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ORIGINAL RESEARCH

# The Impact of Regional Anesthesia Techniques on Pain Control and Opioid Consumption in Sleeve Gastrectomy

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**ABSTRACT**

This study aims to evaluate the effectiveness of erector spinae block (ESP) and transversus abdominis plane (TAP) blocks in reducing postoperative opioid requirements and enhancing pain control in laparoscopic sleeve gastrectomy (LSG) patients. This retrospective study included 90 patients undergoing LSG. The patients were equally allocated into three groups—ESP block, TAP block, and control (no regional anesthesia applied)—with 30 patients in each group. During the allocation process, patients were matched for age and gender. Pain levels were assessed using the Visual Analog Scale (VAS) at 0, 2, 4, 8, 12, and 24 hours postoperatively. Opioid consumption, side effects, patient, and surgeon satisfaction were recorded. Statistical analyses were conducted to compare pain scores, opioid use, and satisfaction levels among the groups. The ESP block group reported the lowest VAS scores, indicating superior pain control. Opioid consumption was significantly reduced in both ESP and TAP block groups compared to the control group, with the ESP group showing the greatest reduction. There was a significant relationship between the amount of opioid used and side effects. Patient satisfaction was highest in the ESP block group, followed by the TAP block group, and lowest in the control group. The ESP and TAP blocks are effective in reducing postoperative opioid consumption and providing better pain control in LSG patients. The ESP block, in particular, offers superior analgesia and higher patient satisfaction compared to the TAP block and no block.

**Keywords: Erector spinae plane block. Laparoscopic sleeve gastrectomy. Opioid consumption. Postoperative pain. Transversus abdominis plane block.**

**Regionel Anestezi Tekniklerinin Sleeve Gastrektomide Ağri Kontrolü ve Opioid Tüketimi Üzerindeki Etkisi**

**ÖZET**

Bu çalışma, laparoskopik mide tüpü gastrektomi (LSG) hastalarında erector spinae bloğu (ESP) ve transversus abdominis plane (TAP) bloklarının postoperatif opioid gereksinimlerini azaltma ve ağrı kontrolünü iyileştirme etkinliğini değerlendirmeyi amaçlamaktadır. Bu retrospektif çalışmaya, LSG uygulanan 90 hasta dahil edilmiştir. Hastalar, her bir grup için 30 hasta olacak şekilde üç gruba eşit olarak dağıtılmıştır—ESP bloğu, TAP bloğu ve kontrol (regionel anestezi uygulanmayan)—ve hastalar yaş ve cinsiyet açısından eşleştirilmiştir. Ağrı düzeyleri, postoperatif 0, 2, 4, 8, 12 ve 24 saatlerde Görsel Analog Skala (VAS) kullanılarak değerlendirilmiştir. Opioid tüketimi, yan etkiler, hasta ve cerrah memnuniyeti kaydedilmiştir. Gruplar arasında ağrı skorları, opioid kullanımı ve memnuniyet düzeylerini karşılaştırmak için istatistiksel analizler yapılmıştır. ESP grubu, kontrol grubuna kıyasla anlamlı şekilde daha düşük VAS skorları göstermiştir. ESP bloğu grubunda en düşük VAS skorları bildirilmiş, bu da üstün ağrı kontrolünü göstermektedir. Opioid tüketimi, ESP ve TAP bloğu gruplarında kontrol grubuna göre anlamlı şekilde azalırken, ESP grubunda en büyük azalma gözlemlenmiştir. Kullanılan opioid miktarı ile yan etkiler arasında anlamlı bir ilişki bulunmuştur. Hasta memnuniyeti, en yüksek ESP bloğu grubunda, ardından TAP bloğu grubunda ve en düşük kontrol grubunda kaydedilmiştir. ESP ve TAP blokları, LSG hastalarında postoperatif opioid tüketimini azaltmada ve daha iyi ağrı kontrolü sağlamada etkilidir. Özellikle ESP bloğu, TAP bloğuna ve herhangi bir blok uygulanmayan gruba kıyasla üstün analjezi ve daha yüksek hasta memnuniyeti sunmaktadır.

