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Description of the double-puncture epidural technique for plastic surgery: a historical cohort

Descripción de la técnica epidural de doble punción para cirugía plástica: una cohorte histórica

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Abstract

Introduction: The epidural technique has been used for anesthesia during surgical procedures and also as a primary anesthetic or adjuvant for pain management.

Objective: To describe the double-puncture epidural technique in plastic surgery.

Methods: Observational retrospective study including data from patients who underwent plastic surgery between 2013 and 2022. For the double-puncture epidural technique intervertebral spaces T3-T4 and/or L1-L2 are identified with patients in the sitting position. The solution used for epidural anesthesia (EA) comprised 30mL of levobupivacaine 0.75%, 10mL of 0.5% bupivacaine, and 20mL of normal saline. First, 20mL of the EA are administered into the T3-T4 space, and later, the remaining 40mL are administered into the L1-L2 space. The catheter is secured with sterile micropore, and the patient is prepared for surgery. Descriptive statistics were used to characterize the population.

Results: A total of 1963 patients were analyzed, of which 79.89% received double-puncture epidural anesthesia. Just a few patients (2.04%) required additional boluses of EA, 1.85% experienced bradycardia and 3.57% developed hypotension. Using the Bromage motor block scale, 97.03% of the patients had a score between 0 and 1. Only 0.38% of the patients had at least one complication. There was no relationship between the type of anesthesia and the variables including puncture level, booster, hemodynamic stability, pump use, and Bromage.

Conclusions: Our results suggest that the double-puncture EA technique is a safe and reliable option, associated with few complications and effective analgesia.

Keywords: Plastic surgery; Epidural anesthesia; Ambulatory care; Anesthesia; Analgesia; Pain management.

What do we know about this problem?

The epidural anesthesia (EA) technique has been used in anesthesia for surgical procedures and it has shown to be effective, safe and with a short recovery time.

Its use for postoperative pain after plastic surgery can help to reduce surgery-related issues such as poor pulmonary function, myocardial ischemia, ileus, thromboembolism, and impaired immune function.

What does this study contribute?

To our knowledge, this is the first study to report results of double epidural puncture in plastic surgery procedures.

This technique was used in most of the patients and was effective in achieving a suitable level of analgesia, obtaining a complete block of the upper segments, including the cervical segments, free from any complications, without major hemodynamic changes, alterations in respiratory dynamics, or toxicity from local anesthetics.

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Resumen

Introducción: La técnica epidural se ha utilizado para la anestesia durante procedimientos quirúrgicos y también como anestésico primario o adyuvante para el manejo del dolor.

Objetivo: Describir la técnica epidural de doble punción en cirugía plástica.

Métodos: Estudio observacional retrospectivo que incluyó datos de pacientes sometidos a cirugía plástica entre 2013 y 2022. Para la técnica epidural de doble punción se identifican los espacios intervertebrales T3-T4 y/o L1-L2 con los pacientes en posición sentada. La solución que se usó para la anestesia epidural (AE) comprendía 30 mL de levobupivacaína al 0,75 %, 10 mL de bupivacaína al 0,5 % y 20 mL de solución salina normal. Primero, se administran 20 mL de la AE en el espacio T3-T4 y luego, los 40 mL restantes, en el espacio L1-L2. El catéter se asegura con micropore estéril y el paciente se prepara para la cirugía. Se utilizaron estadísticas descriptivas para caracterizar la población.

Resultados: Se analizaron 1963 pacientes, de los cuales el 79,89 % recibió anestesia epidural de doble punción. Solo unos pocos pacientes (2,04 %) requirieron bolos adicionales de AE, el 1,85 % experimentó bradicardia y el 3,57 % desarrolló hipotensión. Usando la escala de bloqueo motor de Bromage, el 97,03 % de los pacientes tuvo una puntuación entre 0 y 1. Solo el 0,38 % de los pacientes tuvo al menos una complicación. No hubo relación entre el tipo de anestesia y las variables que incluyen nivel de punción, refuerzo, estabilidad hemodinámica, uso de bomba y Bromage.

Conclusiones: Nuestros resultados sugieren que la técnica de AE de doble punción es una opción segura y confiable, asociada con pocas complicaciones y analgesia efectiva.

Palabras clave: Cirugía plástica; Anestesia epidural; Atención ambulatoria; Anestesia; Analgesia; Manejo del dolor.

