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# Anesthesia for Plastic Surgery Procedures

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Additional information is available at the end of the chapter

<http://dx.doi.org/10.5772/intechopen.81284>

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## Abstract

Plastic surgery is currently more popular and available with increasing frequency throughout the world. Its advances are related to progress in anesthesiology. Nowadays, it is possible to operate patients with pathologies that previously did not allow this type of surgery. The developments in perioperative monitoring, pharmacology, prevention of complications, and the wide communication between patients and physicians, as well as the development of surgical units that facilitate a prompt programming and reduce the total costs, have resulted in a logarithmic growth of plastic and reconstructive surgery procedures. Local, regional, or general anesthesia, anesthetic monitoring, or conscious sedation is used routinely, allowing to manage patients as ambulatory or short stay. Deep vein thrombosis and pulmonary embolism remain the most frequent complications, followed by postoperative pain, nausea, and vomiting.

**Keywords:** plastic surgery, anesthesia

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## 1. Introduction

The current demand for plastic surgery procedures has had a logarithmic growth. The American Society for Aesthetic Plastic Surgery reported that in 2016 in the USA 17.1 million surgical and nonsurgical cosmetic procedures were performed, a figure that indicates a 132% increase since 2000. These procedures represented an expenditure of approximately 16.4 billion US dollars, where breast augmentation is the most popular surgery and the application of Botox is the most performed nonsurgical procedure [1]. Other interesting aspects that have grown around plastic surgery are ambulatory surgery units, short-stay units, and procedures performed in plastic surgeons' medical offices. It is important that anesthesiological care does not decline when surgery is performed in this type of facility and the media and plastic

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surgeons must be made aware, so they do not minimize the risks of this type of surgery, which from the point of view of the anesthesiologists are medium- and high-risk procedures [2, 3]. Regardless of where the surgery is performed, patient safety should be the primary issue at the time of anesthesia-surgery and during its immediate recovery. To ensure patient safety, there are several guidelines that list the most important points of accomplishment that should be followed in this regard. The published guide from SCARE [4], which emphasizes various points of safety, especially the mechanical and pharmacological prophylaxis of deep venous thrombosis (DVT) and pulmonary thromboembolism (PE). A review of the literature on liposuction complications establishes strict guidelines on lidocaine and epinephrine doses, PE prophylaxis, adequate hydration, and other management recommendations [5].

The advances in plastic surgery have been furthered by the progress in anesthesiology, making it the cornerstone on which the surgical progress has been made. Now, it is possible to carry out prolonged and more elaborate surgeries in patients with concomitant pathologies or with anesthesia risks that some years ago were not possible to achieve with the current safety. The availability of new anesthetics and adjuvant drugs, advances in trans- and postoperative monitoring, as well as the early prevention of complications have facilitated these advances. The list of plastic surgical procedures is very extensive, and anesthesia plays a vital role: from local techniques to neuraxial anesthesia and general inhaled or intravenous anesthesia procedures. The growth of outpatient procedures in cosmetic surgery requires effective anesthetic techniques that allow safe home returns shortly after the surgery is over. It is ideal that no surgical procedure in plastic surgery is performed without the presence of a qualified anesthesiologist.

