Negative Pressure Wound Therapy

A Vacuum of Evidence?

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Objective: To systematically examine the clinical effectiveness and safety of negative pressure wound therapy (NPWT) compared with conventional wound therapy.

Data Sources: MEDLINE, EMBASE, CINAHL, and the Cochrane Library were searched. Manufacturers were contacted, and trial registries were screened.

Study Selection: Randomized controlled trials (RCTs) and non-RCTs comparing NPWT and conventional therapy for acute or chronic wounds were included in this review. The main outcomes of interest were wound-healing variables. After screening 255 full-text articles, 17 studies remained. In addition, 19 unpublished trials were found, of which 5 had been prematurely terminated.

Data Extraction: Two reviewers independently extracted data and assessed methodologic quality in a standardized manner.

Data Synthesis: Seven RCTs (n=324) and 10 non-RCTs (n=278) met the inclusion criteria. The overall methodologic quality of the trials was poor. Significant differences in favor of NPWT for time to wound closure or incidence of wound closure were shown in 2 of 5 RCTs and 2 of 4 non-RCTs. A meta-analysis of changes in wound size that included 4 RCTs and 2 non-RCTs favored NPWT (standardized mean difference: RCTs, −0.57; non-RCTs, −1.30).

Conclusions: Although there is some indication that NPWT may improve wound healing, the body of evidence available is insufficient to clearly prove an additional clinical benefit of NPWT. The large number of prematurely terminated and unpublished trials is reason for concern.

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Technology Assessment Database. All searches were last updated in October
2005. Furthermore, the US Food and Drug Administration
(Manufacturer of NPWT devices (KCI and Blue Sky Medical, La Costa,
California) were asked to provide published and unpublished
facturers of NPWT devices (KCI and Blue Sky Medical, La Costa,
California) were asked to provide published and unpublished
data. Detailed information about the search strategies is avail-
able on the Web site of the Institute for Quality and Efficiency in
Health Care (http://www.iqwig.de).

SELECTED CRITERIA

Studies were considered eligible if they evaluated the effect of NPWT
vs conventional wound therapy on wound healing. We included
randomized controlled trials (RCTs) and non-RCTs if they had a
concurrent control group. All abstracts were screened independ-
ently by 2 reviewers (S.G. and J.F.K.). Abstracts were excluded
only if both investigators classified them as clearly not relevant
or if they were not available as full-text articles. All languages were
included. Potentially relevant articles in Chinese13,14 and Russian15
were translated by medically trained native speakers. Subsequently,
all retrieved full-text articles were independently examined by 5
reviewers (all the authors except J.F.K.).

QUALITY ASSESSMENT AND DATA EXTRACTION

Eligible trials were assessed for their quality using standard-
ized methods.16 We evaluated each study regarding trial de-
sign (eg, allocation concealment, blinding of outcome evalu-
ators, definition of primary end point, and sample size
calculation) and trial conduct (eg, sample size included, with-
drawals, quality of statistical analyses, and reporting of ad-
verse effects). In addition, we determined the presence of any
industrial sponsorship for each study. Data from the trials in-
cluded were extracted using standardized forms and were sum-
marized independently in tabular format by 2 reviewers (S.S.
and F.P.). The authors of some publications were contacted to
clarify inconsistencies in trial data, and when possible, the re-
spective replies were included in this analysis.

STATISTICS

Meta-analyses for all primary outcomes were planned, but owing
to the nature of the primary data, a meta-analysis was possible
only for changes in wound size. We used a statistical soft-
ware program (Review Manager 4.2; Cochrane Collaboration,
Oxford, England) to summarize primary data from RCTs and
non-RCTs. As a measure of effect, we calculated the standard-
ized mean difference (SMD) from the difference in means di-
vided by the pooled standard deviation. A random-effects model
was used to pool data into a common estimate of SMD with
95% confidence intervals (95% CIs). Heterogeneity was quan-
tified by I² in the 0% to 100% range. A formal analysis of pub-
llication bias was planned, but it later turned out to be impos-
sible owing to the small number of studies available.

