The use of negative pressure wound therapy: Recommendations by the Wound Healing Association of Southern Africa (WHASA)

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Note that these recommendations are open to commentary from clinicians and can be amended based on these comments and from further research and development.

Definitions

Open abdomen: An open abdomen is usually the result of trauma, abdominal sepsis, severe, acute pancreatitis and in general situations in which intra-abdominal hypertension develops. The main aim of leaving the abdomen open is to prevent abdominal compartment syndrome, controlling bleeding and preventing contamination.[1] This term is generally used in the abdominal wall cannot be closed primarily, regardless of the cause.

Dehisced abdominal wound: Dehisced surgical wounds are defined by the separation of the incision line prior to complete healing resulting in an open wound. Dehisced abdominal wound usually implies the wound has split open, but the abdominal wall remains closed. If the latter has dehisced too, then it is an open abdomen. Abdominal wound dehiscence (burst abdomen, fascial dehiscence) is a severe postoperative complication that can result in evisceration, which is a medical emergency.[2]

Conventional dressings: Conventional dressing is a sterile pad or compress applied to a wound to protect the wound from further harm but does not necessarily mean that the dressing promotes healing.

Advanced dressings: Advanced wound care therapies are focused on keeping the wound moist to encourage healing, following the philosophy that a moist microenvironment promotes the natural healing process.[3] Advanced dressings would include those seen in wound classifications, such as that set out in the WHASA wound classification. These include dressings that can aid debridement, manage moisture, treat infection and promote epithelial advancement.[4] Negative pressure wound therapy (NPWT) on the other hand is seen as a dynamic application.[3]

Deep tissue infection: Deep tissue infection or spreading infection describes the invasion of the surrounding tissue by infective organisms that have spread from a wound. Microorganisms proliferate and spread, to the degree that signs and symptoms extend beyond the wound border. Spreading infection may involve deep tissue, muscle, fascia, organs or body cavity.[5]

Full-thickness burn: When the epidermis and dermis are both destroyed and the burn extends down into the **subcutaneous tissue**, including fat, muscles and even bones, this is referred to as a full-thickness burn (third- and fourth-degree burn).[6]

Another contributing factor to burn severity is how much of the total body surface area (TBSA) is affected. The "rule of nines" is a method of approximation used to determine what percentage of the body is burned in adults. Partial- or full-thickness burns on more than 15% of the body require immediate professional medical attention. The following approximations can be used for adults:

- Head (front and back) ~ 9%
- Front of the torso ~ 18%
- Back of the torso ~ 18%
- Each leg (front and back) ~ 18%
- Each arm (front and back) ~ 9%
- Genitals/perineum ~ 1%

Primary intention: Closure by primary intention occurs if there is no loss of tissue, or when the wound is surgically closed immediately following the injury by direct approximation of the wound margins or by graft or flap.[7]

Secondary intention: Healing by secondary intention occurs when damage has resulted in the loss of tissue and where the skin edges cannot be brought together for wound closure.[8] The injury will extend to deep tissue involving the epidermis, dermis, and underlying tissue. The wound healing process takes longer due to the volume of connective tissue required to fill the wound. Wounds heal by secondary intention where the wound granulates from the base up and epithelialises to form a larger area of scar tissue.[7] Examples of wounds allowed to heal this way are dehisced abdominal wounds complicated by infection or chronic wounds such as pressure injuries when surgery is not an option.

Tertiary intention: Tertiary intention (delayed primary closure) occurs when a wound is initially left open after debridement of all non-viable tissue. Wound edges are surgically brought together after a period of open observation, when the wound appears clean and well-vascularised. If they cannot be brought together then tissue is brought in to reconstruct the defect using skin grafts or flaps. Tertiary intention can also refer to subsequent surgical repair of wounds that were initially left open or not previously closed due to extensive oedema, tissue loss or devitalised tissues or if severely contaminated or infected (deep tissue infection).[9]

Abbreviations

ciNPWT – Closed incisional negative pressure wound therapy

NPWT – Negative pressure wound therapy

NPWTi-d – Negative pressure wound therapy with instillation and dwell time

MOA – Mechanism of action

TBSA – Total body surface area (applicable to burns)

1. Introduction

Wound healing is a complex and dynamic process, wound management is evolving, and modern wound management is a major contributor towards faster wound healing.[10] Funding advanced technologies may reduce additional cost for frequent clinician visits and the use of more products at each visit.

