

## Treatment of chronic wounds with a single-use negative pressure wound therapy system: a case series



**Authors:**

Harikrishna KR Nair,  
Sylvia SY Chong,  
Mohd Hasbullah Bin Husain

**Key words:**

- Chronic wounds
- Negative pressure wound therapy (NPWT)
- Pressure ulcer
- Wound healing

**Abstract:** Negative pressure wound therapy (NPWT), is a wound dressing system that continuously or intermittently applies subatmospheric pressure to the surface of the wound, and provides a positive pressure to the surface of the wound to aid healing. The aim of this study was to assess the healing of chronic wounds treated by single-use NPWT. Study participants were selected by simple random sampling from a pool of patients who were attending their routine follow-up visits in Wound Care Unit in Hospital Kuala Lumpur. During each dressing change, the wound was assessed and cleansed with distilled water. Debridement was performed as necessary. The application of NPWT was a simple 3-steps procedure, removing the release paper from the dressing and positioning it over the wound bed, connecting the tubing from the pump to the dressing and providing negative pressure treatment through the swing. There were five patients with chronic wounds of various size and aetiologies, including a two pressure ulcers/injury (PU), two carbuncles and post-motor-vehicle accident wound, enrolled in the study, all showed complete wound healing. The two abscesses healed on week 6 and 8 with the single use NPWT and the traumatic wound healed in 10 weeks. Both the sacral and gluteal PUs healed on week 28 and week 14. Case 3, the gluteal PU, healed at week 14 due to the good standard of care, 2-hourly repositioning, proper support surface and good nutritional diet. Meanwhile, the sacral PU took double the time i.e. 28 weeks as the wound area is larger and poor adherence to standard of care. NPWT pressure between  $-75$  and  $-125$ mmHg would provide moist environment that is suitable for wound healing. It aids healing by improving the rate of angiogenesis, endothelial proliferation, capillary blood flow, reducing oedema and bacterial burden within the wound. The limitation of this study was the small number of patients and might not represent the population at large. A much larger study would be needed to show the significance of these findings.

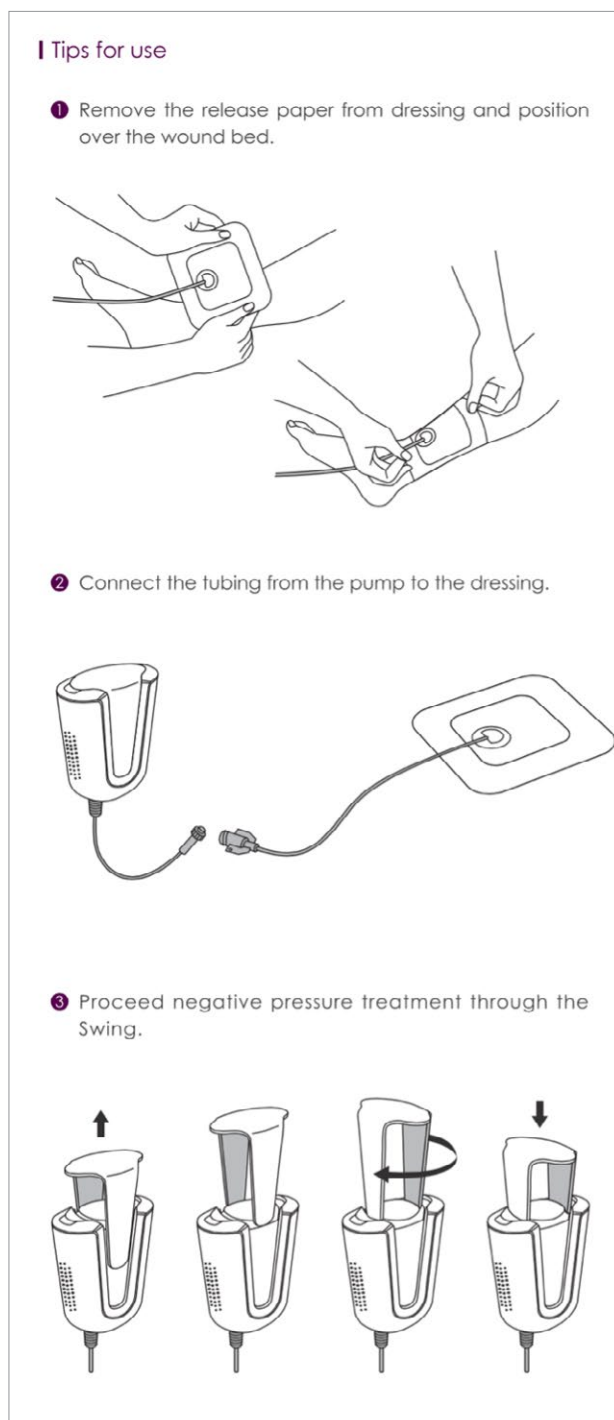
**Harikrishna KR Nair** is a Professor and Head of Wound Care Unit, Dept. of Internal Medicine, Hospital Kuala Lumpur; **Sylvia SY Chong** is a Research Assistant, Wound Care Unit, Dept. of Internal Medicine, Hospital Kuala Lumpur; **Mohd Hasbullah Bin Husain** is a Registered Staff Nurse, Wound Care Unit, Dept. of Internal Medicine, Hospital Kuala Lumpur