INTRODUCTION

General and epidural anesthesia (EA) are the most widely used anesthetic techniques in plastic surgery; (1) however, EA is becoming more popular due to a higher rate of complications and longer recovery times associated with general anesthesia.

The literature indicates that postoperative pain after plastic surgery can increase the risk of atelectasis, pneumonia, myocardial ischemia, ileus, thromboembolism, and impaired immune function. (2–4) Postoperative risks such as pulmonary embolism (PE) in abdominoplasty and liposuction procedures are also present, as well as fat embolism, although the latter is more prevalent in orthopedic operations. (5) The use of EA could be helpful not only for anesthesia during surgical procedures, but it may also contribute to reduce such side effects as it has shown to be safe and associated with fewer complications due to adequate postoperative pain control. As a general rule, the main reason EA helps prevent thromboembolism, is because of the differential nerve-blocking effects of the epidural anesthetic, which are known to spare motor function and allow for intraoperative leg movement. (5)

Various specialists have implemented epidural anesthetic infusions in many different clinical situations. However, its use in plastic surgery is limited due to several reasons such as high costs, safety concerns, or dependence on the patients' understanding and collaboration. (6) Our objective was to describe the experience of double-puncture epidural technique for pain management in individuals who underwent plastic surgery based on historical data.

METHODS

Study design and participants

This is a retrospective observational study with data from patients who underwent plastic surgery managed with EA, EA + local anesthesia and general anesthesia, between 2013 and 2022; however, most of the patients presented in this study were only managed with EA. This study received ethical approval (Ethics Committee No. CBIF-231-24) from the Research Bioethics Committee of the Clínica Farallones on May 30, 2024.

Epidural anesthesia technique

Patients signed the informed consent 60 minutes before surgery, followed by the IV administration of 500mL of Ringer's lactate solution by the nurse. Additionally, the antibiotic administration protocol was initiated according to the institutional policy established by the infections committee.

In the operating room, with the patients in a sitting position, a 2 liters per minute oxygen flow was routinely administered through nasal cannula. Before proceeding with the EA administration, sedation and analgesia were induced with

intravenous midazolam and fentanyl. The EA drug combination used in this study has been identified through extensive anesthesiology experience, and comprised 30mL of Levobupivacaine 0.75%, 10mL of 0.5% bupivacaine, and 20mL of normal saline, for a total amount of epidural anesthetic solution administered to 60mL.

Intervertebral spaces T3-T4 and/or L1-L2 were identified by the anesthesiologist with patients in the sitting position prior to skin infiltration with plain Lidocaine 2%. Epidural space T3-T4 and/or L1-L2 was identified through the loss of resistance to air technique. First, 20mL of the EA are administered into T3-T4, with the remaining 40mL administered later into the L1-L2 space. Subsequently, the catheter is secured with sterile micropore, and the patient is positioned in prone or supine decubitus to start the surgery.

It is important to slowly administer the prepared epidural anesthetic mixture due to the risk of confusion and neurotoxicity as a result of pressure on the excitable nervous tissue. For wet liposuction, the surgeon begins by infiltrating adrenaline solution in the areas to be treated. Generally, two vials of adrenaline are prepared in 1000mL of saline solution.

Settings and variables

The study included all plastic surgeries performed from 2013 to 2022 in 22 different clinics from Cali, Colombia, including abdominoplasty, implant replacement, scar removal, gluteoplasty, lipectomy, lipotomy, liposculpture, liposuction, mammoplasty, and mastopexy, all managed with EA. The variables analyzed were age, sex, procedure type, ASA classification, type of anesthesia, puncture level, duration, reinforcement, hemodynamic instability (bradycardia and hypotension), use of a regional infusion pump, recovery time, Bromage, and complications. Hemodynamic instability was assessed in terms of bradycardia when the heart rate was less than 50 beats per 1 minute, and as hypotension when the mean arterial pressure was less than 50 mmHg. The recovery time variable refers to the total time that the patient spends in the recovery room, from the time he/she leaves the operating room until discharge for home or hospitalization. This variable was measured based on the time it takes for the patient to recover from the effects of anesthesia. The Aldrete scale was used for this assessment.