LITERATURE SEARCH

The literature search identified 2578 unique and poten-
tially relevant citations (Figure 1). Of the 255 poten-
tially relevant full articles, 23 (which described 20 trials)
formed the primary focus. Three studies were excluded
from further evaluation: in 1 RCT, incisional wounds af-
ter ankle surgery were studied, although such wounds
can be sutured,17 and in 2 studies, co-interventions (eg,
use of bioartificial skin18 or the technique of fracture fixa-
tion19) were different between treatment groups. Of the
remaining studies, 7 (reported in 8 articles) were RCTs20-27
and 10 were non-RCTs.28-37

METHODS

SEARCH STRATEGY

Full-text articles relating to NPWT were searched for in
MEDLINE, EMBASE, CINAHL, and the Cochrane Central Reg-
ister of Controlled Trials. Trial registries (http://
clinicaltrials.gov and http://www.nrr.nhs.uk) were screened for
ongoing trials. Search strategies were adapted and broadened
according to the specific structure of each database to com-
tpletely detect nonrandomized trials. In addition, systematic re-
vews were identified in the Cochrane Library by searching the
Cochrane Database of Systematic Reviews, the Database of
Abstracts of Reviews of Effects, and the Health Technology As-
essment Database. All searches were last updated in October
2005. Furthermore, the US Food and Drug Administration
(FDA), other health agencies, clinical experts, and the manu-
facturers of NPWT devices (KCI and Blue Sky Medical, La Costa,
California) were asked to provide published and unpublished

Figure 1. Flow diagram of trial selection. CDSR indicates Cochrane Database of Systematic Reviews; CENTRAL, Cochrane Central Register of Controlled Trials; DARE, Database of Abstracts of Reviews of Effects; and HTA, Health Technology Assessment Database.

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According to information from study registries, authors of publications, and the manufacturer (KCI), a further 19 trials were currently ongoing (n = 7), completed but not published (n = 3), or prematurely terminated (n = 5); the status of 4 trials was unknown (Table 1). Reasons for premature termination of trials included slow enrollment, high attrition rates, changes in clinical practice, and design flaws (KCI, written communication, August 19, 2005); none of the results of these 5 trials have been published to date.

Results were reported for 667 wounds in 602 patients (324 in RCTs and 278 in non-RCTs (Table 2). The overall methodologic quality of the trials was poor. Only 1 of the RCTs clearly described concealment of allocation, high attrition rates, changes in clinical practice, and design flaws (KCI, written communication, August 19, 2005); none of the results of these 5 trials have been published to date.