**Anahtar Kelimeler: Erectör spina plane bloğu. Laparoskopik sleeve gastrektomi. Opioid tüketimi. Postoperatif ağrı. Transversus abdominis plane bloğu.**

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Obesity is a global health issue associated with significant morbidity and mortality due to its related comorbidities.[1] Sleeve gastrectomy (SG) is the most commonly performed bariatric surgery for managing obesity.[2]

Following tissue damage, local inflammatory mediators, such as bradykinin, substance P, prostaglandins, histamine, and serotonin, are released at the surgical site, inducing pain. Impulses from these inflammatory mediators upon tissue destruction activate nociceptors, i.e., free nerve endings that sense pain. Fast, sharp pain is transmitted by myelinated A-delta fibers, whereas slow, chronic pain is carried by unmyelinated C fibers via the spinal cord anterolateral pathway.[3]

The perioperative period is characterized by immune system suppression due to inflammatory pain and surgical stress, which inhibits cytotoxic cells.[4] Multimodal analgesia strategies during this period can benefit immune modulation and minimize immune suppression, thereby reducing postoperative morbidities.[5] Regional anesthesia techniques as part of multimodal analgesia also modulate the immune response by reducing surgical stress and opioid use, which are known to impair cellular and humoral immunity. This helps protect patients from opioid-related side effects and prevents immunosuppression caused by pain and surgical stress. Effective management of immunosuppressive factors is crucial for shorter hospital stays, a more comfortable postoperative process, and reduced hospital costs.[4]

Postoperative pain management can be complicated by serious side effects, such as respiratory depression, cardiopulmonary arrest, urinary retention, ileus, and addictive potential, of high-dose opioids used for analgesia in patients who undergo bariatric surgery.[6,7] Opioids also suppress the immune system by weakening the cytotoxic functions of natural killer cells.[8] Therefore, it is important to reduce opioid use and explore alternative pain management methods that can replace or support opioid therapy.[9]

The Visual Analog Scale (VAS) is a reliable and valid scale for assessing pain severity in postoperative patients.[10]

The Transversus Abdominis Plane (TAP) block, first described by Rafi in 2001, is an intervention that creates a peripheral nerve block in the anterolateral abdominal wall.[11] TAP is the space between the internal oblique and transversus abdominis muscles. An anesthetic is injected into this site for the procedure. Initially, the procedure was performed blindly, but its reliability and success rate have improved with ultrasonography (USG) guidance.[12] The Erector Spinae Plane (ESP) block, introduced as a technique for managing thoracic neuropathic pain and pain associated with thoracic trauma or surgery[13] is based on the columnar arrangement of the erector spinae muscle and retinaculum. This concept suggests that ESP block applications at lower thoracic levels might also provide abdominal analgesia.[14]

This study aims to compare the efficacy of the Erector Spinae Plane (ESP) block and the Transversus Abdominis Plane (TAP) block in managing postoperative pain following sleeve gastrectomy (SG), one of the most commonly performed bariatric surgeries for obesity. Specifically, the study evaluates the effectiveness of both regional anesthesia techniques in reducing postoperative analgesic requirements, opioid consumption, pain intensity, and opioid-related side effects. Additionally, as part of a multimodal analgesia approach, the potential of these blocks to attenuate surgical stress and mitigate immunosuppression will also be indirectly assessed. The ultimate goal is to contribute to the identification of a more effective, safer, and immune-supportive pain management strategy for patients undergoing SG.

## Material and Method

*Study Design and Patient Population*

The study was reviewed and approved by the Harran University Clinical Research Ethics Committee (28.12.2023-25).

The study was designed as a retrospective study. The patients included in the study were selected from those who underwent laparoscopic sleeve gastrectomy (LSG) for morbid obesity in our clinic between January 1, 2023, and June 30, 2023. The patients were equally allocated into three groups—ESP block, TAP block, and control (no regional anesthesia applied)—with 30 patients in each group. During the allocation process, patients were matched for age and gender.

All patients underwent LSG by a single general surgeon. Due to the potential need for analgesics in the postoperative recovery unit, the patients were accompanied by the anesthesiologist, who performed the block procedure. Postoperative pain assessment was performed using VAS score at 0, 2, 4, 8, 12, and 24 hours after the patient was returned to their room.

A Likert-type survey was used to assess patient and physician satisfaction with postoperative analgesia. This survey is a routine assessment tool applied to patients who have undergone obesity surgery during their outpatient follow-up visits in our clinic. During the first outpatient clinic control after discharge, the patient was asked, "Considering the pain I experienced after surgery, I would have surgery again if I went back to the preoperative period"; and the physician was asked, "When I evaluate the patient in terms of pain control, the patient was easy to manage." They were asked to respond to both questions with one of the following responses, which were scored thereafter;

Strongly disagree (1 point)

Disagree (2 points)

Neither agree nor disagree (3 points)

Agree (4 points)

Strongly agree (5 points)

Patients were evaluated by age, sex, body mass index (BMI), American Society of Anesthesiologists physical status classifications (ASA) score, comorbidity, amount of opioid use, VAS score, side effects (urinary retention, cardiopulmonary arrest, respiratory depression and ileus were considered as side effects), patient, and physician satisfaction. Data other than the survey responses were obtained from patient records.