Regarding the pump use variable, this is a record that was kept for patients who required postoperative pain management. The infusion pump can be connected through the epidural catheter, which is prepared with a 250cc of saline solution and 3 vials of 0.75% levobupivacaine. The pump administers the medication at 5cc/hour through the epidural catheter for 72 hours. The use of the pump was optional and completely voluntary considering that it has an additional cost for the patient. For patients with epidural pumps indicated for 72 hours, the protocol was to discharge them (provided the surgeon considered outpatient management and there were no specific reasons for hospitalization) taking the epidural pump with them (ensuring that patients received clear instructions on the use and management of the pump at home). The patient was educated on the role and benefits of using the pump, including the ability to move without pain, accelerated recovery, decreased risk of venous thrombosis in the postoperative period, sympathetic blockade that produces vasodilation and improved organ blood perfusion: intra-abdominal, heart and lung; additionally, handling of opioids is avoided. Even when the patient has a pump, multimodal pain management is implemented by administering acetaminophen and etoricoxib, a new generation of COX-2 inhibitors. The pump is monitored by a trained nurse who visits the patients every day during the first few days postoperatively to ensure proper pump management and to identify any potential surgical or anesthetic complications. Moreover, the anesthesiologist follows the patients' progress by telephone and email for up to 6 months after surgery, in order to identify any early or late complications.

Statistical analysis

Descriptive statistics were used to characterize the population. SPSS software 16 version (IBM; Chicago, IL) was used for statistical evaluation. To perform an unadjusted bivariate analysis, the normal distribution of variables including age, duration, and recovery time was first evaluated using the Kolmogorov – Smirnov test. If normality was not found, the Kruskall-Wallis non-parametric test was used to compare numerical variables. The Chi-Square test was used to identify the existing correlation between the type of anesthesia variable of interest and the other qualitative variables. Pearson correlation coefficient was used to analyze the correlations of the numerical variables. Statistical significance was predefined as a p-value threshold of 0.05.

RESULTS

Data were analyzed from 1963 patients treated in 22 clinics in Cali, Colombia from 2013-2022. Table 1 shows the sociodemographic and clinical characteristics of the patients. Some of the data for the variables evaluated were missing in the patient's medical records, but Table 1 indicates the sample size for each variable. 1916 women (97.76%) and 44 men (2.24%) participated. Most of the patients were treated only with EA (97.40%) and received double-puncture epidural at the T3T4-L1L2 level (79.89%). The majority did not receive booster anesthesia, nor did they present

Table 1. Characteristics of the patients included.

	n	%
Age in years (n=1963) Mean±SD [Min-Max]	34.9±9.7 [15-67]	
Sex (F/M) (n=1960)	1916/44	97.76/2.24
Duration in hours (n=1743)	3.7±1.3 [1.0-7.5]	
Recovery in hours (n=1631)	3.3±0.9 [1.5-6.0]	
ASA (n=1932)		
1	1840	95.24
2	92	4.76
Puncture level[a] (n=1955)		
T3-T4/L1-L2	1562	79.89
T3-T4	365	18.67
L1-L2	12	0.61
L3-L4	16	0.82
Type of anesthesia (n=1963)		
Epidural	1912	97.40
General anesthesia + epidural	46	2.34
Local anesthesia + epidural	5	0.25
Booster (n=1568)		
Yes/No	32/1536	2.04/97.96
Hemodynamic stability		
Bradycardia (n=1568)		
Yes/No	29/1539	1.85/98.15
Hypotension (n=1568)		
Yes/No	56/1512	3.57/ 96.43
Regional infusion pump (n=1808)		
Yes/No	1323/485	73.17/26.83
Bromage (n=1715)		
0	790	46.06
1	874	50.96
2	51	2.97
Complications (n=1332)		
Post-puncture headache	3	0.23
Atrial fibrillation	1	0.08
Tooth fracture	1	0.08
None	1327	99.62

