

# Assessing a new negative pressure wound therapy (NPWT) system in clinical practice

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Negative pressure wound therapy (NPWT) has gained rapid acceptance by clinicians, including plastic surgeons, for the management of acute and hard-to-heal wounds (Moues et al, 2005). The delivery of NPWT to the wound takes two forms, each of which was developed independently, with the major difference between them being the type of dressing used — foam or gauze (Chariker et al, 1989; Argenta and Morykwas, 1997). Both foam and gauze result in the formulation of granulation tissue, but gauze can be easier to fit onto larger or irregular wounds.

It has been demonstrated that NPWT helps to drain excessive fluid and debris from the wound and induces mechanical deformation of tissue at the wound edge (Argenta and Morykwas, 1997; Morykwas et al, 1997; Morykwas et al, 2006).

Furthermore, NPWT creates a moist wound healing environment (Banwell, 1999), which helps to encourage the normal wound healing process.

Published studies indicate that NPWT has the following properties:

- ▶ Reduces bacterial load (Morykwas et al, 1997)
- ▶ Increases granulation tissue formation (Morykwas et al, 1997)
- ▶ Reduces oedema (Lu et al, 2003)
- ▶ Stimulates cell-mediated immune response (Gouttefangeas et al, 2001)
- ▶ Decreases blood vessel permeability (Chen, 2005)
- ▶ Stimulates angiogenesis and blood flow to the wound margins (Evans and Land, 2001; Greene et al, 2006).

There is also evidence to suggest that NPWT may help to remove inhibitory cytokines and activated polymorphonuclear leukocytes from the wound bed, which are in part responsible for hard-to-heal wounds becoming suspended in an inflammatory state (Lambert et al, 2005).

## The Avance® NPWT system

The new Avance® NPWT system (Mölnlycke Health Care) is specifically designed to be used with either a foam- or gauze-based wound dressing, thereby providing clinicians with a choice of modality. Clinicians also have the option of using a soft silicone wound contact layer (Mepitel® with Safetac® technology, Mölnlycke Health Care) as a direct interface layer between the wound bed and the dressing (foam or gauze). This can help to minimise trauma and pain experienced at dressing changes, prevent in-growth of tissue into the wound dressing and protect delicate deep structures.

The Avance NPWT system has been developed as a flexible and easy-to-use treatment that helps to promote wound healing, including drainage and removal of infectious material or other fluids, under the influence of constant and/or intermittent negative pressure. It is lightweight and portable and incorporates a rechargeable battery so that it can be operated independently of the mains, thereby encouraging patient mobility during treatment (Figure 1).

## Avance Foam

The green-coloured foam is made of hydrophobic reticulated polyurethane and has a large open cell structure. It is constructed to distribute the pressure across the wound surface and allow the passage of fluids and exudate through to the negative pressure system.

The foam stimulates wound healing by promotion of granulation tissue formation and is available in small, medium and large size dressing kits. The colour means that bleeding can be monitored more easily and can be recognised in the wound bed (Malmso and Ingemansson, 2011).