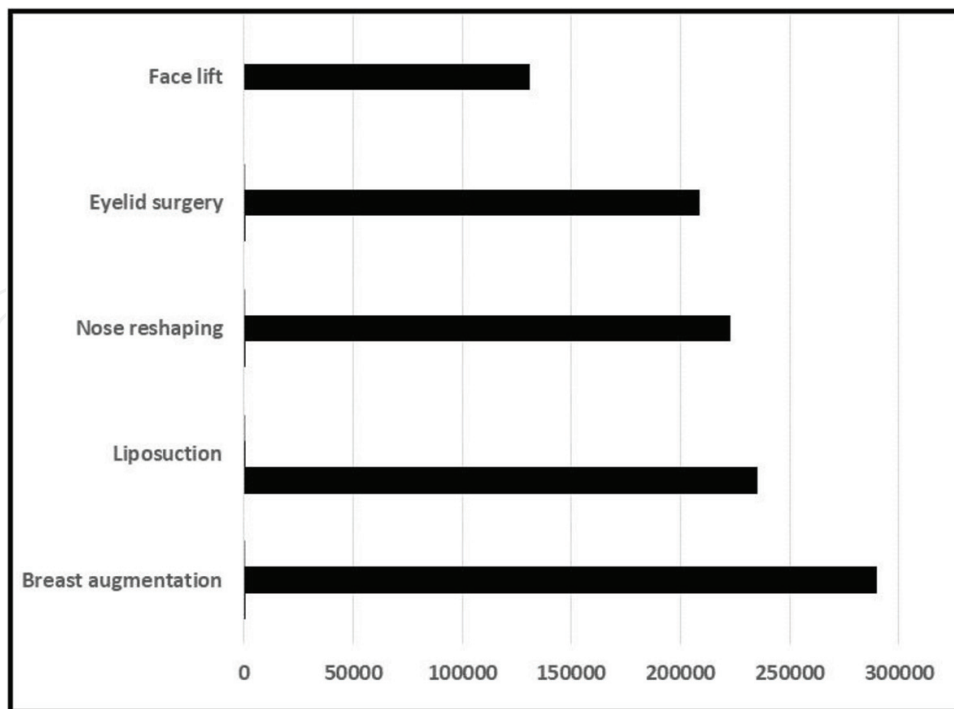
This chapter serves as an introduction to this book, the most frequent plastic surgery procedures are listed, as well as the anesthesia techniques considered to be the most advanced.

## 2. Most frequent plastic surgery procedures

It is important that the anesthesiologist be familiar with all surgical procedures to establish an optimal anesthetic approach (see **Graphic 1** and **Tables 1** and **2**). It is also important to keep in mind that the original surgical plan changes frequently; these last-minute modifications obey the wishes of the patient and sometimes the needs that arise during surgery, situations that lead to adjust the original anesthetic plan.

**Table 2** lists the most frequent surgical procedures in plastic surgery and relates them to the most used anesthesia techniques, making some important observations in postanesthetic care and evolution. These techniques are the most recommended, being possible to use other alternatives or through combinations of anesthetic methods [6].

In plastic surgery, it is common to combine two or more surgical procedures (breast-abdominoplasty, mommy makeover), which in addition to increasing the risks, prolongs the surgical time, and therefore the anesthetic plan must be adapted to the surgeon's new approach. This fact can be determined before starting anesthesia, and in some patients, it is



**Graphic 1.** Most frequent cosmetic surgeries.

Surgery	Women	Men
Breast augmentation	355,671	
Liposuction	309,692	31,453
Blepharoplasty	166,426	28,678
Abdominoplasty	143,005	
Breast reduction	139,926	
Rhinoplasty		30,174
Gynecomastia		19,124
Hair implantation		18,062

**Table 1.** Most frequent procedures according to gender [1].

modified during surgery. For example, in a case where breast surgery is combined with abdomen procedures that could otherwise be managed with neuraxial anesthesia, a lumbar spinal anesthesia with hyperbaric local anesthetic and Trendelenburg position could disseminate the blockade up to T3 for breast surgery, which must be performed first, followed by the abdominal procedure [7]. This approach avoids general anesthesia and favors adequate post-operative analgesia with optimal recovery. Combined epidural-spinal anesthesia is another management option in this surgical setting.

Procedures	Anesthesia	Patient stay	Observations
• Facial surgery			
Rhytidoplasty	CS/GA	24 hours	Moderate pain
Coronal	CS/GA	Ambulatory	Fast track
Open rhinoplasty	CS/GA	Ambulatory	Fast track
Rhinoplasty with bone fracture	GA	Ambulatory	Moderate pain
Blepharoplasty	MAC/CS	Ambulatory	Fast track
Otoplasty	MAC/CS	Ambulatory	Fast track
Laser dermabrasion	CS	Ambulatory	Moderate pain
Implants	MAC/CS	Ambulatory	Fast track
Fat grafting, synthetic materials	MAC/CS	Ambulatory	Fast track
• Body surgery			
Breasts or pectorals	PDB/GA	Ambulatory	Moderate pain
Liposuction	SB, PDB, GA, or local	Ambulatory –24 hours	Mild to moderate pain, bleeding, anemia
Torso	PDB /GA	Ambulatory	Moderate pain
Abdominoplasty	SB, PDB/GA	24 hours	Moderate pain, anemia
Breast pexia of inferior segment	PDB/GA	24 hours	Moderate pain, anemia
Buttocks implants	SB/PDB/GA	Ambulatory	Moderate pain
• Limb surgery			
Brachioplasty	PDB/GA	Ambulatory	Moderate pain
Cruroplasty	SB/PDB/GA	Ambulatory –24 hours	Moderate pain
Liposuction	SB/PDB/GA	Ambulatory	Mild pain