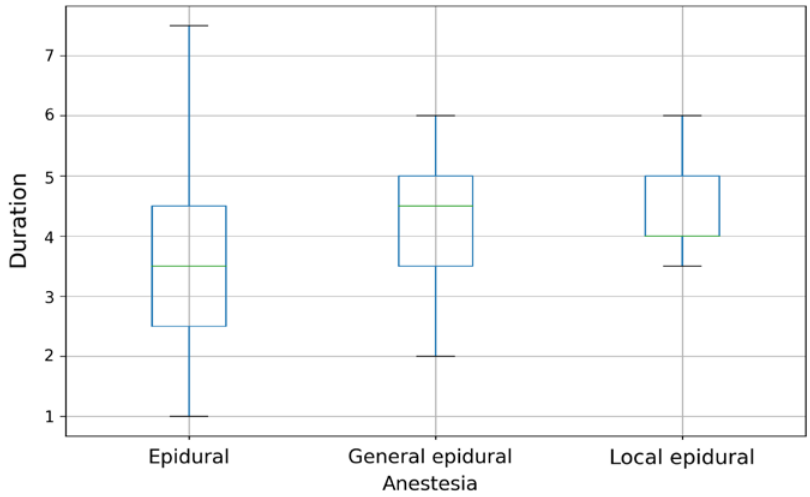
[a]T3-T4/L1-L2, T3-T4, L1-L2, L3-L4.
Source: Authors.

bradycardia or hypotension (97.96%, 98.15%, 96.43% respectively). It should be highlighted that in the Bromage motor block scale, 97.03% of the patients had a score between 0 and 1. Similarly, only 0.38% experienced complications such as post-puncture headache, atrial fibrillation and tooth fracture. No complications or incidents associated with the pump were identified during follow-up.

Bivariate analysis

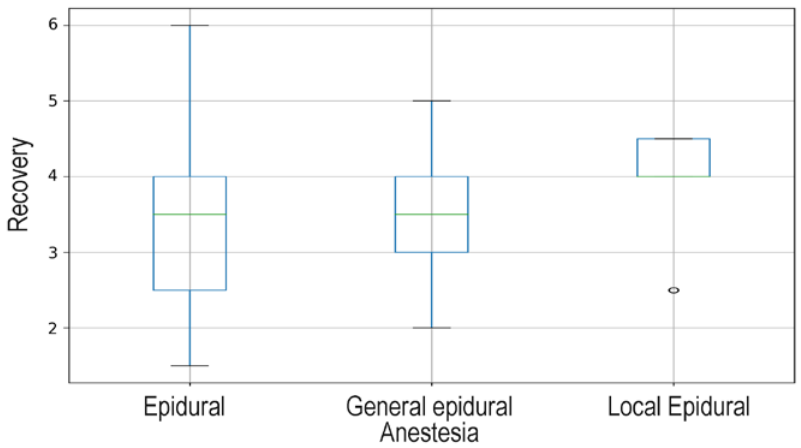
Significant differences were noted in terms of duration (P-value=0.0020) since the group of people receiving general anesthesia usually experiences a longer effect of anesthesia as compared to the group where only EA is administered (Figure 1 and Table 2). On the other hand, the recovery time variable was not related to the type of anesthesia used (Figure 2 and Table 2) (P-value=0.158).

Figure 1. Boxplot representing the duration of the anesthetic effect in hours according to the type of anesthesia used.



Source: Authors.

Figure 2. Boxplot representing recovery from the anesthetic effect in hours according to the type of anesthesia used.



Source: Authors.

Table 2. Bivariate analysis of comparison between quantitative and qualitative variables vs. type of anesthesia.

Quantitative variables	Epidural	General + epidural	Local + epidural	Kruskal-Wallis test	p-value
Age	34.5 ± 9.7	32.4 ± 7.5	40.2 ± 12.2	2.220	0.136
Duration	3.7 ± 1.3	4.3 ± 1.2	4.5 ± 1.0	9.557	0.002
Recovery time	3.3 ± 0.9	3.5 ± 0.9	3.9 ± 0.8	1.991	0.158
Qualitative variables	Epidural	General + epidural	Local + epidural	Chi-square test	p-value
Sex				0.116	0.943
Female	1866 (97.7%)	45 (97.8%)	5 (100.0%)		
Male	43 (2.3%)	1 (2.2%)	0 (0.0%)		
Level of puncture				2.420	0.965
L1-L2	12 (0.6%)	0 (0.0%)	0 (0.0%)		
L3-L4	15 (0.8%)	1 (2.2%)	0 (0.0%)		
T3-T4	358 (18.8%)	6 (13.0%)	1 (20.0%)		
T3-T4/L1-L2	1519 (79.8%)	39 (84.8%)	4 (80.0%)		
Booster				0.899	0.638
Yes	32 (2.1%)	0 (0.0%)	0 (0.0%)		
No	1494 (97.9%)	37 (100.0%)	5 (100.0%)		
Bradycardia				0.813	0.666
Yes	29 (1.9%)	0 (0.0%)	0 (0.0%)		
No	1497 (98.1%)	37 (100.0%)	5 (100.0%)		
Hypotension				0.271	0.873
Yes	55 (3.6%)	1 (2.7%)	0 (0.0%)		
No	1471 (96.4%)	36 (97.3%)	5 (100.0%)		
Use of pump				1.094	0.579
Yes	1290 (73.1%)	30 (78.9%)	3 (60.0%)		
No	475 (26.9%)	8 (21.1%)	2 (40.0%)		
Bromage				1.544	0.819
0	768 (46.0%)	20 (51.3%)	2 (40.0%)		
1	854 (51.1%)	17 (43.6%)	3 (60.0%)		
2	49 (2.9%)	2 (5.1%)	0 (0.0%)		

