Incisional negative pressure wound therapy in bilateral breast reductions patients

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Abstract

Introduction: Incisional negative pressure wound therapy (iNPWT) has been applied to bilateral breast reduction patients and shown a reduction in surgical complications. However, its effects on opioid use and hospitalisation length in this patient group has not been investigated.

Methods: In this single surgeon retrospective cohort study, 52 patients who underwent bilateral breast reduction were analysed, with 23 patients in the iNPWT cohort and 29 in the standard-of-care (SOC) wound dressing cohort. Hospitalisation length, postoperative opioid use and surgical site complications were compared between cohorts. Mean (range) follow-up time was 369.15 (77–1329) days.

Results: Hospitalisation length in days was significantly less in the iNPWT cohort (1.35) than the SOC cohort (2.03). Total ward opioid use was significantly reduced in the iNPWT cohort (45.50mg) compared to the SOC cohort (62.50mg). Discharge opioid prescription was significantly reduced in the iNPWT cohort (125.50mg) compared to the SOC cohort (230.00mg). The number of surgical site complications was significantly different between the groups (p=0.014).

Discussion: This study suggests the use of iNPWT in bilateral breast reduction provides significant benefit through the reduction of hospitalisation, complications and opioid use.

Conclusion: This is the first study to provide evidence for iNPWT in bilateral breast reduction in reducing postoperative opioid use and hospitalisation. It supports current literature showing a reduction in surgical site complications using iNPWT in bilateral breast reduction.

Keywords: negative-pressure wound therapy, mammoplasty, wound healing, analgesics, opioid, hospitalisation
Introduction

Negative pressure wound therapy (NPWT) has been used since the early 1990s to promote wound healing through the application of sub-atmospheric pressure. More recently, negative pressure therapy has been applied to postsurgical incision sites. Incisional negative pressure wound therapy (iNPWT) works through both micro- and macroscopic mechanisms to increase oxygen saturation and blood flow in the skin under the dressing, increase local tissue perfusion and decrease lateral tissue tension while increasing incisional apposition.

Breast reduction is a common plastic surgical procedure that aims to reduce the size of the breasts, alleviating shoulder and neck discomfort associated with oversized breasts. Although complications can be minimised through patient selection and procedural technique, complication rates have been reported to be as high as 53 per cent. Wound healing issues, including dehiscence and superficial infection, make up a majority of complications. However, other complications include hematoma, fat necrosis, nipple necrosis, pain, breast cellulitis and fungal dermatitis.

Previous studies have addressed the use of iNPWT in bilateral breast reduction and it has been found to result in fewer wound-healing complications while improving scar quality and aesthetic appearance. Studies investigating outcomes in caesarian section suggest that iNPWT reduces hospitalisation length and reduces total opioid use and surgical site complications. To our knowledge the effect of iNPWT on these outcomes in patients that have had bilateral breast reduction has not been assessed.

In 2016, opioid deaths accounted for 62 per cent of all drug-induced causes of death and pharmaceutical opioids were implicated in more drug-induced deaths than heroin. At present, in Australia and internationally, there is a drive to decrease both inpatient opioid use and postoperative discharge opioid prescription due to the potential for addiction. Moreover, there is significant patient and community benefit in reducing hospitalisation length, opioid use and minimising wound complications.

The aim of the present study is to evaluate the effect of iNPWT in patients undergoing bilateral breast reduction with respect to opioid use, surgical site complications and hospitalisation length.

Methods

The present study was a retrospective cohort study designed to compare postoperative outcomes in patients receiving iNPWT and those receiving SOC dressings. Ethics approval for this study was obtained from St John of God Health Care’s human research ethics committee.

Fifty-two consecutive patients who underwent bilateral breast reduction mammoplasty between June 2014 and December 2018 were identified and reviewed in this study. The surgeon’s practice changed in August 2017 from using the SOC dressing (n=29) to iNPWT (n=23). All patients were operated upon at a single institution by a single surgeon.

Patients were included if they underwent bilateral breast reduction only and were aged greater than 18 years. Several patients were excluded due to unilateral operation or adjunctive body contouring procedures occurring simultaneous to bilateral breast reduction. Three patients were excluded due to opioid intolerance.

