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Cosmetic

Pain Reduction Using Ropivacaine in Tumescent Solution following Lipoaspiration

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Summary: Tumescent solution utilizing dilute epinephrine and a local anesthetic agent injected into a fat compartment has been shown to effectively minimize blood loss and postoperative pain in liposuction. Ropivacaine has a longer duration of action compared to lidocaine and is a potential analgesic in tumescent solution. We sought to explore the effect of using ropivacaine in a tumescent technique with a focus on its efficacy for pain control postoperatively. The formula for the tumescent technique used combined 1 mL of epinephrine with 30 mL of ropivacaine into 500 mL of injectable saline. Tumescent solution was injected manually into fat donor sites of 10 consecutive patients followed by a 20-minute waiting period before beginning fat aspiration with liposuction cannula. Patients were seen immediately following their surgery and on postoperative day 1 and reported their pain using a numerical scale. Data gathered included the amount of ropivacaine used, average pain rating, and the average amount of fat removed. On average, participants reported little to no pain at the donor sites immediately following surgery and on postoperative day 1. Based on the low need for pain medication, we believe that ropivacaine may be successfully used in tumescent solution to reduce postoperative pain. *(Plast Reconstr Surg Glob Open 2023; 11:e4747; doi: 10.1097/GOX.0000000000004747; Published online 25 January 2023.)*

INTRODUCTION

The tumescent technique has been shown to be an effective method of minimizing blood loss, bruising, and postoperative pain. It gained popularity in the 1990s after Dr. Jeffrey A. Klein created the technique utilizing dilute epinephrine with a local anesthetic agent. This solution was then injected into fat compartments to produce local swelling and firmness.[1]

Traditionally, lidocaine and bupivacaine are used in tumescent formulas. Epinephrine interacts with these local anesthetics to delay their absorption from the subcutaneous tissue into the bloodstream, thereby allowing higher doses of the anesthetic to be used.[2] Furthermore, although epinephrine acts as a vasoconstrictor, lidocaine has the opposite effect (vasodilation).[3] Ropivacaine has vasoconstrictor properties, a similar maximum dose, a longer duration, and a lower risk of cardiac and neurological toxicity than lidocaine and bupivacaine (Table 1).[2,4] We report our experience with ropivacaine in the tumescent technique for lipoaspiration and its efficacy for pain control postoperatively.

MATERIALS AND METHODS

A descriptive study of 33 patients who underwent lipoaspiration for contouring and/or fat grafting by the same surgeon in a single institution was performed. All procedures were done in-office under local anesthesia. No additional medications were used for pain or anxiety. No exclusion criteria were used. Written informed consent was obtained, and the principles described in the 2013 Declaration of Helsinki were strictly followed.

Surgical Technique

Tumescent solution was prepared by combining 1 mL of epinephrine (1:1000) with 30 mL of ropivacaine (150 mg) into 500 mL of normal saline. Two patients

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Table 1. Dosage and Duration of Action for Lidocaine, Bupivacaine, and Ropivacaine

Agent	Maximum Dose w/o Epinephrine, mg/kg	Maximum Dose with Epinephrine, mg/kg	Duration of Action, h
Lidocaine	5	7	0.75–1.5
Bupivacaine	2.5	3	1.5–8
Ropivacaine	3	4	1.5–8

received 40 mg of ropivacaine due to a lower volume of liposuction. This was injected manually to ensure the fat donor sites were infiltrated with tumescent solution. After a 20-minute period to allow for proper vasoconstriction, fat was aspirated using a standard 4-mm internal diameter blunt liposuction cannula from the abdomen (n = 33) and flanks (n = 5). The fat was then decanted and injected into the patient's face using a 20-gauge needle at different sites for aesthetic enhancement. Subsequently, patients were monitored for complications in the postanesthesia care unit (PACU). Postoperative pain was evaluated immediately following surgery and on postoperative day (POD) 1 using a validated numerical reporting scale. Zero represented no pain, and 10 represented the maximum amount of pain.