### Table 1. Characteristics of Ongoing and Prematurely Terminated Randomized Controlled Trials

<table>
<thead>
<tr>
<th>Source, Year of Trial Start, KCI ID</th>
<th>Type of Wounds</th>
<th>Control Treatment</th>
<th>Planned Sample Size, No.</th>
<th>Active Treatment Phase</th>
<th>Observation Period</th>
<th>Planned Publication Date</th>
<th>Current Status of Trial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adams et al, 1999^</td>
<td>Split-thickness skin graft donor site ulcers</td>
<td>Semipermeable membrane dressings</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Enrollment planned to end in 2002, unpublished</td>
</tr>
<tr>
<td>Armstrong et al, 2001-VAC 2001-08</td>
<td>Diabetic foot ulcers</td>
<td>Moist wound therapy</td>
<td>Initially 206, later 338</td>
<td>112 d</td>
<td>NA</td>
<td>December 2007</td>
<td>Ongoing, abstract on 46 patients published^</td>
</tr>
<tr>
<td>Bayar et al, 2002-VAC 2002-09</td>
<td>Sternal wound infection</td>
<td>Moist wound therapy</td>
<td>116</td>
<td>84 d</td>
<td>NA</td>
<td>February 2009^</td>
<td>Terminated early, unpublished</td>
</tr>
<tr>
<td>Foo et al</td>
<td>Diabetic foot ulcers</td>
<td>Moist gauze dressing</td>
<td>NA</td>
<td>Not given</td>
<td>NA</td>
<td>NA</td>
<td>Status unknown</td>
</tr>
<tr>
<td>Fryer et al, 2000</td>
<td>Pressure ulcers</td>
<td>Saline wet-to-moist dressings</td>
<td>120</td>
<td>Not given</td>
<td>NA</td>
<td>NA</td>
<td>Enrollment planned to end in 2001, unpublished</td>
</tr>
<tr>
<td>Greer et al, 1998</td>
<td>Pressure ulcers</td>
<td>Wet-to-moist dressings</td>
<td>160</td>
<td>NA</td>
<td>1 y</td>
<td>NA</td>
<td>Terminated after enrollment of 16 patients, unpublished</td>
</tr>
<tr>
<td>Gupta et al, 2001</td>
<td>Chronic infected wounds</td>
<td>Not given</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Status unknown</td>
</tr>
<tr>
<td>Lantis et al</td>
<td>Split-thickness skin grafts</td>
<td>Moist wound therapy</td>
<td>NA</td>
<td>7 d</td>
<td>90 d</td>
<td>NA</td>
<td>Abstract on 12 patients published</td>
</tr>
<tr>
<td>McCarthy M, et al, 2005^</td>
<td>Ischemic leg ulcers</td>
<td>Not given</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Enrollment planned to end in 2006, unpublished</td>
</tr>
<tr>
<td>Molnar et al, 2001-VAC 2001-00</td>
<td>Hand burns</td>
<td>Silver sulfadiazine</td>
<td>50</td>
<td>48 h</td>
<td>NA</td>
<td>December 2005^</td>
<td>Ongoing, abstract on 23 patients published^</td>
</tr>
<tr>
<td>Niezgoda et al, 2001-VAC 2001-01</td>
<td>Pressure ulcers</td>
<td>Moist wound therapy</td>
<td>Initially 258, later 330</td>
<td>84 d</td>
<td>NA</td>
<td>April 2008</td>
<td>Ongoing, abstract on 67 patients published^</td>
</tr>
<tr>
<td>Orgill et al, 2002-VAC 2002-10</td>
<td>Open abdominal wounds</td>
<td>Moist wound therapy</td>
<td>116</td>
<td>84 d</td>
<td>NA</td>
<td>March 2006^</td>
<td>Terminated early, abstract on 30 patients published^</td>
</tr>
<tr>
<td>Stannard et al, 2001-VAC 2001-06</td>
<td>Open fractures</td>
<td>Saline-soaked fine mesh gauze</td>
<td>300</td>
<td>Until completed wound healing</td>
<td>Until wound closure or infection</td>
<td>December 2007</td>
<td>Terminated early, abstract on 27 patients published^</td>
</tr>
<tr>
<td>Vuerstaek et al, 2001-VAC 2001-05</td>
<td>Chronic leg ulcers</td>
<td>Conventional wound care</td>
<td>60</td>
<td>Until completed wound healing</td>
<td>1 y</td>
<td>July 2006</td>
<td>Ongoing, abstract on 60 patients published^</td>
</tr>
<tr>
<td>Walker et al, 1998^</td>
<td>NA</td>
<td>Standard wound drainage (Medinorm)</td>
<td>48</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Enrollment planned to end in 2000, unpublished</td>
</tr>
</tbody>
</table>

Abbreviation: KCI, Kinetic Concepts Inc; NA, not available.

^ Estimated date of publication at the start of the trial.

^ Registered at the UK National Research Register (N0084029434 for Walker, N02345095365 for Adams, and N0123138623 for McCarthy).


^ Registered at ClinicalTrials.gov (Identifiers NCT00121537 for McCarthy and NCT00234559 for Niezgoda).

^ Preliminary results of these trials have now been published.19
location. Blinding of outcome evaluation was performed in 5 studies. Intention-to-treat analyses were explicitly described in 3 studies and could be assumed in 6 further studies. Sample size calculation was reported in only 1 trial. In that trial, the primary end point was changed to comply with FDA recommendations. In 3 trials, data originating from different wounds in the same patient were analyzed using standard statistics without controlling for the dependence between wounds. Study duration varied from 3 days to 1 year.

CLINICAL RESULTS

Wound closure (secondary healing or surgical closure) was described as the incidence of complete wound closure in 2 studies and as the time to wound closure (complete or incomplete) in 7 studies. Only 2 of the 5 RCTs and 2 of the 4 non-RCTs reported a significant advantage in favor of NPWT. Owing to the heterogeneity of results and the different outcome definitions used, no meta-analysis was performed.

Eight studies (5 RCTs and 3 non-RCTs) analyzed changes in wound size, measured as either wound volume or wound area. Two of these studies had to be excluded from the meta-analysis: 1 non-RCT failed to report measures of variability, and an RCT had a crossover design. Pooled data showed a significant reduction in wound size in favor of NPWT (RCTs: SMD, −0.57; 95% CI, −0.94 to −0.20; non-RCTs: SMD, −1.30; 95% CI, −2.07 to −0.54). Heterogeneity, as quantified using the I² statistic, was 0%. One RCT presented detailed information on the generation of granulation tissue and reported a significantly faster rate in patients treated with NPWT.

