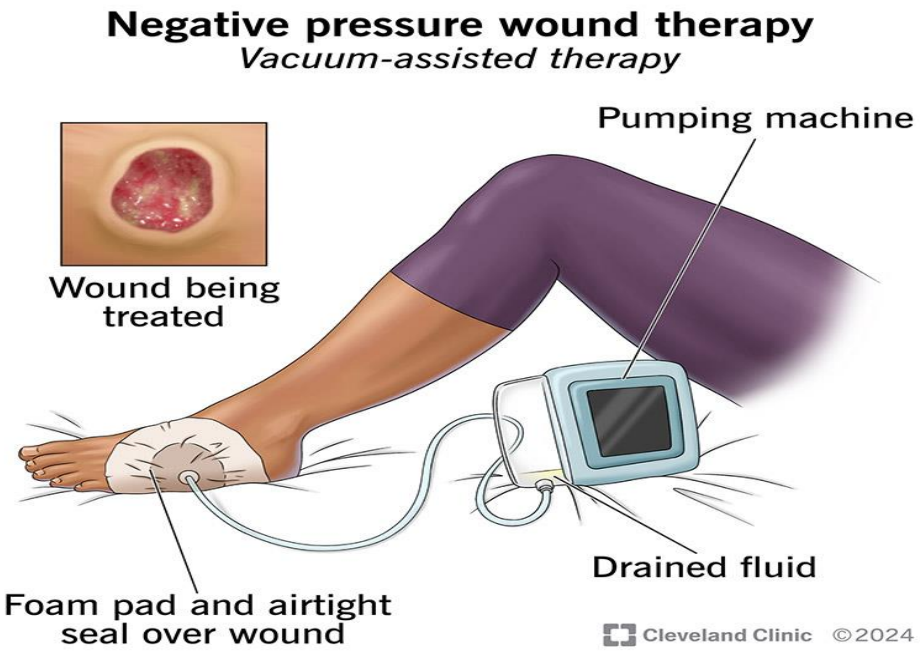

Fig. 03: NPWT uses a machine to take fluid and bacteria from wound.

IV. Types of Wounds Treated by NPWT

While many types of wounds can be treated using NPWT, it is commonly used for wounds that are at risk of not healing or have already stalled (Source 10). In addition to pressure ulcers, diabetic ulcers, and postsurgical wounds, NPWT is used for traumatic wounds, vascular leg ulcers, and sometimes burns. (Source 1, 5, 7, 9). The appropriate amount of negative pressure can vary depending on the type of wound, location, and other individual factors related to the patient. While fundamental application principles apply to all, there are some unique considerations for certain wound types.

A. Pressure Ulcers

Once effectively offloaded, NPWT can be extremely helpful in decreasing the size of the wound as well as managing the significant exudate commonly seen in these sites. Generally, a continuous pressure of -125mmHg is standard for pressure ulcers located at the hips/sacrum/buttocks.

B. Diabetic Foot Ulcers

Diabetic Foot Ulcers generally treated with a continuous pressure range from -80mmHg NPWT cannot be used in patients who ambulate on the wound or patients with acute infection. Compliance with offloading is essential in these patients. If in doubt, it is best to use an alternate dressing material.

C. Postsurgical (trauma, skin grafts, flaps, dehisced wounds, other)

Treatment pressure ranges from -50mmHg to -100mmHg is recommended for skin grafts and other surgical sites (Source 7, 9, 10). Vacuum pressure is typically determined by the amount of exudate and contour of the wound bed. NPWT is often used as an adjunct in clinic or office applications of allografts, xenografts, and synthetic materials. Outpatient application of these products can be significantly facilitated by NPWT in terms of stimulating tissue ingrowth, managing exudate, and keeping the graft in place.

D. Burns

Localized full-thickness burn wounds may be treated with a combination of negative pressure in conjunction with a graft. There must be uninjured skin all around the wound to allow for the application of the device's adhesive film, making it unsuitable for extensive burn injuries.

Partial thickness burns do not typically benefit from NPWT.

E. Venous leg ulcers

One must be mindful of wound exudate and peri-wound skin when considering NPWT for venous wounds. Many patients with venous disease have severe lichenification and/or maceration, which prevents the effective placement of the adhesive film required for the device. On carefully selected patients, however, an ultraportable device can be useful and allow the patient continued ambulation. The patient still requires standard management of venous insufficiency, including leg elevation and compression.

