Community, Indigenous and Subacute Services
Metro North Hospital and Health Service

Negative Pressure Wound Therapy
Self Directed Learning Package
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Introduction

Negative Pressure Wound Therapy (NPWT) is widely used in the management of complex wounds within hospital and community environments. The aim of this self-directed learning package (SDLP) is to increase the theoretical knowledge of community based health care professionals in NPWT, and facilitate the effective utilisation of NPWT for the treatment of complex wounds and support the client’s journey in the community setting.

There are various NPWT delivery systems in use within the Metro North Health Service. KCI Medical (KCI) and Smith & Nephew (S & N) devices are available within the four MNHHS hospitals and the type of device used in the community setting will be determined by the hospital. Each brand of device requires the brand specific dressings ie. Smith and Nephew device requires Smith and nephew NPWT dressing kits and KCI device requires KCI dressing kits.

Objectives

On completion of this self-directed learning package the clinician will have a sound theoretical knowledge of NPWT and develop skills in, its uses, applications, and contraindications and have the ability to competently perform NPWT dressing changes and troubleshoot dressing and device issues.

Components of NPWT

1. Dressing/s to fill cavity:
   - Allows exudate to flow freely into the NPWT tubing
   - Delivers negative pressure evenly over the wound surface
2. Non-adherent interface (if required)
3. Tubing with port
4. Tube: connects the device via a canister to the dressing
5. Semi permeable dressing (Drape): to create an airtight seal, covering all the components
6. NPWT device: Not all the devices have the same features or require the same guidelines

Please refer to the ‘product specific’ user manuals

How does the device work?

NPWT applies controlled negative pressure (Vacuum) at the wound surface through a specialised dressing, this assists in drawing the wound edges together, removing wound debris and actively promoting granulation (KCI, 2010).

Clinical Benefits of NPWT

NPWT promotes healing through multiple actions:
- Increases vascular perfusion
- Reduces excess fluid and localised oedema
- Stimulates formulation of granulation tissue
- Protects from outside contaminants
- Removes barriers to cell migration and proliferation
- Reduces bioburden
- Maintains moisture balance
- Assists in wound contraction
Indications
NPWT is indicated in a variety of wounds these include:
- Post Operative wounds
- Dehiscence’s of surgical wounds
- Pressure ulcers
- Diabetic/neuropathic ulcers
- Traumatic wounds
- Skin flaps/grafts
- Venous ulcers
- Explored fistulae

Contraindications
- Poorly perfused tissue: i.e. clients with severe peripheral arterial disease with an Ankle Brachial Pressure Index (ABPI) readings of less then or equal to 0.5mmhg. These clients require further investigation and may identify a need for revascularisation.
- Untreated osteomyelitis
- Certain tissue types:
  - Necrotic (eschar) tissue - large amounts of necrotic tissue or tissue covered with a dry eschar (Best result is obtained post debridement).
  - Malignancy - NPWT may increase mitosis of malignant cells but it can be considered post tumour removal if tissue margins are cleared of malignant cells.
  - Exposed arteries, veins or organs.
  - Cavity/sinus and unexplored fistulae – Cavities where the origin is not visible. Fistulae must be investigated to establish the extent and if there is communication between organs.

Precautions
- Clients with neuropathic aetiologies, lack or absence of sensation may predispose the client to not recognising pressure, or a decrease in circulation which has the potential to cause further tissue breakdown.
- Untreated or inadequately treated infection.
- Ischemia to incision or incision area.
- Burns are to be debrided prior to the application of NPWT.
- Wounds in close proximity to blood vessels, delicate fascia, vital organs or exposed tendons.
- Do not apply NPWT to blind or unexplored wound cavities or sinuses.
- Sharp edges or bone fragments must be covered to prevent puncturing of organs or vessels. Where possible smooth and cover residual edges to decrease risk of injuries should shifting of structures occur.
- Clients with a risk of bleeding (long term anticoagulant therapy, haemophilia, sickle cell disease) or those who are actively bleeding or have irradiated blood vessels/ organs.
- Clients with allergies to adhesives and silver products if using silver foam.
- Sickle cell disease affects the shape of the red blood cell – these change during an acute phase of injury/disease and may cause microcirculation obstructions / blockages which can lead to extreme pain. Clients could require lower pressure settings or therapy to be discontinued due to pain.
- Magnetic Resonance Imaging (MRI) and Hyperbaric Oxygen Unit: Do not take the NPWT device into these environments. The dressings may remain on the client under the direction of the treating radiologist or treating physician.
- Children require wound contact layers to reduce adherence of dressings to the wound surface and minimise pain. Pressure levels should be increased or decreased according to tolerance levels and continuous pressure is recommended. KCI recommendation: Neonates and infants 50-75mmHg, Children 75-100mmHg and adolescents 75-125mmHg. Particular care should be taken not to damage the peri-wound skin.
- Fluid loss should be closely monitored especially in neonates and infants, considering the volume in both the tubing and the canister.