CS = conscious sedation; GA = general anesthesia; PDB = peridural block; SB = spinal block; MAC = monitored anesthetic care; fast track = direct access to hospital room.

**Table 2.** Most frequent procedures in cosmetic surgery.

### 3. Pre-anesthetic evaluation

“Primum non nocere” is a Latin phrase meaning “first, to do no harm” and is an old statement that has been one of the principal precepts of bioethics for several centuries. This concept is the purpose of pre-anesthetic assessment, which in patients scheduled for plastic surgery should not be any different from that of patients operated of other procedures and should be timely, complete, interdisciplinary, and dynamic. This evaluation is a vital instrument for the medical and nursing team, as well as for the patients and their families since it gives them the opportunity to know the patient and their environment, the reasons that led to surgery, fears of, and above all, to discuss the prejudices and doubts about anesthesia. These patients have peculiarities that make them different; on the one hand, most are healthy people, individuals who do

not intend to cure a disease but to improve their self-esteem through better physical appearance. On the other hand, they are extremely demanding patients in terms of perfection in the results and do not tolerate errors or side effects. It is prudent to explain the various anesthetic techniques available for the type of surgery scheduled, as well as the benefits and risks of each anesthetic procedure, especially those attributed to the planned technique. It is also the best time for them to meet the anesthesiologist and become familiar with his/her credentials and experience. These last points are fundamental to gain patient confidence and to diminish their anxiety and the possibility of an eventual legal conflict.

The pre-anesthetic evaluation should be made several days in advance. Regardless of the physical condition of each patient, a complete clinical history and detailed and oriented physical examination are fundamental in the pre-anesthetic assessment. It is essential to determine the physical integrity or possible deterioration of the patient, especially the neurological and cardiopulmonary systems, as well as a detailed analysis of the airway and the spine. The patients must be evaluated regarding their emotional state and their ability to tolerate surgeries with prolonged times and difficult recoveries. Plastic surgery patients are divided into two major categories: healthy patients and patients with one or more systemic pathologies, such as acquired heart diseases, pneumopathies, diabetes mellitus, venous insufficiency, and hyperlipidemia, this last one being the most common. The age at which cosmetic surgery is performed is variable: 35–50 years (45%), 51–64 years (26%), 19–34 (22%), 65 or more (6%), and minors to 18 years (2%) [3].

*The healthy patient.* Most plastic surgery patients are in good physical shape (ASA 1–2); those with facial surgery are usually more than 50 years old, although cosmetic facial surgery has currently increasing frequency in younger people. Patients who undergo surgery on body segments tend to be younger with purely esthetic goals, but recently there is a growing group of overweight patients who have undergone bariatric surgeries and consult the plastic surgeon seeking corrective procedures for skin excess secondary to excessive weight loss, which should be categorized as unhealthy patients [8, 9]. Patients without apparent comorbidities are potentially healthy people; however, we must be sure that this statement is true. Once the patient has been evaluated by the plastic surgeon, it is recommended that those over 50 years old are also evaluated by an internist and have complete clinical exams according to the surgery plan. These tests should include blood count with platelets, prothrombin time, partial thromboplastin time, INR, complete blood chemistry, and urinalysis. HIV testing is convenient, as well as hepatitis B and C antigens in some patients [3, 6]. Pregnancy test is recommended in women of childbearing age.