All 3 studies on the use of NPWT in patients with skin grafts found similar take rates. Repeated operations after skin grafting were reported significantly less often in the NPWT group in 1 non-RCT. Of the 4 studies reporting methods of surgical wound clo-
The only study to analyze differences between treatment groups for repeated amputation rates noted a (non-significant) reduction in favor of NPWT. Adverse event rates were similar between NPWT and conventional therapy in 7 studies, whereas 2 studies reported fewer complications when using NPWT. In 1 RCT, infections were more common in patients treated with NPWT.

### Table 3. Incidence of Wound Closure and Time to Wound Closure

<table>
<thead>
<tr>
<th>Source</th>
<th>Definition of Outcome Criterion (Unit)</th>
<th>NPWT, Mean (SD/Sample Size)</th>
<th>Control, Mean (SD/Sample Size)</th>
<th>Significance Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armstrong and Lavery, 2005</td>
<td>Complete or surgical closure within 16 wk (No. of patients)</td>
<td>43 (NA/77)</td>
<td>33 (NA/85)</td>
<td>.04</td>
</tr>
<tr>
<td>Ford et al, 2002</td>
<td>Complete nonsurgical closure within 16 wk (No. of patients)</td>
<td>31 (NA/77)</td>
<td>25 (NA/85)</td>
<td>NA²</td>
</tr>
<tr>
<td>Joseph et al, 2000</td>
<td>Successful secondary wound healing within 6 wk (No. of patients)</td>
<td>2 (NA/20)</td>
<td>2 (NA/15)</td>
<td>NA</td>
</tr>
<tr>
<td>Mouës et al, 2004</td>
<td>Surgical closure with flap surgery (No. of patients)</td>
<td>6 (NA/20)</td>
<td>6 (NA/15)</td>
<td>NA</td>
</tr>
<tr>
<td>Wanner et al, 2003</td>
<td>Time to 90% change of wound volume as estimated from the Kaplan-Meier curve (days)</td>
<td>45 (NA/18)</td>
<td>56 (NA/18)</td>
<td>.04</td>
</tr>
<tr>
<td></td>
<td>Time to possibility of surgical closure in Kaplan-Meier analysis (days)</td>
<td>6 (NA/29)</td>
<td>7 (NA/25)</td>
<td>.19</td>
</tr>
<tr>
<td></td>
<td>Time to 50% reduction of wound volume (days)</td>
<td>27 (10/11)</td>
<td>28 (7/11)</td>
<td>&quot;No time benefit&quot;</td>
</tr>
</tbody>
</table>

#### Randomized Controlled Trials (n = 5)

<table>
<thead>
<tr>
<th>Source</th>
<th>Definition of Outcome Criterion (Unit)</th>
<th>Time of Measurement (Unit)</th>
<th>Blinded Assessment</th>
<th>NPWT, Mean (SD/Sample Size)</th>
<th>Control, Mean (SD/Sample Size)</th>
<th>Significance Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eginton et al, 2003</td>
<td>Relative change in wound volume after 2 wk</td>
<td>Yes</td>
<td>−59.0% (9.7/7)</td>
<td>−0.1% (14.7/7)</td>
<td>.005</td>
<td></td>
</tr>
<tr>
<td>Ford et al, 2002</td>
<td>Relative change in wound area after 2 wk</td>
<td>Yes</td>
<td>−16.4% (6.2/7)</td>
<td>5.9% (17.4/7)</td>
<td>Not significant</td>
<td></td>
</tr>
<tr>
<td>Joseph et al, 2000</td>
<td>Relative change in wound volume after 6 wk</td>
<td>Yes</td>
<td>−51.8% (38/20)</td>
<td>−42.1% (38/15)</td>
<td>.46</td>
<td></td>
</tr>
<tr>
<td>Mouës et al, 2004</td>
<td>Relative change in wound volume per day</td>
<td>No</td>
<td>−3.8% (1.9/15)</td>
<td>−1.7% (2.2/13)</td>
<td>&lt;.05</td>
<td></td>
</tr>
<tr>
<td>Wanner et al, 2003</td>
<td>Relative change in wound area after 2 wk</td>
<td>No</td>
<td>−25% (26/11)</td>
<td>−14% (30/11)</td>
<td>Not given</td>
<td></td>
</tr>
</tbody>
</table>