RESULTS

Descriptive statistics were used to determine the amount of ropivacaine used, mean pain rating, and average amount of fat removed. The patients (n = 33) were all female, the average age was 47.1, the average BMI was 26.2, and none of them were pregnant. Patient characteristics, ropivacaine dose, and postoperative pain ratings are summarized in **figure, Supplemental Digital Content 1**, which displays the patient demographics and postoperative pain ratings, **http://links.lww.com/PRSGO/C372**. On average, 185.45 mL of lipoaspirate was obtained. Patients reported minimal pain at the donor sites. No complications were observed. A few patients had to take medications for pain, which primarily consisted of acetaminophen, oxycodone/acetaminophen, or hydrocodone/acetaminophen; however, most participants (n = 28) did not require any pain medications postoperatively. The average pain rating immediately following surgery was 2.42 of 10 (range: 1–6). On POD 1, the average pain ratings were 1.03 of 10 (range: 0–5).

DISCUSSION

Although lidocaine is the most commonly used local anesthetic in liposuction procedures, it is highly cytotoxic and can compromise the stromal vascular fraction (SVF) and adipose-derived stem cell (ASC). This can compromise fat graft survival rates. In contrast, ropivacaine has been shown to be less cytotoxic to human mesenchymal stem cells.[5–7] However, a more recent study by Goldman et al investigated the cytotoxicity of ropivacaine and lidocaine on ASCs via a dose–response study in a cell culture model. The researchers found no significant difference in cytotoxicity between the two local anesthetics.[8] The conflicting findings of recent studies on ropivacaine cytotoxicity underscores the need for further research to elucidate the effects of different local anesthetics on adipose stem cell survival.

Takeaways

Question: Can ropivacaine be used in liposuction tumescent solution?

Findings: The use of ropivacaine led to low postoperative pain scores with no significant difference in pain scores between POD1 and POD6.

Meaning: Ropivacaine is a safe, long-lasting analgesic suitable for use in tumescent solution for lipoaspiration.

Additionally, the ropivacaine has a longer duration of action than lidocaine, which improves patient recovery following liposuction procedures.[8] Our experience with ropivacaine suggests that patients need little, if any, pain medications after liposuction. Furthermore, ropivacaine can be given in lower doses than lidocaine to achieve a longer analgesic affect. However, there is still a need for analgesia during the procedure because ropivacaine has a longer time of onset. Therefore, xylocaine with epinephrine is preferred in cases without sedation or general anesthesia.

The concurrent use of epinephrine with ropivacaine does not alter the time of onset, duration of action, or systemic absorption of ropivacaine. Additionally, it has side effects similar to other local anesthetics. Ropivacaine has been associated with methemoglobinemia, which requires immediate discontinuation of the anesthetic and prompt treatment, most commonly with methylene blue.[9] Additionally, central nervous system side effects (vision or hearing changes, perioral numbness, paresthesia, etc.) occur at similar rates when infused with either ropivacaine or bupivacaine, with the only notable exception being that muscle twitching occurred more commonly with bupivacaine. Ropivacaine also produces significantly fewer cardiac side effects, such as depression of cardiac conductance, QRS widening (QRS duration > 100 ms), and reduced diastolic function, than bupivacaine. This phenomenon occurs because ropivocaine is a pure S(−) enantiomer of bupivacaine. Compared to R(+) bupivacaine, the S(−) isomers bind less avidly to the cardiac sodium channels.[10] Therefore, it can be concluded that ropivacaine is a safer alternative analgesic for patients undergoing lipoaspiration procedures.

Finally, there have been no studies on ropivacaine use only for lipoaspiration. Therefore, these data will be of importance in plastic surgery procedures which utilize lipoaspirate for fat grafting and reconstruction of soft-tissue defects, as these procedures rely on adipose stem cell viability to reduce fat graft volume loss postoperatively. The purpose of this study was to present an initial case series with pain ratings because, to our knowledge, this has not yet been done. Further research is needed to address the efficacy of ropivacaine in tumescent solution, including pain control based on the ratio

of fat extracted to the tumescent solution injected as well as the maximum recommended dosage in liposuction procedures.

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