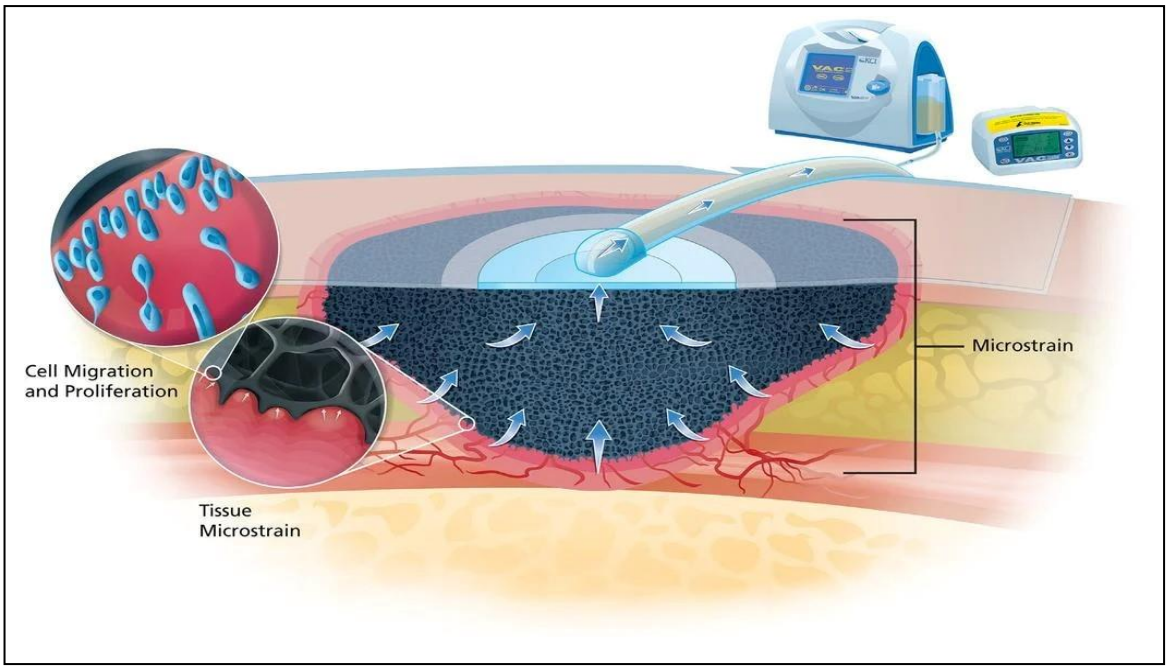

Fig. 04: Mechanism of NPWT.

V. Negative pressure wound therapy work

Negative Pressure Wound Therapy (NPWT) is a medical technique that utilizes controlled suction to accelerate wound healing and promote tissue regeneration. The process involves the application of a specialized dressing to the wound site, creating an airtight seal. A connected vacuum pump then creates a controlled negative pressure within the dressing, which exerts a pulling force on the wound area. This pulling force serves several purposes:

- **Removal of Excess Fluid:** The negative pressure helps to draw out excess fluid, blood, and other wound exudates. This reduces swelling and minimizes the risk of infection by clearing away debris and bacteria.
- **Enhanced Blood Flow:** NPWT promotes improved blood circulation around the wound area.
- This increased blood flow delivers essential nutrients, oxygen, and immune cells that are crucial for tissue repair and growth.
- **Tissue Contraction:** The negative pressure can cause gentle contraction of the wound edges, aiding in wound closure and reducing the wound's overall size.
- **Stimulation of Granulation Tissue:** The controlled suction encourages the formation of granulation tissue the new connective tissue that supports wound healing.
- **Reduced Bacterial Load:** By removing excess fluid and promoting a healthier wound environment, NPWT helps to decrease the bacterial load within the wound, reducing the risk of infection.
- **Increased Healing Factors:** The mechanical stress applied by the negative pressure can trigger the release of growth factors that promote cellular activity and tissue regeneration.

NPWT is particularly useful for chronic wounds, diabetic ulcers, pressure ulcers, and post-surgical wounds that are slow to heal. It should be administered under the guidance of medical professionals who can assess the wound's progress and make adjustments to the therapy as needed.