#### Nonrandomized Controlled Trials (n = 4)

<table>
<thead>
<tr>
<th>Source</th>
<th>Definition of Outcome Criterion (Unit)</th>
<th>Time of Measurement (Unit)</th>
<th>Blinded Assessment</th>
<th>NPWT, Mean (SD/Sample Size)</th>
<th>Control, Mean (SD/Sample Size)</th>
<th>Significance Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doss et al, 2002</td>
<td>Change in wound area per day (cm²)</td>
<td>No</td>
<td>−4.6 (No data/20)</td>
<td>−3.2 (No data/22)</td>
<td>Not given</td>
<td></td>
</tr>
<tr>
<td>Etoz et al, 2004</td>
<td>Change in wound area until surgical closure (cm²)</td>
<td>No</td>
<td>−20.5 (11.9/12)</td>
<td>−9.5 (4.1/12)</td>
<td>.03</td>
<td></td>
</tr>
<tr>
<td>McCallon et al, 2000</td>
<td>Relative change in wound area until surgical closure or hospital discharge</td>
<td>No</td>
<td>−28.4% (24.3/5)</td>
<td>9.5% (16.9/5)</td>
<td>Not given</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: NPWT, negative pressure wound therapy; NA, not available or not applicable.

* Difference is not significant, with $P = .19$ in the Fisher exact test (own calculation).

b Data are medians.
c Data were derived from Figure 1 of the cited article. We assumed that figure legends had been interchanged because the text of the article suggests an advantage for NPWT.
d Data on variation are 95% confidence intervals.

### Table 4. Changes in Wound Size

<table>
<thead>
<tr>
<th>Source</th>
<th>Definition of Outcome Criterion and Time of Measurement (Unit)</th>
<th>Blinded Assessment</th>
<th>NPWT, Mean (SD/Sample Size)</th>
<th>Control, Mean (SD/Sample Size)</th>
<th>Significance Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eginton et al, 2003</td>
<td>Relative change in wound volume after 2 wk</td>
<td>Yes</td>
<td>−59.0% (9.7/7)</td>
<td>−0.1% (14.7/7)</td>
<td>.005</td>
</tr>
<tr>
<td>Joseph et al, 2000</td>
<td>Relative change in wound volume after 6 wk</td>
<td>Yes</td>
<td>−51.8% (38/20)</td>
<td>−42.1% (38/15)</td>
<td>.46</td>
</tr>
<tr>
<td>McCallon et al, 2000</td>
<td>Relative change in wound area until surgical closure or hospital discharge</td>
<td>No</td>
<td>−28.4% (24.3/5)</td>
<td>9.5% (16.9/5)</td>
<td>Not given</td>
</tr>
</tbody>
</table>

Abbreviation: NPWT, negative pressure wound therapy.

a The SD was calculated from the $P$ value.
b Data were taken from the cited article; data in Figure 5 are slightly different (NPWT vs control, 47% vs 39%).
c Data were taken from Figure 3 of the cited article; data in Figure 4 are slightly different (NPWT vs control, 27% vs 10%).
d Data were calculated from raw data shown in Table 1 of the cited article.
with NPWT. Pain was not measured in a standardized manner in any study. Mortality was reduced significantly in the NPWT group in 1 non-RCT in patients with an open abdomen. Hospital stay was shortened by NPWT in 1 non-RCT but was similar in 4 other non-RCTs. An economic analysis was performed in 1 RCT, yielding similar overall costs for NPWT and conventional therapy.

**COMMENT**

The results of this systematic review show that clinical evidence on NPWT consists of only a few small trials of insufficient methodologic quality. Results in favor of NPWT were seen for surrogate variables of wound healing, such as reduction in wound size and formation of granulation tissue. However, although this may facilitate surgical closure, according to the FDA, only “complete wound closure . . . is one of the most objective and clinically meaningful wound healing endpoints” and “the clinical benefit of incremental wound size changes has not been established.” The FDA also noted that a claim of facilitation of surgical closure by an NPWT device should be supported by adequately designed trials to evaluate complete wound closure after application of the surgical graft. Furthermore, a recent RCT (published after completion of the literature search for this review) reported that NPWT did not result in significantly faster granulation or wound surface reduction compared with modern wound dressings.

Some patient-relevant outcomes, such as a reduction in repeated operations after skin grafting, also indicated a more favorable effect of NPWT. However, data were scarce, and these findings should be interpreted with caution owing to various methodologic flaws in the trials analyzed. In clinical practice, NPWT has enormous importance, and it is therefore disappointing that the total number of patients included in this review was 602, which contrasts sharply with the thousands of NPWT applications performed each day worldwide. This problem of lack of research also affects many other wound therapies, probably because wound healing represents a complex and heterogeneous scientific problem. Owing to the large number of still unpublished trials and especially the unreported early termination of trials, the potential for publication bias is high. Our decision not to include abstract publications and confidential study reports complies with current recommendations.

