Traditional and single use NPWT: when to use and how to decide on the appropriate use? Recommendations of an expert panel

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Negative pressure wound therapy (NPWT) is a concept that has been around for over 20 years. There is now more choice, potential and possibilities for the use of the NPWT for different indications. An international group of specialist surgeons with a high level of experience of NPWT in various wound types convened to discuss the use of NPWT today. The group used their own experiences and current literature to discuss the appropriate use of traditional and single use NPWT and when and how to use traditional and single use NPWT in complement with each other and other therapies.

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Negative pressure wound therapy (NPWT) can be used for the management of a wide range of different wound types, including traumatic, hard-to-heal and chronic wounds, and wounds covered with flaps and/or skin grafts (World Union of Wound Healing Societies [WUWHS], 2016). NPWT can be considered for wounds at every stage of healing. Recent progress in NPWT has been the development of single use NPWT (sNPWT) devices *[Box 1]*. For special treatment requirements, NPWT can be used in combination with a wound cleanser or topical solution, so called NPWT instillation (NPWTi), predominantly for septic and contaminated wounds.

Aims of the expert panel

An expert panel of surgeons specialising in colo-rectal surgery, general surgery and vascular surgery from across Europe gathered in Vienna, Austria on May 28 2019. The group used their own experiences and current literature to discuss the appropriate use of traditional and single use NPWT and when and how to use traditional and single use NPWT in complement with each other and other therapies. They also aimed to identify the patients who would benefit from closed incision NPWT (ciNPWT).

Mechanism of NPWT

The mechanism of NPWT and key benefits are now well established *[Box 2]*, but solid clinical evidence is still necessary. Experimental studies are currently under way to achieve a deeper understanding of the mechanisms of action of NPWT and to further extend its clinical uses. There are also over 40 active, recruiting clinical

Box 1. Types of NPWT.

Traditional NPWT (or stationary): Traditional NPWT systems include a canister for fluid collection from the wound. The pressure applied is adjustable, with continuous and intermittent modes of operation possible. Often powered by a main electricity source, traditional NPWT devices are mostly used for inpatients but can also be adjusted for the use in outpatient care. Moreover, traditional NPWT can be adapted and used with a wound cleanser (NPWT instillation).

Single use NPWT (sNPWT; or pocket, cannister-free, mechanically powered, disposable, portable): Some sNPWT devices are canister-free and handle fluid mainly through evaporation from the outer layer of the dressing. Mainly suitable for low to moderate exudate levels. The pressure is applied continuously and is not usually adjustable. sNPWT devices are often battery powered, and tend to be used in outpatient care, although more research is required.

Closed incision NPWT (ciNPWT; or prophylactic, preventative): NPWT used on primary closure surgical sites to reduce risk of surgical site complications, such as infection, seroma, haematoma, local skin ischaemia and necrosis, dehiscence and delayed healing. Both traditional and sNPWT can be used as ciNPWT.

Box 2. Actions of NPWT that support healing in open wounds (Lalezari et al, 2017).

- Provides a physical barrier to external contamination
- Removes excess wound exudate and facilitates moist wound healing
- Wound contraction
- Oedema reduction
- Granulation tissue formation
- Angiogenesis
- Improved tissue formation.

trials on NPWT listed on *www.clinicaltrials.gov*, but the challenge to conduct randomised controlled trials (RCTs) remains high due to the nature of surgery and patient individuality.

NPWT: indications, contraindications and cautions

Traditional NPWT is mostly used for acute and chronic open wounds for which primary closure is not possible, such as open abdomen, trauma wounds, breast reconstruction, diabetic foot and venous leg ulcers, burns and graft sites. The range of NPWT indications is continuously growing as especially traditional NPWT units are adapted and modified by specialised surgeons to treat even more complicated wounds in terms of size and location on the body; however, caution is required for paediatrics and neurosurgical specialities *[Table 1]*.