VI. Benefits of Negative Pressure Wound Therapy

Negative Pressure Wound Therapy (NPWT) offers several benefits in the field of wound care and management:

- **Enhanced Wound Healing:** NPWT promotes faster wound healing by increasing blood flow, oxygen delivery, and nutrient supply to the wound area, which is essential for tissue regeneration.
- **Reduced Infection Risk:** The removal of excess fluid and debris, along with the creation of a controlled wound environment, helps lower the risk of infection by minimizing bacterial colonization.
- **Management of Exudate:** NPWT efficiently removes excess wound exudate, reducing the risk of maceration (softening of skin due to prolonged exposure to moisture).
- **Stimulation of Granulation Tissue:** The therapy encourages the formation of granulation tissue, which is crucial for wound healing as it provides a scaffold for new tissue growth.
- **Closure of Wound Edges:** NPWT can gently bring together wound edges, facilitating wound closure and reducing wound size.
- **Pain Management:** By reducing pressure on nerve endings and creating a stable wound environment, NPWT can alleviate pain associated with some chronic wounds.

- **Minimized Scarring:** Proper wound healing through NPWT can result in less noticeable scarring and better aesthetic outcomes.
- **Broad Applicability:** NPWT can be used for a variety of wound types, including diabetic ulcers, pressure ulcers, surgical wounds, traumatic wounds, and more.
- **Versatility:** NPWT can be customized and adjusted based on wound characteristics and healing progress, allowing for individualized treatment plans.
- **Patient Comfort:** By promoting quicker healing and reducing pain associated with chronic wounds, NPWT can significantly improve a patient's overall comfort and quality of life.

It's important to note that NPWT should be administered under the supervision of healthcare professionals who are experienced in wound care. The benefits of NPWT can vary depending on the specific wound, patient's overall health, and adherence to the treatment plan.

VII. Negative pressure wound therapy (NPWT) in modern Era.

A. Development of Negative pressure wound therapy from 18th to 19th Century Innovations

The 18th and 19th centuries marked a period of significant medical advancement, influencing the development of NPWT. Innovators of the time introduced more refined **suction devices**, which were crucial in the transition from manual methods to mechanical solutions. The period also saw the first documented medical studies exploring the effects of negative pressure on wound healing. These studies provided a scientific basis for the techniques, validating the observations made by earlier practitioners and setting the stage for further innovations. Key figures in medicine during these centuries pioneered experiments and developed technologies that directly contributed to the principles underlying modern NPWT.

B. 20th Century Breakthroughs and the Advent of Modern NPWT Systems

The real transformation in wound care began in the 20th century with significant breakthroughs that led to the development of modern NPWT systems. Technological advancements during this era enabled the creation of portable NPWT devices, which offered more controlled and effective treatment options. These devices allowed for precise pressure adjustments, better wound monitoring, and were more user-friendly, making them suitable for widespread clinical use. The culmination of these advancements was marked by significant clinical trials and subsequent FDA approvals, which heralded the acceptance of NPWT in mainstream medicine. These milestones not only validated the efficacy of NPWT but also established it as a standard of care for managing complex wounds, significantly impacting patient outcomes.

C. Current Applications of NPWT in Healthcare

Negative Pressure Wound Therapy is a vital tool in modern healthcare, widely used across various settings to manage both acute and chronic wounds. This therapy is particularly effective for treating conditions such as diabetic ulcers, burns, and surgical incisions. The benefits of NPWT are significant, including faster healing times and reduced infection rates, which contribute to its popularity in wound management.

VIII. Role of NPWT in Modern Wound Management

NPWT plays a crucial role in the landscape of contemporary wound management. It is an integral part of the treatment plans for patients who require careful wound monitoring and management. Health authorities and professional bodies often recommend NPWT as a standard care procedure due to its effectiveness in promoting healing and preventing complications. Here's how NPWT fits into modern medical practice:

- **Enhances healing**: By reducing edema and improving circulation.
- **Decreases bacterial load**: Helps in lowering the risk of infections.
- **Promotes tissue growth**: Encourages the formation of granulation tissue.

IX. Integration and Impact of NPWT in Long-term Care Facilities

In long-term care facilities, NPWT has been a game-changer, especially for treating elderly patients or those with mobility issues. Integrating NPWT into these settings involves several considerations:

- **Staff training**: Ensuring that the care teams are well-versed in operating NPWT devices.
- **Cost implications**: Balancing the benefits of NPWT with its costs to manage budgets effectively.
- **Patient outcomes**: Monitoring the improvements in patients' conditions to assess the effectiveness of NPWT.

