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ORIGINAL ARTICLE

Breast

The Value of Tumescent Infiltration in Bilateral Breast Reduction: Optimizing Vasoconstriction

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Background: Surgical adjuncts should improve surgical outcomes but should not increase complications. Epinephrine reduces bleeding in breast reduction, but various doses and volumes have been used. The ideal dose of epinephrine is still debated. The aim of this study was to assess blood loss after infiltration of 1 L of tumescent fluid containing epinephrine at a concentration of 1 in 100,000 (1 in 10^5) and 1200 mg of lignocaine in patients undergoing bilateral breast reduction.
Methods: Thirty-three consecutive patients undergoing bilateral breast reduction were included in the study. Data captured included age, mass of tissue removed, volume of blood loss, and surgical complications, especially hematoma formation.
Results: The mean age was 41 years (range, 17–74 years). The mean mass of tissue removed was 786 g (range, 307–1339 g). The mean total blood loss was 76 mL (range, 50–200 mL)—that is, 38 mL per side. One patient presented with a unilateral swelling and pain after 48 hours and underwent exploration. A venous pool of <100 mL of blood was evacuated. One patient suffered bilateral nipple loss of >50%, and another patient suffered loss of 30%. The mean follow-up is 9 months (range, 2–20).
Conclusion: One liter of Ringer's lactate containing epinephrine at a concentration of 1 in 10^5, when injected into the breasts (500 mL per breast) before breast reduction, results in a massive reduction in blood loss. *(Plast Reconstr Surg Glob Open 2020;8:e3050; doi: 10.1097/GOX.0000000000003050; Published online 20 August 2020.)*

INTRODUCTION

Before the injection of vasoconstrictors, it was not uncommon for patients undergoing bilateral breast reductions to require a blood transfusion.[1–3] Subsequent studies showed that epinephrine infiltration, even in small volumes and at low concentrations, reduced blood loss and negated the need for transfusions.[3–9] The next stage in this evolution was the advent of the tumescent solution.[10] Jones and Grover[11] using tumescence infiltration without epinephrine in facelifts reported reduced swelling and less bleeding. However, tumescent fluid more commonly uses a low concentration of epinephrine.[10] Klein[10] showed using liposuction that tumescent fluid infiltration containing epinephrine at a concentration of 1 in 10^6 reduced blood loss from 42% to 2% when compared with dry liposuction. Other studies[12,13] similarly confirmed these benefits, but used the injection dose in smaller volumes and used a lower concentration of epinephrine.

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Received for publication March 3, 2020; accepted June 22, 2020.

DOI: 10.1097/GOX.0000000000003050

Initially, a pilot study was performed on 20 patients undergoing unilateral breast reduction using a keyhole pattern and a contralateral mastectomy. Five hundred milliliters was injected to the side having the breast reduction. Most patients also received enoxaparin postoperatively. There were no hematomas, and the only complication was minor wound breakdown at the T junction.

The primary aim of this study was to minimize blood loss in patients undergoing bilateral breast reduction. This was based on 2 caveats. The first was that tumescence alone, even without epinephrine, reduces bleeding[11] although, in that study, the volume of blood loss was not quantitated. The second caveat was to deliver epinephrine (in the tumescent fluid) at a concentration that yields maximum vasoconstriction. The solution used consisted of 1 L of Ringer's lactate, 60 ml of 2% lignocaine, and 10 ampoules of 1 mL of epinephrine at a concentration of 1:1000 (hence the concentration of epinephrine is 1 in 10^5 in the tumescent fluid). This study reports on the outcome of injection of 1 L of a modified tumescent fluid on blood loss in 33 consecutive patients undergoing bilateral breast reduction over a 3 and a half year period.

METHODS

A retrospective analysis was performed on all patients undergoing bilateral breast reduction over a 3 and a half year period. Exclusion criteria were patients undergoing

Disclosure: *The author has no financial interest to declare in relation to the content of this article.*

mastopexy or pexy augmentation. Also, patients with a bleeding diathesis, whether inherited or drug induced, were also excluded.

