

# Erector Spinae Plane Block is Equivalent to Tumescant Local Anesthesia for Perioperative Pain Control with Abdominal Harvest for Fat Grafting

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**Background:** There is increasing evidence that lidocaine is toxic to adipocytes and their precursors, which can contribute to the variability in fat graft resorption. Erector spinae plane (ESP) block is a new technique to provide analgesia of the trunk and would avoid lidocaine at the fat graft donor site. The aim of this study was to compare the efficacy of ESP block versus tumescant local anesthesia (TLA).

**Methods:** A retrospective review was performed for all patients who underwent autologous fat grafting from the abdomen at the University of New Mexico Hospital between February 2016 and March 2019. These patients received either ESP block or TLA during abdominal fat harvest. The primary endpoints were intraoperative, postoperative, and total morphine equivalents.

**Results:** There was no difference in the mean intraoperative, postoperative, and total morphine equivalents administered between the ESP and TLA groups.

**Conclusions:** ESP block is equivalent to TLA for analgesia when using an abdominal donor site for fat harvest. ESP block should be considered in fat-grafting cases to avoid the potential toxicity of lidocaine to the viability of adipocytes and preadipocytes. (*Plast Reconstr Surg Glob Open* 2022;10:e4532; doi: 10.1097/GOX.0000000000004532; Published online 23 September 2022.)

## INTRODUCTION

Fat grafting to the breast is indispensable in the armamentarium of plastic surgeons to optimize the breast appearance during reconstruction. Fat grafting has been applied to mask contour irregularities and add volume supplementation in breast conservation therapy and in both implant-based and autologous reconstructions.<sup>1</sup> Additional applications include addressing postmastectomy syndrome, capsular contracture, radiation injury, and fat necrosis.<sup>1</sup> Fat grafting has been shown to be safe without an increase in cancer risk.<sup>1</sup> The major drawback is the unpredictable graft resorption, which can vary between 20% and 90% at 1 year after transplantation.<sup>2</sup> There has been significant research in fat harvesting, preparation, and injection techniques to minimize damage to the

adipocyte-derived stem cells, preadipocytes, and adipocytes to maximize graft survival.<sup>3</sup>

Tumescant local analgesia (TLA) allows for liposuction/fat harvest of the abdomen while minimizing the amount of anesthesia and blood loss. Use of TLA is the standard of care when performing small- to mid-volume liposuction procedures. In large-volume cases, liposuction is performed under general anesthesia due to concerns of local anesthesia toxicity and fluid overload. Most common tumescant solutions today contain lidocaine, bicarbonate, and epinephrine.<sup>4</sup> There is increasing in vitro and in vivo evidence that local anesthetics may have detrimental effects on the viability of adipocytes and their precursors,<sup>2,5-10</sup> which would decrease overall fat graft survival.

Erector spinae plane (ESP) block was introduced by Forero et al<sup>11</sup> in 2016 as an interfascial plane block for chronic thoracic pain control. There is extensive cranio-caudal diffusion of the anesthetic, allowing for wide coverage with a single injection.<sup>12,13</sup> The indications for ESP block have been expanded for abdominal surgery,<sup>12,14-19</sup> but it has never been utilized for liposuction.

The use of the ESP block would avoid the need for instillation of lidocaine at the fat graft donor site and potentially avoid its cytotoxic effects on adipose cells and their precursors. In this study, we describe our experience with the ultrasound-guided ESP block as an alternative to

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TLA for autologous fat grafting with an abdominal donor site.

## MATERIALS AND METHODS

Institutional review board approval was obtained for this retrospective chart review. Inclusion criteria were adults (equal to or greater than 18 years) who underwent autologous fat grafting harvested from the abdomen at the University of New Mexico Hospital between February 2016 and March 2019. All patients received either TLA or ESP block during their procedure. Patients were excluded if they underwent fat grafting from any site other than the abdomen. ESP block was compared with TLA to assess its efficacy in pain control. Primary outcome measures were intraoperative, postoperative, and total morphine equivalents, along with any complications associated with the ESP block. The postoperative morphine equivalents only included additional pain control administered in the postoperative recovery unit. Morphine equivalent conversions were available for all opioids given and ketorolac. Additional data collected included age, BMI, comorbidities, amount of fat prepared, and additional ancillary procedures. To better control for potential intraoperative, confounding variables, a post hoc analysis was performed for patients who underwent fat grafting alone without additional breast procedures.