NPWT can be used as a prophylactic method for patients at high risk of surgical site infections (SSIs), or other post-surgical complications, such as people with diabetes or obesity, as well as for surgeries where there is a high risk of SSIs (e.g. colorectal surgery; Sahebally et al, 2018) or for clean–contaminated wounds (Willy et al, 2016). ciNPWT has been shown to be beneficial to reduce SSI rates, seroma/haematoma formation and wound dehiscence, and to improve scar quality (Hyldig et al, 2016; WUWHS, 2016).

The threshold for ciNPWT initiation is not yet clear, therefore, further studies are required to identify patients who may benefit from ciNPWT. Technical aspects, like ciNPWT set-up, type of sponges, pressure level and duration of NPWT also need to be clarified.

Table 1. General list of indications, contraindications and cautions of the use of NPWT.
N.B. Clinicians should check the contraindications and cautions for the specific NPWT device under consideration (Apelqvist et al, 2017; Tettelbach et al, 2019; WUWHS, 2019).

Indications: traditional NPWT	Indications: single-use NPWT	Contraindications: traditional and single-use NPWT	Contraindications: single useNPWT	Cautions

■ Traumatic wounds and high-risk incisions after surgery
■ Chronic wounds with delayed or impaired healing
■ Dermatofasciotomy wounds
■ Management of infection after endoprosthesis or meshimplantation
■ Surgical site infections
■ Osteomyelitis (individual indication based on severity and extent)
■ Exposed tendon, bone or implanted metalwork
■ Acute burns and scalds
■ Acute trauma to the lower limb
■ Open abdominal wounds
■ Direct fascial closure
■ Infected blood vessels and vascular grafts
■ Lymphocutaneous fistula
■ Leg ulcers
■ Pressure ulcers (category 2 and 3)
■ Diabetic foot ulcers
	■ Clean, closed post-operative incision at high risk of infection and/or wound dehiscence
	■ Chronic wounds with smaller area and limited exudation
	■ Skin grafts (depend on the size of grafts)
		■ Full thickness burns
		■ Severe peripheral arterial disease Necrotic tissue with eschar
		■ Untreated osteomyelitis
		■ Exposed blood vessels, nerves, organs or anastomotic sites in wound or near the vagus nerve
		■ Malignancy in the wound (unless treatment is palliative)
		■ Non-enteric and unexamined fistulas
		■ Remove the NPWT unit for patients requiring:
		  ■ Magnetic resonance imaging (MRI)
		  ■ Treatment in a hyperbaric oxygen chamber (HBOT)
		  ■ Defibrillation
		■ Osteomyelitis (individual indication based on severity and extent)
			■ Inadequately drained wounds and fistulas
			■ Infected wounds
			■ High volume of exudation
			■ Special indications required non-adhesive layers, big wound dressing and higher pressure (for example open abdomen)
				■ Neurosurgery
				■ Paediatrics
				■ Acute bleeding, coagulation disorders and patients being, treated with anticoagulants

However, current practice is to change dressing or reconsider prophylactic effectiveness of the ciNPWT system when the sponge becomes full of exudate.

Further clinical trials and data collection into registries are required to identify the impact on quality of life (QoL), prevention of major complications (e.g. morbidity), as well as cost effectiveness of ciNPWT. These aspects can provide a stronger theoretical base to define firm indication criteria in the future.

sNPWT is also increasingly being used as ciNPWT as a preventative for complications, such as SSI and dehiscence (Strugala and Martin, 2017). It may also aid healing by reducing lateral tension across the closed incision, improving lymphatic drainage (Karlakki et al, 2013; WUWHS, 2019). sNPWT are recommended in cases with less amounts of expected wound exudate, as well as in cases when early hospital discharge is planned. But again, guidance is needed to clarify and identify best practices.