Several facilities have reported positive changes after incorporating NPWT into their care protocols, noting better wound healing rates and enhanced patient satisfaction. These successes underscore the value of NPWT in improving the quality of care in long-term settings.

X. Technological Advancements in NPWT

Negative Pressure Wound Therapy (NPWT) has seen significant technological advancements that have greatly enhanced its functionality and accessibility. The development of more sophisticated **NPWT pumps**, **canisters**, and **dressings** has revolutionized how wounds are treated across various settings, including the expanding field of in-home care. These innovations have made NPWT systems not only easier to use but also more effective in managing wound care.

Several key innovations have played pivotal roles in enhancing the efficiency of NPWT systems.

Improvements in battery life and portability have made these devices more accessible to a broader range of healthcare providers and patients. Modern NPWT devices feature user-friendly interfaces that simplify the management of wound care, making the systems more appealing and easier to handle. Noteworthy advancements include:

- **Extended battery life**: Allows for longer use without the need for frequent recharging, facilitating uninterrupted treatment.
- **Enhanced portability**: Ensures that patients can maintain their daily routines with minimal disruption while undergoing continuous wound therapy.
- **Improved user interfaces**: Make it easier for both patients and healthcare providers to operate the device, ensuring proper usage and adherence to treatment protocols.

Recent **patents** and **industry awards** have recognized these technological advancements, underlining their importance and impact in the field of wound care.

DISCUSSION

Negative Pressure Wound Therapy represents a major shift in wound management, combining mechanical and physiological principles to create an ideal healing environment. The discussion highlights several key areas:

1. Mechanistic Strength of NPWT

NPWT improves wound outcomes through multiple synergistic effects—fluid removal, reduction of bacterial load, stimulation of angiogenesis, and micro-deformation–induced tissue growth. These effects are particularly beneficial in wounds with high exudate, contamination, or delayed healing potential.

2. Broad Clinical Utility

The therapy is applicable to a wide range of acute and chronic wounds, including traumatic injuries, diabetic ulcers, dehisced surgical wounds, and graft sites. Tailoring pressure levels according to wound type enhances treatment success.

3. Historical Evolution

The document underscores the long human effort to use suction to heal wounds—from Roman healers to early suction syringes—culminating in modern VAC systems. This historical context highlights the continuity and refinement of negative pressure concepts.

4. Technological Innovations

Modern NPWT systems now include portable devices, improved dressings, adjustable suction levels, and fluid-instillation therapy. These advancements increase convenience, mobility, and adaptability for both inpatient and outpatient care.

5. Implementation Challenges

Despite clear benefits, NPWT requires trained personnel, proper patient selection, and consideration of cost. Adhesive seal limitations (e.g., in venous ulcers with lichenified skin) and complications in non-compliant patients (e.g., ambulating on diabetic foot ulcers) remain challenges.

6. Role in Modern Healthcare Settings

NPWT is increasingly integrated into long-term care facilities and home-based wound management programs, improving patient comfort and reducing hospital stays. Evidence-based guidelines and RCTs support its use in surgical wounds healing by secondary intention.

CONCLUSION

Negative Pressure Wound Therapy has become an indispensable tool in contemporary wound care, transforming the management of complex, contaminated, and chronic wounds. By optimizing the wound environment, reducing infection risk, and promoting rapid granulation tissue formation, NPWT significantly improves healing outcomes across diverse clinical scenarios. Its evolution from ancient suction practices to modern, technology-driven systems demonstrates its longstanding therapeutic value. Continued advancements in portable devices, instillation therapy, and user-friendly interfaces are expanding NPWT's accessibility and effectiveness. As clinical evidence continues to support its benefits, NPWT is poised to remain a cornerstone of advanced wound management in both hospital and long-term care settings.