During this pre-anesthetic interview, the intake of medications such as nonsteroidal anti-inflammatory drugs (NSAIDs), vitamin E, weight loss medications, contraceptives, herbs, as well as history of illegal drug use or any prescription medicines should be questioned. It is frequent that these “healthy” patients utilize thyroid hormones, antidepressants, benzodiazepines, high doses of vitamins and minerals, as well as herbs, food supplements, and teas that could interact with the drugs used in the perianesthesiological time. Patients underestimate the importance to ingest these products, so it is imperative that both the surgeon and the anesthesiologist emphatically investigate whether patients ingest such products since many of them have anticoagulant, antiplatelet, procoagulant, and arrhythmic or potentiate the effects



of anesthetics. Heller et al. [10] found that plastic surgery patients used herbs or supplements in 55% versus the general population 24% ( $p < 0.001$ ). The most used by their patients were chondroitin 18%, ephedra 18%, echinacea 8%, garlic 6%, ginseng 4%, and ginger 4%. Fifty-four percent of the supplements/herbs taken by these patients have pharmacological interference with anesthetic drugs or can affect surgery. In 85% of the cases, patients were not told to stop taking these herbs or supplements before surgery, except for those who ingested ephedra in which 100% of the surgeons indicated their suspension. This study demonstrated the ignorance of physicians regarding the undesirable effects of herbalism in plastic surgery patients. A Mexican study in ambulatory patients [11] found that 65% took ginseng and *Ginkgo biloba* combined, 17.5% ingested garlic, and 5% chamomile tea. **Table 3** lists some herbs and food supplements that should be discontinued 1–2 weeks before the surgery [10–13].

Product	Effect	Product	Effect
Fish oil	Antiplatelet, vasodilation	Kava ( <i>Piper methysticum</i> root)	Interacts with local anesthetics, barbiturates, increase sedative potency
Garlic ( <i>Allium sativum</i> )	Antiplatelet	St. John's wort ( <i>Hypericum perforatum</i> )	Induces cytochrome P450 3A4. Interacts with midazolam, alfentanil, lidocaine, calcium blockers, and serotonin receptor agonists
Alfalfa ( <i>Medicago sativa</i> )	Anticoagulant Enhances warfarin and ginger effect	Ginseng ( <i>Panax ginseng</i> )	Anticoagulant
Dong quai ( <i>Angelica sinensis</i> )	Anticoagulant, antiplatelet	Wild lettuce	Enhances warfarin
Anise	Anticoagulant	Black cohosh	Antiplatelet
Celery	Antiplatelet	Arnica	Anticoagulant
Saffron	Anticoagulant	Papain (papaya proteinase I)	Hemorrhage risk
Boldo ( <i>Peumus boldus</i> )	Enhances warfarin	Kelp	Anticoagulant
Bromelain	Anticoagulant	<i>Plantago major</i>	Coagulant
<i>Castanea sativa</i>	Anticoagulant	Horseradish	Anticoagulant
Onion	Antiplatelet	Licorice root ( <i>Glycyrrhiza glabra</i> )	Antiplatelet
Clove	Antiplatelet	Red clover	Anticoagulant
Chili pepper (Nahuatl chili)	Antiplatelet	Turmeric ( <i>Curcuma longa</i> )	Antiplatelet
Ephedra	Vasoconstriction, cardiac infarction, cerebral thrombosis, arrhythmias, hypertension	<i>Valeriana officinalis</i>	Increases sedative effect
Echinacea	Promotes infections, allergies, probable hepatotoxic and impaired blood flow	Vitamin E	Antiplatelets
Ginkgo biloba	Antiplatelet	Asiatic ginseng	Anticoagulant, antiplatelets, hypoglycemic

**Table 3.** Effects of some herbs and foods.

*The patient with comorbidities.* There are a group of patients who undergo cosmetic surgery and who have one or more added pathologies that warrant a more thorough pre-anesthetic evaluation, which may end up postponing surgical intervention or suspend it indefinitely. Diabetic, hypertensive, cardiac, pulmonary, obese, anemic, hypo-/hyperthyroid, patients with rheumatological diseases, and so on are subjects for consultations with the internist or the appropriate subspecialist to stabilize their concomitant pathologies before programming plastic surgery. It is common for the plastic surgeon to miss some of these systemic pathologies during patient evaluation, so it is mandatory that in the initial anesthesiological assessment a condition that may interfere not only with anesthesia but also with surgery itself or during the healing period should be meticulously researched, such as thrombophilias, hypo-/hyperthyroidism, pheochromocytoma-paragangliomas, lupus, sickle cell disease, drug addiction, and many more. It is the anesthesiologist's role, in conjunction with the surgeon, to refer the patient to the appropriate specialist. Once the patient has been assessed by the internist or a subspecialist, it is advisable to perform a second pre-anesthetic evaluation to be sure that the patient is able to be anesthetized, as well as to know in advance the specialist's recommendations.