## Case report

This article reports on the management of a 30-year-old woman

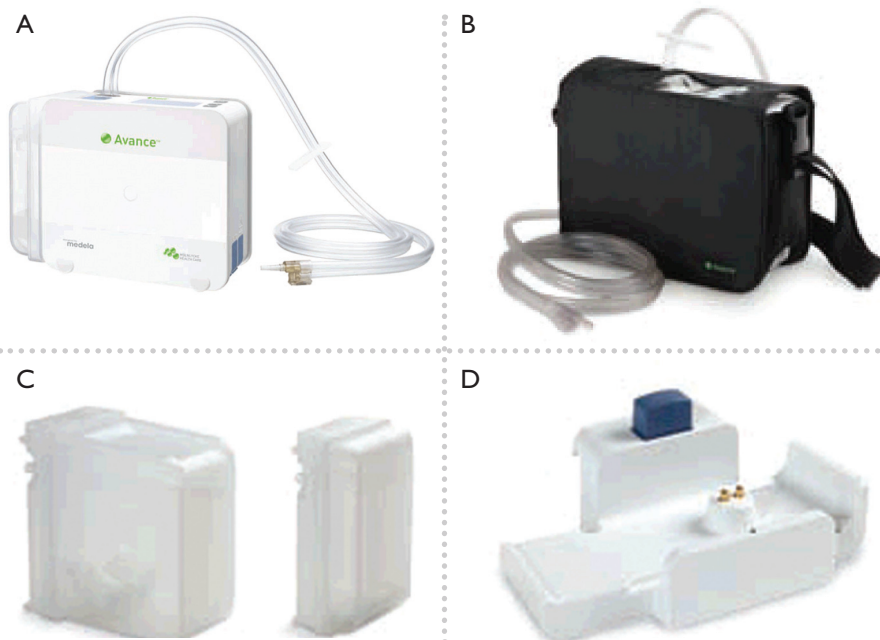


Figure 1. Avance pump (A), carrying case (B), canisters (300 and 800ml sizes) (C) and docking station (D).

who was admitted as an emergency with an abscess in her buttocks that caused her to develop sepsis. This resulted in her being admitted to an intensive care unit to be ventilated for respiratory failure. As part of her management she was treated with the Avance NPWT system and then traditional dressings. She was normally fit and well apart from a diagnosis of Crohn's disease, an inflammatory disease of the gastrointestinal tract. The Crohn's disease had been controlled for years by a low fibre and low residue diet.

The patient was admitted to the general hospital from home with a right buttock abscess, which she said had just 'appeared overnight'. She collapsed at home and lay on the floor

**The Avance NPWT system helps to promote wound healing, including drainage and removal of infectious material or other fluids, under the influence of constant and/or intermittent negative pressure.**

for eight hours before admission and was brought as an emergency call because of the sepsis in the buttock abscesses (16 May, 2011). She was immediately taken to theatre and underwent a laparotomy, colectomy and the formation of a Brooke ileostomy to combat the Crohn's disease. After these procedures, she was subsequently returned to theatre on 18, 20, 23 and 25 May, 2011 for further debridement of these wounds.

At the time of her initial assessment by the author on 13 June, 2011, the patient was an inpatient on the intensive care unit. This was some time after her admission, as her condition first had to be stabilised. She had a 31cm



Figure 2. The two wounds on the patient's buttocks.

laparotomy wound with clips *in situ* and a copious amount of fluid was oozing from the suture line. The author felt that this complex wound was in danger of dehiscence, as the suture line was leaking and there was redness, erythema and hardening of the tissue.

The right buttock wound measured 17 x 15cm. The wound bed was full-thickness and consisted of 90% yellow sloughy tissue and 10% necrotic tissue. The left buttock wound measured 6 x 8cm and was also a full-thickness wound. The wound bed consisted of 50% pink granulation tissue and 50% yellow sloughy tissue. There were two tracks connecting the wounds, which the author was able to identify with a gloved finger:

The patient had also developed bilateral blistered heels. The left heel had a superficial hospital-acquired category 2 pressure ulcer measuring 1 x 1cm (European Pressure ulcer Advisory Panel/National Pressure Ulcer Advisory Panel [EPUAP/NPUAP], 2009). The right heel had a category 2 de-roofed blister measuring 5 x 5cm (EPUAP/NPUAP, 2009).

The patient was catheterised and was undergoing hourly fluid balance measurements to assess her kidney output. She was also being nursed on an alternating mattress with a profiling bed frame. As well as this she was being turned every two hours. She was extremely unwell due to the sepsis from her wounds and was being ventilated. Her nutrition was compromised and her dietary requirements were being managed by the hospital dieticians, who worked closely with the author to ensure wound healing was a priority, for example, her diet was altered to include a high level of protein.