*Inclusion and Exclusion Criteria*

Pursuant to the inclusion criteria, patients aged 18–60 years, patients with ASA scores of I, II, and III, and a BMI of >35 kg/m$^2$ were included in the study.

For the exclusion criteria, patients with missing data in their records, patients who were allergic to local anesthetics, refused a regional block, underwent concomitant surgeries, experienced intraoperative or postoperative complications within the first 24 hours, had a platelet count of <100,000, had known coagulopathy, or had a history of opioid addiction. Patients who underwent concomitant surgeries (e.g., cholecystectomy) were excluded from the study due to the potential for increased surgical morbidity and higher analgesic requirements. Additionally, patients with coagulopathy or low platelet counts were excluded due to the elevated risk of bleeding, and individuals with opioid dependence were excluded as they may require higher opioid doses for effective analgesia.

*General Anesthesia, ESP, and TAP Block Applications*

At induction of anesthesia, all patients received 2 mg/kg propofol, 0.5 mg/kg atracurium, and 2 mcg/kg fentanyl based on their corrected ideal weight. No additional analgesics or anti-inflammatories were administered. 1000 mg of 1st generation cephalosporin was administered intravenously for preoperative antibiotic prophylaxis. The same anesthesiologist performed regional anesthesia to ensure consistency in the study results. All regional anesthesia procedures were performed on the operating table upon induction of anesthesia. The control group did not receive regional anesthesia. Intravenous (IV) opioids were used for postoperative analgesia in all groups based on the patient’s needs and VAS scores. If required, postoperative patients received intravenous morphine sulfate infusion at a dose of 0.1 mg/kg of body weight.

*ESP Block Application*

ESP block was performed immediately after induction of anesthesia to investigate its effect on postoperative analgesia. It was performed on the operating table before induction of general anesthesia. Overall, 10% povidone–iodine was used for skin preparation. The probe was covered with a sterile drape. All ESP blocks were performed by the same anesthesiologist, who was experienced in ultrasound-guided regional anesthesia techniques. A wide-bandwidth (1–8 MHz) convex probe (Esaote®, MyLab5, Italy) and a 22G, 50 or 100 mm, isolated facet-type needle (Braun Sonoplex, Melsungen, Germany) were used to perform the multifrequency block. Blocks were performed bilaterally using an intraplane approach at the T8 level with the patient in the prone position. The convex probe was placed 2–3 cm lateral to the spine using a sagittal approach. The needle was inserted deeply into the erector spinae muscle after the erector spinae muscle and transverse processes were identified (Figure 1). The correct position of the needle tip was verified by 0.5–1 ml of local anesthetic (LA). 20 ml of 0.25% bupivacaine was administered as local anesthetic to perform the ESP block. local anesthetic spread was confirmed in both cranial and caudal directions.

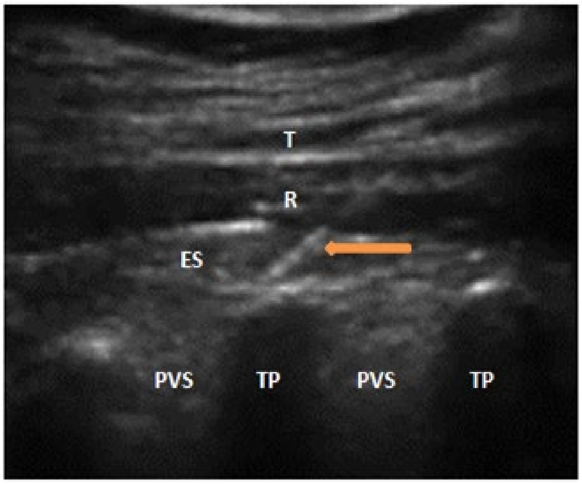


***Figure 1:***
*Identifying the layers and determining the needle position in ESP Block application (T: Trapezius muscle, R: Rhomboid muscle, ES: Erector Spinae muscle, TP: Transverse process, PVS: Paravertebral space, area marked with an arrow: Needle insertion and drug administration)*