Negative pressure wound therapy as a treatment modality is supported by a large body of evidence which includes RCTs, cohorts and case series, which have demonstrated the benefits of NPWT in managing both chronic and acute wounds. While there is a large body of evidence available on NPWT, even the RCTs are often considered of poor quality, but this has more to do with the known challenges of conducting trials on wound care products often due, not least of all, to the heterogenous nature of wounds and patients. This is well known but nonetheless such guidelines give greater credence where this "best available evidence" is used with clinical experience i.e., evidence-based practice.[11]

As clinical scenarios vary so do clinical indications for NPWT. Even if it were possible to develop guidelines for the use of NPWT, there will always be cases that fall outside of these guidelines but where its use would be indicated. Similarly, there may be cases for which NPWT is not ideal but that fall within the guidelines for its use. Recommendations that are embedded in a purely academic perspective might not represent clinical practice and could be problematic to apply in clinical settings.[7] WHASA believes that advanced wound management lends itself towards a genuine "evidence-based medicine" approach, where practitioners should make conscientious, explicit, and judicious use of current best evidence in making decisions about the care of the individual patient. It means integrating individual clinical expertise with the best available external clinical evidence from systematic research.

WHASA, as a multidisciplinary organisation, incorporating a team approach towards wound healing, and the primary resource for healthcare professionals to foster research and education while advancing wound management has produced these best practice recommendations to further evidence-based wound care using NPWT in South Africa. These recommendations aim to promote optimum outcomes with NPWT cost-effectively and is the collaboration between wound care specialists across multiple surgical disciplines. WHASA, therefore, supports the recognition by EWMA that, while the ongoing controversy regarding high-level evidence in wound care, in general, is well-known, there is a consensus that clinical practice should be evidence-based. This can be difficult to achieve due to confusion about the value of the various approaches to wound management; however, we must rely on the best available evidence.

These recommendations have been adapted to the South African (SA) context, drawing from the best available international research and clinical expertise, complemented with uniquely a South African experience, when making treatment decisions for individual SA patients. These recommendations follow those of the European Union of Wound Healing Societies and therefore are not the result of a further comprehensive literature review, where this had been done extensively for the EWMA guidelines. (https://ewma.org/fileadmin/user_upload/EWMA.org/Project_Portfolio/EWMA_Documents/JWC_EWMA_supplement_NPWT_Jan_2018_appendix.pdf).

These SA recommendations are intended to be used by consumers, clinicians, policymakers and funders, and should be read in conjunction with current international guidelines and evidence of clinical best practice and experience, many of which are referenced in this paper, in the interests of improving patient-centred decision-making and outcomes for all parties involved.

These recommendations should not be viewed as a rewriting of any accepted guidelines, but as an attempt to draw attention to current best practice principles as practised in SA. WHASA does not intend to promote or impose any method or product on any individual patient, but reserve the right, as our responsibility, to inform them of available alternatives, and the rationale for these recommendations.

The WHASA expert panel recommends that clinicians applying NPWT should be trained as such. Several studies underline the fact that lack of skills and knowledge of the practitioner delivering the care contributes to unfavourable outcomes.[12]

2. Principal of negative pressure wound therapy

Notwithstanding the fact that the use of NPWT is proven as safe, certain circumstances may result in complications, despite being used under the "correct guidelines", if the practitioner does not understand the MOA of NPWT. The WHASA NPWT Expert Panel recommends an approach whereby the principles and MOA of NPWT and its resultant clinical outcomes is understood. Understanding what NPWT does to tissues will guide clinicians and medical funders to determine whether it is indicated for a specific treatment.

NPWT refers to a controlled negative pressure (sub-atmospheric) system that is applied topically onto or into the wound.[11] The wound is filled with a porous interface and sealed with an occlusive adhesive polyurethane drape. A drain connects the wound interface to the vacuum source that delivers a negative pressure. The suction is generated from the vacuum source to the wound bed, leading to a negative pressure in the interface and removal of exudate.[11]

Paradoxically, this negative pressure in the interface results in a compressive force on the wound, with a resultant increase in tissue pressure.[13] Understanding this paradoxical biomechanical phenomenon helps explain why NPWT is so effective in reducing oedema, more so than any other dressing or device. It also explains the MOA resulting in the collapsing of enterocutaneous fistulae, resulting in reduced fistula output. Lastly, it also explains why NPWT has the potential to reduce tissue perfusion adjacent to the foam, highlighting potential contraindications.[14] In some instances, this principle can even be used as an indication when capillary or lymphatic oozing from soft tissue needs to be controlled The latter would not be indicated on non-compressible tissue, such as bone.

It can therefore be seen that understanding these basic principles of the mechanism of action are far more important in determining the indications and contraindications of NPWT than literature alone.

It MUST therefore be understood that:

1. NPWT reduces tissue oedema
2. NPWT increases formation of granulation tissue
3. The above two primary MOAs result in an increase in perfusion at a later stage, which serves as a secondary MOA.
4. Used in conjunction with instillation with a dwell-time NPWT can reduce wound contamination.