### Erector Spinae Plane Block Technique

After informed consent was obtained, ESP blocks were performed preoperatively by an anesthesiologist. Patients were sedated with midazolam (up to 2mg) and fentanyl (up to 100 mcg). After sterile preparation, ultrasonography of the transverse process at the level of T7 or T8 was performed with a parasagittal longitudinal view. The skin was infiltrated with 1% lidocaine, then a 22 gauge × 80mm echogenic needle was used to approach the ESP using hydrodissection with sterile saline. When the plane was identified and after negative aspiration, local anesthetic was injected. The same process was performed on the contralateral side to complete the bilateral ESP blocks.

If further revision of the breast reconstruction was planned, the concentration of local anesthetic was decreased, and volume was increased. The higher volume allowed for greater dermatomal spread when the surgical site covered multiple dermatomes. Continuous hemodynamic monitoring was performed throughout the procedure to monitor for complications. The patients were observed for any adverse effect related to ESP block like infection, hematoma, local anesthesia toxicity, vascular puncture, pneumothorax, and persistent neurologic deficit.

### Fat Grafting Protocol

All procedures were performed under general anesthesia with monitoring oversight by an attending anesthesiologist. The TLA and ESP groups had similar techniques performed for fat harvest from the abdomen. In the TLA group, the tumescent solution contained 400mg of lidocaine, 150mg of bupivacaine, and 1mg of epinephrine in 1000mL of 0.9% normal saline. In the ESP group, the

## Takeaways

**Question:** How does the efficacy of the ESP compare to tumescent technique when harvesting fat from the abdomen?

**Findings:** ESP is as safe and effective as tumescent solution in controlling pain intraoperatively and immediately postoperatively.

**Meaning:** Since ESP provides an equivalent amount of pain control as tumescent solution, ESP can be used for analgesia instead of tumescent solution with local anesthetic, therefore preventing the potential systemic complications and the negative effects local anesthetic has on adipocytes and preadipocytes harvested when fat grafting.

tumescent solution contained 1mg of epinephrine in 1000mL in 0.9% normal saline. The abdomen and flanks were infiltrated with the corresponding tumescent solution using a standard tumescent technique. Once the skin demonstrated blanching, we began the fat harvest using 3- and 4-mm liposuction cannulas. The fat was then processed using the Revolve system in preparation for fat grafting.

### Statistical Analysis

The statistical analysis was performed using *t* tests comparing the two arms of the study, including the basic demographics, surgical factors, and pain medication requirements (intraoperatively, postoperatively, and total). A *P* value of less than 0.05 was considered significant.

## RESULTS

There were a total of 111 patients who underwent 168 cases of autologous fat grafting from the abdomen during the time period. There were patients who required multiple fat grafting sessions, and each individual case was stratified, depending on the analgesic technique chosen. There were 45 cases (37 patients) in the ESP group, and 123 cases (74 patients) were in the TLA group. There were no significant differences in patient demographics and comorbidities (Table 1). More specifically, there was no significant difference in potential baseline conditions that may increase the analgesic requirement, such as chronic pain disorder, baseline use of pain medications, and psychiatric disorder. There were no significant differences in intraoperative variables including the need for additional ancillary procedures (all were minor scar revisions) and volume of fat harvested (Table 2).

