Incisional negative pressure wound therapy after hemiarthroplasty for femoral neck fractures – reduction of wound complications

Johannes Pauser1, Matthias Nordmeyer1, Roland Biber1, Jonathan Jantsch2,3, Carsten Kopschina1, Hermann J Bail1 & Matthias H Brem1

1 Department of Orthopaedic and Trauma Surgery, Klinikum Nürnberg - A Teaching Affiliate of Friedrich-Alexander, University Erlangen-Nuremberg, Nuremberg, Germany
2 Medical Microbiology, University Hospital Erlangen, Friedrich-Alexander University Erlangen-Nuremberg, Erlangen, Germany
3 Institute for Medical Microbiology and Hygiene, University Regensburg, Regensburg, Germany

Abstract

The aim of the study was to evaluate the use of incisional negative pressure wound therapy (iNPWT) in wound healing after femoral neck fracture (FNF) treated with hip hemiarthroplasty (HA) and its influence on postoperative seromas, wound secretion, as well as time and material consumption for dressing changes. The study is a prospective randomised evaluation of iNPWT in patients with large surgical wounds after FNF. Patients were randomised either to be treated by iNPWT (group A) or a standard wound dressing (group B). Follow-up included ultrasound measurements of seroma volumes on postoperative days 5 and 10, duration of wound secretion, and time and material spent for wound dressing changes. For comparison of the means, we used the t-test for independent samples, P > 0.05 was considered significant. There were 21 patients randomised in this study. Group A (11 patients, 81 ± 5.6 years of age) developed a seroma of 0.257 ± 0.75 cm³ after 5 days and had a secretion of 0.9 ± 1.0 days, and the total time for dressing changes was 14.8 ± 3.9 minutes, whereas group B (ten patients, 82.6 ± 8.6 years of age) developed a seroma of 3.995 ± 5.01 cm³ after 5 days and had a secretion of 4.3 ± 2.45 days, and the total time for dressing changes was 42.9 ± 11.0 minutes. All mentioned differences were significant. iNPWT has been used on many different types of traumatic and non-traumatic wounds. This prospective, randomised study has demonstrated decreased development of postoperative seromas, reduction of total wound secretion days and reduction of needed time for dressing changes.

Introduction

Negative pressure wound therapy (NPWT) has become a widely used therapy for many different indications in the treatment of wounds (1–4). The indication to use the NPWT has also reached the field of closed surgical wounds. In the beginning, the incisional negative pressure wound therapy (iNPWT) was evaluated after severe trauma (5–8). The field of the application of iNPWT increased widely in recent times (9,10). However, published studies with a high level of evidence are still rare (9). The suggested mode of action includes an increase of blood flow, oxygen saturation and angiogenesis (5,9,11).

The purpose of this study was to evaluate different aspects of wound healing after fractures of the femoral neck treated by hemiarthroplasty (HA). We compared the reduction of the

Key Message

- this prospective, randomised controlled trial has demonstrated decreased development of postoperative seromas, reduction of total wound secretion days and reduction of needed time for dressing changes
development of postoperative seroma in the wound area, the total time of secretion, the total time needed for the wound care (dressing changes) and the material needed for dressing changes.

**Material and methods**

A total of 21 patients with femoral neck fracture (FNF) were scheduled for hip HA. They were randomised into two groups. Group A (11 patients) was treated with iNPWT over the sutured wound area, whereas group B (ten patients) received the standard wound dressing of our department, consisting of a dry wound coverage (compresses attached to the skin). The surgical intervention was identical in both groups. A standard transgluteal approach was used in all cases. HA was performed with a cemented shaft (Excia© Aesculap© B. Braun AG, Melsungen, Germany) and a self-centring bipolar head by the same manufacturer.

All patients received two Redon® drains, one in the deep area of the wound (subfascial) close to the protheses and other above the closed fascia (subcutan). The postoperative physiotherapy and mobilisation were also identical for both groups.

The iNPWT group (group A) was treated with a PREVENA™ system (KCI, San Antonio, TX). The PREVENA system was left on the wound for 5 days including the day of surgery.

In addition to daily clinical examination, all wounds/seroma were analysed by ultrasonography on the fifth and tenth day after surgery.

Before surgery, plasmatic coagulation was assessed in all patients with the Quick prothrombin time test. Postoperatively, the immediate amount of wound secretion in the Redon® drain canisters was quantified. In addition, the length of the incision was measured. We monitored the duration of secretion from the wounds, and assessed the total amount of dressing changes and the time necessary to perform the dressing changes. We quantified the material that was used for dressing changes (compresses and gloves).

Statistical significance was calculated with the Prism v4.0 GraphPad software (GraphPad Software). For Gaussian distributed data, the student’s t-test was used. For non-Gaussian distributed data, the Mann–Whitney test was used.

Informed consent was obtained from each patient. The study was approved by the local ethics committee (Re-No. 68_12 B) and conforms to the principles of the Declaration of Helsinki.