Data collected from retrospective medical record review included age, body mass index (BMI), American Society of Anesthesiologists (ASA) classification, smoking status, preoperative medications, past medical history, postoperative medications, length of stay and occurrence of complications. Operative details collected included resection weight, skin pattern technique, dermoglandular pedicle, prophylactic antibiotics and operation time.

Scheduled follow-up occurred at one week, two weeks, six weeks, six months and one year. However, patients were seen more frequently if complications occurred. Mean (range) follow-up time was 369.15 (77–1329) days. The higher, maximum follow-up time was due to the fact...
that some patients were seen after their breast reduction surgery for consultations regarding other issues. Pain, opioid use and complications were assessed at each follow-up appointment. The minimum follow-up time was deemed appropriate to detect complications.

**Surgical technique**

All patients received general anaesthesia with a single dose of intravenous antibiotics (cephazolin). Regional anaesthesia occurred in every case through single-shot pectoralis plane (PECs II) or thoracic paravertebral blocks using an appropriate dose of local anaesthetic. Wise pattern or circumvertical skin resection patterns were used with either superomedial, inferior or superior pedicles. No drains were used in the iNPWT cohort. The SOC cohort received bilateral size 14 French Blake drains which were all removed on postoperative day one. Drain removal occurred before discharge criteria were satisfied and thus did not affect hospitalisation length.

The product used was a single-use, portable iNPWT system with a replaceable exudate canister (Prevena, Acelity, San Antonio, Texas) (**Figure 1**). The device creates topical negative pressure of 125mmHg and is designed to be applied continuously to the wound for five to seven days. In this study, all patients underwent a seven day treatment period.

Various sized dressings were used depending on skin resection pattern. Standard of care treatment involved application of an adhesive non-woven fabric dressing (HYPAFIX, Smith and Nephew, Watford, UK), gauze and adhesive fabric dressing again. A supportive postoperative garment was fitted prior to recovery of anaesthesia in the SOC cohort. No garment was fitted in the iNPWT cohort.

Administration of opioids was determined by clinical indication. The person making the decision on opioid administration was not blinded to the wound therapy cohort. Opioids used in this study included oxycodone, tramadol, morphine, tapentadol, fentanyl, oxycodone with naloxone and codeine. All patients received non-opioid analgesia (paracetamol and celecoxib) in conjunction with opioid analgesia. Analgesia was provided to patients reporting pain scores of greater than six out of 10 regardless of wound therapy type. Discharge criteria was defined as patient able to mobilise, subjective pain score less than four out of 10 and feeling subjectively well. Discharge criteria was the same for both cohorts.

**Outcomes**

Opioid use was measured in oral morphine equivalents. Total discharge prescription opioid dose was defined as the total amount of opioids provided at discharge for use as an outpatient. Inpatient opioid use was measured from the time a patient was received on the ward to the time they were discharged. This will be referred to as total ward opioid use. It does not include opioids used intraoperatively or in the immediate postoperative period. The immediate postoperative period was defined as the time from the end of the operation until the patient returned to the ward. This was analysed separately as opioid consumption during this time would not be affected by dressing type. Daily ward opioid use was calculated by dividing the total ward opioid use by hospitalisation length.

Surgical site complications included unanticipated local inflammatory response, dehiscence, surgical site infection, delayed healing, nipple or areola necrosis and abscess. Complications were counted only once, even if a patient had more than one complication occur. Complications were assessed and managed by the treating surgeon based on clinical requirement.

Hospitalisation length was measured in full days since surgery occurred.

*Fig 1. iNPWT placement*
Statistical analysis

Data analysis was performed using Microsoft Excel (North Ryde, New South Wales, Australia) and IBM SPSS® software (St Leonards, New South Wales, Australia). The samples were relatively small and distributions of some variables were found to be skewed so nonparametric methods were used in data analysis. Mann-Whitney U tests were used to compare scale variables and Fisher exact tests to compare categorical variables across the two groups. Predictors of opioid use were identified using multiple regression analysis. Significance was established at p-value of less than 0.05.