Parameters	ASA 1	ASA 2-3	Observations
Clinical history	Yes	Yes	The general and oriented clinical review made by the anesthesiologist anticipates problems such as difficult airway, spinal anomalies, mental alterations, family environment, and possibility of a lawsuit
Physical examination	Yes	Yes	
Specialist consultation	NE	Yes	It is prudent to know the opinion of the geriatrician, pulmonologist, cardiologist, endocrinologist, surgeon, and family therapist in search of polypharmacy, drug interactions, etc.
Electrocardiogram	Only >50 years old	Yes	Arrhythmias, ischemia, growth, or dilatation of heart cavities
Chest X-ray	NE	Yes	Useful in smokers, suspected tuberculosis, neoplasms, emphysema, kyphosis
Echocardiogram	No	R	Compulsory study in patients with severe arterial hypertension, ischemic patients, and patients with dilated cardiomyopathy
Spirometry	No	R	Its usefulness has not been demonstrated; however, it is recommended in chronic pneumopathy and smokers
Blood test	Yes	Yes	Diagnosis of subclinical anemia
Coagulation tests	Yes	Yes	TP, TPT, INR, and bleeding time are mandatory in anticoagulants, hepatocellular damage, severe sepsis, prolonged fasting, and extreme malnutrition
Complete blood chemistry	Yes	Yes	Kidney, hepatocellular, metabolic, and electrolyte evaluation
Urinalysis	NE	Yes	Loss of blood and proteins, changes in urine density
HIV, hepatitis, drugs, pregnancy	R	R	They are requested based on the clinical history and experience data. HIV is prudent for the protection of medical and paramedical personnel

NE = not essential; R = recommendable.

**Table 4.** Parameters for pre-anesthetic evaluation in plastic surgery [5].



Elderly patients require a more elaborate evaluation, in which it is wise to include the geriatrician. In this group of sick patients, a list that includes all the medications they take should be made, including antihypertensive, diuretic, vasodilator, MAO inhibitors, antidepressants, analgesics, hormones, hypoglycemic agents, vitamins and minerals, etc. The anesthesiologist must be familiar with these drugs and know their possible drug interactions. The usual pre-anesthetic assessment parameters in healthy patients and patients with comorbidities are listed in **Table 4**.

There are patients who should not be operated, and this decision must be made by the anesthesiologist, regardless of the opinion of the patient and his/her surgeon since loss of safety rules leads to catastrophic nonreversible events [14].

Once the anesthetic assessment has been finalized and the best anesthetic plan has been agreed upon and the possible eventualities discussed, the informed consent must be obtained, which as a rule must be signed by the patient, the doctor, and a witness. This document should mention the details of the proposed anesthetic technique, its side effects, and possible complications in a detailed manner. A well-prepared informed consent is a legal document that does not exclude us from a lawsuit, but when it is not done properly, it can be a legal component against the medical team [14–16].

#### **4. Pre-anesthetic medication**

The goal of pre-anesthetic medication is to help the patient to arrive to the operating room with sedation, hypnosis, prevention of nausea and vomiting, and with preemptive analgesia. Midazolam and lorazepam are the most commonly used benzodiazepines. Midazolam is more useful in short procedures, although it is less amnesic than lorazepam. There is evidence that melatonin 3–10 mg administered as part of pre-anesthetic medication reduces preoperative anxiety, decreases postoperative pain intensity and opioid consumption, improves postoperative sleep quality, and reduces emergence behavior and postoperative delirium. Also, preoperative melatonin could reduce oxidative stress and anesthetic requirements [17–20]. To prevent nausea and vomiting, it is advisable to use two or more drugs [21]; combining droperidol with dexamethasone is as effective as the combination of ondansetron with dexamethasone. Metoclopramide tends to disappear due to its low clinical effectiveness compared to the new antiemetics. It is convenient to administer omeprazole or ranitidine to reduce the acidity and volume of the gastric secretion. Preemptive analgesia is achieved with the administration of various drugs such as intravenous magnesium, NSAIDs, gabapentinoids, and ketamine to name a few.

