INTRODUCTION

Postoperative pain remains a significant challenge following breast reconstruction surgery, resulting in slower recovery, longer hospital admission, increased resource utilization, and poor patient satisfaction.1–8 Furthermore, postoperative narcotic usage and prolonged general anesthesia leads to nausea and vomiting, which predisposes patients to bleeding, hematoma formation, dehydration, aspiration, and delayed mobilization.9–16 There has been increasing focus on optimizing postoperative pain following breast reconstruction, particularly with regional nerve blocks.

Epidural nerve blocks are commonly employed in abdominal and thoracic surgeries and have been shown to reduce postoperative pain and limit opioid consumption.17 Their role in microsurgical free flap breast reconstruction is unclear, as their purported benefits of reduced pain and narcotic usage is met with concerns with respect to intraoperative hypotension leading to increased vasoressor use.

Epidural Nerve Blocks Increase Intraoperative Vasopressor Consumption and Delay Surgical Start Time in Deep Inferior Epigastric Perforator Free Flap Breast Reconstruction

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Background: Epidural nerve blocks (EA) have been widely used in abdominal and thoracic surgery as an adjunct to general anesthesia (GA). The role for EA in microsurgical free flap breast reconstruction remains unclear with concerns regarding its impact on flap survival and operating room efficiency. The purpose of this study was to examine the effectiveness of epidural blocks in patients undergoing deep inferior epigastric perforator (DIEP) flap breast reconstruction.

Methods: A retrospective analysis of patients undergoing DIEP breast reconstruction under GA alone was compared with those receiving EA/GA. Electronic records were analyzed for patient demographics, intraoperative data, and postoperative outcomes. The primary outcome was 48-hour narcotic usage and secondary outcomes were intraoperative vasopressor consumption, surgical delay, and safety profile.

Results: Sixty-one patients underwent DIEP reconstruction, 46 (75%) underwent EA/GA and 15 (25%) underwent GA alone. Epidural blocks were associated with a significant delay in operating room start time (67.8 min versus 45.6 min; P = 0.0004). Patients in the EA/GA group also had a significant increase in vasopressor use (n = 38 versus n = 8; P = 0.037); however, there was no difference in flap complication rate [1 (2%) versus 2 (13%); P = 0.15]. Postoperatively, patients who received an epidural block had a reduced average pain score (1.1 versus 2.2; P = 0.0235), but there was no difference in 48-hour narcotic usage.

Conclusions: Although epidural blocks reduce postoperative pain following DIEP flap breast reconstruction, they increase intraoperative vasopressor use and delay the start time of the case. Further studies are required to elucidate whether the benefits of improved pain control outweigh the potential risk for increased surgical complications and increased health care costs. (Plast Reconstr Surg Glob Open 2019; 7:e2105; doi: 10.1097/GOX.0000000000002105; Published online 15 January 2019.)

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The objective of this study was to examine the effectiveness of epidural nerve blocks in patients undergoing breast reconstruction with the deep inferior epigastric perforator (DIEP) free flap.

**MATERIALS AND METHODS**

A retrospective review (OHSN-REB #20170925-01H) of patients undergoing DIEP free flap breast reconstruction by a single surgeon was performed from 2015 to 2017. Patients were included if they underwent immediate or delayed DIEP flap breast reconstruction under general anesthesia, with or without an epidural nerve block. Patients were excluded if they received intraoperative local anesthesia or an alternative regional nerve block. All patients receiving an epidural nerve block received a standardized dose of bupivacaine preoperatively by an anesthesiologist trained in regional anesthesia.

Patient electronic medical records were examined for patient demographics (age, body mass index, tobacco use, prior chemotherapy, prior radiotherapy, American Society of Anesthesiologists classification, reconstruction stage, and laterality); intraoperative data (duration of surgery, vasopressor use, surgical delay time, time in postanesthetic care unit, complications), and postoperative data (48-hour opioid consumption, average pain score, antiemetic use, antipruritic use).

The primary outcome of interest was 48-hour narcotic usage measured in oral morphine equivalents, calculated by standardized tables. Secondary outcomes were intraoperative vasopressor consumption of phenylephrine and/or ephedrine, average postoperative pain score, surgical delay time, postoperative antiemetic/antipruritic consumption, and procedure-related complication rates. The surgical delay time was calculated by the difference between surgical cut time and planned operating room start time.

Statistical analysis was performed using SAS Version 9.3 software. Descriptive statistics were calculated using Fisher’s exact and chi-square tests for categorical variables and t tests for continuous variables. Cox proportional hazard ratios and logistic regression were used for multivariate analyses to control for confounding variables. Demographic and clinical characteristics were compared using ANOVA. P values of 0.05 or less were considered statistically significant.