There was no significant difference in the operating room opioid administration between the TLA and ESP block groups ( $65 \pm 26$  mg versus  $70 \pm 24$  mg;  $P > 0.05$ ). There was no significant difference in the postoperative morphine equivalents between the two groups ( $32 \pm 25$  mg versus  $38 \pm 27$  mg;  $P > 0.05$ ). Correspondingly, there was no significant difference in the total morphine requirements when comparing the TLA and ESP blocks ( $96 \pm 35$  mg versus  $108 \pm 39$  mg;  $P > 0.05$ ). These data are summarized in Table 3. There was one unplanned admission in both the

**Table 1. Demographics and Comorbidities**

Demographics	ESP	TLA	P		
Total fat grafting cases	45	123			
No. patients	37	74			
Age (y): mean (SD)	48 (13)	47 (10)	>0.05		
BMI: mean (SD)	28 (5)	28 (5)	>0.05		
Comorbidities	ESP n (37)	Percentage	TLA n (74)	Percentage	P
Diabetes	2	5	9	12	>0.05
Hypertension	6	16	15	20	>0.05
Hyperlipidemia	5	14	11	15	>0.05
Coronary artery disease	0	0	1	1	>0.05
Chronic pain	8	22	10	14	>0.05
Pain medications (other)	5	14	4	5	>0.05
Smoking	0	0	5	7	>0.05
Anxiety or depression	12	32	23	31	>0.05

**Table 2. Surgical Factors**

Surgical Factor	ESP	TLA	P
Total fat grafting cases	45	123	
Tumescent infiltrated (mL): mean (SD)	449 (186)	499 (209)	
Secondary procedures performed	33	83	>0.05
Total fat prepared (mL): mean (SD)	66 (40)	76 (47)	>0.05

ESP and TLA groups for pain control. Both patients were discharged the following day. There were no reported complications with the ESP block.

Similar analysis was performed in patients who underwent fat grafting only. There was no significant difference in volume of fat harvested or the volume of injectable fat after preparation (Table 2), and the average dose of local anesthetic was approximately 200 mg of lidocaine and 75 mg of bupivacaine, which is well within the acceptable safe dosing for the patients. There were no significant differences in intraoperative, postoperative, and total morphine equivalents administered between the ESP block and TLA groups (Table 4). A subgroup analysis was also performed for patients who underwent fat grafting and had secondary procedures performed. There were no significant differences in terms of volume of fat that was prepared or in intraoperative, postoperative, or total morphine equivalents (Table 5).

**Table 3. Analgesic Requirements**

Surgical Factor	ESP	TLA	P
Morphine equivalents	Mean (SD)	Mean (SD)	
Intraoperative	70 (24)	65 (26)	>0.05
Postoperative	38 (27)	32 (25)	>0.05
Total	108 (39)	96 (35)	>0.05
Unplanned admissions	n (%)	n (%)	>0.05
	1 (2)	1 (1)	

**Table 4. Fat Grafting Alone**

Surgical Factor	ESP	TLA	P
No. patients	10	25	
Total fat grafting cases	12	40	
Total fat prepared (mL): mean (SD)	69 (47)	73 (39)	>0.05
Morphine Equivalents	Mean	Mean	
Intraoperative (SD)	56 (25)	55 (23)	>0.05
Postoperative (SD)	29 (20)	25 (16)	>0.05
Total (SD)	84 (35)	80 (25)	>0.05

## DISCUSSION

Fat grafting can be utilized to address disfiguring soft tissue defects. The successful long-term treatment with fat grafting is limited by variable viability of the transplanted fat. More specifically, the mature adipocytes and preadipocytes must survive, and the differentiation of preadipocytes into adipocytes can further maintain the volume of transplanted fat. More recent studies have focused on the impact of lidocaine on adipocyte and preadipocyte viability. Lei et al<sup>6</sup> showed that exposure to lidocaine diminished the viability of mature adipocytes. Multiple studies have demonstrated that local anesthetics decrease preadipocyte viability,<sup>5,7-9</sup> but the effects on differentiation have been conflicting. Keck et al<sup>5</sup> demonstrated that local anesthetics decreased the ability of preadipocytes to differentiate into adipocytes; however, Gugerell et al<sup>7</sup> did not see an effect of lidocaine on adipogenic differentiation. The only conflicting study was by Shoshani et al,<sup>20</sup> which did not find any effect on lidocaine on fat graft weight and volume. This is likely attributed to the centrifugation and washing of the fat, which removed the lidocaine before transplantation.<sup>8,10</sup>

