NEGATIVE PRESSURE WOUND THERAPY IN SALVAGING THE DIABETIC FOOT- AN A.I.M.S EXPERIENCE

Authors: Dr Amit Kumar C Jain*, Dr Ajit Kumar Varma**, Dr Mangalanandan+, Dr Arun Bal++, Dr Harish Kumar+++

Abstract:
Negative pressure wound therapy (NPWT) is a new technology that has been shown to promote healing in many different types of wounds. Over the past several years, NPWT has emerged as a commonly employed option in the treatment of complex wounds.

We retrospectively reviewed 40 patients on whom NPWT was used to salvage the diabetic foot. Ninety percent of our patients’ feet were salvaged using this modality. NPWT was required for healing of the wounds in 20% of patients after peripheral angioplasty. The majority of the patients required negative pressure wound therapy for approximately one to three weeks. This is one of the largest series reported from India on the use of NPWT in salvaging diabetic feet and limbs.

Key words: NPWT, Diabetic foot, ulcers, limb salvage

Introduction

It is estimated that in 2005, around 150 million people world wide afflicted by diabetes mellitus lived in the developing countries.¹ The lifetime risk for foot ulcers in people with diabetes has been estimated to be 15%.² Furthermore, foot ulcers precede more than 80% of non-traumatic lower limb amputations.³

Healing of surgical wounds in individuals with diabetes poses several special concerns. Salvage of a functional terminal organ of weight bearing allows these individuals to remain more mobile and independent, as compared with patients who have undergone transtibial or more proximal level amputations.⁴

Negative pressure wound therapy (NPWT) is a novel technology that can be used to salvage post surgical diabetic foot wounds. It is known by various names such as TNP (topical negative pressure), VAC® (Vacuum assisted closure, KCI, San Antonio, TX, USA), VST (Vacuum Sealing technique), etc.⁵ The use of negative pressure has been shown to accelerate debridement and promote healing in different types of wounds. This study aims at providing our experience of negative pressure wound therapy in salvaging diabetic foot wounds.
A retrospective study was carried out from April 2008 to August 2009 in the Department of Endocrinology, Diabetic lower limb and Podiatric surgery at Amrita institute of Medical Sciences and Research Centre, Cochin, Kerala, India. This is a tertiary care superspeciality medical college teaching hospital. Our institute is well established as a diabetic limb salvage centre and is the largest of its kind in India. All the patients on whom negative pressure wound therapy was applied during this period were studied.

The following were inclusion and exclusion criteria:

Inclusion Criteria
1) Type 2 diabetes mellitus
2) Post operative patients
3) Wounds involving the diabetic foot
4) Debrided wounds
5) Peripheral obstructive vascular disease (A.B.I < 0.9)

Exclusion Criteria
1) Wounds in non diabetic patients
2) Wounds at sites other than foot
3) Undebrided infected wounds

A total of 40 patients had undergone NPWT during this period. We applied NPWT only on post operative wounds in the diabetic foot for salvaging the foot, usually between 24-72 hours after surgery. In 36 patients (90%), NPWT was successful in salvaging the foot. NPWT is considered a success when the entire base of the ulcer is covered with granulation tissue. The wound was either allowed to close spontaneously or was skin grafted at later stage.

NPWT was considered to be a failure in 4 patients (10%). 1 patient died during the therapy and 3 patients required below knee amputation as the wounds failed to heal.

Twenty patients (50%) on whom NPWT was applied had peripheral arterial disease with non revascularizable lesions. Eight patients (20%) on whom NPWT was applied had undergone prior lower limb angioplasty. In these patients, the ulcer did not show signs of healing even after successful angioplasty. Only 12 patients (30%) on whom NPWT was utilized had normal Ankle Brachial Indices (A.B.I).