**RESULTS**

Sixty-one patients who underwent DIEP flap breast reconstruction were included in the study, of which 46 (75%) patients underwent EA in addition to general anesthesia (EA/GA), and 15 (25%) who underwent GA alone (Fig. 1). There was no statistically significant difference between groups with respect to age, body mass index, laterality of reconstruction, ASA score, smoking history, and rates of chemotherapy or radiation (Table 1).

There was no difference in duration of surgery or flap complication rate (Table 2); however, there was a statistically significant delay in operating room start time in the EA/GA group (67.8 min versus 45.6 min; P = 0.0004). Furthermore, patients in the EA/GA group had a statistically significant increase in intraoperative vasopressor consumption (n = 38 versus n = 8; P = 0.0367). Postoperatively, patients who received an epidural block had reduced average pain score (1.1 versus 2.2; P = 0.0255); however, there was no difference in 48-hour narcotic consumption (Table 3).

**DISCUSSION**

The role of epidural anesthesia in DIEP free flap breast reconstruction remains unclear. Lou et al demonstrated that epidural anesthesia improved postoperative pain, nausea/vomiting, and decreased opioid consumption without increasing the risk of flap thrombosis. Furthermore, other authors argue that epidural blocks induce vasodilation and therefore improve flap perfusion and oxygenation.
The purported benefits, however, are balanced by a reasonable concern that compensatory vasopressor utilization may increase the incidence of vasospasm and flap thrombosis.

The results of the present study demonstrate that there is a modest improvement in postoperative pain scores with EA/GA in DIEP autologous breast reconstruction. Although there was a decrease in the 48-hour narcotic requirements between the two groups, the difference was not statistically significant, nor was there a significant difference in the intraoperative total volume of crystalloid administered between the EA/GA and GA groups, with or without vasopressor use. Although the flap complication rate was not statistically higher in the EA/GA group, it is conceivable that the present study was underpowered to appreciate such an effect.

To the best of our knowledge, this study is the first to evaluate whether epidural nerve blocks decreased operating room efficiency. Operating rooms have limited treatment capacity, so optimal usage of resources is imperative. Delaying the start time of the case can have important financial implications, as an already lengthy surgery may run overtime leading to increased direct and indirect operative costs.22

Although the present study is limited by its power and retrospective design, these early results will hopefully inform larger randomized control trials to further investigate whether the pain improvement gained from epidural blocks outweighs the potential risk for complications secondary to increased vasopressor use. Furthermore, a cost effectiveness analysis must be performed to determine the impact of the surgical delay associated with epidural nerve blocks in DIEP breast reconstruction.

CONCLUSIONS

The use of epidural nerve blocks in DIEP flap breast reconstruction is associated with a modest improvement in postoperative pain score, while contributing to operative delays and increasing intraoperative vasopressor requirements.

Table 2. Intraoperative Data

| Outcome                          | EA/GA (N = 46) | GA (N = 15) | P     |
|----------------------------------|---------------|-------------|-------|
| Duration of surgery (min)        | 439±109       | 437±120     | 0.7887|
| Surgical delay time (min)        | 67.8±21.8     | 45.6±13.9   | 0.0004|
| Time in PACU (hr)                | 5.5±4.8       | 4.7±1.5     | 0.5682|
| Flap complication                 | 1 (2.17)      | 2 (13.3)    | 0.1468|
| Pulmonary embolism               | 0 (0)         | 0 (0)       |       |
| Flap compromise                  | 1 (2.17)      | 0 (0)       |       |
| Arterial thrombosis              | 0 (0)         | 1 (6.67)    | 0.2459|
| Venous thrombosis                | 0 (0)         | 0 (0)       |       |
| Flap salvage                     | 0 (0)         | 1 (6.67)    | 0.2459|
| Flap failure                     | 0 (0)         | 0 (0)       |       |
| Patient received vasopressor     | 38 (82.6%)    | 8 (53.3%)   | 0.0367|
| Ephedrine administration         | 36 (78.3%)    | 8 (53.3%)   | 0.0958|
| Phenylephrine administration     | 19 (41.3%)    | 2 (13.3%)   | 0.0631|
| Intraoperative fluid administered (cc) | 2,480±1,508  | 2,865±1,975 | 0.4311|

PACU, postanesthetic care unit.