The above four basic principles should form the foundation which guides clinical indications and contraindications for its use. Although a protocol listing the potential clinical indications for NPWT will be given by this panel, this serves merely as a set of examples of such indications and is by no means exhaustive of the possible indications (providing that the rationale behind its use is in keeping with the four basic principles described above).

3. Outcomes-based therapy

To measure efficacy of a treatment modality like NPWT, it is important to consider the intended outcome of the therapy and include this as a measure for efficacy. Considering the method of action of NPWT the following could be considered as outcome measures:

- Reduction in oedema
- Reduction in bioburden
- Granulation tissue formation
- Wound contraction
- Reduction in wound size
- Reduction in pain
- Wound bed prepared for secondary suture or grafting
- And an increase in patient quality of life.

Quality of life

Impact of NWPT on quality of life

Experience with NPWT demonstrates that, while wound closure may be enhanced, problems are encountered with patient compliance, malodour, and occasional pain during therapy. Moreover, ambulatory patients may be admitted to hospital are immobilised during treatment when the standard NPWT is applied. If patient satisfaction, which is related to QoL, is diminished as a result of these problems, then issues with compliance can be anticipated, potentially leading to poor results. While patients may be inconvenienced for a short period when 'attached' to the device, the trade-off is the faster healing rate. The ultimate goal is to ambulate these patients in the shortest time without compromise to wound healing.

All patients should be told about physical symptoms such as pain, malodour and discomfort. Patients should be told of quality-of-life issues prior to TNP therapy. Given that treatment can be prolonged, they should be warned of possible changes in their quality of life during or after it. For example, ambulatory patients need to be told that negative pressure may impair their physical symptoms. Although NPWT aids wound closure in complex wounds, it may worsen the QoL of some patients.

The first exploratory study to investigate changes in health-related quality of life (HRQoL) in a cohort of patients undergoing NPWT presented with acute and chronic wounds was conducted by Mendonca et al.[15] Prior to this, there have been no published studies on quality of life in patients receiving NPWT.

Vuerstaek et al. compared QoL, pain scores, the total time needed for wound care until complete wound closure, and the costs per ulcer in a prospective randomised trial of treatment of chronic leg ulcers comparting NPWT and modern wound dressings. Quality of life. The study groups showed significant increases in QoL at the end of therapy. During the first week, the QoL score was significantly lower in the NPWT group, however, this difference disappeared in the second week. A possible explanation for the initial decrease in QoL might be that patients experienced the necessity of strict bed rest in this study as a factor negatively influencing QoL. This is assumed to change with patients being more ambulatory already in the first week using portable NPWT units, which should be the aim for all patients.[16]

Ousey et al. (2014)[17] found that NPWT patients achieved better social life scores than those on standard therapy, probably attributed to the patient being more confident to go out and due to exudate containment, not living alone and in future potentially improve with the introduction of smaller and patient-friendly devices.

Quality of Life (QoL) can and is affected by many factors: disease process, social factors, intelligence, expectations, anxiety and depression, patient involvement and perceived control. It would be difficult for any study to measure all these factors and to accurately ascertain the relative impact of each.

To do so would necessitate a healthy baseline pre-disease questionnaire, a living with chronic disease questionnaire, pre-wound, and post-wound questionnaires, coupled with an analysis of intelligence, coping, social interaction and other complex factors such as perceived relationships with health care professionals and the level of inclusion in decision-making with regard to patient care.[18]

A systematic review by Jansen et al. observed that QoL temporarily lowered during the first week of treatment, possibly due to anxiety, after which a similar or better QoL was reported when compared with standard wound care. Benefits can be summarised as an overall decrease in the frequency of patient disturbance for wound management and improved comfort when moving. The reported free range of movement during NPWT was a surprising major positive characteristic if a portable device was used. When non-transportable NPWT devices are used, motion restriction and hospitalisation may lead to higher levels of anxiety.[11]

Many authors conclude that true QoL can only be elicited if an accurate baseline is established, or if data is collected over a long enough period to allow comparison of scores over time.

4. Cautions and special precautions in the use of NPWT

Cautions and special precautions will be addressed under each different wound aetiology. The list below outlines contra-indications for NPWT.

Caution should be taken in the following instances: (adapted from 11)

- Clotting disorders
- Active bleeding in the wound bed, post debridement, unless the bleeding is minor capillary bleeding in a soft wound bed
- Exposed organs, vasculature, or anastomoses
- Presence of eschar or dry necrosis on the wound bed
- Neoplastic tissue
- Untreated osteomyelitis
- Non-enteric and unexplored fistulae

5. Fundamentals of NPWT systems

This section will describe the technology, i.e., the different delivery systems (how they function) and a description of the different interface applications.