The process of wound healing involves a complex series of events that are interlinked and dependent on local and systemic factors (Guo and DiPietro, 2010). Recognition and eradication of these factors are fundamental steps in successful wound management.

Negative pressure wound therapy (NPWT), is a wound dressing system that continuously or

intermittently applies subatmospheric pressure to the surface of the wound, causing negative pressure, which in turn has positive effects on the wound healing trajectory or cascade. NPWT guidelines suggested pressure between  $-75$  and  $-125$ mmHg would provide a moist environment (Wayne et al, 1996; Bryan, 2004; Apelqvist et al, 2017) that is suitable for wound healing. NPWT improves the rate of angiogenesis (Fabian et al,

Figure 1. Directions on how to use the single-use negative pressure wound therapy device, Anscare SIMO NPWT System (provided by BenQ Materials Corp, Taiwan)



2000; Chen et al, 2005), endothelial proliferation (Scherer et al, 2008), capillary blood flow (Morykwas et al, 1997; Wackenfors et al, 2004; Chen et al, 2005; Wackenfors et al, 2005), while reducing oedema (Kamolz et al, 2004; Simman et al 2004) and the bacterial burden (Mouës et al, 2004) within the wound. Pressure greater than  $-125\text{mmHg}$  is known to cause pain (Borgquist et al, 2010).

A case study of 20 patients with infected

wounds, using NPWT as an adjunct therapy, showed that NPWT stimulates infection-free scar tissue formation in a short time (Jones et al, 2016). In another pilot study involving 15 patients with infected wounds, NPWT instillation showed a significant decrease in the mean-time to bioburden reduction, wound closure and hospital discharge compared with traditional wet-to-moist wound care (Gabriel et al, 2008). Both of these study outcomes demonstrates NPWT as being able to reduce the need for complex surgical procedures and decrease inpatient care requirements for these complex, infected wounds.

An evaluation of NPWT with low pressure and gauze dressing in a 30 patients prospective cohort study shows 43% achieved at least 50% wound area reduction after four weeks of therapy (Lavery et al, 2014). In a randomised controlled trial (RCT), prophylactic NPWT application to laparotomy wounds after an abdominal surgery minimised the risk of developing surgical site infection (SSI) compared with the control group (O'Leary et al 2017). Efficacy of NPWT in reducing SSI rate is also evident in two other studies with ileostomy closure sites (Cantero et al, 2016; Poehnert et al, 2017).