Results

Demographics

There were 29 patients in the SOC cohort and 23 in the iNPWT cohort. Patient demographic and operation details are presented in Table 1. There was no significant difference in age, BMI, diabetes or smoking status, resection weight, pedicle used and operation time between the two cohorts. There was a statistically significant difference between the cohorts in terms of skin resection pattern and local anaesthesia regional block type. The results for length of stay, opioid use and discharge prescription and surgical site occurrences are presented in Table 2.

Length of stay

Hospitalisation length was significantly different between the SOC and iNPWT cohorts (p<0.001). The mean (standard deviation—SD) length of stay for the SOC cohort was 2.03 (SD=0.33) days and the mean for the iNPWT cohort was 1.35 (SD=0.49) days. The mean difference was 0.69 days (33.99%).

Table 1. Demographics

|                          | iNPWT (n = 23) | SOC (n = 29) | p-value |
|--------------------------|---------------|-------------|---------|
|                          | Mean | St dev | Mean | St dev | p-value |
| Age (years)              | 39.90 | 14.90  | 47.80 | 14.50  | 0.061   |
| BMI                      | 30.10 | 4.70   | 30.30 | 4.60   | 0.775   |
| Resection weight (g)     | 1246.00  | 1038.00 | 1114.00  | 625.00  | 0.525   |
| Operation time (minutes) | 181.20 | 26.34  | 190.20 | 40.32  | 0.199   |
| Smoking                  | 0.00  | 0.00   | 0.00  | 0.00   | 0.000   |
| Diabetes                 | 4.00  | 17.39  | 1.00  | 3.40   | 0.157   |
| Block                    | Paravertebral | 0.00 | 0.00 | 19.00 | 65.52 | 0.000   |
|                         | PECS II       | 23.00  | 100.00 | 10.00 | 34.48 |         |
| Skin resection pattern   | Circumvertical | 9.00 | 39.13 | 10.00 | 34.48 | 0.003   |
|                         | Vertical      | 1.00   | 4.34   | 14.00 | 48.28 |         |
|                         | Wise pattern  | 13.00  | 56.52  | 5.00  | 17.24 |         |
| Pedicle                 | Superior      | 2.00   | 8.69   | 0.00  | 0.00  | 0.066   |
|                         | Superomedial  | 14.00  | 60.87  | 24.00 | 82.76 |         |
|                         | Inferior      | 7.00   | 30.43  | 5.00  | 17.24 |         |

St Dev = standard deviation; a=Mann-Whitney U test, b=Fisher exact test
Effect of iNPWT on opioids and opioid prescription

There was a significant difference in total discharge opioid prescription (p<0.001). The mean discharge prescription for the SOC cohort was 230.00 (SD=115.00)mg and the mean discharge prescription for the iNPWT cohort was 125.50 (SD=63.60)mg. The mean difference was 104.60mg (45.47%).

The difference in total ward opioid use was statistically significant between the cohorts (p=0.045), although this is shown using multiple regression (below) to be attributable to different hospitalisation lengths rather than directly to cohort. The mean total ward opioid use for the SOC cohort was 62.50 (SD=39.60)mg and the mean of the iNPWT cohort was 45.50 (SD=38.25)mg. There was no significant difference in the amount of opioids administered in the immediate postoperative period (p=0.060). The SOC cohort had a mean administration of 9.20 (SD=13.60)mg while the iNPWT cohort had a mean of 16.00 (SD=16.20)mg.

Given that patients were hospitalised for a significantly different length of time, daily ward opioid use was also calculated. There was no statistically significant difference between the groups in terms of daily ward opioid use (p=0.598). The mean SOC cohort daily ward opioid use was 31.30 (SD=19.50) mg and the mean iNPWT cohort daily ward opioid use was 33.60 (SD=32.10) mg.

Surgical site complications

There was a statistically significant difference between the SOC and iNPWT cohorts in terms of frequency of surgical site complication (p=0.014). The number of patients with surgical site complications in the SOC cohort was 13 (44.80%) while the iNPWT had three (13.00%). The complications that occurred have been stratified into categories in Table 2. More than one complication occurred in some patients. These were included in the categories for Table 2 but not in statistical analysis of surgical site complications as patients having more than one complication were only counted once.