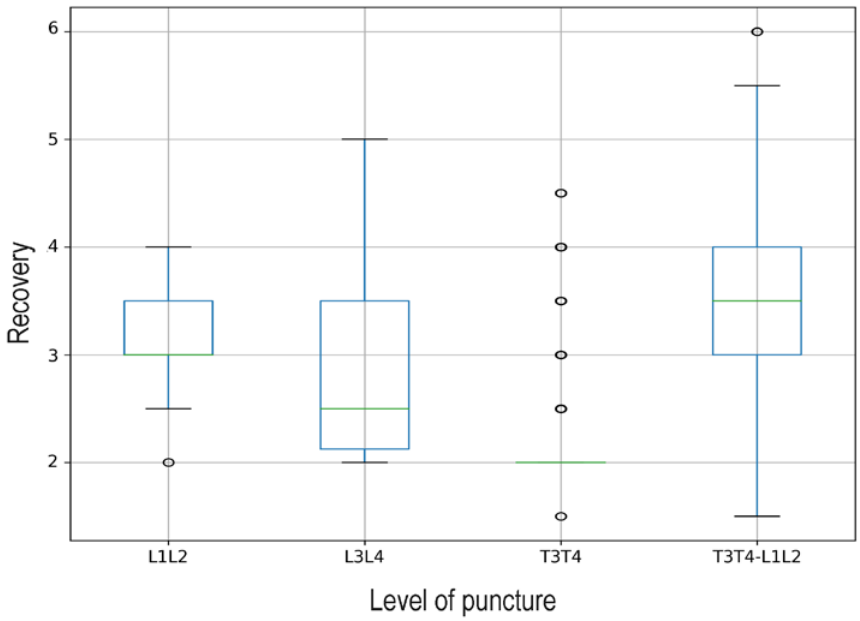
Source: Authors.

The chi-square tests for the qualitative variables did not show differences in the p-value indicating a relationship between the type of anesthesia and the variables sex, level of puncture, booster, hemodynamic stability, use of pump, and Bromage (P-value>0.05) (Table 2).

A group comparison of the different categorical variables identified that there were no significant differences in terms of the recovery of the variable and the sex of the patient (p-value=0.254). However, there were differences in the recovery times according to the puncture level (Figure 3), specifically between T3-T4 and L1-L2, and T3-T4 and T3-T4/L1-L2 (p-value= 0.000). The median recovery time was shorter in the T3-T4 group with a median of 2 hours (IQR: 2.0, 2.0) compared to the T3-T4/L1-L2 group with 3.5 hours (IQR: 3.0, 4.0).