(KCI, 2012; S & N Renasys™, 2013)

**Client and Wound Considerations**

Prior to application and during treatment:

- Holistic assessment of the client and wound to ensure the NPWT is suitable for the requirements of client and the wound.
- Maintain principles of Aseptic Non touch technique (ANTT)
- Assessment of the wound type and tissue involved as this will affect the choice of product and therapeutic negative pressure level required.
- Actively engaging clients in their NPWT treatment and encouraging them to provide feedback on their experience.
- Assess the home environment and ensure the client/family/caregiver can read and understand the safety information, and respond to device alarms and follow instructions for use (World Union of Wound Healing Societies, 2008)
- NPWT discontinuation will be largely dependent on client compliance / tolerance and information gained from a comprehensive wound assessment.
- It is expected that the wound will display signs of improvement after two dressing changes.
- Weekly wound measurements and photographs should be attended to compare previous dimensions and appearances as this will provide evidence of healing.
- Measurement of the exudate volume at each dressing change (note: fluid/balance/monitoring is vital in infants and young children), a decrease in exudate level is an expected outcome of NPWT.
NPWT Goals

<table>
<thead>
<tr>
<th>Long Term</th>
<th>Short term</th>
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<tbody>
<tr>
<td>To manage and protect the wound by improved fluid management, prevention of environmental insult (providing a splint) and infection.</td>
<td>To prepare the wound for surgical closure by controlling bioburden, improving the quality of the tissue in the wound bed (including a reduction of the size) and complexity of the wound.</td>
</tr>
<tr>
<td>To improve client comfort by reducing pain, frequency of dressing changes, managing odour and fluid and improving client mobility.</td>
<td>To improve the outcome after Split Thickness Skin Graft by preventing post-op complications (graft failure).</td>
</tr>
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(Birke-Sorensen et al., 2011)

Consider discontinuation when the following occurs
- Frank blood or pus is evident in the canister and/or dressing.
- Haematoma is evident underneath the dressing.
- Granulation tissue is level with the surrounding skin.

Note: If removing NPWT ensure treating consultant is advised or agreeable.
(S & N Renasys™, 2013)

Pain Management

Clients’ pain should be assessed at each dressing change and a sudden increase or change in the character of the pain requires further investigation, client should be referred back to GP or referring consultant contacted to discuss if there are concerns.

The following should be considered at dressing changes to reduce pain and maximise client comfort:
- Advise and educate client to turn device off 20-30 minutes prior to appointment, this will alleviate discomfort on dressing removal.
- Educate the client to ensure analgesia is taken 30 minutes prior to dressing changes and as prescribed.
- Consider a non-adherent wound interface underneath the wound filler to reduce pain and trauma to the wound bed upon removal of dressings (Vowden, 2014).
- Consider using Gauze filler or white foam if black foam filler is causing discomfort.
- Ensure use of remove wipes and instil warmed saline into the dressing prior to removal.

NPWT Settings

- The most common pressure level is 120-125mmHg, this may be raised or decreased in increments of 10mmHg with Smith and Nephew devices and 25mmHg with the KCI devices.
- Pressure levels should only be adjusted in consultation with the treating consultant or qualified wound clinicians ensuring pressure settings are aligned with clinical guidelines for wound aetiology, pain, age, risk of bleeding and poor nutritional status.
Target pressure for white foam (KCI) requires the pressure of 150mmHg – 175mmHg due to density of the foam (please refer to clinical guidelines).

**Frequency of dressing changes**

Although company/product recommendations should be adhered to, the frequency of dressing changes will be largely determined by the wound assessment. If the client is comfortable and the wound is progressing, dressing changes should occur approximately three times per week. In the event of heavy exudate or increased bioburden more frequent dressing changes may be required (KCI, 2010; S & N Renasys™, 2013).

The usual recommendation is to change dressings every 48 hours, before in-growth into the foam becomes a concern (Malmsjo et al., 2010).

If foam dressing is being used and requiring twice weekly changes consider using interface to minimise client discomfort and trauma to the wound bed.

**Continuous versus intermittent Therapy**

The most common choice for NPWT is the continuous setting. Continuous means the unit will apply continuous and consistent negative pressure; this form of NPWT is recommended for the first 48 hours in all wounds. Intermittent therapy is where the NPWT is usually programmed to turn on for a period of time (e.g. 5 minutes) and then pauses for a period of time (e.g. 2 minutes).