Table 3. Postoperative Data

| Outcome                          | EA/GA (N = 46) | GA (N = 15) | P     |
|----------------------------------|---------------|-------------|-------|
| Average pain score (/10)         | 1.1±1.3       | 2.2±1.7     | 0.0255|
| 48-hr Narcotic usage (Oral morphine equivalent, mg) | 41.3±48.1 | 87.9±140 | 0.3463|
| Antemetic requirement in PACU (no. patients) | 17 (37.0) | 4 (26.7) | 0.4664|
| Antipruritic requirement in PACU (no. patients) | 5 (10.8) | 0 (0) | 0.3206|

PACU, postanesthetic care unit.

The use of epidural nerve blocks in DIEP flap breast reconstruction is associated with a modest improvement in postoperative pain score, while contributing to operative delays and increasing intraoperative vasopressor requirements.

REFERENCES

1. Vadivelu N, Schreck M, Lopez J, et al. Pain after mastectomy and breast reconstruction. Am Surg. 2008;74:285–296.
2. Voigt M, Fröhlich CW, Waschke KF, et al. Prophylaxis of postoperative nausea and vomiting in elective breast surgery. J Clin Anesth. 2011;23:461–468.
3. Tasmuth T, von Smitten K, Hietanen P, et al. Pain and other symptoms after different treatment modalities of breast cancer. Ann Oncol. 1995;6:453–459.
4. Quinn AC, Brown JH, Wallace PG, et al. Studies in postoperative sequelae. Nausea and vomiting—still a problem. Anaesthesia. 1994;49:62–65.
5. Macrae WA. Chronic pain after surgery. Br J Anaesth. 2001;87:98–105.
6. Arabia S, Terkawi AS. Improving analgesic efficacy and safety of thoracic paravertebral block for breast surgery: a mixed-effects meta-analysis. Pain Phys. 2015;18:E757–E780.
7. Poleshuck EL, Katz J, Andrus CH, et al. Risk factors for chronic pain following breast cancer surgery: a prospective study. J Pain. 2006;7:626–634.
8. Kwekkeboom K. Postmastectomy pain syndromes. Cancer Nurs. 1996;19:37–43.
9. Miaskowski C. A review of the incidence, causes, consequences, and management of gastrointestinal effects associated with postoperative opioids administration. J Perianesth Nurs. 2009;24:222–228.
10. Jolley S. Managing post-operative nausea and vomiting. Nurs Stand. 2001;15:47–52; quiz 53.
11. Jaffe SM, Campbell P, Bellman M, et al. Postoperative nausea and vomiting in women following breast surgery: an audit. Eur J Anaesthesiol. 2000;17:261–264.
12. Apfel CC, Greim CA, Haubitz I, et al. A risk score to predict the probability of postoperative vomiting in adults. Acta Anaesthesiol Scand. 1998;42:495–501.
13. Wesmiller SW, Bender CM, Conley YP, et al. A prospective study of nausea and vomiting after breast cancer surgery. *J Perianesth Nurs*. 2017;32:169–176.
14. White PF, O’Hara JF, Roberson CR, et al.; POST-OP Study Group. The impact of current antiemetic practices on patient outcomes: a prospective study on high-risk patients. *Anesth Analg*. 2008;107:452–458.
15. Gan TJ, Diemunsch P, Habib AS, et al.; Society for Ambulatory Anesthesia. Consensus guidelines for the management of postoperative nausea and vomiting. *Anesth Analg*. 2014;118:85–113.
16. Janicki PK, Vealey R, Liu J, et al. Genome-wide association study using pooled DNA to identify candidate markers mediating susceptibility to postoperative nausea and vomiting. *Anesthesiology*. 2011;115:54–64.
17. Rodgers A, Walker N, Schug S et al. Reduction of postoperative mortality and morbidity with epidural or spinal anaesthesia: results from overview of randomised trials. *Bmj*. 2000;321(7275):1493.
18. The data analysis for this paper was generated using SAS software. Copyright © 2018 SAS Institute Inc. SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc., Cary, NC, USA.
19. Lou F, Sun Z, Huang N, et al. Epidural combined with general anesthesia versus general anesthesia alone in patients undergoing free flap breast reconstruction. *Plast Reconstr Surg*. 2016;137:502e–509e.
20. Galvin EM, Niehof S, Verbrugge SJ, et al. Peripheral flow index is a reliable and early indicator of regional block success. *Anesth Analg*. 2006;103:239–243, table of contents.
21. Chen C, Nguyen MD, Bar-Meir E, et al. Effects of vasopressor administration on the outcomes of microsurgical breast reconstruction. *Ann Plast Surg*. 2010;65:28–31.
22. Gupta B, Agrawal P, D’ souza N, et al. Start time delays in operating room: Different perspectives. *Saudi J Anaesth*. 2011;5:286–288.