- Core NPWT
- NPWT with installation
- NPWT for the treatment of open abdomens
- Incisional negative pressure therapy

Technology description and key features required of NPWT therapy units and dressing systems

NPWT therapy units	NPWT foam dressing sets (usually includes dressing, drape, tubing with relevant pressure pads, connectors, ruler etc.)		
Therapy units may provide one or all the following therapies for ambulatory treatments: • NPWT • NPWTi-d • CiNPT • Open abdomen (OA)	**Open pore, hydrophobic, reticulated polyurethane foam dressing**	**Open pore, hydrophobic, reticulated foam and silver dressing**	**Polyvinyl alcohol (PVA) dressing**
Adjustable pressure settings and therapy modes ideally in increments of 25 mmHG from -25 to -200 mmHg	Assists granulation tissue formation, facilitates and enhances exudate removal, while providing a closed, moist wound healing environment while proving an equal distribution of negative pressure to the wound bed	Micro bonded with metallic silver via a proprietary metallisation process, providing an effective barrier to bacterial penetration	When granulation tissue needs to be controlled for more comfortable dressing changes and can be used where hyper granulation responses are likely, for tunnels and undermining and to bolster split thickness skin grafts to assist in minimising discomfort
Prescribed pressure level should be maintained at the wound site for optimal healing outcomes	Foam should be easily trimmed to fit the contours of deep or irregularly shaped wounds	Dressing pores should come in direct contact with the wound, eliminating the need for additional silver dressing layers that may inhibit negative pressure and granulation.	Should have a higher tensile strength facilitating removal from tunnels and undermining
Leak detection helps to identify and troubleshoot dressing leaks early; should include audible alerts	Availability of a variety of configurations for bridging techniques and offloading when treating multiple wounds	Micro-bonded metallic silver should be uniformly distributed throughout the dressing, providing silver even after sizing	Open cell non-reticulated properties help minimise ingrowth of granulation tissue for a more comfortable dressing change
Aids prevention and clearance of blockages	NPWTi-d dressings should provide even distribution and removal of topical wound solutions across the wound bed. Used when granulation is NOT a primary treatment goal in the wound healing process, but rather for effective wound cleansing, particularly cavity wounds or wounds with complex geometries.	Protection provided should be an effective barrier to bacterial penetration and able to able to reduce aerobic, gram-negative bioburden	Less adherent material than normal dressing for use as a bolster for skin grafts. Pre moistened with sterile water
Large interface screen that simplifies therapy programming	Specialised NPWTi-d dressings are available for use to cleanse the wound, promote wound healing, and facilitate the removal of infectious materials. Provides mechanical movement at the wound surface in combination with cyclic delivery and dwell of topical solutions, which facilitates removal of thick wound exudate, such as fibrin, slough, and other infectious materials. Provides clinicians with another option to help clean large complex wounds when complete surgical debridement is not possible or appropriate.		
Continuous and intermittent with dynamic pressure control (DPC) maintains a steady and/or a low level of negative pressure at the wound site	ciNPT dressings using the same open cell reticulated foam should allow even pressure distribution, create a barrier to external contaminants, conform to articulating joints for movement and contain ionic silver.		
For NPWTi-d system should have the option to determine the correct fluid volume usage during instillation phase	ciNPT dressings are intended to manage the environment of surgical incisions that continue to drain following sutured or stapled closure by maintaining a closed environment and removing exudate via the application of negative pressure wound therapy		

For NPWTi-d volumetric fluid delivery of solutions should be automatic and repetitive without need for dressing removal	Specialised open abdomen (OA) dressing sets should contain a fenestrated visceral protective layer, perforated foam, tubing set, drape and requisite canister for large volume exudate removal		
Downloadable history reports. Image capture and storage on the unit may be an advantage	The ideal open abdomen (OA) dressing system should allow for rapid access for re-entry, reduce facial damage, separate abdominal wall and viscera and enhance fluid removal from paracolic gutters. Furthermore, the foam should provide suitable medial tension that helps minimise facial retention and loss of domain		
Canisters for collection of wound exudates should be available with therapy units in relevant sizes subject to exudate volume, e.g., 300 ml, 500 ml, 1 000 ml			
ciNPT therapy units should deliver a continuous negative pressure (e.g., -50 to -125 mmHG)	ciNPWT consists of a closed, sealed system that applies suction (negative pressure) to the incision site. The incision is covered or packed with an open-cell foam or multi-layer absorbent dressing. Continuous negative pressure ranging from -50 mmHg to -125 mmHg is maintained by connective tubing between the dressing to a vacuum pump. This helps promote healing by maintaining a sealed environment, holding the incision edges together and removing exudate	Devices that contain a canister draw fluid and infectious material away from the incision site and into a replaceable canister. Devices with canisters can manage surgical incisions with high exudate levels. Canister-less devices hold fluid in the dressing and rely on fluid evaporation to manage exudate. Canister-less devices can manage incisions with lower exudate levels	