The aim of intermittent therapy is to stimulate granulation tissue formation in a wound where granulation may have slowed. However the sudden changes in NPWT may cause pain at the wound site and the efficacy of the dressing seal may alter. The treating medical team and/or the wound management clinical nurse will advise if intermittent pressure is to be utilised.

**Intermittent therapy is not recommended in the following wounds:**

- Where it is difficult to maintain a seal e.g. around toes.
- Where the client is experiencing discomfort and/or pain.
- With tunnelling/undermined areas (as continuous therapy ensures that the wound is kept closed, the edges collapsed and granulation stimulated).
- Where there are high levels of exudate.
- Where a splinting effect is required (Abdominal/sternum).
- Grafts and flaps (to prevent shear).

(KCI, 2010).

**Allergies**

If signs of an allergic reaction develop (redness, swelling, urticaria, rash) discontinue use and contact the treating team/ wound management nurse for alternative management (S & N Renasys™, 2013).

**Hints and Tips**

**Foam/Gauze:**

- Should fit the shape of the wound.
- When more than one piece of foam is used all foam should stay in contact with each other.
• Document in the wound management plan the number of foam/gauze dressings used, particularly in cavity dressings.
• Do not over pack a wound as this may inhibit wound progression.
• Ensure the foam/gauze does not come into contact with the peri wound as it could cause excoriation.
• Do not cut foam / gauze over the top of the wound as fibres can shed into the wound bed.
• Ensure the foam /gauze is larger than the port but not protruding over the wound frame onto the peri wound.
• Consider foam /gauze shrinkage once pressure is applied, as filler needs to be level with surrounding skin and level with wound edges.

Drape:

• Should cover 3-5cms beyond the wound edge.
• Ensure peri wound is dry prior to application, use skin prep to protect peri wound.
• Application is easier when using strips of drape that are smaller and are more manageable.
• Do not stretch the drape on application.

Port:

• Position the port in the centre of the drape over the foam.
• Ensure the opening in the drape for the track pad meets the requirements of the device.

Canister:

• Change a minimum of once per week to control odour or when its full.(Infection Control)
• If leak detected check canister and tubing for damage to canister or tubing.
• Take care when changing KCI canisters to avoid breaking connection join.

Maintaining a seal

To avoid seal issues ensure the following:
• Prepare the peri wound and surrounding area with skin prep to ensure skin is dry and free from residual oil based substances used in adhesive removers.
• Frame the wound with hydrocolloid or in difficult areas (around toes) Eakin seal or Renasys or KCl gel strips can be used to assist with sealing.
• Ensure the foam /gauze fills the entire cavity of the wound to become level with the surrounding skin.
• Ensure tubing is positioned on a flat surface away from bony prominences and pressure areas.
• Loosely secure the tubing with an additional piece of tape a few centimetres away from the wound, this prevents pulling of the tube which can potentially tear the port away from the dressing.

Disconnecting the NPWT:

• Disconnection from the unit should be avoided, however, if necessary for not more than two hours. If disconnected for longer than two hours the dressing requires changing.
Options for treating multiple wounds

Y-Connector:

- To be used for more than one wound, if the wounds are highly exudating or unable to be bridged.
- Ensure Y-connector is changed weekly with canister.
- Do not use a Y-connector to connect infected with non-infected wounds.

The Bridging technique:

- Recommended for wounds within close proximity and of similar pathologies. Do not bridge wounds of different aetiologies or bridge an infected wound to a non-infected wound.
- Protect the skin between the wounds with a hydrocolloid or film dressing (at least 5cm in width) connecting the wounds.
- Connect the two wounds with wound filler (gauze/foam) ensuring that each piece is in contact with each other (Foam/gauze).
- Apply the port centrally over the wound bridge to ensure that exudate from one wound is not drawn across to another.
- This technique can also be used to move the port/drain to a non-weight bearing area. For example wounds to the plantar surface or heel of the foot. 
  (Note: appropriate off-loading of the foot is essential to maximise the therapeutic benefits of NPWT).

Use of NPWT over skin grafts / dermal substitutes

- It is important to achieve a light and uniform pressure over the graft to ensure constant bolstering of graft and prevent haematoma or seroma formation. NPWT should aid in keeping the graft in place and reduce excessive moisture (which may assist to reduce bio burden). NPWT should be started as soon as possible after graft/ flap placement.
- Black foam target pressure 75-125mmhg, non adherent interface layer required.
- White foam target pressure 125mmhg (titrate up for more drainage), no interface layer required.
- Therapy does usually exceed 5 days.
- If any sign of infection occurs remove the dressings and assess the wound. Significant drainage after the first 24 hours may be an indication of complications.