#### **5. Anesthesia techniques**

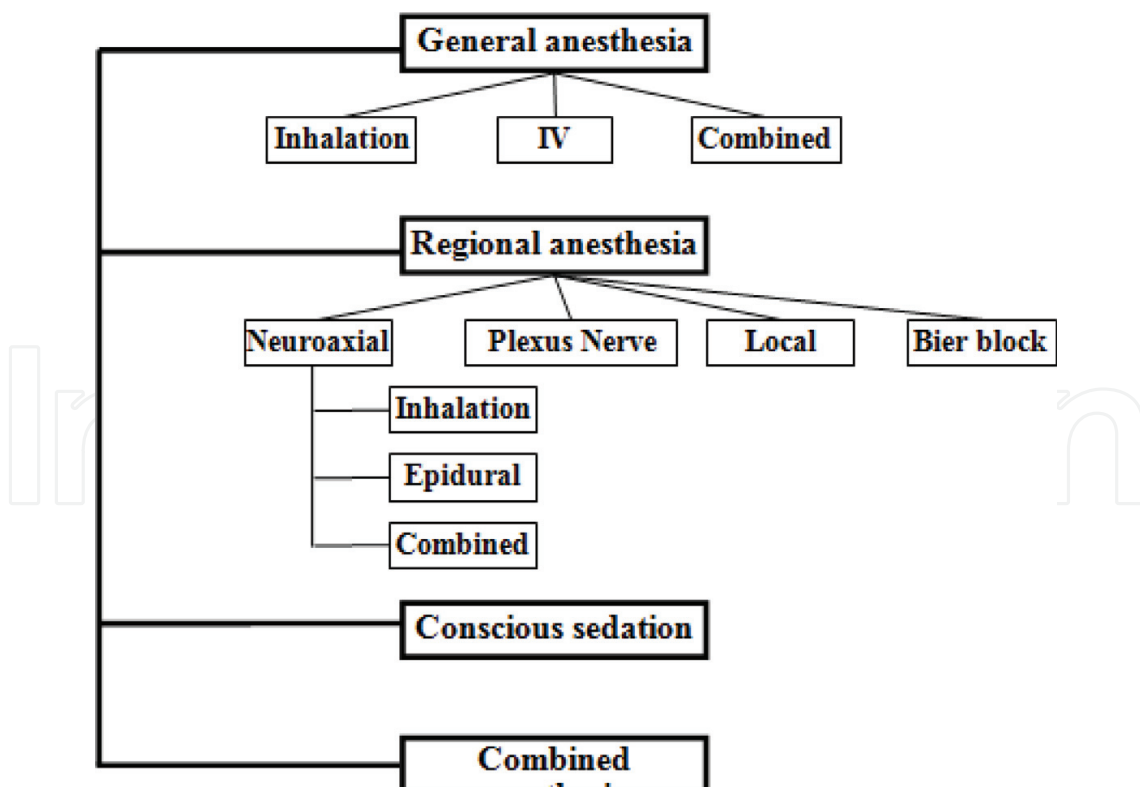
In general terms, regional anesthesia techniques are more recommendable than those of general anesthesia since they have less complications and favor a safer recovery, with better postoperative analgesia. In the following paragraphs, several anesthetic procedures are

discussed and are related primarily to outpatient surgery since most plastic surgery patients are discharged the same day of their intervention. **Figure 1** shows all the anesthetic techniques that can be used in plastic surgery procedures, a wide range of combinations being possible.

For more details of some anesthetic technique, the reader is referred to the pertinent chapters of this book.