The patient had a high body mass index (BMI) of 100.4 and her MUST (Malnutrition Universal Screening Tool) rating was 0 (Todorovic, 2003), indicating that she was low risk but needed repeat screening. Therefore, she was referred to the dietetic team so that her nutritional needs could be monitored while she was being ventilated.

Other tests/assessments ordered by the author, included:

- ▶ Waterlow score (to assess the risk of pressure ulceration): 23 (Waterlow, 1987)
- ▶ Serum albumin: 14 (a low serum albumin is indicative of pressure ulcer risk) (Anthony et al, 2011)
- ▶ Haemoglobin: 8.9 (a normal haemoglobin score is 12–18g/dl, whereas a low score can impair wound healing)
- ▶ White cell count 12.1 (a raised white cell count indicates the an infection is present).

### Management

The author decided that the ulcers on the patient's right and left heels should be dressed with a hydrocolloid and changed every four days. Hydrocolloids are suitable for superficial wounds, which do not produce excessive quantities of exudate. They also have occlusive properties that promote the optimum environment for wound healing.

The laparotomy wound was dressed with Advadraw® (Advancis Medical) and C-View Film (Aspen Medical) and changed when required, which was sometimes up to twice a day.

The patient's buttock wounds were daily dressed with Sorbsan® Ribbon (Aspen Medical) and Biatain® Foam (Coloplast) and she was upgraded to a TheraPulse™ (KCI) mattress to assist with the management of her complex pressure relief requirements and to promote wound healing. The mattress was scheduled to turn her from side-to-side every 15 minutes.

The surgical consultant decided not to take her back to theatre as he believed she had a fistula in the abdominal wound. At this point, the option of NPWT was dismissed as the consultant was reluctant to use it due to the fistula.

On 13 June, 2011 the surgical

consultant requested NPWT to the buttock wounds. It was decided the best way to apply the NPWT dressing was to place the patient in the prone position while she was anaesthetised. This had to be coordinated with intensive care staff and the anaesthetics department, as she needed to be ventilated due to respiratory failure. As a result of her body mass, she also required a large number of staff to assist her into a prone position using a slide sheet.

### Application of NPWT to the buttocks

On removal of the dressings on the patient's buttocks, the left buttock wound measured 12 x 9cm and the right 4.5 x 3.5cm (Figure 2). There was still an 8cm-long finger width track running from one side of the wound to other. The appearance of the tissue was 50% pink and 50% sloughy yellow, although it did appear to be well-perfused.

The Avance® (Mölnlycke Health Care) NPWT was applied in the following way. A piece of hydrocolloid dressing was cut into narrow strips and then applied to the periwound edges to ensure a good seal. Mepiseal® (Mölnlycke Health Care) was also used to protect the vaginal area, where it was difficult to provide a seal that would last until the next dressing change. The green foam incorporated in the Avance NPWT system was bridged from the left buttock wound over to the right in order to receive the NPWT.

The drape and draining were then applied — the drapes enable the system to maintain an effective seal. This connects to the canister allowing the exudate to drain away from the wound. The NPWT pump was set at -120Hmgs on continuous therapy (the normal level of NPWT). The seal was further enhanced by using a maternity pad over the top of the dressing.

The clinicians were instructed that if the NPWT lost its seal for longer than two hours maximum, the wound would require redressing with Sorbsan Ribbon and Biatain Foam, or reapplication of the NPWT.

The NPWT dressing changes were performed on Mondays, Wednesdays and Fridays.

The NPWT to the buttocks was applied under anaesthetic in intensive care as the patient was being ventilated for a five-week period of treatment (she later moved to the high-dependency unit — where she was weaned off the ventilator — after a total of nine weeks on intensive care). She was alert and awake but very anxious about her dressing changes and required sedation so that she could cope with the pain. The buttock wounds were very deep and complex and would normally require a high level of analgesia. Also, the moment the team started the dressing changes she would begin to panic despite reassurance (the patient continued to undergo dressing changes while being heavily sedated, even when she was on the high-dependency unit, in preparation for a move to a general ward).

