# Nutrition And Negative Pressure Wound Therapy: Improving Outcomes

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Negative pressure wound therapy (NPWT), also known as vacuum-assisted closure (VAC) therapy, has been used since the early 1990s for the treatment of both acute and chronic wounds. It is now used both in the home and acute care settings for a variety of wounds including diabetic foot ulcers, dehisced wounds, skin grafts, skin flaps, partial-thickness burns, and open abdomens, to name a few.[1, 2]

NPWT works by applying negative pressure to the wound leading to the removal of fluids and debris.[1] The negative pressure can be either intermittent or continuous and can range from 40-200 mm Hg. The system consists of dressing material to pack and seal the wound, tubing for fluid removal from the wound area, a canister to collect waste material and a pump that generates a vacuum.[1] Dressings are usually changed two to three times a week.

There are multiple benefits to wound healing seen with the use of these devices, including increased oxygenation of and blood flow to the wound bed; enhanced tissue epithelialization and granulation and reduced edema and bacterial colonization at the wound site.[3] The vacuum effect can also enhance wound contraction.[4]

## Client Selection And Assessment

Successful use of this form of wound therapy requires appropriate client selection and a thorough assessment of a client's type of wound, medical history, comorbidities and willingness and ability to adhere with the NPWT regimen.[1,4]

The nutritional status of the client must also be considered both prior to initiation and during treatment with NPWT. Nutrition risk is often overlooked despite evidence that poor nutrition, or malnutrition, can lead to delayed wound healing, increased risk of infection and wound dehiscence.[5] NPWT can also increase the risk of malnutrition through loss of fluid and protein, negatively impacting successful wound healing. This article looks at the impact that NPWT may have on the nutritional status of a client and how optimizing nutrition intake - particularly energy, fluid and protein - will enhance successful outcomes.

## Wounds Increase Nutrition Requirements

When a wound is present, nutritional requirements are increased, particularly for energy (calories), protein and fluid. Wound healing is an anabolic process requiring a steady stream of nutrients and fluid to the wound bed throughout all stages of the wound healing cascade. Nutrient needs are influenced by prior nutritional status, the number and severity of wounds and other comorbid conditions. Current nutrition recommendations for wound healing are listed in Table 1.[6-8]

Malnutrition may impact the duration of NPWT required for wound closure/healing. Poor nutrition status has been shown to be a risk factor leading to longer courses of treatment.[3] Depending on the wound type and size, NPWT can incur significant fluid and protein losses which, if not replaced, can lead to depletion, further contributing to malnutrition and decreasing the ability to heal.[8] Poor nutrition status may contribute to impaired immunity leading to higher risk of infections at the wound site. Improved nutrition status may result in shorter duration for NPWT, reduced costs associated with this therapy, and improved client outcomes.

*Nutrition status impacts wound healing and poor nutrition may require a longer course of NPWT.*

## Exudate: More Than Just Fluid

In addition to the recommended baseline nutrition requirements for wound healing, losses from the exudate must be replaced in the diet or from enteral/parenteral nutrition (see Table 1). It is relatively straightforward to quantify exudate volumes collected and estimate additional fluid replacement requirements. However, wound exudate is more than just fluid. Protein, electrolytes, and even vitamins and minerals are also drawn out of the wound, regardless of the wound type.[9]

**Table 1:** Nutrition Recommendations for Wound Healing with NPWT[6-8]

| Nutrient | Recommendation for Wound Healing | Additional Requirements for NPWT |
|---|---|---|
| **Energy** | 30-35 kcal/kg/d | |
| **Protein** | 1.25-1.5 g/kg/d (up to 2.0 g/kg in critical care) | Add 1.5-3.0 g/100 ml exudate |
| **Fluid** | 1 ml/kcal or 30-35 ml/kg | Add exudate losses. The higher range is recommended with larger wounds or open abdomen treatments where the volume of exudate may be significant. |
| **Micronutrients** | Multivitamin with minerals (MVM) | If evidence of deficiency, supplement individual micronutrients in addition to a standard MVM |

Not considering NPWT nutrition losses leads to an underestimation of nutrition needs, negatively impacting wound healing and increasing the risk of malnutrition.