The age, body mass index, and mass of breast tissue resected were recorded. Also, the intraoperative pulse and blood pressure (BP) were recorded, and these parameters were also recorded for the first 24 hours postoperatively. Patients were discharged after 24 hours.

A modified tumescent solution was mixed containing 1200 mg of lignocaine and 10 ampoules of epinephrine (supplied as 1-mL ampoules at a concentration of 1 in 10^3). This is added to a warm liter of Ringer's lactate. This creates a concentration of epinephrine of 1 in 100,000 (1 in 10^5). Note that in comparison, mixing the solution advocated by Klein,[10] only 1 ampoule with 1 mL of epinephrine of 1 in 10^3 would be used, leading to a concentration of 1 in 10^6.

The whole liter was injected preoperatively after anesthetic induction, but before preparing and draping (500 mL per side), allowing about a 15-minute period between infiltration and starting surgery. In all cases, a superomedial pedicle was used, and the solution was injected globally into the breast, except for the superomedial pedicle (Fig. 1). The tumescent fluid is injected subcutaneously (Fig. 2) along the incision line, as well as injected by stabbing an 18-gauge needle into the breast parenchyma (Fig. 3). In all cases, the senior resident performed one side (randomly selected) of the bilateral breast reduction.

During the operation, abdominal swabs were assessed by the anesthetist at the end of the procedure, and the total blood loss was recorded by the anesthetist. The anesthetist was told that a tumescent fluid containing lignocaine and epinephrine would be injected, and was asked to report whether there were any spikes or drops in pulse or BP. Should an arrhythmia occur, that would also be highlighted.

All patients received a postoperative absorbent dressing covered by a polyurethane sheet and received intravenous paracetamol for 24 hours. Intramuscular morphine was available, if required.

No patients received intra- or postoperative deep vein thrombosis thromboprophylaxis. No patients had drains inserted.

The dressings were inspected at 24 hours, and if the dressing became soaked or leaking had occurred, it was changed. The patients were followed up weekly for the first 3 weeks to monitor for complications, especially relating to bleeding. Other breast reduction complications were also recorded. Ethical approval was obtained by the institutional board review (HREC 596/2018).

RESULTS

The average age was 41 years (range, 17–74). The average mass of tissue removed was 786 g (range, 307–1339 g).

Intraoperative Pulse and BP

The anesthetist did not report any spikes or drops in either pulse or BP.

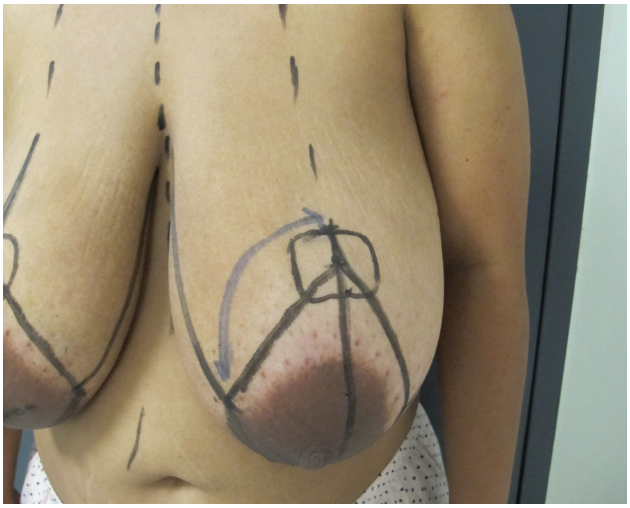

Fig. 1. Patient marked before bilateral breast reduction using Wise keyhole pattern and superomedial pedicle. Each breast, except for the pedicle (shown by blue arrow), will be injected with 500 ml of modified tumescent fluid.

Fig. 2. The breast is injected subcutaneously along the incision line.