Complementary use of traditional NPWT and single-use NPWT

Traditional NPWT and sNPWT are complementary, and can be used sequentially as treatment progresses (WUWHS, 2019). Based on the condition of the wound and patient, wound closure can begin with traditional NPWT and can be continued with sNPWT; especially for wounds in the final healing phase as sNPWT can be worn for up to 7 days. The switch to sNPWT is often triggered when the sponge no longer fits the wound, or the wound no longer had volume.

As for all clinical-decision making, patient QoL is an important parameter that should also be considered in the selection of traditional NPWT or sNPWT. For example, the switch to sNPWT may be suitable for outpatient treatment and for patients who will benefit from the potential for earlier discharge from hospital and the ability to mobilise sooner (WUWHS, 2016).

Considerations for selecting NPWT modality

A variety of factors should be taken into account when selecting an NPWT device for a patient and wound *[Table 2]*. *Figure 1* is adapted from the WUWHS (2019) consensus document on 'Wound exudate, effective assessment and management'. Wound type is a more important factor than surgery type when considering when and which form of NPWT is appropriate, but the choice between traditional and sNPWT depends on the individual patient, the clinician's experience and local protocols. If switching between traditional NPWT and sNPWT, wound and patient factors, such as patient QoL, should be considered.

Future research

All unhealed and chronic wounds, as well as wounds in patients with healing disorders or at high risk of surgical site complications should be considered for NPWT, but NPWT is

Table 2. Important parameters in NPWT clinical decision making (WUWHS, 2019).

Parameters	Considerations
Wound size	There is no upper limit to wound size for traditional NPWT; smaller wounds are better suited for sNPWT.
Volume of exudate in 24 hours	Volume of exudate is less of an issue for traditional NPWT as canisters are available in different sizes.
Density of exudate	Traditional NPWT is able to cope better with varying densities of exudate; sNPWT is more appropriate for low density exudate.
Location of the wound	The NPWT dressing needs to conform to the three-dimensional shape of the anatomical region of the wound sufficiently well to avoid dead space and to form the seal needed for the device to work.
Care setting	Traditional NPWT should be changed by a clinician, and may be more appropriate for inpatients. However, depending on the device's size, use in the outpatient settings is possible. sNPWT are often selected for ambulatory patients and can sometimes be changed by the patient if they are willing, competent and able.
Infection	Traditional NPWT is more appropriate to use than sNPWT for infection.
Condition of the surrounding skin	Traditional NPWT can be used on irritated or macerated skin, while sNPWT requires more caution.
Patient preference or need	Patients who are physically active or working are likely to prefer a portable device that is small and discreet.