As exudate losses increase, so do protein requirements. Estimates of the protein content of the exudate are between 1.5-3.0 grams per 100 ml.[6,8] For some wounds, this can be significant; particularly long-duration NPWT treatments, large wounds, open abdomens, high output wounds or when there are multiple wounds requiring NPWT. Among hospitalized patients, where available, a nitrogen balance study can be conducted with a correction factor to account for protein in wound exudate and other losses from drains, fistulas or the gastrointestinal tract to ensure the adequacy of the nutrition prescription.[10]

## Other Losses: Micronutrients and Electrolyte

Various micronutrients play a role in wound healing and immune function, including vitamins A, C and D, as well as iron, copper, selenium and zinc. Decreased levels of these micronutrients have been associated with delayed wound healing and compromised immune function.[11]

Both micronutrient and electrolyte loss during NPWT can be significant. Only one study that we are aware of has been conducted on micronutrient losses during NPWT and the sample size was quite small, pointing to a lack of research in this area.[9] Extrapolating from the burns literature, where evidence is more robust (though further research is still needed), micronutrient losses are known to be high in wound exudate and supplementation may reduce infection rates and improve wound healing.[12-15] Use of high calorie, high protein, arginine, zinc and antioxidant enriched oral nutrition supplements may help offset micronutrient losses in NPWT and improve outcomes, as has been shown for those with a Category/Stage II or greater pressure injury.[7] Additionally, provision of a standard multivitamin with minerals and periodic monitoring of micronutrient status is warranted, with supplementation to treat deficiency when evident. A nutrition focused physical exam can be a valuable tool for the hospitalized patient undergoing NPWT, where many micronutrient levels will be falsely increased or decreased due to the presence of inflammation. See Table 2 for nutrition support recommendations during NPWT.

Similarly, electrolyte losses in wound exudate can be high.[8] Periodic monitoring of serum levels and supplementation as indicated should be implemented to prevent complications of deficiency. As with gastrointestinal and urinary losses, wound exudate losses during NPWT should be considered in estimating electrolyte replacement needs. Higher losses during NPWT warrant more frequent monitoring.

## Monitor Nutrition Status

All clients with a wound should be screened for malnutrition and referred to a Registered Dietitian (RD) for individual nutritional assessment. Please see Malnutrition and Wound Healing for further information on nutrition screening tools.

In addition, due to the risk of nutritional depletion, proactive nutrition therapy and optimiza-

**Table 2:** Nutrition support in NPWT [6, 16]

| Route | Recommendation | Note |
|---|---|---|
| **Oral nutrition supplements (ONS)** | Provide high calorie, high protein, arginine, zinc and antioxidant ONS | Not yet available in Canada as an oral supplement. |
| **Enteral formula** | Provide high calorie, high protein, arginine, zinc and antioxidant enteral formula | At present, the only available product in Canada is Pivot 1.5 ® (Abbott Canada) |
| **Parenteral nutrition** | Higher protein dose to account for losses in wound exudate, with standard vitamins/trace elements. | Parenteral glutamine may be considered in surgical patients undergoing NPWT |

tion will help prevent malnutrition for those who are well-nourished when starting NPWT. This is particularly important if exudate losses are high. While there currently are no established thresholds, it is the opinion of the authors that exudate volumes exceeding 250 ml/day warrant attention from a registered dietitian.

## Preoperative Assessment By Dieititian Important

For elective surgeries where NPWT is expected to be used postoperatively, preoperative assessment by a Registered Dietitian may help improve outcomes. Similarly, for malnourished patients, preoperative nutritional support for 7-14 days may improve postoperative outcomes.[16]

During treatment with NPWT, client weight, ability to conduct activities of daily living (ADLs) and instrumental activities of daily living (iADLs), fluid status, blood glucose when diabetes is present and overall wound healing should be monitored. Poorly healing wounds, unexplained weight loss, declines in functional status or erratic blood glucose measures should prompt more aggressive nutritional intervention, if aligned with the client's goals, and referral to other members of the health-care team where indicated (e.g., MD/NP, pharmacist, OT/PT, diabetes educator).

## Conclusion

Paying attention to the volume of exudate and replacing losses of fluid, protein, micronutrients and electrolytes incurred by NPWT has the potential to improve the overall nutrition status of the client, improve wound healing, reduce risk of infection, reduce health-care costs and, most importantly, improve outcomes for our clients. Proactive nutrition intervention should be considered with all clients to help prevent nutrition concerns from developing. RDs have a key role to play in wound care and can help clients meet their individual nutrition needs to optimize healing and beyond.

Further research into the impact of NPWT on exudate losses and nutrition status is warranted to help in the creation of nutrition guidelines to improve patient outcomes.

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