*TAP Block Procedure*

Following the induction of general anesthesia, the surgical site was cleaned with an antiseptic solution on the operating table, and a sterile cover was placed over the linear ultrasound probe (Esaote®, MyLab5, Italy). To capture the optimal image, the probe was moved vertically or tilted up and down along the abdominal wall toward the costal margin and iliac crest. Once it obtained a clear view, the probe was secured in position, spanning from the superficial to deep layers and displaying the skin, subcutaneous fat tissue, external oblique muscle, internal oblique muscle, transversus abdominis muscle fascia, and peritoneum. A 100-mm, 22-G needle (Braun Sonoplex, Melsungen, Germany) was advanced anterior to posterior using an in-plane technique under ultrasound guidance. Careful aspiration was performed to confirm proper placement of the needle tip between the fascial planes of the internal oblique and transversus abdominis muscles. Subsequently, a test dose of 1 mL of 0.25% bupivacaine was administered to confirm proper needle localization (Figure 2). Following this, 20 mL of 0.25% bupivacaine solution was injected simultaneously on both the right and left sides under ultrasound guidance, after which the surgical procedure was initiated.

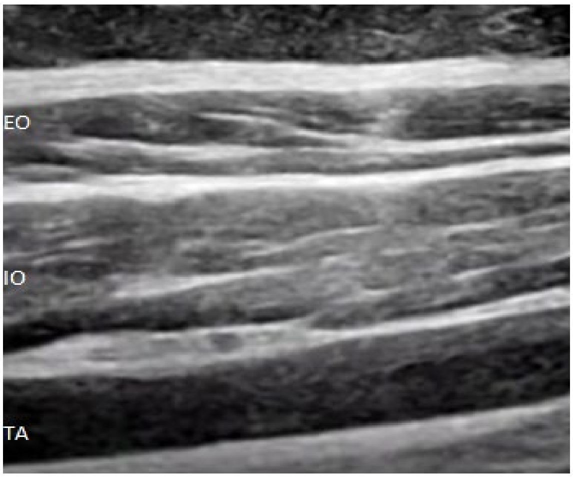


***Figure 2:***
*Identifying layers in the TAP Block application (EO: External oblique muscle, IO: Internal oblique muscle, TA: Transversus abdominis muscle)*

All patients underwent LSG, performed by a single general surgeon. Following surgery, the anesthesiologist who performed the block procedure accompanied the patients in the post-anesthesia care unit to address any potential analgesic needs. Once the patient was transferred to the regular ward, pain assessments were conducted based on the VAS score at 0, 2, 4, 8, 12, and 24 hours after surgery.

## *Statistical Analysis*

All statistical analyses were performed using SPSS for Windows, version 25.0 (IBM SPSS Inc., Chicago, IL, USA). The Shapiro–Wilk test was employed to assess the normality of the data distribution. As the data did not follow a normal distribution, continuous variables are presented as medians and minimum-maximum, while categorical variables are reported as counts (n) and percentages (%). Between-group comparisons involving more than two independent groups were conducted using the Kruskal–Wallis H test. The Friedman test was applied to evaluate changes in intragroup VAS scores over time (at 2, 4, 8, 12, and 24 hours), followed by post-hoc pairwise comparisons with Bonferroni correction. The Chi-square test was used for the analysis of categorical variables. All analyses were performed using a 95% confidence interval, and a two-tailed p-value less than 0.05 was considered statistically significant.

## Results

The study including 25 (27.8%) male and 65 (72.2%) female patients. The mean age of the patients was 33.2 ± 9.5 years, where the mean BMI was 46.3 ± 5.3 kg/m². Overall 46 (51.1%) patients were classified as ASA 2 and 44 (48.9%) as ASA 3. There were no significant intergroup differences by age, sex, BMI, ASA score, and comorbidity variables (p > 0.05 for each) (Table I).