**Results**

We randomised 11 patients (mean age \(=\) 81.6 ± 5.2 years) to group A and 10 patients (mean \(=\) 82.6 ± 8.6 years) to group B. Both groups displayed normal coagulation times according to Quick prothrombin time test (group A: 90.72 ± 6.55; group B: 93.3 ± 6.85; \(P = 0.3903\)). There was no significant difference in postoperative wound size between both the groups (group A: 16.4 ± 3.87 cm; group B 17.7 ± 3.64 cm; \(P = 0.4437\)). Furthermore, both groups displayed similar volume of wound secretion in the Redon® drain canisters after 2 days (group A: 341 ± 107 ml; group B: 379 ± 260 ml; \(P = 0.6649\)). 80% of patients in group B displayed seromas over the whole observation period, whereas only 18% and 36% patients treated with iNPWT suffered from a seroma at days 5 and 10 post-surgery, respectively.

iNPWT-treated patients required fewer dressing changes: 54 dressing changes in 10 patients, equating to 5.4 per patient in group A; and 95 changes in 11 patients equating to 9.5 in group B (Figure 1), less days of wound secretion (Figure 2), less time for wound care (Figure 3) and less material for dressing changes (Figures 4–6).

**Discussion**

Since the development of NPWT, the indications for the use of NPWT have been mainly acute and chronic wounds.
The spectrum of indications increased over the time (2,18). Several studies described a positive effect on wound healing and a reduction of wound healing complications combined with a safe administration and low risk of side effects (19,20). The application of NPWT on closed wounds resulted in a reduction of seromas and reduction of wound complications in high-risk wounds (9,21). A recent study demonstrated a significant reduction of seromas in the postoperative wound area when iNPWT was used in the elective setting of total hip arthroplasty in patients suffering from osteoarthritis.

However, we analysed in this study the effectiveness of iNPWT in much older patients affected with a higher risk for the development of wound complications (average age of this study >81 versus <71 years) (21) with a severe fracture with large traumatic haematomas in the fracture area, compared with the literature (21). Some studies showed that older patients have a higher risk of suffering from complications after severe trauma and surgical interventions (22–24).

This study provides evidence that iNPWT may be useful to treat surgical incision wounds. To the best of our knowledge, significant reduction of wound complications after FNFs treated with HA by using iNPWT was previously unreported. In addition, iNPWT treatment reduced the time and material needed for the postoperative wound care.

This study used ultrasound as a standardised imaging modality to detect seromas in the wound area. The high sensitivity of the evaluation of the wound area by using this imaging modalities showed the reduction of mean seroma volumes directly underneath the surgical incision. The results were significant on the first ultrasound examination after 5 days and were shown as a tendency after 10 days. The results described for elective surgery in the literature (21) are vice versa: They showed a significant reduction after 10 days and a tendency after 5 days. This difference in the ultrasound examinations might be due to the different wound surroundings. In this study, a large traumatic haematoma in fracture area was present, spreading into the surrounding tissue and being not completely removable during the surgical procedure. We found a significant increase of wound drainage days in the control group. The persistent drainage of wound ‘fluids’ through the incision might have also reduced the subcutaneous seroma we found over the course of 10 days.

By reducing the secretion days, the risk of wound infections might also decrease as the wound can heal without a persisting open entrance for bacteria. Therefore, we rate the seroma on the fifth day and the duration of the secretion as a substantial factor of the wound healing. The evaluation on the tenth day has also shown a tendency of lower seromas, but not significantly. This might be caused by a reduction of the seromas in group B, which could be the result of the prolonged secretion. We believe that prolonged secretion is an important risk factor of early postoperative infections. Unfortunately, high-ranking scientific evidence is still not complete and the risk factor of secretion for the development of wound infection should be evaluated in future studies. The reduction of secretion was also observed by other study groups who were evaluating NPWT devices over closed wounds. Stannard et al. showed a reduction of haematoma and drainage after iNPTW treatment of high-energy trauma injuries (5,25). Decarbo et al. recommended the use of NPWT in high-risk wounds, for example, after total ankle replacement (6). The reason why the seroma in the iNPWT and the secretion time is reduced is still not completely evaluated.

Horch et al. showed a significantly increased blood flow, a significant higher oxygen saturation and post-capillary venous
filling compared with a baseline measurement, before a NPWT device was added to healthy skin (11). These findings might be a reason why we found a reduction of seroma and wound drainage in our patients treated with iNPWT. Another potential positive effect which might have led to our results is the reduction of lateral tension (9,26). ‘The function of sutures or other surgical closures is to bring the wound edges together and to reduce lateral tension that causes the wound to gape’ (9).

The results of this study are in accordance with the findings from other studies. Kaplan et al. showed a faster recovery of patients who suffered from severe trauma with soft tissue defects if a NPWT device was applied early, that is, on post-operative day 1 or 2 of the treatment in comparison to patients who received this treatment later (27). According to the findings of Horch et al., early application of NPWT appears to have a positive impact on wound healing (11). In this study, the iNPWT was applied immediately after surgical closure of the wound.

Another interesting aspect of this study is the significant reduction of time, and material needed for wound care time (15 versus 43 minutes) and wound care. Together with its positive effects on the wound healing, the time- and resource-saving aspects encourage to implement the iNPWT for the treatment of surgical incisions.

A limitation of this study is that only a relatively small number of patients were enrolled in a single centre. In the future, multicentre studies are needed to include a larger number of patients of different ages and longer follow-up time. Another limitation is the fact, that we only used a product of a single manufacturer. For all other vendors and products, the portability has still to be evaluated. Furthermore, products from different vendors need to be assessed. However, up to now for all other vendors and products, the portability has still to be evaluated.

Conclusion

The application of iNPWT in closed wounds after HA for fracture treatment might help to reduce complications of prolonged wound healing and postoperative seroma in the wound area. Furthermore, it may save time needed for wound care.

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References

wound therapy to prevent seromas and treat surgical incisions after total hip arthroplasty. *Int Orthop* 2012;36:719–22[Epub 2011/07/15].