Two comprehensive systematic reviews on NPWT were published in 2003 and 2004. A strength of the present review lies in the substantial amount of further evidence that could be included, thus doubling the number of patients recruited into RCTs. Furthermore, we included non-RCTs to avoid overselective attention to RCTs. As a result of the highly sensitive search strategy, it seems unlikely that any pertinent article was missed. Owing to its size (162 patients, which is similar to the total number of patients included in the other 6 RCTs) and high quality demands, the trial by Armstrong and Lavery is of special importance. Although it was published in a journal that endorses the CONSORT statement, the publication lacked a clear description of methodologic details, such as concealment of allocation, sufficiently detailed reasons for losses to follow-up, and definition of outcome criteria. Only the first of these issues could be fully clarified by the authors. We also received a written statement from KCI noting that the study’s primary end point had

<table>
<thead>
<tr>
<th>Source</th>
<th>RCTs</th>
<th>Non-RCTs</th>
<th>Subtotal (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients, No.</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>(95% CI)</td>
</tr>
<tr>
<td>Ford et al, 2002</td>
<td>20</td>
<td>-51.8 (38.0)</td>
<td>15</td>
</tr>
<tr>
<td>Joseph et al, 2000</td>
<td>18</td>
<td>-78.0 (72.0)</td>
<td>18</td>
</tr>
<tr>
<td>Moulis et al, 2004</td>
<td>15</td>
<td>-3.8 (1.9)</td>
<td>13</td>
</tr>
<tr>
<td>Wanner et al, 2003</td>
<td>11</td>
<td>-25.0 (28.0)</td>
<td>11</td>
</tr>
<tr>
<td>Subtotal</td>
<td>64</td>
<td>97</td>
<td>-0.57 (-0.94 to -0.20)</td>
</tr>
</tbody>
</table>

**Figure 2.** Effects of negative pressure wound therapy (NPWT) vs conventional wound therapy on changes in wound size: random-effects model of standardized mean differences (SMDs) (95% confidence intervals [CIs]). RCT indicates randomized controlled trial.
been changed during recruitment to comply with FDA recommendations.

52 Different definitions of the primary end point (complete wound closure including or excluding surgical wound closure) affected the significance of the overall results.

The inclusion of non-RCTs in this review may be criticized. Although the existence of RCTs on wound-healing devices shows that these trials can be conducted, one must acknowledge that, for a variety of reasons, they are more difficult to implement than clinical drug trials. Some experts in the field of wound healing have emphasized that randomized trials on NPWT may be unnecessary and even unethical given the large effects observed in uncontrolled studies.

Our decision to include nonrandomized studies with a concurrent control group, therefore, strikes a fair balance between the scientifically sound evaluation of a therapy and the clinical problems of performing the studies necessary for such an evaluation. It seems unwarranted to include studies with nonconcurrent controls. One should also note that NPWT may have striking benefits in some rare diseases (eg, complex reconstructions in plastic surgery), for which it may be impossible to conduct RCTs.

The clinical and economic importance of NPWT has increased tremendously in recent years because NPWT is an innovative and commercially successful concept for the management of difficult-to-treat wounds of nearly every etiology. In addition to worldwide marketing, the most important reasons for the success of NPWT are probably its assumed safety and the facilitation of wound care; for example, in patients with large or heavily secreting wounds. In general, conventional dressings require more frequent changing, which may result in increases in nursing interventions, discomfort for patients, and length of hospital stay. A recent publication that includes health economic data reported advantages of NPWT in wound care; NPWT yielded significantly lower nursing staff costs and less time involvement than treatment with modern wound dressings. The overall costs for treatment groups were similar. It was also noted that “many” patients reported that NPWT was more comfortable than previous dressings (eg, owing to fewer dressing changes and less odor), but detailed data were not provided. The manufacturers of NPWT devices are currently emphasizing the safety and applicability of NPWT in ambulatory settings; however, the data identified in the present review are insufficient to make any statements on the use of NPWT in outpatients.

In summary, many patients have been treated with NPWT, but the present body of evidence is small and insufficient to clearly prove an additional clinical benefit of NPWT compared with conventional wound therapy. However, the absence of evidence does not prove the absence of effectiveness, and there are signs of a clinical benefit of NPWT, which should be confirmed in well-designed trials. To date, industrial, medical, and governmental institutions have not initially adequate and timely research to verify the assumed effects of NPWT. Therefore, physicians and health policymakers should reconsider the widespread use of NPWT outside the setting of clinical trials until better evidence is available.

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