Multiple regression analysis

Multiple regression analysis was performed to investigate whether demographic factors including age, body mass index (BMI), resection weight, operation time, dressing type, block, pattern and pedicle, along with other variables, influenced opioid use. The only significant predictors of daily

| St Dev = standard deviation; a=Mann-Whitney U test, b=Fisher exact test |

| Table 2. Outcomes | iNPWT (n = 23) | SOC (n = 29) | P-value |
|-------------------|---------------|-------------|---------|
| **Hospitalisation length (days)** | Mean | St dev | Mean | St dev | p-value |  |
| | 1.35 | 0.49 | 2.03 | 0.33 | 0.000 |  |
| **Opioids (mg)** | | | | | |
| Immediate postoperative | 16.02 | 16.20 | 9.24 | 13.58 | 0.060 |  |
| Total ward | 45.50 | 38.25 | 62.50 | 39.60 | 0.045 |  |
| Daily ward | 33.60 | 23.10 | 31.30 | 19.50 | 0.598 |  |
| Discharge prescription | 125.50 | 63.60 | 230.00 | 115.00 | 0.000 |  |
| **Complications** | | | | | |
| | Number | Per cent | Number | Per cent | p-value |  |
| Patients with complications | 3.00 | 13.00 | 13.00 | 44.80 | 0.014 |  |
| Haematoma/seroma | 0.00 | 0.00 | 1.00 | 3.40 | 1.000 |  |
| Wound breakdown | 0.00 | 0.00 | 7.00 | 24.10 | 0.013 |  |
| Nipple necrosis | 0.00 | 0.00 | 0.00 | 0.00 | – |  |
| Wound infection | 2.00 | 8.70 | 4.00 | 13.80 | 0.682 |  |
| Fat necrosis | 0.00 | 0.00 | 1.00 | 3.40 | 1.000 |  |
| Suture abscess | 1.00 | 4.30 | 2.00 | 6.90 | 1.000 |  |

Effect of iNPWT on opioids and opioid prescription
ward opioid use ($R^2=19\%$) were age ($p=0.018$) and immediate postoperative opioid use ($p=0.033$). Total ward opioid use ($R^2=29\%$) was influenced by hospitalisation length ($p=0.003$) and immediate postoperative opioid use ($p=0.016$), hospitalisation length ($p=0.003$) and age ($p=0.016$). Discharge opioid prescription was not significantly related to daily ward opioid prescription ($p=0.246$). Dressing type ($p=0.000$) was found to be the only factor influencing discharge opioid prescription ($R^2=26\%$). Local anaesthetic block type, skin resection pattern and pedicle type did not affect opioid use.

Post hoc power calculations for the multiple regression models suggest sufficient power. Using the quoted $R^2$ to calculate the effect size and increasing the number of predictors by one to allow for inclusion of an additional (nonsignificant) predictor the achieved power was 80 per cent for daily opioid use, 96 per cent for total ward opioid use and 97 percent for discharge opioid prescription.

**Discussion**

The use of iNPWT in patients having bilateral breast reductions is becoming more routine. It is thought to augment normal wound healing through optimising microscopic vascular conditions as well as facilitating optimal wound edge positioning and tension reduction. The removal of exudate from the wound is also a possible mechanism in prevention of complications.

The results of the present study support current literature showing that use of iNPWT in bilateral breast reduction reduces postoperative complications and improves outcomes. Furthermore, they indicate that iNPWT is associated with a significant reduction in surgical site complication occurrences, decreased total ward opioid use and discharge opioid prescription as well as decreased hospitalisation length.