Approximately thirty percent of patients required more than 21 days of NPWT for their ulcers to granulate. (TABLE 1)

<table>
<thead>
<tr>
<th>Duration of NPWT</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 7 days</td>
<td>01</td>
<td>02.5%</td>
</tr>
<tr>
<td>7 - 14 days</td>
<td>17</td>
<td>42.5%</td>
</tr>
<tr>
<td>15 - 21 days</td>
<td>10</td>
<td>25%</td>
</tr>
<tr>
<td>&gt;21 days</td>
<td>12</td>
<td>30%</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 1: The duration of usage of NPWT

Thirteen patients (32.50%) on whom NPWT was used had severe peripheral occlusive vascular disease (P.O.V.D) in addition to the previously mentioned 12 patients who had normal A.B.I. (TABLE 2).

<table>
<thead>
<tr>
<th>ABI</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 0.9</td>
<td>12</td>
<td>30%</td>
</tr>
<tr>
<td>0.6 – 0.89</td>
<td>09</td>
<td>22.50%</td>
</tr>
<tr>
<td>0.3 – 0.59</td>
<td>13</td>
<td>32.50%</td>
</tr>
<tr>
<td>&lt; 0.3</td>
<td>01</td>
<td>02.50%</td>
</tr>
<tr>
<td>&gt;1.30 (noncompressible)</td>
<td>05</td>
<td>12.50%</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 2: The distribution of usage of NPWT according to Ankle Brachial index (ABI)

One patient died on the 4th day of NPWT due to cardiac arrest. Thus, the majority of the wounds (67.5%), required less than 3 weeks of negative pressure wound therapy prior to healing or grafting.
Discussion

NPWT was first investigated by Morykwas and Argenta et al in 1997. They used a swine model to investigate the effect of negative pressure applied via vacuum assisted closure on wound healing. Today, NPWT (Fig. 1) is a commonly employed option in treatment of complex wounds. The technique of NPWT is very simple. Proprietary foam with an open cell structure is introduced into the wound and the wound drain with lateral perforations is laid on top of it. The entire area is then covered with a transparent adhesive membrane, which is firmly secured to the healthy skin around the wound margin. When the exposed end of the drain tube is connected to vacuum source, fluid is drawn from the wound through the foam and evacuated into a reservoir for subsequent disposal.

NPWT helps in wound healing by removing the interstitial fluid, increasing the blood flow and decreasing the tissue bacterial level. It has since been proposed that application of sub-atmospheric pressure produces mechanical deformation or stress within the tissue, resulting in protein and matrix molecule synthesis and enhanced angiogenesis. From various studies, it has been shown that a negative pressure value of 125mmHg appears to be optimum when applied in a cyclical fashion. NPWT therapy has also been shown to be cost effective in use.

Numerous papers have described the use of NPWT in the treatment of a variety of wound types including extensive degloving injuries, infected sternotomy wounds and various soft tissue injuries prior to surgical closure, grafting or reconstructive surgery. Banwell et al. have found that immediate application of NPWT following injury/ debridement produced good results. They recommended changes of dressings every 4-5 days. We normally apply the NPWT dressing between 24-72 hours following surgery and this is subsequently changed every 3-4 days.

In one study involving 313 patients, the average duration of vacuum therapy was 16.7 days. Similarly, the majority of our patients (67.5%) required NPWT for 1-3 weeks. During this period the majority of wounds would granulate. There were, however, 3 patients in our study in whom the wound did not show healthy granulation tissue. They ended up with below knee amputations. One additional patient died due to coronary artery disease during NPWT therapy.

Twenty percent of the patients underwent NPWT after successful angioplasty because the wounds failed to granulate spontaneously. There was only one patient (2.56%) who had an ABI of less than 0.3 on whom NPWT was applied for wound healing. He, however, succumbed to a below knee amputation because of his peripheral vascular insufficiency.
Conclusion

NPWT is an effective modality in salvaging the foot, especially post surgically. We achieved a success of 90% in salvaging the limb in diabetic patients using NPWT and prevented proximal major amputations. Our average duration of application of NPWT in our institution is 1-3 weeks. NPWT is a cost effective tool that can be used to salvage the foot even in cases where revascularization (angioplasty) could not heal the wounds primarily.

References