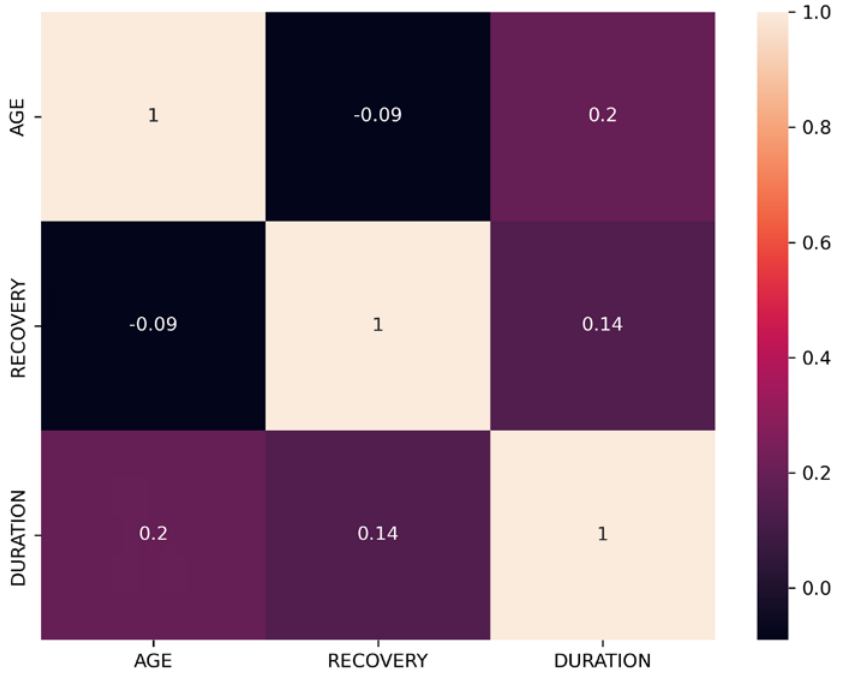
Finally, there were positive correlations between age vs. duration of the anesthesia effect (Pearson's coefficient 0.19, P-value<0.001), and recovery time vs. duration of anesthesia effect were low (Pearson's coefficient 0.14, P-value <0.001) (Figure 4).

Figure 3. Boxplot representing recovery from the anesthetic effect in hours according to the level of puncture used.



Source: Authors.

Figure 4. Heat map representing the correlations between quantitative variables.



Source: Authors.

DISCUSSION

The goal of the study was to describe the double-puncture epidural technique in plastic surgery. The findings suggest that this is a safe and reliable approach in a large sample. Only a few cases developed complications, but most of them were not directly related to the use of EA as there are other factors that could have some influence. Despite the high frequency of plastic surgery procedures (7), currently there are no consensus on the management protocols and anesthesia methods for this type of surgery. (7)

Although some anesthesiologists may believe that EA cannot be used together with general anesthesia, this study showed no contraindication for using both types of anesthesia. It should be noted that this

combination was not used in all plastic surgery procedures, but only in those that required such combination. Previous studies have also used this combination with safe results in procedures such as liposuction, gluteoplasty, and breast reconstruction. (1,8)

To our knowledge, no other studies have been published regarding double epidural puncture for plastic surgeries. This is the first report on this technique, used in 79.89% of the operated patients. During our years of experience in anesthesiology, we have learned that for some surgeries, a single puncture is not enough; if the 60cc of epidural solution were administered into the L1-L2 space, it doesn't reach the upper thoracic levels, even when increasing the volume, and consequently, the patient experiences pain. In this context, we already had experience in making high punctures between T3-T4 for mammoplasties alone; however, when combined with liposculpture, an additional puncture was performed in the lumbar spaces. Our results show that this technique is effective in obtaining a complete upper segments block, including the cervical segments, without any complications, hemodynamic changes, alterations in respiratory dynamics, or toxicity from local anesthetics.

On the other hand, the combined use of epidural and local anesthesia requires significantly lower doses of local anesthetic agent than the maximum dose allowed. This combination has been previously reported in plastic surgery procedures. (9,10) Though general anesthesia is the most widely used approach in plastic surgery, there are some concerns because it involves a higher risk, in addition to longer recovery times and complications as compared with EA. It is for this reason that some anesthesiologists prefer the latter as it has shown to be safer and effective for postoperative pain management, making the recovery process easier. (8,11)

It is worth noting that the duration of the anesthesia effect is not directly associated with the use or non-use of EA, but rather with the mixture of drugs used. The results herein reported show that the duration of the anesthesia effect was shorter when using only EA, and the results of the Bromage scale show that patients could move easily after surgery since EA does not cause a severe motor block. Moreover, based on the hemodynamic stability variables analyzed, there were only a few cases of bradycardia or hypotension which were managed accordingly.