Fig. 3. The breast is also injected by stabbing the needle into the parenchyma of the breast at about 3-cm intervals, along the incision line.

Postoperative Pulse and BP

There were no spikes in BP or hypotensive episodes. Some patients had mild elevation of their BP in the first 12 hours postoperatively, but this responded to analgesia.

Blood Loss

The average total blood loss was 76 mL (range, 50–200 mL)—that is, the average per breast was 38 mL. The surgical procedure took approximately 2 hours on average.

Hematoma

One patient presented after 48 hours, complaining of a painful, tense left breast. Exploration revealed a small hematoma composed of dark, clotted blood, suggestive of a venous ooze, <100 mL in volume. No acute arterial bleeder was found. This patient had been on selective serotonin reuptake inhibitors. No other patients underwent exploration at any stage for bleeding. One patient had a soiled dressing at 24 hours, which was changed.

Other Complications

One patient had bilateral loss of the nipple areola complex (>50%). She had preoperative measurements of suprasternal notch to nipple distances of 43 and 41 cm, respectively, and nipple to inframammary fold distances of 21 cm bilaterally. The mass of tissue removed was 980 g (right) and 870 g (left), respectively. She reported being an occasional smoker.

The patient who underwent exploration of her left breast developed persistent sinuses, which took 6 months to heal. Tests for acid fast bacteria were negative. Her right breast healed without complications. The 74-year-old woman with a body mass index of 35 developed unilateral loss of 30% of the areola, which responded to dressing.

Follow-up

The mean follow-up was 9 months (range, 2–20 months).

DISCUSSION

The aim of any surgical adjunct or drug is to enhance surgical outcome but not to increase complications. In this study, there were no acute arterial bleedings occurring in the first 2 weeks postoperatively. However, reducing the risk of hematoma is only one by-product of this injected tumescent solution. The risk of requiring a blood transfusion is nullified.[5–9] Hardwicke et al[6] reported that the need for blood transfusion was 20 times greater if epinephrine was not used. Some studies[5,13] have also suggested that the procedure is quicker if epinephrine is infiltrated before surgery.

Most studies regarding tumescent fluid have concentrated on the optimal dose of lignocaine,[10,15–17] with less emphasis on epinephrine. In fact, 55 mg/kg has been shown to be a safe dose in liposuction.[18] In a 60-kg woman, this would translate into a total dose of 3300 mg. In this study, the total dose was only 1200 mg—well within "normal" limits. Hence, it is not surprising that there were no clinical signs of lignocaine toxicity. The higher dose of lignocaine in this study may also have conferred more complete analgesia during the procedure, decreasing patient demands during the operation—an observation noted by the anesthetist—but this is difficult to quantify. However, it does seem tautological, and Gutowski[13] in a review of tumescent analgesia confirmed that tumescence fluid infiltration decreased anesthetic requirements. Others[16,19] have also shown that the epinephrine prolongs the analgesic effect of lignocaine in a dose-dependant manner.

A number of studies[16,17,19] have noted that increasing the dose of epinephrine increases the magnitude of vasoconstriction. A meta-analysis investigating the use of various doses of epinephrine infiltration (varying in concentration from 1 in 200,000 to 1 in 1,000,000) in reduction mammoplasty reported a mean blood loss of 170 mL (range, 308–151 mL).[6] These studies[19–22] have also suggested that maximum vasoconstriction occurs at a dose of 1 in 100,000 (ie, 1 in 10^5), which is confirmed in this study, where the mean blood loss was less than half (total mean 76 mL, 38 mL per breast) than that reported above. In fact, a number of studies[1,4] have already used this concentration of epinephrine in breast reduction, but injected smaller volumes, and showed a decreased blood loss without any deleterious effects.