The intensive care staff were taught how to perform the NPWT dressing changes to the buttocks and initially required a lot of support. The manufacturer of the Avance system provided excellent support and gave the clinicians confidence to undertake the dressing changes without supervision towards the fourth week of the patient's treatment.

### Application of NPWT to the abdominal wound

The abdominal wound had completely dehisced by 20 June 2011 and measured 26 x 6.5cm. It comprised 20% sloughy yellow and 80% pink tissue and was well-perfused (Figure 3).



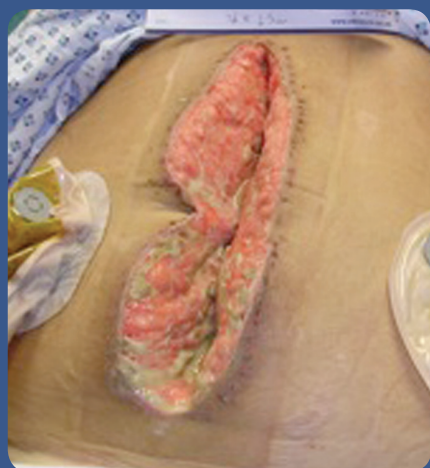


Figure 3. The dehiscent abdominal wound.



Figure 5. The wound bed was well perfused.



Figure 6. Both buttocks showed pink granulation tissue.



Figure 4. The wounds are flush to the skin.

The author demonstrated the application of NPWT to the nurses. First the wound was cleansed with saline to remove any residual dressing remnants in the wound bed. Hydrocolloid strips were applied to the periwound edges to ensure a good seal. Mepitel® (Mölnlycke Health Care) was applied to the wound bed and then one piece of green foam was placed over the top and shaped to the wound. The foam had a channel cut for the drainage tube to fit into. The drape was applied and checked to ensure it provided a good seal. The Avance pump was set at -120Hmg on continuous therapy.

By the second week of NPWT to the abdominal wound, the nursing staff on the intensive care unit were happy to instigate the dressing change without supervision. The author coordinated

the dressing changes and ensured that assistance from the company or herself was available when required.

#### Ongoing management

The author used the TIME framework to assess the wounds and to decide on the optimum dressing regimen (Schultz et al, 2003; Dowsett, 2008). TIME is a systematic approach to implementing wound bed preparation and a useful approach to focusing on the wound bed:

- T:** represents the tissue type
- I:** refers to the presence or absence of infection/inflammation
- M:** represents moisture balance and avoidance of desiccation or maceration
- E:** represents the wound edges, i.e. are they non-advancing or non-migrating. The aim is to promote wound closure, therefore, it is essential to remove the barriers to this process.

On 17 June, 2011 the surgical consultant reviewed the patient's progress with the author and was happy with the improvement in the buttock wounds. The left buttock was static at 17 x 15cm and the right buttock wound now measured 4 x 5cm, although it was not as deep and was starting to heal. There was still a track between the wounds, but the wound bed now consisted of 50% pink granulation tissue and 50% yellow

sloughy tissue and was well perfused. The amount of exudate drainage was considerably less.

The sepsis was now resolving and it was agreed that the rectal tube that had been put in place to drain faeces would remain *in situ* until the wounds had healed sufficiently. The NPWT was continued and reviewed weekly by the author.

On 13 July, 2011 the patient was moved to the high-dependency unit. The author reviewed the buttock wounds. The rectal tube was still *in situ* and draining faeces. It was decided to discontinue the NPWT as substantial progress had been made and the wounds were flush with the skin (Figure 4). The patient was nursed laterally and the buttock wounds were dressed every 48 hours with Sorbsan Ribbon, Eclipse® (Advancis Medical) and C-View, although she was still heavily sedated and on the high-dependency unit.

Table 1 shows the total number of weeks that the NPWT dressing was in use.