Dressing a wound with undermining:

- Continuous therapy is recommended in the presence of undermining (KCI, 2010; S & N Renasys™, 2013).
- White foam to be used in all undermined areas, beginning at the distal end ensuring not to pack foam into undermined areas.
- For KCI dressings, when the volume of fluid decreases and granulation tissue is noted; the foam can be gently placed in undermined areas all the way to the distal part
of the wound - Gently pull the foam out 1-2cm leaving some foam in the wound to communicate with the foam in the wound bed. This will allow the wound cavity edges to granulate from the distal portion of the wound.

OR

- Fill the defect to skin level with Saline-moistened wound filler (S & N Renasys™, 2013).

- If a drain is used into the undermining, ensure that the drain size is not larger than the space created by the undermining. A drain that is too large will potentially cause pressure necrosis to the fragile skin bridges. Pressure necrosis may occur if there is overextension when the drain and wound filler are inserted.

Wounds that tunnel

- Do not place fill material into blind or unexplored tunnels
- Document in the notes and mark on the dressing the exact number of wound filling material placed into all aspects of the wound to ensure that all pieces are removed during dressing changes. Adjunct dressings such as non-adherent contact layers or silver dressings should also be noted.

- V.A.C. White foam is recommended by KCI to be used with their NPWT system in tunnelled or undermined wounds. Always cut the foam wider at the one end. This will ensure that the opening of the tunnel remains open until the distal portion of the tunnel has closed. In the initial application cut the foam to a size that accommodates the tunnel’s dimensions, plus 1-2cm. into the wound bed. Gently put the foam into the tunnel all the way to the distal portion. The foam in the tunnel should be in contact with the foam in the wound.

- With Subsequent dressing changes, as exudate reduces and granulation tissue is noted, the foam can be gently placed into the tunnel all the way to the distal part of the wound - Gently pull the foam out 1-2cm. leaving some foam in the wound to communicate with the foam in the wound bed. This will allow the wound to granulate from the distal portion of the wound. (KCI, 2010; S & N Renasys™, 2013).

Use of NPWT over skin flaps:

- Higher pressures may be required for large bulky flaps to assist in bolstering.
- If signs of infection occur the dressings should be removed and the wound assessed. Significant drainage after 24 hours post-surgery may indicate a complication underneath the dressing.
- If the flap needs to be inspected during therapy, cut the foam in half before applying it and place the drape in strips, with one strip directly over the area where the two foam halves meet. Removing this strip of drape will allow separation of the foam to inspect the wound. After inspection the drape can be resealed by applying a new strip and then continue with therapy.
- If the Wound is exuding heavily, a thin strip of V.A.C. White Foam can be used under the flap and between the sutures, to wick fluid from the interior of the flap. Ensure that this is in direct contact with the Foam dressing used covering the sutures.

(KCI, 2010; S & N Renasys™, 2013).
Enterocutaneous Fistulae

An enterocutaneous fistula is a fistulae communicating between the skin and intestine. The fistulae may also be described by the amount of output:

- High output: 500ml or more/24hrs
- Medium output: 200-500ml./24hrs
- Low output: less than 200ml/24hrs

In small bowel enteric fistulae the aim is to convert from a high to a low output fistulae (Reduced oral intake and low residue diets may also be used to achieve this).

When treating an open abdomen where enteric fistulae are present, the potential for abdominal contamination should be considered if effluent is not appropriately managed/isolated. The goal of treatment for acute fistulas may be complete closure whereas for chronic fistulae the aim will be to segregate the fistula from the abdominal wound (surgical repair may be required).

*Note: NPWT may help to promote healing in wounds with an enterocutaneous fistulae but specialist management is required.*

(KCI, 2010; S & N Renasys™, 2013).

Body cavity wounds

Underlying structures must be covered by natural tissues or synthetic materials that form a complete barrier between the underlying structures and the wound filler

- **Exposed tendons:** Healthy exposed tendons should be protected against trauma and desiccation by covering them with fascia or muscle or a non-adherent contact layer. The V.A.C. White foam dressing may be used on the tendon without the non-adherent layer on discretion of the lead clinician (Kinetic Concepts Inc., 2007).

- **Exposed nerves and blood vessels:** Exposed nerves and tendons should be protected by moving available fascia or muscle over them (surgery) or one or more layers of a non adherent contact layer.