In fact, the ideal concentration of epinephrine has been debated for >50 years.[16] Sheikh et al[16] suggested that the dose that produces maximal vasoconstriction should be used. Their study investigating various concentrations of epinephrine showed that maximal vasoconstriction occurred at 10 µg/mL, that is 1 in 100,000 (viz. 10 ampoules of epinephrine at a concentration of 1 in 1000 injected into 1 L of Ringer's lactate) as used in this study, not 1 in 1,000,000 as described by Klein[10] for liposuction. This is not the first study to use epinephrine at that concentration. In fact, it is commercially available at that dose, for example, in the United States,[20] Sweden,[19] and the United Kingdom.[19] It has been widely used at this concentration in many cosmetic procedures, including blepharoplasty[20] and hand surgery,[17] but administered in smaller volumes. Interestingly, some commercial preparations[19] contain even higher concentrations of epinephrine (1 in 80,000—xylocaine dental adrenalin supplied by Dentsply Ltd, Weybridge, Surrey, United Kingdom, or Dentsply Ltd, York, Pa.). Lignocaine is a vasodilator; thus, some epinephrine for vasoconstriction to inhibit bleeding is required. Epinephrine in the blood stream is rapidly inactivated, with its systemic effect lasting 2 minutes.[22,23] Furthermore, systemic toxicity can be aborted by phentolamine, an antidote to epinephrine.[21]

However, in this study, there was no evidence of epinephrine toxicity on the cardiovascular system. Kinsella et al,[24] using epinephrine infiltration at a dose of 1 in 80,000, similarly reported no cases of unstable tachycardia or hypotension in children undergoing cleft palate repair: the concentration of epinephrine they used is even higher than in this study. A meta-analysis also observed that there was no significant difference in complication rate related to epinephrine infiltration.[6] The fears related to epinephrine have now been debunked. Epinephrine can be safely used in digital blocks, and, as already noted, it is widely used at a concentration of 1 in 100,000. Although hematoma was used as an objective measure of outcome in this study, there are also other benefits that are difficult to quantify. Jones and Grover[11] noted that tumescent infiltration alone distended tissue planes, making dissection easier. Similarly, O'Donoghue et al[9] reported that a higher concentration of epinephrine enabled a bloodless dissection, which mirrors our experience and highlights another benefit of optimizing vasoconstriction.

There are a number of limitations to this study. There was no control arm where epinephrine was not used, but this seemed ethically difficult to justify. In the published literature[3,7,8] where a control arm was used (one breast receiving no infiltration of epinephrine), the breast that was injected with various doses and concentrations of epinephrine showed a "significant decrease in intraoperative blood loss."[8] There were different anesthetists used, and obviously each anesthetist administers an anesthetic slightly differently. The study did not measure blood levels of epinephrine; however, as this is rapidly inactivated in the blood stream, it does not seem warranted. In addition, measuring blood loss is not an exact science,[25] a problem highlighted by Hardwicke et al[6] in their systematic review of epinephrine infiltration in reduction mammoplasty. This problem is aggravated in that the swabs also contain some of the tumescent fluids, perhaps suggesting that the blood loss maybe more difficult to measure, and if anything, is overestimated. Commercially available local anesthetic cartridges that are used for blepharoplasty[21] for example, or multiple other procedures,[17,19] contain epinephrine at doses of 1 in 100,000 or even 1 in 80,000.

This study suggests that the value of tumescent infiltration can be enhanced by maximizing the concentration of epinephrine and injecting epinephrine at a dose that yields maximal vasoconstriction. Not only is blood loss much reduced, negating the need for transfusion and/or massive fluid intake intraoperatively, but from a surgical point of view, dissection is much easier. There seems to be no deleterious effects from this dose of lignocaine either.

This study suggests that using a higher concentration of epinephrine that has been shown to produce maximal vasoconstriction, when applied in a tumescent infiltration, is safe and will also reduce blood loss and lower the incidence of hematoma formation. This higher concentration of epinephrine (now applied with tumescent infiltration) delivers the same concentration of epinephrine as that used daily in commercially available preparations. Not only is blood loss dramatically reduced, negating the need for transfusion, but from a surgical point of view, dissection is much easier, as the planes are bloodless.

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