In acute management of burns, NPWT is proven to reduce ischaemia, oedema formation and wound progression (Morykwas et al, 1999; Kamolz et al 2004; Schrank et al 2004; Molnar et al, 2006). NPWT is used with caution in paediatric patients as their skin thickness and composition (Birchenough et al 2008; Stamatas et al, 2009), body surface area (Passaretti and Billmire, 2003) and formation rates of granulation tissue (Mooney et al, 2000) differs in comparison with adults. However, on suitable paediatric patients, NPWT is convenient to be used as it reduces the frequency of dressing change and allows for greater mobility than some standard dressings (Contractor et al, 2008).

## Aim

The aim of this study was to assess the healing of chronic wounds treated by single-use NPWT.

## Methodology

Study participants were selected by simple random sampling from a pool of patients who were attending for their routine follow-up visits at the Wound Care Unit in Hospital Kuala Lumpur. During each dressing change, the wound was assessed and cleansed with distilled water. Debridement was done when necessary. The application of NPWT was a

### Case 1. A category IV sacral pressure ulcer

- A 62-year-old, Malay gentleman, with diabetes mellitus and hypertension
- He developed category IV sacral pressure ulcer following a laparotomy, right hemicolectomy and double barrel stoma
- NPWT treatment was initiated and the pressure ulcer completely healed after 28 weeks.

#### Week 0

2cm x 8.5cm x 5cm



#### Week 28

Wound healed



### Case 2. A back carbuncle

- A 60-year-old, Malay gentleman, with diabetes mellitus, hypertension and an carbuncle on his back
- He had saucerization four months before starting NPWT.
- He was previously treated with superoxidised solution, hydrogel and hydrofiber Ag dressing.

#### Week 0

3cm x 2cm x 4cm



#### Week 6

Wound healed



simple 3-step procedure (Figure 1), removing the release paper from the dressing and positioning it over the wound bed, connecting the tubing from the pump to the dressing and providing negative pressure treatment through the swing. Patients and caretakers were advised on proper management of pressure ulcers (PU) such as 2-hourly positioning, the use of a proper support surface and good nutritional diet for faster wound healing.

The trial was conducted in accordance with the guidelines set in the Declaration of Helsinki and approved by the hospital review board. Informed consent and permission to use clinical images and case details for publication/research purposes were obtained before starting the study.

#### Device used in the study

The NPWT used for this case study was Anscare SIMO NPWT System which was provided by BenQ Materials Corp, Taiwan.

#### Results

We enrolled five patients with chronic wounds of various size and aetiologies, two PU, two abscesses and one post-motor-vehicle accident wound, in this study.

All five cases showed complete wound healing. The two abscess healed on week 6 and 8, while the traumatic wound healed in 10 weeks. Both the sacral and gluteal PU healed on week 28 and week 14 respectively

#### Case 1

A 62-years-old, Malay gentleman, with

underlying diabetes mellitus and hypertension (*Case 1*). The patient had a perforated appendiceal tumour, which led to a laparotomy, right hemicolectomy, and double barrel stoma in the same month. However, two months postoperative, the patient developed category IV sacral PU. The ulcer size was 2cm x 8.5cm x 5cm on presentation. NPWT treatment was initiated and after 28 weeks of treatment the PU was completely healed.

### Case 2

A 60-year-old, Malay gentleman, with underlying diabetes mellitus and hypertension (*Case 2*). Patient had saucerization (surgical excavation

of tissue forming a shallow depression to aid drainage from infected areas of a wound) for the carbuncle over his back under private general practitioner, four months before the start of NPWT. Patient was previously on superoxidised solution, hydrogel and hydrofiber Ag dressing. Once NPWT was started the wound healed after 6 weeks

### Case 3

A 51-year-old, Indian gentleman, with underlying hypertension, diabetes mellitus and history of a stroke (six months before). He had developed a bilateral gluteal PU due to prolonged intubation in the intensive care unit (*Case 3*). Initially

#### Case 3. A bilateral gluteal pressure ulcer

- A 51-year-old Indian gentleman, with hypertension and diabetes mellitus, who had a stroke six months ago
- Patient developed a bilateral gluteal pressure ulcer (PU) due to prolonged intubation in intensive care unit
- NPWT was initiated four months after trial of hydrofiber Ag and polyurethane foam
- The PU was completely healed after 14 weeks treatment.