(KCI, 2010; S & N Renasys™, 2013).

Wounds at risk of infection

NPWT should be used with consideration of other treatment options when infection is a risk. This includes more frequent dressing changes, debridement, antibiotic therapy, appropriate pressure settings and use of fenestrated antimicrobial dressings at the wound interface underneath gauze/foam (Malmsjo et al., 2010).

Consider the use of the V.A.C. Granufoam Silver if a KCI device is in operation. The foam should be in direct contact with the wound surface for maximum effectiveness (KCI., 2010).

Consider the use of a dressing or gauze interface containing silver underneath the cavity filler e.g actioat flex or atrumann AG. The dressing should allow free passage of fluid/oxygen (Birke-Sorensen et al., 2011).
Assessment of the wound with NPWT:

1. Wound dimensions:
   - Should be decreasing as healing progresses

   *When there are minimal or no changes in wound size:*

   - Cut the foam slightly smaller than the wound edges to enhance epithelial cell migration in superficial wounds, ensuring that the edges will not roll.
   - Trial intermittent therapy as per guidelines if the client is able to tolerate.
   - Evaluate underlying systemic factors that may delay the healing process (e.g., nutrition, pressure, pain).
   - Assess for wound infection: (culture/biopsy if necessary). Signs of possible infection include fevers, tenderness, redness, swelling, rash, increase in temperature around the wound, purulent discharge and a strong odour. Systemic infection may cause an increase in temperature, headache, nausea, vomiting, dizziness, fainting, orthostatic/refractory hypotension, sore throat with swelling of the mucus membranes and erythroderma (sunburn like rash).

2. Colour:
The colour of the granulation tissue should become a deeper red as perfusion increases.

   If dark granulation tissue appears:

   - Assess for mechanical trauma caused by pressure at weight bearing wound sites and pressure caused by other devices (e.g., stoma belt, off loading boot).
   - Rule out mechanical trauma caused by dressing removal.
   - Ensure foam/gauze is not over-packed into wound.
   - Do not stretch the drape over the foam, roll the drape over.
   - Decrease pressure settings (10-25mmHg).
   - Evaluate client pathology to assess clotting times if the client is taking anticoagulants.

3. Volume and appearance of exudate:

   *Exudate should slowly decrease over time*

   - The colour may change from serous to serous-sanguineous. This is due to increased perfusion and disruption of capillary buds as granulation tissue increases.
   - A rapid increase of bright red blood in tubing and/or canister requires immediate investigation.
   - If the wound appears macerated (white) or excessively moist ensure that the device was operational for the recommended therapy time.
   - Consider increasing the pressure to encourage removal of excess exudates (10-25mmHg).

4. Rapid deterioration in the wound condition:

   - Ensure the device is functioning to the recommended time per day (certain devices have a therapy meter that can record therapy time).
   - Check for small air leaks and patch if necessary.
• Change dressings more often ensuring changes every 48 hours where possible.
• Ensure thorough cleansing of the wound at each dressing change, if odour remains even after thorough cleaning this may be a possible sign of infection.
• Assess for wound infection: (culture/ biopsy if necessary). Signs of possible infection include fevers, tenderness, redness, swelling, rash, increase in temperature around the wound, purulent discharge and a strong odour. Systemic infection may cause an increase in temperature, headache nausea, vomiting, dizziness, fainting, orthostatic/refractory hypotension, sore throat with swelling of the mucus membranes and erythroderma (sunburn like rash).
• Check for Osteomyelitis where appropriate (X-ray, bone scan).
• Consider wound debridement if necessary. Rolled or non viable wound edge should be debrided as it will inhibit formation of granulation/ epithelial growth.

5. Odour:

Due to the interaction between the foam and wound fluids which may contain proteins and bacteria, wounds treated with NPWT have a unique odour.

• If malodour remains after thorough cleaning of the wound, this may be a possible sign of infection.
• In certain therapy units antibacterial gauze/ foam interfaces may assist in reducing odour.
• Using a canister with gel can greatly reduce odour.
• If the therapy unit itself remains the source of odour, consider contacting the company/hospital supplying the device for a replacement or change of filters.

For further recommendations on specific wound types/ filler use and pressure settings please refer to KCI and Smith and Nephew Clinical Guidelines.
Short Assessment

1. Provide three examples when NPWT is contraindicated.
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___________________________________________________________________________

2. Provide two examples of when you would cease NPWT.
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3. What education would you provide the client regarding pain and NPWT?
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4. What would be your management plan if the wound being treated with NPWT became infected?
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5. How long can the NPWT be off before a dressing change is required?
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References