**Table I.** Comparison of Clinical and Demographic Characteristics based on Postoperative Analgesia Methods

| | **Overall** (n = 90) | **Group** | | | **p** |
|---|---|---|---|---|---|
| | | **Control** (n = 30) | **ESP** (n = 30) | **TAP** (n = 30) | |
| **Age** † | 33.2 ±9.5 | 34.5 ±9.9 | 29.9 ±8.6 | 35.2 ±9.5 | 0.054* |
| **Sex** ‡ | | | | | |
| Male | 25 (27.8) | 7 (23.3) | 10 (33.3) | 8 (26.7) | 0.679** |
| Female | 65 (72.2) | 23 (76.7) | 20 (66.7) | 22 (73.3) | |
| **BMI** † | 46.3 ±5.3 | 46.3 ±6.1 | 46.3 ±5.0 | 46.2 ±4.7 | 0.992* |
| **ASA Score** ‡ | | | | | |
| 2 | 46 (51.1) | 13 (43.3) | 14 (46.7) | 19 (63.3) | 0.252** |
| 3 | 44 (48.9) | 17 (56.7) | 16 (53.3) | 11 (36.7) | |
| **Comorbid Conditions,** *present* ‡ | 12 (13.3) | 4 (13.3) | 4 (13.3) | 4 (13.3) | 0.999** |

ESP: Erector Spinae Plane, TAP: Transversus Abdominis Plane, BMI: Body Mass Index, ASA: American Society of Anesthesiologists

***.** One-way ANOVA. ****.** Pearson's Chi-Squared/Fisher–Freeman–Halton test, **‡:** n (%), **†:** Mean ± Standard deviation

There were significant differences between the groups by mean and maximum VAS scores, opioid use, patient, and physician satisfaction (Table II).

The number of patients with comorbid diseases was 12 (13.3%). The median and maximum VAS value was 3.7 and 6, respectively. Opioid use was necessary in 70 patients (77.8%), with a median opioid dose of 200 mg. Side effects associated with opioid use were observed in a total of 35 patients. There was no significant intergroup difference by the incidence of side effects associated with opioid use (p = 0.311). In terms of the patient satisfaction scores, 1 (1.1%) participant scored 1 point, 6 (6.7%) scored 2 points, 43 (47.8%) scored 3 points, 32 (35.6%) scored 4 points, and 8 (8.9%) scored 5 points. In terms of physician satisfaction, 6 (6.7%) participants scored 2 points, 33 (36.7%) scored 3 points, 32 (35.6%) scored 4 points and 19 (21.1%) scored 5 points.

**Table II.** Comparison of VAS Scores, Opioid Use and Satisfaction based on Postoperative Analgesia Methods

| | **Overall** (n = 90) | **Group** | | | **p** |
|---|---|---|---|---|---|
| | | **Control** (n = 30) | **ESP** (n = 30) | **TAP** (n = 30) | |
| **VAS Median** § | 3.7 [0.3 – 7.5] | 4.3 [1.3 – 6.5] | 3.2 [0.3 – 5.2] | 3.9 [2.2 – 7.5] | 0.037* |
| **VAS Max.** § | 6.0 [2.0 – 10.0] | 7.0 [2.0 – 10.0] | 5.0 [2.0 – 9.0] | 6.0 [4.0 – 10.0] | 0.016* |
| **Opioid Consumption,** *yes* ‡ | 70 (77.8) | 30 (100.0) | 16 (53.3) | 24 (80.0) | <0.001** |
| Amount of Opioids (*mg*) § | 200.0 [100.0 – 300.0] | 200.0 [100.0 – 300.0] | 100.0 [100.0 – 300.0] | 200.0 [100.0 – 300.0] | <0.001* |
| **Postoperative Side Effects,** *present* ‡ | 35 (38.9) | 15 (50.0) | 10 (33.3) | 10 (33.3) | 0.311** |
| **Patient Satisfaction** ‡ | | | | | |
| 1 | 1 (1.1) | 0 (0.0) | 0 (0.0) | 1 (3.3) | |
| 2 | 6 (6.7) | 3 (10.0) | 2 (6.7) | 1 (3.3) | |
| 3 | 43 (47.8) | 20 (66.7) | 5 (16.7) | 18 (60.0) | <0.001** |
| 4 | 32 (35.6) | 7 (23.3) | 18 (60.0) | 7 (23.3) | |
| 5 | 8 (8.9) | 0 (0.0) | 5 (16.7) | 3 (10.0) | |
| **Physician Satisfaction** ‡ | | | | | |
| 2 | 6 (6.7) | 5 (16.7) | 1 (3.3) | 0 (0.0) | |
| 3 | 33 (36.7) | 16 (53.3) | 5 (16.7) | 12 (40.0) | <0.001** |
| 4 | 32 (35.6) | 8 (26.7) | 10 (33.3) | 14 (46.7) | |
| 5 | 19 (21.1) | 1 (3.3) | 14 (46.7) | 4 (13.3) | |