The main focus of this paper is to investigate a perceived difference in opioid requirements retrospectively. Postsurgical discharge opioid prescriptions have significant implications for the community. Significant chronic pain can arise from acute postoperative pain and postsurgical opioid prescriptions can act as a gateway to increasing use. However, a recent study suggested an 18 per cent increase in opioid based prescriptions for postoperative patients from 2010 to 2016. A systematic review of 810 unique patients found that 67–92 per cent of postsurgical patients had unused opioids and that 42–71 per cent of opioid tablets went unused. A prospective study of 35 outpatient breast reduction patients found that 72 per cent took any opioids while a mean of 12.5 tablets of 5.0mg oxycodone hydrochloride were left unused. Our results showed significantly reduced opioid prescription at discharge. The mean difference of 104.6mg (45.47\%) represents almost 14 tablets of 5.0mg oxycodone hydrochloride that were not prescribed. Additionally, discharge opioid prescription is correlated with an increased risk of opioid abuse. Of note, no patients in the iNPWT group requested further prescriptions.

We found the iNPWT group to have a statistically significant reduction in total ward opioid use. This is consistent with the findings of a randomised controlled trial involving 92 patients undergoing caesarean delivery which found a significant reduction in total postoperative opioid use. We found no significant difference in daily ward opioid use. This suggests that the lower total postoperative opioid use was due to hospitalisation length rather than wound therapy cohort. Nevertheless, the combination of reduced total ward opioid use and reduced discharge opioid prescriptions means that patients were exposed to a lower opioid dose overall. Inpatient opioid use has been shown to be correlated with opioid use at postoperative day 90. A reduction in total opioid use therefore has significant implications for patients.

Our results showed a significant reduction in surgical site complications using iNPWT. This is consistent with previous studies investigating iNPWT in bilateral breast reduction. This has also been shown in other contouring surgery. The overall proportion of patients having at least one surgical site complication in this study was 30.7 per cent. This is consistent with a cohort study investigating drained and drainless breast...
reduction, which found a complication rate of 27 per cent. The most common complications in the SOC cohort were wound breakdown (24.1%) and wound infection (13.8%). The most common complications in the iNPWT cohort were wound infection (8.6%) and suture abscess (4.3%). There were no cases of wound breakdown in the iNPWT cohort. The significant reduction in wound breakdown in the iNPWT cohort is consistent with current literature.

Incisional negative pressure wound therapy has been shown to reduce hospitalisation length in pressure ulcer and orthopaedic surgery. We found a significant reduction in hospitalisation length in the iNPWT cohort. Reduced hospitalisation is associated with significant benefits to both patient (decreased respiratory and thromboembolic complications) and the community (allocation of resources and access).

Multiple regression analysis allowed for investigation of factors affecting opioid use. Age was a predictor of total and daily opioid use which is supported in the literature. However, the cohorts did not differ in a statistically significant manner in relation to age. Opioid use in the immediate postoperative period was also a predictor of total and daily opioid use. However, the cohorts did not differ in a statistically significant manner in relation to immediate postoperative period opioid use. Although the cohorts differed significantly in terms of skin resection pattern and regional anaesthetic block type, these factors were shown to not influence opioid use.

Limitations of this study are predominantly linked to the retrospective cohort design.

This paper is based on the operations of a single surgeon and the evolution of their practice over time to iNPWT. We attempt to analyse the extent of this bias through multivariate analysis. Although the difference in immediate postoperative period opioid use was not statistically significant, it is possible that it still had some effect on the opioid use on the ward. Additionally, opioid prescribing was not blinded or controlled due to the retrospective nature of the study. While these factors may have influenced opioid provision, pain was adequately controlled on patient request regardless of wound therapy type. A supportive garment was only used in the SOC cohort. Supportive garments can be a source of pain which may have influenced the outcome. Although regression analysis showed that block type and skin resection pattern did not influence opioid use, the fact that they were significantly different between the cohorts may present a bias regardless. While all drains were removed on postoperative day one and were not seen to affect hospitalisation length, it is possible that their removal affected opioid use.

**Conclusion**

This single-surgeon retrospective cohort study showed the use of iNPWT in bilateral breast reduction reduced hospitalisation length, opioid use and surgical site complications in this cohort. There are significant social implications for both patients and the wider community in decreasing opioid use, hospitalisation and complications in breast reduction surgery. Further prospective and randomised studies are needed to consolidate evidence regarding iNPWT in bilateral breast reduction.

**Disclosure**

The authors have no financial or commercial conflicts of interest to disclose.

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