On removal of the dressing, the left buttock wound measured 12 x 5cm and there was a very small track that required packing with Sorbsan Ribbon. The right buttock wound measured 3 x 3cm with a 2cm track, which was

not attached to the other wound and was healing well. The wound bed comprised 100% pink tissue, which was well-perfused and bleeding easily. It was also nearly flush with the skin. The care pathway of using Sorbsan Ribbon to fill both tracks and then Eclipse 15 x 15cm secured with C-View was continued.

Despite still being sedated, the patient was quite distressed during this buttock dressing change, so the abdominal wound was not reviewed until 18 July, 2011, when it measured 20 x 3cm. The wound bed comprised 100% pink tissue and was well-perfused with blood. The wound was 2cm deep.

**The sepsis was now resolving and it was agreed that the rectal tube that had been put in place to drain faeces would remain in situ until the wounds had healed sufficiently.**

At this point the blood results had mostly improved to:

- ▶▶ Waterlow score: 11
- ▶▶ Serum albumin: 24
- ▶▶ Haemoglobin: 10.

However, the white cell count had increased slightly to 14.5.

The NPWT was discontinued on 18 July 2011 after a period of four weeks (Figure 5).

The patient had begun mobilising around the high-dependency unit but was not able to sit in a chair for another few weeks until her buttocks had healed. She remained on the TheraPulse mattress to maintain the healing and to prevent any deterioration. She had commenced a light diet and appeared to be in good spirits. She still had the rectal tube

**Table 1**  
Number of weeks that NPWT was employed

Weeks	Left buttock wound size	Right buttock wound size	Abdominal wound size	Status	Location
1	17 x 15cm	6 x 8cm	31cms	No NPWT	ITU
2	17 x 15cm	4 x 5cm	26 x 6.5cm	NPWT begun	
3	17 x 15cm	4 x 5cms	23 x 6cm		
4	12 x 5cm	4 x 3cm	23 x 6cm		
5	12 x 5cm	3 x 3cm	20 x 3cm	Traditional dressing on buttock wounds	High dependency unit
6	10 x 7cm	3x2cm	19 x 2.5cm	Traditional dressing on abdominal wound	General ward
7	9 x 5cm	1 x 1cm	9 x 2.5cm		
9	2.5 x 2cm	4 x 1cm	17 x 1cm		
12	3 x 1cm	Healed	17 x 1cms		

*in situ* and the medical consultants decided to leave it in place until 25 July, 2011 to ensure that no faeces were draining into the wound. The urinary catheter was still *in situ*.

Going forward, the author advised continuing with the Sorbsan Ribbon and Biatain Foam every 48 hours for the abdominal wound, and Sorbsan Ribbon, Eclipse and C-View for the buttock wounds.

The patient was transferred to a general surgical ward on 25 July, 2011 and reviewed by the author every two weeks. The abdominal wound was reviewed on 25 July, 2011 and had decreased to 19 x 2.5cm and was 2cm deep. The tissue was 100% pink and well-perfused. The left buttock wound measured 10 x 7cm and the right buttock wound measured 3 x 2cm. Both wound beds comprised 100% pink granulation tissue.

The rectal tube was removed, although the urinary catheter remained *in situ* and the patient was placed on an autologic alternating mattress to maintain the healing process and prevent secondary trauma.

The author recommended that the dressing regimen on the buttock wounds be changed to PolyMem® Max (Ferris Mfg) with C-View film. This was to be changed every four days, which is ideal for completing the final stage of wound healing.

In the case of the abdominal wound, the author advised continuing with the Sorbsan Ribbon and Biatain Foam and changing them every 48 hours. The author continued to review the patient every two weeks to monitor the progress of the wounds.

By 3 August, 2011, the abdominal wound had decreased to 9 x 2.5cm



Figure 7. The buttock wounds continued to reduce in size.



Figure 8. The abdominal wound progressed well to healing.



Figure 9. The left buttock wound comprised 100% granulation tissue.

and 1 cm in depth. The wound bed now comprised 90% pink tissue and 5% yellow sloughy tissue and was well perfused.

