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Best evidence topic

Should infected laparotomy wounds be treated with negative pressure wound therapy?

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ABSTRACT

A best evidence topic in surgery was written according to a structured protocol. The question addressed whether there is any benefit in treating infected laparotomy wounds with negative pressure wound therapy (NPWT). Forty-five papers were found using the reported search; of which 4 represented the best evidence to answer the question. The evidence on this subject is limited; there is a single non-randomised controlled trial, 2 prospective cohort studies, and 1 retrospective cohort study discussed in this paper. From the available literature, the use of NPWT in infected laparotomy wounds does reduce the length of hospital stay, the number of dressing changes required and promote faster wound healing.

1. Introduction

A best evidence topic was constructed according to a structured protocol. This is fully described in a previous publication in the IJS.[1]

2. Clinical scenario

You are the senior house officer on a colorectal ward in a University teaching hospital and you are undertaking the daily ward round. A 55 year old male who underwent a laparotomy for a hemicolectomy 6 days ago complains that his wound is painful. On examination his abdominal laparotomy wound looks infected and is oozing haemoserous fluid. Biochemistry demonstrates an elevated CRP and white cell count and microbiology confirms a staphylococcus wound infection. You discuss this case with one of the wound care specialist nurses who recommends the use of negative pressure wound therapy (NPWT) to dress the wound in favour of conventional wound therapy. Unsure if NPWT is clinically proven to provide benefit in infected laparotomy wounds, you resolve to consult the literature.

3. Three part question

In patients with infected laparotomy wounds, does NPWT, as compared to other conventional wound therapies, improve clinical outcomes?

4. Search strategy

Search was completed using PubMed interface: ("abdomen" OR "laparotomy") AND ("negative pressure wound" OR "vacuum assisted closure"). Cochrane Library database was also searched using the terms: ("Vacuum assisted therapy" or "negative pressure wound therapy"). A search was also done using Google Scholar with the terms: ("abdominal" OR "laparotomy") AND "infected" AND ("negative pressure wound therapy" OR "Vacuum-assisted closure"). Reference year was limited to 2005 to 2013. Reference lists of selected articles were also examined.

5. Search outcome

PubMed search identified 186 results. 88 papers discussed NPWT use in the open abdomen/laparostomy. 12 papers were of NPWT use in non-infected laparotomy wounds. 85 papers were irrelevant to the topic. Only 1 paper by Zhen et al. was relevant.

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A search in the Cochrane Library database identified 128 results. Of which 25 were reviews, 16 were economic evaluations, 18 were technological assessments and 4 were method studies. 65 were trials, of which 57 were trials of NPWT in other wounds, 4 were relating to NPWT use in the open abdomen, 3 were irrelevant. 1 paper by Mees et al. was relevant.

Google scholar search found 1420 results. Of these, 4 papers that compared the use of NPWT with conventional therapy in infected laparotomy wounds were chosen. 2 of the 4 papers were already selected in the PubMed and Cochrane Library search.

Overall, 4 articles: 1 non-randomised controlled trial, 2 prospective cohort studies, 1 retrospective cohort study represented the best evidence available and were selected for analysis.

6. Results

The results of the four papers (1 non-randomised controlled trial, 2 prospective cohort studies and 1 retrospective cohort study) are summarised in Table 1.

7. Discussion

Mees et al.[2] reported a small ($n = 62$) non-randomised controlled trial comparing the use of vacuum associated closure therapy ($n = 14$) to conventional advanced wound care (AWC) therapy ($n = 48$) in the treatment of infected abdominal wall wounds seen over the period of January 2006 to 2008. For the purpose of wound healing evaluation, the wounds were rated in terms of a wound score. On days 2 and 4, the vacuum associated closure (VAC) group had a significantly ($p < 0.05$) improved wound score compared to the conventional AWC group. At day 12, both groups demonstrated plateauing of the wound score improvements. The post-treatment wound scores were not significantly different between the two groups (Post-treatment wound score: AWC 18.5 ± 1.63 vs. VAC 19.69 ± 1.14. Pre-treatment wound score: AWC 12.81 ± 2.91 vs. VAC 17.13 ± 2.5). These results suggest that VAC may be better than conventional AWC therapy in short term wound healing, but this benefit is lost with time. It also advised on the ideal length of VAC use. The VAC group also had a significantly ($p < 0.05$) higher reduction of wound area (Vacuum assisted closure 3.71 ± 1.35 vs. AWC 0.8 ± 0.53 cm^3/day). Due to inconsistent documentation, only 15 patients participated in the evaluation of wound size reduction. VAC dressings also required a longer time for changes; small wounds (<8 × 3 × 3 cm), 10.5 ± 1.71 vs. 15.63 ± 3.15 min; medium wounds (8 × 3 × 3 to 12 × 6 × 6 cm), 12.0 ± 2.69 vs. 24.23 ± 1.60 min; large wounds (>12 × 6 × 6 cm), 15.67 ± 1.92 vs. 31.32 ± 3.75 min). Incidence of incisional hernia in both groups were not significantly different (AWC [$n = 38$] 18.4% vs. VAC [$n = 11$] 20.4%).