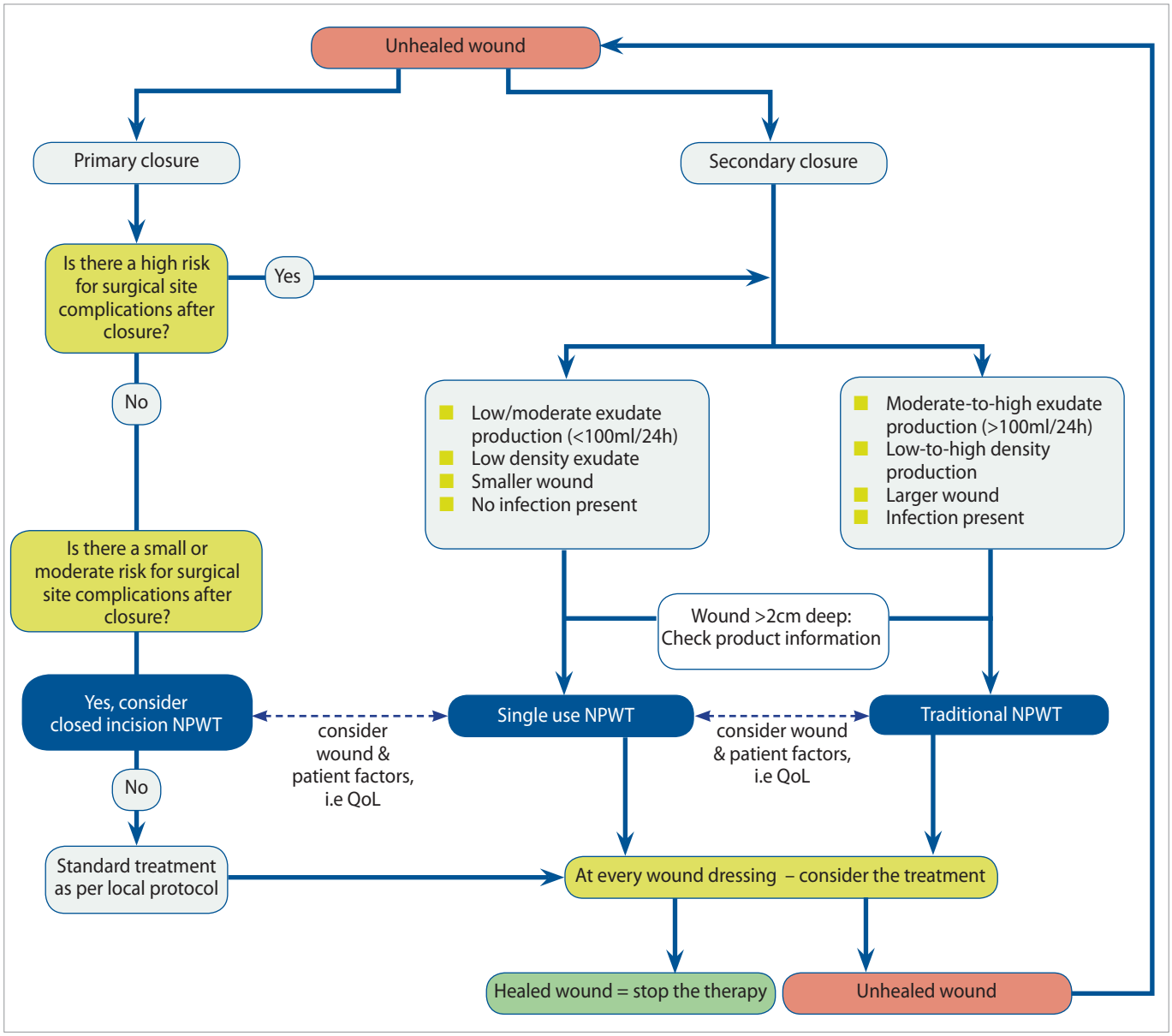

Figure 1: Considerations for selecting NPWT modality adapted from WUWHS, 2019.

still underused in practice. This may be due to resource constraints and/or the lack of 'gold standard' clinical evidence. Clear guidance and pathways are required to enable clinicians to use the appropriate therapy confidently and efficiently in practice, for example evidence-based recommendations of indications and more technical support (e.g. Birke-Sorensen et al, 2011).

Clarification where NPWT is not required and identification of the closed wounds that should always be treated with ciNPWT would be useful. On the technical side, there is a need for clear recommendation on pressure setting for different areas, how often to change the wound dressing, when to move from traditional NPWT to sNPWT, when to stop the therapy and when instillation will be most effective.

RCTs are often seen as the highest level of evidence but they are difficult to conduct for NPWT due to wound and patient variation. Conducting other types of research or creating a shared database or register, such as a European Observatory of NPWT cases, may be beneficial.

Clinical experience and case reports

Case reports using NPWT highlight the ever-broadening uses of NPWT and modification. *Box 3* highlights two such cases. Practical tips that can have a positive impact of NPWT on patient outcomes are shown in *Box 4.*

Remember, NPWT is not the solution for all wound healing issues, an holistic approach to wound healing is essential. Ensure nutrition and blood circulation are optimised, and rehabilitation and treatment of systemic or local infections are in place if required.