ESP: Erector Spinae Plane, TAP: Transversus Abdominis Plane, VAS: Visual Analogue Scale,
***.** Kruskal–Wallis test**. **,** Pearson's Chi-Squared/Fisher–Freeman–Halton test, **‡:** n (%), **§:** Median [Min–Max]

For group comparisons, there were significantly lower scores in the ESP group compared to the control group by mean value of VAS and maximum VAS value (p = 0.037, p = 0.016, respectively). The mean VAS value and maximum VAS value were lower in the TAP group compared to the control group. However, this difference was not significant (p < 0.05, p < 0.05, respectively). The comparison of intra-group and inter-group VAS scores over time is presented in Table III (In light of a significant intergroup difference at baseline [0 hours], delta values were derived by subtracting the 0-hour measurements from subsequent time points; these delta values were then subjected to further statistical analyses).

A comparison of median VAS values over time by groups is shown in Figure 3.

There was also a significant intergroup difference by opioid use. ESP and TAP block treatments significantly reduced postoperative opioid consumption compared to the control group (p < 0.001, p < 0.001, respectively). Opioid use in the ESP group was significantly lower compared to the TAP group (p = 0.001). Postoperative opioid analgesic treatment was necessary in all patients in the control group, 53.3% in the ESP group, and 80% in the TAP group.

**Table III.** Comparison of VAS Scores Over Time Across Groups

| | **Group** | | | **p*** |
|---|---|---|---|---|
| | **Control** (n = 30) | **ESP** (n = 30) | **TAP** (n = 30) | |
| **VAS** | | | | |
| 2 hours | 1.0 [0.0 – 5.0] | 1.0 [-3.0 – 4.0] | 1.0 [-2.0 – 3.0] | 0.047 α |
| 4 hours | 1.0 [-1.0 – 6.0] | 1.0 [-2.0 – 4.0] | 2.0 [-3.0 – 4.0] | 0.019 α |
| 8 hours | 2.50.0 [0.0 – 6.0] | 1.0 [-4.0 – 6.0] | 2.0 [-2.0 – 6.0] | 0.039 α |
| 12 hours | 4.0 [0.0 – 8.0] | 2.0 [-2.0 – 6.0] | 2.5 [-2.0 – 4.0] | 0.001 α, § |
| 24 hours | 4.0 [0.0 – 9.0] | 2.0 [-2.0 – 6.0] | 3.0 [-1.0 – 5.0] | 0.005 α |
| p** | **<0.001** a,b,c,d | **<0.001** c,d,e | **<0.001** b,c,d | |

VAS: Visual Analogue Scale, ESP: Erector Spinae Plane, TAP: Transversus Abdominis Plane,
**α:** Control vs ESP, **§:** Control vs TAP, **a:** 2. Hours vs 8. Hours, **b:** 2. Hours vs 12. Hours, **c:** 2. Hours vs 24. Hours, **d:** 4. Hours vs 24. Hours, **e:** 8. Hours vs 24. Hours
*Kruskal–Wallis H test., **Friedman test, Median [Min–Max] (Post-Hoc with Bonferroni correction)

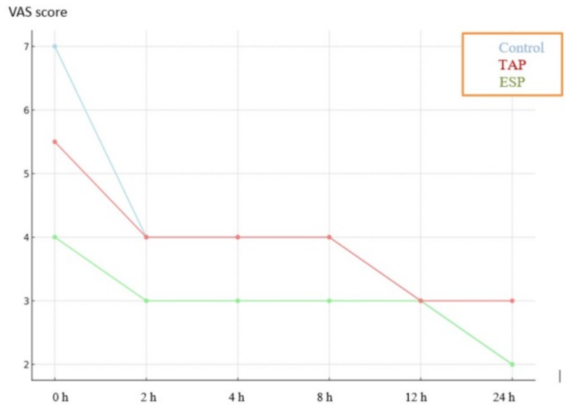


***Figure 3:***
*Temporal Changes in Median VAS Scores Across Groups*

Postoperative side effects associated with opioid use were observed in a total of 35 patients: 15 in the control group and 10 each in the ESP and TAP groups. This difference was not statistically significant (p = 0.311). However, when comparing the opioid doses used in patients with side effects to those without, the opioid use was significantly higher in the group with side effects (p = 0.026).