The low rate of complications is worth noting, reflecting the safe use of this type of anesthesia in plastic surgery. Among the complications, the only one directly related to the type of anesthesia is post-puncture headache, which has been previously documented as one of the most common risks when accidentally puncturing the dura mater during the administration of anesthesia. (12) In this respect, our results are in contrast to previously published studies such as the one by Cardoso-Pinheiro et al. (13) and that of Rosique et al. (14) However, there are other studies such as the one by Filson et al. (15) in which similar to our study, no serious complications were found. The complications reported in other studies may be related to a different combination of EA used or to the patients' comorbidities.

In terms of the EA drug combination used in plastic surgery, each study reports its own combination. In this study we used the EA that has shown the best results according to our long experience in this field. Levobupivacaine was used due to its pharmacological characteristics, a lower risk of cardiac or neurological toxicity (16) and is not strongly associated with motor blockade as compared to other agents and also because this technique has been reported in previous studies. (1,17,18) Normal bupivacaine exhibits a higher risk of cardiac and neurological toxicity, in addition to being associated with motor blockade.

This particular EA provided an adequate balance between an optimal sensory and motor block, considering that it is not prudent or safe to operate on a patient who is not immobile, given the high risk of interfering with the surgical instruments, which could result in a fatal mistake. Therefore, we used a single vial of 0.5% racemic bupivacaine to achieve incomplete motor block and three vials of Levobupivacaine for a sensory block with a much lower risk of toxicity. (19)

The use of the infusion pump has been previously reported in other studies and proved to be effective in the management of postoperative pain. (6) Our study highlights that the use of the pump did not result in any complications and that, although EA alone provides an adequate duration of analgesia, the pump was efficient in maintaining analgesia for 72 more hours.

In the patients included in our study sedation and analgesia were induced with intravenous midazolam and fentanyl. Midazolam is one of the most widely used sedatives. (7) It is a short-acting benzodiazepine that provides antegrade amnesia, sedation, and anxiolysis in patients. Though some studies have shown that this sedative it is not as effective as dexmedetomidine with morphine and propofol for plastic surgeries such as rhinoplasties, (20) we did not experience any major complications with the use of midazolam. Similarly, the study by Harel et al. (21), used oral midazolam as a sedative before rhinoplasty, achieving effective and safe results. Moreover, fentanyl is a synthetic opioid analgesic similar to morphine but more potent (22) and is commonly used with Midazolam for conscious sedation in ambulatory cosmetic surgery procedures (23).

The limitations of this study include the small sample size of patients treated with general anesthesia and epidural which prevented a comparison with the patients only treated with epidural. However, this comparison was not the primary objective of our study, further limiting the ability to interpret any potential differences. The conventional definition of hypotension as

<65 mmHg was not used; instead, we used <50 mmHg. The reason is that most patients were young and without comorbidities, allowing controlled hypotension as part of the protocol. No hypotensive agents were used, but vasodilation from sympathetic blockade was allowed to reduce blood pressure to that limit, though such low level was not reached. Numerous studies validate the controlled hypotension approach to avoid blood loss; however, this depends greatly on the type of surgery and the patient. In this study, no short- or long-term complications occurred with such limit of mean arterial pressure. Finally, due to the retrospective nature of our study, some data were missing, as medical records are often incomplete; we did not plan any analysis for missing data. Additionally, all our comparisons were unadjusted, which means that potential confounders were not accounted for, making our analytical findings exploratory in nature.

CONCLUSIONS

Our results suggest that the double-puncture EA technique is a safe and reliable option, associated with few complications and effective analgesia. Moreover, the double-puncture epidural technique used in most patients was effective in providing a suitable level of analgesia. Further studies will focus on comparing the effectiveness of general and EA.

ETHICAL DISCLOSURES

Ethics Committee approval

This study received ethical approval (Ethics Committee No. CBIF-231-24) from the Research Bioethics Committee of the Clínica Farallones, on May 30, 2024.

Protection of persons and animals

The author states that no experiments in human beings or animals were conducted for this research.

Confidentiality of the data

The author states that they have followed their institutional protocols on the disclosure of data from the participants.

Right to privacy and informed consent

The author declare that this article does not disclose any patient data.

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Authors contributions

The authors made contributions to the design of the study, to the collection and tabulation of the data, to the analysis and interpretation of the results; critical review and approval of the final manuscript.

Assistance for the study

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Conflict of interests

No conflicts of interest to disclose.

Presentations

None declared by the authors.

Appreciation

None declared by the authors.

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