The study conducted by Mees et al. had several limitations. It had a small sample size of 62 and the patients were not allocated randomly. Patients were selected for VAC or conventional AWC therapy according to a set of self-defined criteria. Application of selection criteria resulted in more obese patients with BMI >40 (5 out of 6) included in the VAC group ($p < 0.05$) and more oncological operations (23 out of 24) in the group receiving standard AWC therapy ($p < 0.05$). Furthermore the VAC cohort had higher pre-treatment wound scores (VAC 17.3 ± 2.5 vs. conventional AWC therapy 12.81 ± 2.91, $p < 0.05$) and a larger wound area (VAC 127.77 ± 65.22 vs. conventional AWC therapy 36.22 ± 31.37 cm^3, $p < 0.05$). Further confounding the results was that the VAC group received an average of 8.75 days of pre-treatment with standard AWC therapy. The authors described employment of prior treatment with standard wound therapy due to previous experience where 40% of patients who received VAC alone had a relapse of the original infection. All these factors reduce the reliability of the results.

Shrestha et al.[3] reported a case series of 9 patients who developed deep wound infection with dehiscence and discharge after renal transplantation from the period of October 2002 to 2006. The 9 patients were first started on conventional treatment for infected wounds before they were switched to VAC therapy. This switch was done to all 9 patients after cavities developed and copious discharge persisted despite being on conventional wound treatment. Results from the study showed that the use of VAC therapy allows a shorter hospital stay than conventional treatment (VAC: 5 days, range 2–12 days. Conventional wound therapy: 11 days, range 5–20 days. $P = 0.003$). Complete healing was achieved in all 9 patients. This study was limited by the absence of a separate control group. Results from the VAC therapy were compared to effects of the conventional treatment attempted prior to VAC therapy. Therefore, the results also suggest that VAC therapy is more effective than conventional wound therapy as it can treat wounds where conventional therapy failed. The small sample size ($n = 9$) and sequential uses of treatment modalities make it difficult to draw any firm conclusions from this study.

Marquardt et al.[4] reported 7 patients who developed surgical site infection following median laparotomy which was treated with NPWT and Polyhexamethylene Biguanide (PHMB) gauze. Average pain scores of 1.30 were reported using visual analogue scales. On average, the wounds took 7.43 days to heal. The authors say that fewer dressing changes were needed with NPWT than with PHMB moist to dry gauze therapy but no quantitative data was given. Unlike other studies highlighted in this paper, this study used PHMB gauze dressing instead of foam dressing. Several studies comparing gauze dressings and foam dressings have found no significant difference in terms of clinical outcome and cosmetic results.[6–9] In a previous paper Marquardt et al. compared PHMB gauze dressing to foam dressing.[5] Whilst it was claimed that PHMB gauze dressing allowed faster application (attributed to the ability of the drain to be wrapped in the PHMB gauze without 'cutting' as required when using foam), no quantitative data on application time was provided in the report. PHMB gauze dressings also lack protection against *Pseudomonas aeruginosa* infection. In this study, *P. aeruginosa* was found to colonise the PHMB gauze dressings after 2–3 days. The work by Marquadt et al. lacks substantial quantitative data and does not use any form of statistical analysis. Furthermore, the study[4] only suggests that NPWT with PHMB gauze is a safe way of treating infected laparotomy wounds. It does not compare NPWT to conventional therapy and therefore does not prove that NPWT is better and more efficient than conventional therapy. The study has a small sample size ($n = 7$) which reduces its reliability. There is also a potential conflict of interest as the study was funded by Medela Inc.

Zuo Jun Zhen et al.[10] conducted a retrospective cohort study comparing 70 patients treated with a closed suction irrigation method (CSIM) and 60 controls treated with conventional saline dressings. All patients had post-laparotomy wound infection. The CSIM is a modification of the NPWT involving irrigation with normal saline and a vacuum pump to collect the irrigant and the wound exudate. The study found that CSIM resulted in a shorter mean hospital stay (CSIM 9.2 ± 0.1 vs. conventional wound therapy 20.5 ± 0.6 days, $p < 0.001$), shorter healing time (CSIM 8.1 ± 0.1 vs. conventional wound therapy 18.5 ± 0.6 days, $p < 0.001$) and reduced reinfection rate (CSIM 7.1% vs. conventional wound therapy 21.7%, $p < 0.05$).

Of the literature presently available, the work by Zuo et al. has the largest study size of 130 participants. This paper also uses a CSIM instead of the standard NPWT. No research that compares the effectiveness of CSIM against the VAC therapy was found. The results shown from this paper demonstrate that CSIM can be used in the treatment of infected laparotomy wounds and is better than conservative treatment. However, though CSIM is a modification of NPWT, these results may not be representative of the standard NPWT.