Patient satisfaction was significantly higher in the ESP group compared to both the control and TAP groups (p < 0.001). Specifically, patient satisfaction in the ESP group increased by 58% (p = 0.009). No significant difference in patient satisfaction was observed between the TAP and control groups (p > 0.05). Advanced statistical analyses further confirmed that the ESP group exhibited significantly higher levels of patient satisfaction (p = 0.009). Regarding physician satisfaction, the ESP group demonstrated significantly higher scores than the TAP and control groups ($p < 0.001$). No significant difference in satisfaction was observed between the TAP and control groups. Advanced statistical analyses identified maximum VAS scores, opioid dose, and patient satisfaction as significant factors influencing physician satisfaction, with each variable showing statistical significance ($p < 0.05$). Opioid use (r = −0.472) and maximum VAS values (r = −0.451) had a significant adverse effect on physician satisfaction, while patient satisfaction had a significant positive relationship (r = 364). Correlations between the opioid dose, physician and patient satisfaction, and clinical variables are summarized in Table IV (The correlation coefficient, denoted as r, ranges from -1 to +1. A value of r close to -1 indicates a negative correlation between the variables, while a value close to +1 suggests a positive correlation).

**Table IV.** Correlations Between Clinical Variables and Opioid Consumption, Patient Satisfaction, and Physician Satisfaction

| | Opioid (Milligram) | | Patient Satisfaction | | Physician Satisfaction | |
|---|---|---|---|---|---|---|
| | r | P | r | p | r | p |
| **VAS Median** | 0.364 | 0.002 | -0.250 | 0.018 | -0.359 | <0.001 |
| **VAS Max.** | 0.327 | 0.006 | -0.266 | 0.011 | -0.451 | <0.001 |
| **Age** | 0.179 | 0.139 | -0.236 | 0.025 | -0.195 | 0.066 |
| **BMI** | -0.004 | 0.973 | 0.108 | 0.311 | 0.015 | 0.886 |
| **ASA** | 0.033 | 0.788 | 0.007 | 0.951 | 0.174 | 0.100 |
| **Patient Satisfaction** | -0.213 | 0.077 | | | | |
| **Physician Satisfaction** | -0.472 | <0.001 | 0.364 | <0.001 | - | - |
| **Sex** | 0.075 | 0.539 | 0.113 | 0.290 | 0.124 | 0.246 |
| **Comorbid Conditions** | 0.028 | 0.815 | 0.054 | 0.613 | 0.066 | 0.538 |
| **Postoperative Side Effects** | -0.267 | 0.026 | 0.140 | 0.187 | 0.178 | 0.093 |

VAS: Visual Analogue Scale, BMI: Body Mass Index, ASA: American Society of Anesthesiologists, Spearman's rho.

## Discussion and Conclusion

Postoperative surgical stress and pain induce the release of corticotropin-releasing hormone (CRH) from the hypothalamus, which in turn causes the release of adrenocorticotropic hormone (ACTH) from the anterior pituitary lobe and ultimately cortisol from the adrenal cortex. These two factors also induce the release of vasopressin from the posterior pituitary. Another effect is on the sympathetic nervous system. By stimulating the sympathetic nervous system, it causes activation in the renin–angiotensin–aldosterone axis, leading to an increase in epinephrine and glucagon release, a decrease in insulin levels, and a decrease in renal blood flow.[15] All these neuroendocrine-metabolic responses and alterations in the hypothalamic–pituitary–adrenal axis result in immunosuppression. Regional anesthesia provides significant advantages for intraoperative management of the hypothalamic–pituitary–adrenal axis, including reduced stress response, better glycemic control, improved recovery, and potentially lower risks of chronic pain and recurrence of cancer.[3] These factors help regional anesthesia serve an appropriate choice in various surgical contexts.

The efficacy of ESP and TAP blocks in postoperative pain management was demonstrated in various previous studies and they were recommended for multimodal analgesia management.[16,17] The results of the present study on the reduction of postoperative opioid use using ESP and TAP blocks in patients, who underwent LSG, was largely consistent with the previous studies.

There are recent studies in the relevant literature on the positive efficacy of the postoperative multimodal approach on analgesia management.[18,19] Yashraj Jain et al. suggested that the use of multimodal analgesia strategies in postoperative pain management was important to reduce opioid consumption and side effects.[9] Upon a literature review by Yuliana et al. on postoperative pain management, it was reported that appropriate management strategies could optimize pain relief and reduce side effects.[20] This strategy is consistent with the results of the present study that ESP and TAP blocks were effective in reducing opioid consumption.