Conclusions

The key parameters for selecting either traditional NPWT or sNPWT are wound size, exudate level, density of exudate and location of the wound; however, the choice of NPWT device should be kept as simple as possible, and must be individualised to the patient.

All wounds suspected of healing disorders may benefit from NPWT and should be considered for treatment. As NPWT becomes a more common surgical procedure, the

Box 3. Case reports courtesy of Dominik Walczak.

Case 1: A 53-year-old female patient was admitted due to cancer of the mouth floor. The tumour had invaded the mandible and tongue. An extensive resection of the anterior part of mandible, tongue tip and mouth floor was performed. A bilateral neck dissection was also performed. The postoperative defect was reconstructed with a fibula osteocutaneous free flap.

Eight days after surgery, a pharyngocutaneous fistula appeared on the neck. Saliva and purulent content were exiting from the fistula. NPWT (Vivano®Tec, Paul Hartmann AG) was applied to fistula: black sponge was cut into an L-shape, with the long branch wrapped with a silicone wound contact layer (Atrauman® Silicone, Paul Hartmann AG) to protect the vessels of the neck. The short branch of the black sponge was covered in stoma paste to prevent air leak. The pump was set to a continuous negative pressure of 125 mmHg, and dressings were changed every second day. The patient was fed by a nasogastric tube. NPWT was administered for 10 days. Over time, the size of the sponge became smaller and smaller. Adequate granulation tissue formation was achieved. and the fistula closed. After closing the fistula, oral feeding was commenced and no saliva leakage was observed. In this case, if the wound had taken too long to heal, the patient would not have qualified for radiotherapy; NPWT accelerated healing and closure of the fistula.

Case 2: A 56-year-old female patient was admitted due to melanoma metastasis to inguinal lymph nodes. The patient had previously had an excisional biopsy of a suspicious mole on the left calf, which was identified as a stage T3 melanoma.

A sentinel lymph node biopsy was performed, and the patient underwent inguinal lymph node dissection. After primary wound closure, a single-use NPWT device was applied to reduce the risk of surgical site infection and seroma formation. Stoma paste was placed in skin folds and around drain to prevent air leak. Dressings were changed every fifth day. In total, closed incision NPWT was administered for 15 days. A small area skin necrosis appeared in proximal part of wound; however, the necrotic tissue was superficial. After debridement of necrotic tissue, the wound healed by secondary intention.

Box 4. Tips when using NPWT.

To encourage patient uptake

- Make therapy as simple as possible

To relieve pain

- Turn off suction 5–10 minutes before dressing change to reduce pressure
- Use lidocaine irrigation before dressing change
- Use a medical adhesive remover and avoid pulling the foil too forcefully, which may damage the skin
- Use an intermittent layer (for example silicone with perforations) between polyurethane sponge and the wound, especially on sensitive and granulated wounds

To maintain dressing seal

- Ensure surrounding skin of the wound is dry
- Use smaller parts of adhesive foil in complicated body contours (i.e. groin)
- Use stoma paste as a sealant around the wound dressing
- For traditional NPWT with canisters, localise the port of the dressing at lowest part of the wound, where the highest collection of exudate is expected. For sNPWT without canister, localise the port of dressing far from the wound to use all the space of dressing to collect the exudation
- In highly exudating wounds, apply the dressing pad as fast as possible and turn on of the pump to avoid fluid collection below the foil

To make the therapy effective

- If there is no improvement after two wound dressings, consider whether a change the strategy is required

indications for all modes of NPWT are expected to continue to expand. The use of sNPWT is growing faster, mainly due to the increased use in outpatient care, while traditional NPWT has a constant but slow increase due to new indications being identified by surgeons.

Traditional NPWT and sNPWT can be used as complementary devices in a step-up or step-down approach along the healing pathway. All members of the multidisciplinary team should be confident in the role and benefits of NPWT. WINT

Declaration

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