6. Recommendations according to wound aetiology

The following section will describe how negative pressure therapy is applicable according to the different wound aetiologies as well as recommendations from WHASA. We have utilised a "traffic light" system in the level of recommendations.[19]

Strong recommendation: strong levels of evidence support this recommendation.	 Yes, definitely use it
Moderate recommendation: moderately strong levels of evidence and expert opinion supports this recommendation.	 Consider utilising the therapy
Weak recommendation: Levels of evidence are not sufficient, or this is a contra-indication for use.	 Definitely don't use it

6.1 Traumatic or surgical wounds

Description of the wound aetiology

Traumatic wounds include but is not limited to the following examples:

- preoperative flap or graft
- large open soft tissue defects
- exposed bones, tendons, or blood vessels (appropriate choice of foam or interface dressing required in these circumstances)
- fasciotomy wounds
- open degloving injuries with skin loss
- Open fractures where the skin defect could not be closed primarily.

Evidence review

NPWT should be used as first-line treatment in preoperative wound bed preparation post debridement of any wound, for 7–10 days prior to definitive surgery,[7] unless the definitive surgery cannot be undertaken due to systemic factors, e.g. hypoalbuminaemia In these situations, NPWT can be used as an interim dressing to keep the wound in its newly debrided state until the systemic factors have been corrected.

Similarly, for open fractures where the skin defect could not be closed primarily, NPWT should be utilised between initial debridement and final soft tissue reconstruction as it significantly reduces morbidity and healing times.[11] When utilising NPWT as a treatment modality the primary treatment goal should be wound closure by either secondary intention or preparing the wound for surgical closure.[20,21]

Recommendations

Indication	Recommendation
For open fractures that could not be closed primarily, NPWT should be utilised between initial debridement and final soft tissue reconstruction as it significantly reduces morbidity and healing times.	

Traumatic or surgical wounds where there is a need for oedema reduction and/or stimulation of granulation tissue is required to facilitate closure by secondary intension or by delayed primary closure or reconstruction with skin grafts or flaps.	
Take caution to use appropriate interface when tendon or bone is exposed (moistened white foam or wound contact layer), but NPWT is the treatment of choice when surgical procedures cannot cover exposed bone, tendon, or prosthesis	
Underlying arterial impairment not addressed	

6.2 Abdominal wounds

Description of the wound aetiology

The term "open abdomen" is used when the abdominal wall cannot be closed primarily, regardless of the cause.

An open abdomen can develop:

- As a result of blunt trauma, which refers to a type of physical trauma caused to a body part, either by impact or injury (e.g., automobile accidents).
- From penetrating abdominal trauma (e.g., gunshot, stabbing).
- From non-traumatic aetiologies, usually, a result of intra-abdominal sepsis:
  Open Abdomens are life threatening. NPWT facilitates decompression and expedites closure of the abdomen. The implications of secondary sepsis can be fatal which will lead to an increase in mortality rate. "Frozen Abdomen", which is caused by delayed closure, also increases length of stay with escalating costs. Forced abdominal wall closure could result in ischemia and necrosis of the abdominal facia.[1]

Evidence review

Betancourt et al. concluded in a cost evaluation of temporary abdominal closure methods in abdominal sepsis, that the costs relating to managing abdominal sepsis in the septic, open abdomen vary according to the temporary abdominal closure utilised.[22]

If the hospital length of stay, intensive care unit length of stay and number of surgeries required are the main parameters used in determining costs, the use of NPWTi-d with 0.9% saline solution instillation reduces costs by nearly 50% in comparison to conventional NPWT and Bogota Bag. In this instance, the method that appeared more expensive at first glance, resulted in a considerable cost reduction when compared to therapies that utilise less expensive materials.[22]

Recommendations

Indication	Recommendation
Open Abdomens are life threatening. NPWT facilitates decompression and expedites closure of the abdomen.	
NPWT with instillation is effective in reducing infection in an infected open abdomen.	

6.3 Dehisced abdominal wounds

Description of the wound aetiology

Any postsurgical dehisced abdominal wounds with an intact abdominal wall (no bowel exposed) where size and severity of the wound and exudate level cannot be managed by advanced wound dressings.

Evidence review

The mechanism of action of NPWT does not only contribute to mechanical drainage but also a reduction in dead spaces in wound defects as well as a reduction in bioburden and cellular activation.[11] With dehiscence, reducing peri-wound oedema means a secondary closure is possible sooner.