With the increasing evidence of the detrimental effects of lidocaine on adipocytes and preadipocytes, a major concern is how to obtain analgesia of the abdominal donor site. In our study, we compared the efficacy of the ESP block with the standard of care, TLA, for liposuction. The results from this study indicate the equivalence of ESP block and TLA for the immediate perioperative pain control. This would allow complete avoidance of lidocaine exposure to the harvested fat to maximize the survival of the adipocytes and preadipocytes. The ESP block would have to be performed by an anesthesiologist, which may limit its availability. In this clinical setting, it would need to be performed bilaterally to ensure complete anesthetic block of the abdominal donor site.

**Table 5. Fat Grafting with Secondary Breast Procedure**

Surgical Factor	ESP	TLA	P
No. patients	31	62	
Total fat grafting cases	33	83	
Total fat prepared (mL): Mean (SD)	65 (38)	78 (51)	>0.05
Morphine Equivalents	Mean (SD)	Mean (SD)	
Intraoperative	75 (22)	69 (27)	>0.05
Postoperative	41 (29)	35 (28)	>0.05
Total	116 (37)	104 (37)	>0.05

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The use of ESP block would additionally avoid the potential of lidocaine toxicity from using TLA. The maximum safe dosage of tumescent lidocaine is unknown, but years of experience have shown that 55 mg/kg tumescent lidocaine is safe.<sup>21</sup> However, toxicity can still occur if lidocaine is absorbed too rapidly, metabolism is too slow, patients have low serum protein concentrations, or surgery is canceled before liposuction can be completed.<sup>21</sup> Measuring serum lidocaine levels, Klein and Jeske<sup>21</sup> recommended dosing of 45 mg/kg of tumescent lidocaine, which would still result in a risk of toxicity of less than 1/1000 according to their estimates. ESP block would avoid these ambiguities by following well-established guidelines for maximum local anesthesia dosing.

There are limitations to our study. The addition of ancillary procedures to the breast will invariably increase the opioid requirements. When performing these revision procedures, the concentration of the local anesthetic utilized in the ESP block was diluted to allow greater volumes and further spread of the local anesthetic. It was unclear whether the anesthetic was able to diffuse cranially to cover the breast. There is also the possibility that the resultant pain control may have been decreased because of inadequate coverage of the breast and/or abdominal dermatomes. On our initial analysis, there was a similar percentage of patients in each group who had additional revisions of their breast reconstruction at the time of fat grafting. There was variability in the procedures performed and the amount of additional stimulus evoked. Because of these limitations, we did perform a post hoc analysis of patients undergoing fat grafting alone. This would eliminate any additional pain stimuli to the breast and attempt to better evaluate the abdominal analgesia provided by ESP block and TLA. There was still not a significant difference in opioid requirements in the perioperative period between the ESP block and TLA.

Another limitation is that we were unable to adequately assess the patient's pain control on the following day. Our study demonstrates equivalency between TLA and ESP block during the immediate perioperative period. Tumescent anesthesia is slowly absorbed, providing continued analgesia up to 18–24 hours, whereas ESP blocks utilizing ropivacaine may last as little as 7–8 hours. TLA may demonstrate superiority to ESP block when assessing the pain control at postoperative day one. A randomized, controlled study would be necessary to address these shortcomings.

This was a retrospective analysis in which blinding was not able to be performed. There was no proscribed limit to the amount of opioid medications or multimodal analgesia that was allowed in these patients. While standard multimodal analgesics were used routinely, we cannot unequivocally say that the same multimodal regimen was used in each anesthetic. Nonstandard adjuncts such as dexmedetomidine, ketamine, acetaminophen, beta blockade, or other modalities known to have minor effects on pain control may further complicate the primary outcome measure of morphine equivalent dosing within the perioperative period.

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