##### Week 0

4.5cm x 1.5cm x 3cm



##### Week 14

Wound healed



#### Case 4. A right thigh carbuncle

- A 64-year-old Malay lady, with diabetes mellitus, hypertension and a right thigh abscess
- The abscess underwent saucerization, NPWT treatment was initiated shortly afterwards
- The wound healed had healed by week 8.

##### Week 0

4.5cm x 6cm x 2cm



##### Week 8

Wound healed



### Case 5. A traumatic shin wound

- A 53-year-old Malay lady, with no known medical illness, and a deep wound following a motorbike accident seven weeks earlier
- Initially she was treated with wound ointment and polyurethane foam
- NPWT was started and by week 10 the wound had completely healed.

**Week 0**  
3.5cm x 2.5cm



**Week 10**  
Wound healed



hydrofiber Ag and polyurethane foam, however after four months it was decided to use NPWT as wound healing progression was slow.

On presentation the PU measure measure 4.5cm x 1.5cm x 3cm, after 14 weeks of NPWT the the ulcer completely healed.

### Case 4

A 64-year-old, Malay woman, with underlying diabetes mellitus and hypertension. She had a right thigh carbuncle that was treated with saucerization (*Case 4*).

NPWT treatment was initiated shortly after the saucerization. At the start of NPWT the wound was 4.5cm x 6cm x 2cm, after 8 weeks the wound was completely healed.

### Case 5

A 53-year-old, Malay lady, with no known medical illness. She had a motorbike accident with a deep wound at left shin (*Case 5*), 7 weeks before initiation of NPWT.

Patient was previously on natural remedy ointment and polyurethane foam before NPWT. As wound healing progression was slow. it was decided to try the single-use NPWT system. On starting treatment the wound size was 3.5cm x 2.5cm after 10 weeks of NPWT the wound has completely healed.

### Discussion

Case 3 was a gluteal PU that healed at week 14 due to the site and the good standard of care, including 2-hourly repositioning, a proper

support surface and good nutritional diet. Meanwhile, the sacral pressure injury wound took double the time i.e. 28 weeks as the wound area is larger and poor adherence to standard of care.

NPWT increases the rate of angiogenesis (Fabian et al, 2000; Chen et al, 2005), endothelial proliferation (Scherer et al, 2008) as well as reduces oedema (Kamolz et al, 2004) and bacterial burden (Mouës et al, 2004). Hypoxic environment in NPWT increases inflammatory cytokines, hence, stimulating wound healing (Huang et al, 2014; O'Leary et al, 2017).

Patients with limited mobility and heavily exudating wounds used larger mains-operated NPWT in hospitals. The Anscare SIMO NPWT System used in this study is portable, small and lightweight, enabling patients to have continuous NPWT without limiting patient's mobility. This lightweight, battery-powered units are suitable for ambulatory patients with minimal-to-moderate levels of exudative wound. Anscare SIMO NPWT System is able to promote blood circulation (Morykwas et al. 1997; Wackenfors et al, 2004; Chen et al, 2005; Wackenfors et al, 2005) and exudate management (Wayne et al, 1996; Bryan, 2004; Apelqvist et al 2017) for a better wound healing. This system has a smart indicator for dressing change notification and display of negative pressure status by colour band and sensing knob. This use of this device allows patients to take a light shower.

## Limitations

The limitation of this study was the small number of patients and might not represent the population at large. A much larger study would be needed to show the significance of this finding.

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## Declaration of interest

BenQ Materials Corporation sponsored the Anscare SIMO NPWT used for this study. The author has no conflicts of interest to declare.

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