Recommendations

Indication	Recommendation
Any dehisced abdominal wounds with intact abdominal wall (no bowel exposed) where size and severity of the wound and exudate level cannot be managed by advanced wound dressings.	
NPWT with instillation is effective in reducing infection in an infected dehisced abdomen.	
Do not use if wound size and severity does not merit NPWT	

6.4 Sternal dehiscence

Description of wound aetiology

Sternal dehiscence is a complication of wound healing following open chest surgery. It carries a particularly high mortality rate (up to 35%).

Evidence review

Studies indicate the use of NPWT in the treatment of post-sternotomy mediastinitis is associated with reduced mortality as well as a reduced number of surgical interventions and treatments.[11] A retrospective comparative study between NPWTi-d and conventional dressings published by Chowdhry[23] showed that NPWTi-d reduced the time to wound closure, the number of therapy days, and the number of debridement/dressing changes for muscle flap reconstruction of pre-existing sternal wounds that had failed to close following a previous cardiac procedure.

In addition, this study showed that NPWTi-d followed by closure and application of ciNPWT reduced drain duration in closed sternal wounds when compared with conventional dressings followed by closure and application of wound closure strips.

Recommendations

Indication	Recommendation
NPWT is recommended for treatment in dehisced sternal wounds and is the method of choice for post sternotomy mediastinitis.	
NPWT should probably be used with caution in a haemodynamically unstable patient	
The open sternum is not an indication for NPWT due to underlying exposed structures that may rupture and bleed.	

6.5 Vascular surgery

Description of the wound aetiology

Complications arising from vascular surgery are limb and life threatening and infections in vessels and prosthetic vascular grafts carry a high morbidity and mortality rate as they can result in bleeding, sepsis, peripheral emboli, limb ischemia and death.

Evidence review

High levels of evidence support the use of NPWT for the treatment of infected vessels and vascular grafts.[24-26]

Recommendations

Indication	Recommendation
NPWT is recommended for treatment of in high-risk surgical patients with a fully exposed infected prosthetic vascular graft together with debridement and appropriate antibiotic therapy	
Continuous suction at lower levels is recommended to avoid bleeding (-50 to -100 mmHg)	

6.6 Diabetic foot ulcers

Description of the wound aetiology

A diabetic foot ulcer is described as an ulceration of the foot of a person that presents with Diabetes Mellitus and is associated with neuropathy and or peripheral arterial disease of the lower limb.[27]

Evidence review

It is important to note that early onset of NPWT and NPWT with instillation have been associated with shortened hospital stays and a higher percentage of limb salvage, with consequent decreased overall medical costs.[28] Sajid et al.[29] concluded in a randomised control trial comparing NPWT with Advanced dressings in the treatment of diabetic foot ulcers that NPWT is more effective than advanced dressings in reduction of wound size, managing exudate and overall outcomes for patients with DFUs thus, earlier implementation is advised.[30]

Recommendations

Indication	Recommendation
NPWT should be utilised as first line treatment postsurgical intervention in the DFU if ischemia and infection has been excluded and is classified as a GRADE A2 or A3 as according to the University of Texas Classification.	
Armstrong et al.[30] recommended the use of negative pressure therapy for the treatment of diabetic foot ulcers as it increased healing rates when compared with standard wound care.	
Chronic diabetic foot wounds that do not demonstrate expected healing progression with standard or advanced wound dressings after 4 weeks of therapy should be considered for NPWT.	
NPWT must be considered as an advance therapy to achieve wound closure for Texas Grade 2 and 3 diabetic feet without ischaemia.[7] The use of NPWT on diabetic foot ulcers should be a second line treatment when no surgical debridement was done and only considered if a chronic wound has not reduced by 50% over a 4-week period despite optimised blood glucose management, addressing ischemia, utilising offloading and treating infection.[31]	
Ischemia due to concomitant peripheral arterial disease	

6.6 Skin grafts

Description of the wound aetiology

In order for skin grafts to take there needs to be a well-vascularised wound bed. In chronic wounds, a well-granulated wound bed represents a well-vascularised wound bed. NPWT appears to be the most successful modality to achieve a well-granulated bed and is commonly used to prepare wound beds for skin graft closure.

Skin grafts require immobilisation and light compression, without the presence of blood or fluid beneath them, in order to be incorporated successfully onto the wound bed. The MOA of NPWT addresses all of these factors successfully, hence its common use for skin graft fixation.

Evidence review

Preoperative wound bed preparation and postoperative graft stabilisation

Use of NPWT prior to grafting showed improved outcomes when compared to standard care.[32] There is strong evidence to suggest that there is an increase in skin graft take rate and improved scar quality after NPWT fixation of skin grafts.[11]

Recommendations

Indication	Recommendation
NPWT should be used as first line treatment to optimise a wound bed for skin grafting and also for intraoperative stabilisation in cases where there is a high risk of graft loss (grafts that are difficult to stabilise due to anatomical location or in patients with comorbidities).	