REFERENCES

1. Sinha K., Chauhan V.D., Maheshwari R., Chauhan N., Rajan M., Agrawal A. Vacuum assisted closure therapy versus standard wound therapy for open musculoskeletal injuries. Adv Orthop. 2013 doi: 10.1155/2013/245940.
2. Bonner TJ, Mountain A, Allison K, Sargent I, Adedapo S. Management of a complex hind foot war injury with negative wound therapy: a case study. *Foot (Edinb)*. 2009; 19: 177-180.
3. Harris T. Poisoned wounds. The Medical Examiner. 1838; 1: 250-254.
4. Price J. Dominique anel and the small lachyrmal syringe. Med History, 1969; 13: 340-354.
5. History of Syringes. Faculty of Health Sciences, n.d. Available at: http://health.adelaide.edu.au/surgery/society/A%20history%20of%20syringes.pdf
6. Davis A., Appel T. Printers' Devil; Arlington, MA: 1979. Bloodletting instruments in the national museum of history and technology; pp. 27–33.
7. Otterbourg K. The bloody patent battle over a healing machine. Fortune Management. CNN Money, Oct-Nov. 2012.
8. Dirckx John H. Negative pressure wound therapy. Health Professions Insititure. December 2008:17-18.

9. Chetter IC, Oswald AV, Fletcher M, Dumville JC, Cullum NA. A survey of patients with surgical wounds healing by secondary intention; an assessment of prevalence, aetiology, duration and management. *J Tissue Viability* 2017; 26: 103–07.
10. Chetter IC, Oswald AV, McGinnis E, et al. Patients with surgical wounds healing by secondary intention: a prospective, cohort study. *Int J Nurs Stud* 2019; 89: 62–71.
11. Sandy-Hodgetts K, Carville K, Leslie GD. Determining risk factors for surgical wound dehiscence: a literature review. *Int Wound J* 2015; 12: 265–75.
12. McCaughan D, Sheard L, Cullum N, Dumville J, Chetter I. Patients' perceptions and experiences of living with a surgical wound healing by secondary intention: a qualitative study. *Int J Nurs Stud* 2018; 77: 29–38.
13. Saramago-Goncalves PR, Claxton K, Welton N, Soares M. Bayesian econometric modelling of observational data for cost-effectiveness analysis: establishing the value of negative pressure wound therapy in the healing of open surgical wounds. *J R Stat Soc Ser A Stat Soc* 2020; 183: 1575–93.
14. Chetter I, Arundel C, Bell K, et al. The epidemiology, management and impact of surgical wounds healing by secondary intention: a research programme including the SWHSI feasibility RCT. NIHR Journals Library, 2020.
15. Dumville JC, Owens GL, Crosbie EJ, Peinemann F, Liu Z. Negative pressure wound therapy for treating surgical wounds healing by secondary intention. *Cochrane Database Syst Rev* 2015; 2015: CD011278.
16. Negative Pressure Wound Therapy (NPWT). https://www.3m.co.uk/3M/en_GB/Medical-GB/products/negative-pressure-wound-therapy/ (accessed May 15, 2024).
17. Monsen C, Wann-Hansson C, Wictorsson C, Acosta S. Vacuum-assisted wound closure versus alginate for the treatment of deep perivascular wound infections in the groin after vascular surgery. *J Vasc Surg* 2014; 59: 145–51.
18. Armstrong DG, Lavery LA. Negative pressure wound therapy after partial diabetic foot amputation: a multicentre, randomised controlled trial. *Lancet* 2005; 366: 1704–10.
19. Biter LU, Beck GMN, Mannaerts GHH, Stok MM, van der Ham AC, Grotenhuis BA. The use of negative-pressure wound therapy in pilonidal sinus disease: a randomized controlled trial comparing negative-pressure wound therapy versus standard open wound care after surgical excision. *Dis Colon Rectum* 2014; 57: 1406–11.
20. Dalla-Paola L, Carone A, Ricci S, et al. Use of vacuum assisted closure therapy in the treatment of diabetic foot wounds. *J Diabet Foot Complications* 2010; 2: 33–44.
21. Liu Z, Dumville JC, Hinchliffe RJ, et al. Negative pressure wound therapy for treating foot wounds in people with diabetes mellitus. *Cochrane Database Syst Rev* 2018; 10: CD010318.
22. Chetter I, Arundel C, Martin BC, et al. Negative pressure wound therapy versus usual care for surgical wounds healing by secondary intention (SWHSI-2 trial): study protocol for a pragmatic, multicentre, cross surgical specialty, randomised controlled trial. *Trials* 2021; 22: 739.
23. Elia M. The MUST report: nutritional screening of adults a multidisciplinary responsibility. Development and use of the 'Malnutrition Universal Screening Tool' ('MUST') for adults. BAPEN, 2003.
24. National Institute for Health and Care Excellence. Nutrition support for adults: oral nutrition support, enteral tube feeding and parenteral nutrition (CG32). National Institute for Health and Care Excellence, 2017.