Elshazly et al. compared the feasibility and efficacy of ESP and TAP nerve blocks in patients undergoing bariatric surgery and reported statistically significant lower VAS scores in the ESP group at 30 min, 18 h, and 24 h after extubation.[1] Conversely, Saber et al.[21] and Wassef et al.[22] reported that TAP nerve blocks were not effective in reducing pain scores in LSG and bariatric surgery patients, respectively. In the present study, maximum and mean VAS values were significantly lower in the ESP group compared to the control group, while there was no statistically significant difference between the TAP and control groups. ESP nerve blocks may be more effective in pain management as they provide both visceral and somatic analgesia. The effectiveness of the TAP block in reducing VAS scores may have been limited, likely due to its selective blockade of somatic pain originating from the abdominal wall.

Elshazly et al. also reported that the opioid requirements were significantly higher in patients who received TAP blocks compared to those who received ESP blocks.[1] Similarly, Altıparmak et al. compared TAP and ESP blocks in laparoscopic cholecystectomy and found that ESP blocks were more effective in reducing opioid use.[23] In this study, ESP and TAP block groups had significantly reduced postoperative opioid consumption compared to the control group, with the ESP group requiring less opioid than the TAP group. Postoperative opioid analgesic treatment was necessary for all patients in the control group, 53.3% in the ESP group, and 80% in the TAP group.

Eadie et al. reported that regional anesthesia applications provided significant benefits to avoid the side effects of opioid use.[24] These results were consistent with a study by Bolesta et al.[25] However, in this study, there were no significant intergroup differences by side effects. Notwithstanding the above, the opioid dose was significantly higher in favor of the group with side effects.

Sinha and Mittal reported that patient satisfaction scores associated with analgesia were significantly higher in patients who underwent bariatric surgery and received TAP block compared to the control group.[12,26] The present study investigated both patient and physician satisfaction and found that ESP block application significantly increased the level of satisfaction compared to TAP and control groups.

In conclusion, our study demonstrated that both ESP and TAP blocks are effective in reducing pain and opioid consumption following LSG. Notably, the ESP block was more effective in decreasing opioid requirements and postoperative VAS scores. This may be attributed to the blockade of both the dorsal and ventral branches of the spinal nerves by the ESP block, which provides analgesia to both the abdominal wall and internal organs, thus targeting both somatic and visceral pain. In comparison, TAP block application reduced postoperative opioid consumption and nearly significantly decreased VAS scores in our study relative to the control group. We hypothesize that with larger sample sizes in future studies, the reduction in VAS scores with TAP block may reach statistical significance. The lower effectiveness of the TAP block compared to the ESP block may be explained by the fact that the TAP block provides analgesia only to the abdominal wall.

This study has several limitations. First, the relatively small sample size may restrict the generalizability of the findings. Moreover, no power analysis was conducted to determine the adequacy of the sample size, which limits the confidence in the statistical robustness of the results. Future studies with larger cohorts and appropriate power calculations are needed to enhance the accuracy and reliability of the findings. Second, the retrospective design of the study inherently limits the ability to establish causal relationships and increases the risk of selection bias. Third, the study did not include randomization, which may have introduced confounding variables that could affect the outcomes. Additionally, our analysis did not separate patients into subgroups based on conditions such as diabetes, which may cause neuropathy and influence pain perception and analgesic response. Grouping such comorbidities together without stratification may obscure the effects of the nerve blocks in specific populations. Furthermore, the study focused exclusively on patients undergoing laparoscopic sleeve gastrectomy (LSG), which limits the applicability of the results to other surgical procedures. Future research should investigate the efficacy of ESP and TAP blocks in a wider variety of surgeries to improve the external validity of the findings. Lastly, long-term outcomes were not assessed in this study. Long-term follow-up studies are essential to evaluate the sustained effectiveness of these nerve blocks and to monitor for potential delayed adverse effects.

Furthermore, subjective measurements were used in our study. Individual differences and patient perceptions played an important role in the evaluation of subjective data such as pain and satisfaction. This is a factor that should be considered when interpreting the results. The time difference between the administration of the ESP block prior to anesthesia induction and the TAP block following induction may be considered another limitation of the study.

The study found that VAS scores were significantly lower in the ESP group, and both ESP and TAP blocks significantly reduced postoperative opioid consumption. This reduction in pain and opioid use is important for preventing immunosuppression and minimizing-related side effects. Further comprehensive, large-scale studies are needed to confirm these findings and enhance clinical applications.

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