6.7 Burns

Description of the wound aetiology

Burn wounds are classified according to aetiology and severity and includes thermal burns, chemical or electrical burns or radiation burns. The depth and severity depict the treatment.

Evidence review

Strong levels of evidence suggest the early application of NPWT improves the quality of healing as it reduces oedema and optimises wound healing, moreover it reduces the risk for secondary surgery and enables better care.[11]

The literature review for the use of NPWT in various aspects of burn care/ different phases of burn care with available supporting clinical evidence are the following:[33]

1. Use of NPWT for management of acute burn wounds

NPWT in the management of acute burns to provide a healing environment that will prevent progression of the burn wound, prevent infection, and provide a moist environment for wound healing while limiting evaporative fluid losses.[33]

NPWT: to help prevent conversion of zone of stasis (partial thickness burns) to necrosis (full-thickness burns) in the acute phase of burns by controlling oedema, improving microcirculation, and reducing build-up of inflammatory mediators.[7,33]

2. Use of NPWT for large burns (> 15%) as practical temporising measure

NPWT used in large burns in few studies showed reduction in regrafting surgeries, lower infection rates, less frequent dressing changes, decreased pain, decreased ventilator use, improved fluid management, and decreased length of stay.[32,33]

3. Use of NPWT as a bolster dressing for autografts

Use of NPWT as a bolster showed improved outcomes when compared to standard dressings particularly in wounds that have complex surface morphology.[32]

Use of NPWT as a dressing over graft donor sites showed improved outcome when compared to conventional dressing.[32]

Recommendations

Indication	Recommendation
NPWT can be used in acute burn injuries for different indications at the discretion of the practitioner. Strong levels of evidence support the use of NPWT to bolster skin substitutes. Evidence further supports the use of NPWT in acute burns even in haemodynamically unstable patients as the fluid loss can be controlled and dressing change frequency is reduced.	
NPWT is not a substitute for skin grafts or allografts but adjuvant therapy to aid wound bed preparation.	
Use of NPWT directly on a full-thickness burn is contra-indicated as this represents necrotic tissue with eschar present (Vig et al., 2011)	

6.8 Venous lower leg ulcers

Description of wound aetiology

Chronic venous insufficiency resulting in increased ambulatory venous hypertension is the leading cause of venous lower leg ulcers. Associated signs and symptoms like oedema, haemosiderin staining, lipodermatosclerosis and alterations in the microcirculation could result in skin breakdown and a chronic hard to heal wound located on the lower leg.[7]

Evidence review

For lower leg ulcers of venous origin as confirmed by a ABPI between 0.8 and 1.2, NPWT could be considered to prepare the wound for surgical closure or skin graft if progress is not satisfactory (30% reduction in 4 weeks) with only compression bandages.[7]

Compression bandages to treat and manage venous stasis should be used in conjunction with negative pressure if so indicated.[34]

Recommendations

Indication	Recommendation
Use NPWT only if wound progress has not been satisfactory: < 30% reduction in surface area within 4 weeks. Adequate arterial supply must be confirmed by ABPI, TBPI in diabetics or TcPO2 when available.	
NPWT should not be used as a stand-alone treatment but in conjunction with compression therapy to address underlying cause.	
If the patient has chronic venous insufficiency and peripheral arterial disease with ABPI of < 0.6, NPWT is contraindicated, and revascularisation should be done.	

6.9 Pressure injuries

Description of the wound aetiology

A pressure injury is localised damage to the skin and underlying soft tissue usually over a bony prominence or related to a medical or other device. The injury can present as intact skin or an open ulcer and may be painful. The injury occurs as a result of intense and/or prolonged pressure or pressure in combination with shear. The tolerance of soft tissue for pressure and shear may also be affected by microclimate, nutrition, perfusion, co-morbidities and condition of the soft tissue.

The NPIAP classifies pressure injuries as follows:

Stage I: Non-blanchable erythema of intact skin

Stage II: Partial-thickness skin loss with exposed dermis

Stage III: Full-thickness skin loss

Stage IV: Full-thickness skin and tissue loss

Once a pressure injury has occurred the wounds typically require a debridement, including trimming of any protuberant bony surfaces, followed by a flap reconstruction to resurface the defect with soft tissue. This operation should not occur until the patient and their surroundings are optimised, to prevent complications or a recurrent pressure sore.

When circumstances are not optimal, the wound is often debrided of all necrotic tissue and a temporising NPWT dressing is placed until such time that the reconstruction can be done. In certain instances, a patient's condition does not allow for debridement, in which case NPWT can be used to manage wound exudate and to allow for the small amount of mechanical debridement that occurs during dressing changes.