The left buttock wound measured 9 x 5 cm and the right buttock 1 x 1 cm. Both wound beds comprised 100% pink granulation tissue (Figure 6). The patient

continued on the autologic mattress with two-hourly repositioning and the author advised that she could sit out on an alternating seating cushion for a maximum of two hours at a time. She was eating well and the urinary catheter remained *in situ*.

The dressing regimen remained constant for the next two weeks and on 7 September, 2011 the abdominal wound had decreased substantially. The left buttock now measured 2.5 x 2 cm and the right buttock 4 x 1 cm. Both comprised 100% pink granulation tissue (Figure 7). The patient was continued on the autologic mattress and sat on the alternating seating cushion for a maximum of two hours at a time. She was eating well and mobilising around the ward with less assistance than before. She did ask if she could be taken off the alternating mattress, but the author explained that it was required for completion of the healing process as secondary trauma could easily occur and delay wound healing.

The author advised that the dressing on the left buttocks be changed to Polymer Max with C-View film every four days, and that the right buttock be dressed with a hydrocolloid, again every four days.

On the 16 September, 2011 the abdominal wound had decreased to 17 x 1 cm. The right buttock wound was

now healed completely and comprised very pink fragile tissue. The left buttock wound measured 3 x 1 cm and comprised 100% pink granulation tissue.

The patient was still on the autologic mattress and sitting on an alternating cushion for a maximum of two hours at a time. She continued to eat well and still moved around the ward with assistance. She again asked if she could be taken off the alternating mattress, but the author reiterated that the healing was nearly complete and the mattress needed to be continued for a little longer.

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**The patient had begun mobilising around the high-dependency unit but was not able to sit in a chair for another few weeks until her buttocks had healed.**

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The author advised that the left buttock wound and the abdominal wound dressings be changed to Biatain Foam with C-View every four days. The dressing on the right buttock continued to be dressed with a hydrocolloid every four days.

On the 20 September, 2011 the abdominal wound had almost healed, although it was producing exudate (Figure 8).

The right buttock had now healed completely and comprised very pink fragile tissue. The left buttock wound measured 3 x 1 cm and the wound bed comprised 100% pink granulation tissue (Figure 9). The patient continued with the autologic mattress and was still sitting out on the alternating seating cushion for a maximum of two hours at a time. She continued to eat well.

The author advised that the left buttock should be dressed with Biatain



Foam with C-View every four days. The right buttock was continued with a hydrocolloid every four days. At this point the abdominal wound was changed back to Sorbsan Ribbon and Biatain Foam every three days, as the wound had become wet as a result of the exudate.

### Aftercare

The patient was discharged to her own home and was totally independent. She had lost five stone as a result of her illness, but was happy with this weight loss and aimed to maintain it as a health benefit. The patient was followed-up in outpatients on 5 October, 2011 and did not require any further dressings.

### Conclusion

This case report features three complex wounds that were treated with the Avance NPWT system. The management of these wounds required a great deal of collaboration between members of the multidisciplinary team and the company representative to ensure that the NPWT dressing took place according to an appropriate time schedule.

Good communication was essential so that all the clinicians involved were aware of when the dressing was due to be renewed, especially as this patient was anaesthetised on the intensive care unit and the team had to work around the theatre schedule, which meant careful planning.

Initially, the prospect of healing was remote due to severe sepsis. However, working in partnership to use the NPWT system resulted in good clinical outcomes and improved quality of life for the patient. **WUK**

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### Key points

- ▶▶ Negative pressure wound therapy (NPWT) has gained acceptance by clinicians and plastic surgeons in the management of acute and hard-to-heal wounds.
- ▶▶ This case report features three complex wounds that were treated with the Avance® NPWT system.
- ▶▶ Initially the prospect of healing was remote due to severe sepsis. However, working in partnership to use the NPWT system resulted in good clinical outcomes and improved quality of life for the patient.

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