Evidence review

There seems to be a lack of high-level evidence to support the use of NPWT in the treatment of pressure injuries. Considering the mechanism of action of NPWT the use of NPWT to treat stage 3 and 4 pressure injuries is associated with faster healing times, reduction in complications and lower costs.[9]

Recommendations

Indication	Recommendation
NPWT may be used in NPIAP stage 3 and 4 pressure injuries until surgical closure is possible/desirable after debridement of necrotic tissue.	
Alternatively, NPWT can be considered to achieve closure by secondary intention (7) in cases where surgery is not an option.	
ciNPWT indicated postoperatively to reduce wound dehiscence after flap surgery Exposed bone would need an interface dressing if this is the case or PVA foam	

6.10 Enterocutaneous fistulae

Description of the wound aetiology

Enterocutaneous fistulae (ECF) are defined as abnormal communications between the gastrointestinal tract and the skin and are often associated with intra-abdominal sepsis. They carry a relatively high mortality rate (10–20%), predominantly because of intraabdominal sepsis and organ failure.[35]

Evidence review

In a review article, Misky et al.[36] found that the mean ECF closure was 64.6% with NPWT compared to 50% with conventional conservative therapy. They therefore concluded that the evidence is debatable whether NPWT accelerates ECF closure based on these numbers, although admitted that the levels of evidence presented by the studies, they reviewed were poor, making it difficult to draw conclusions. They did however also agree that "despite the limited evidence available, the literature suggests, nevertheless, that VAC therapy may be used safely to treat patients with ECF resulting from surgery either as a definitive tool to achieve closure or as a bridge to definitive surgery".

When assessing the evidence, it must be borne in mind that, despite the difficulty in conducting appropriate studies in this setting, it is still widely used as a treatment for ECF, especially in the academic settings. This is based on a sound understanding of the MOA of NPWT and that these dressings can compress and collapse fistulae, providing the fistula is in collapsible tissue and the effluent level is low (ideally less than 500 ml/day). The fact that most studies do not take the latter facts into consideration when doing comparative studies most likely accounts for the lack of strong evidence supporting the use of NPWT for this indication.

Recommendations

Indication	Recommendation
The NPWT expert panel recommends the use of NPWT for this indication in certain circumstances, providing the clinician has a sound understanding of how the biomechanics of NPWT affects different fistulae, e.g., fistulae that have high outputs or are adjacent to rigid structures, such as ribs, are less likely to collapse under the action of NPWT than those with low outputs or that are within softer tissues.	
Do not use in unexplored fistulae	

7. Closed incisional negative pressure therapy (ciNPT)

Postoperative wound complications are common following surgical procedures. Hip and knee arthroplasties report a rate of up to 10% of wound complications. Postoperative wound complications, such as infection, dehiscence, and formation of haematoma or seroma, are common complications of surgical procedures.[37] Patients at risk for these complications include diabetic patients, obese patients and patients with other co-morbidities that might influence healing. Overall ciNPT use is associated with a decrease in wound complications, wound dehiscence, haematoma/seroma formation and reduction in Surgical Site Infection.[11]

Evidence review

In an RCT done by Karlakki et al.[38] the authors explored the potential benefits of a portable, single use, incisional negative pressure wound therapy dressing ciNPT on wound exudate, length of stay (LOS), wound complications, dressing changes and cost-effectiveness following total hip and knee arthroplasties. A total of 220 patients were enrolled and an improvement was seen in the study (CiNPT) group compared to control in all areas. Peak postsurgical wound exudate was significantly reduced (p = 0.007). The reduction of overall length of stay (0.9 days, 95% confidence interval (cI) -0.2 to 2.5) was not significant (p = 0.07) but there was a significant reduction in patients with extreme values of LOS in the CiNPT group (Moses test, p = 0.003). There was a significantly reduced number of dressing changes (mean difference 1.7, 95% cI 0.8 to 2.5, p = 0.002), and a trend to a significant four-fold reduction in reported postoperative surgical wound complications (8.4% control: 2.0% CiNPT, p = 0.06).[37] Hyldig et al.[39] concluded that CiNPT can reduce postoperative complications like wound infection and seromas in high risk patients.

A Cochrane review done in 2020 does state that there is moderately sufficient evidence to suggest that CiNPT can reduce the incidence of surgical site infection.[40]

Recommendations

Indication	Recommendation
ciNPT is recommended for use to decrease wound complications, wound dehiscence, haematoma and seroma and surgical site infection.	

8. Conclusion

Within the clinical setting, guidelines are intended to guide, but each case should be considered on its own merit. Providing the clinician's indications are in keeping with the four key MOAs mentioned earlier we recommend approving the use of NPWT, providing that good wound progress can be demonstrated. Should there be poor progress, the clinician should evaluate whether there are any other local and systemic factors that could be hindering wound healing and ensure they have been addressed.

9. References

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