### 5.1. Conscious sedation

The objective of conscious sedation is to have a patient in a status of restfulness that allows the surgeon to inject local anesthetics and perform their operative procedure with safety and comfort for the patient, while the anesthesiologist is responsible for drug sedation and checking the stability of all systems using conventional monitoring and added BIS. The most frequent surgeries are those of the face and neck, hair implants, liposuction of small areas, dermabrasion with laser, and occasionally breast implants. A clear understanding must be established with the patient and the surgeon about the objectives of conscious sedation: *the technique is not anesthesia*, so the operative pain is managed by the surgeon through the frequent injection of local anesthetics. The opioids used in these cases are a primary part of sedation, not for analgesia. **Figure 2** shows the most important differences between conscious sedation and general anesthesia; note that in conscious sedation the patient maintains the integrity of the airway and its protective reflexes, unlike general anesthesia. There is a tenuous



**Figure 1.** Anesthesia techniques that can be used for plastic surgery.

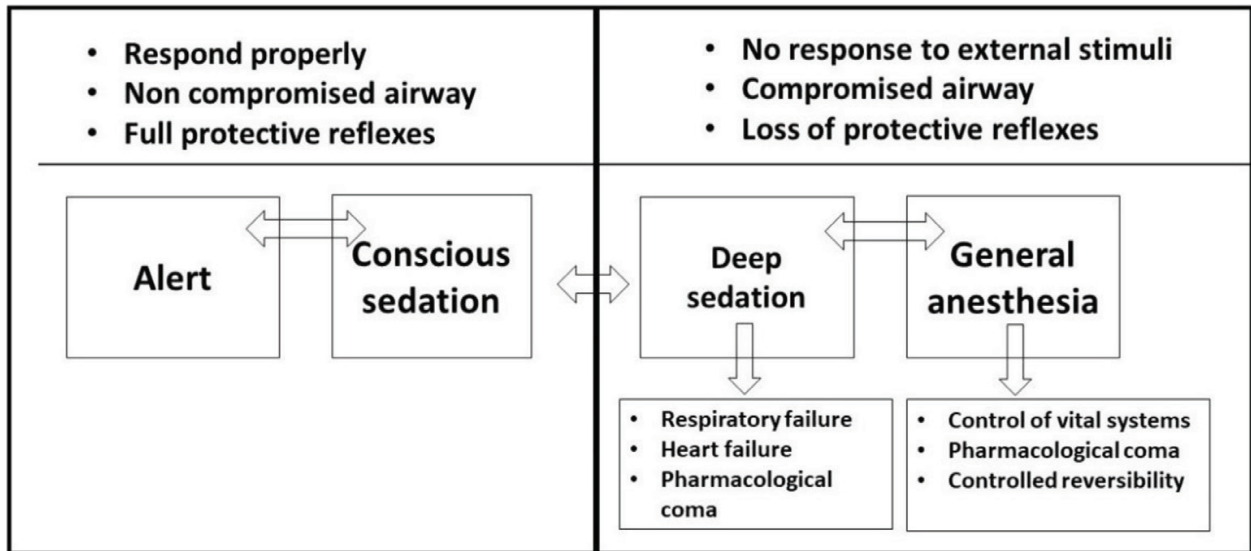


Figure 2. Spectrum of alertness, conscious sedation, deep sedation, and general anesthesia [6].

line of separation between deep sedation and general anesthesia, a situation that often warrants securing the airway and protecting the patient changing the technique to general anesthesia.

There are several types of drugs that are used in conscious sedation: anxiolytics, sedatives, butyrophenones, barbiturates, hypnotics, opioids, and alpha2 agonists (Table 5).

The 2018 ASA guidelines for sedation added the following recommendations: patient evaluation and preparation, continual monitoring of ventilatory function with capnography to supplement standard monitoring by observation and pulse oximetry, presence of an individual in the procedure room with knowledge and skills to recognize and treat airway complications, sedatives and analgesics not intended for general anesthesia (e.g., benzodiazepines and

Anesthesia techniques	Opioids	Benzodiazepines	Hypnotics	Alpha-2	Anesthetic gases	Muscle relaxants
TIVA	Fentanyl, remifentanyl, alfentanil	Midazolam	Propofol, ketamine	Dexmedetomidine	Nitrous oxide	Vecuronium rocuronium, atracurium
General	Fentanyl Morphine	Midazolam, diazepam	Propofol, ketamine, thiopental	Clonidine, dexmedetomidine	Desflurane Sevoflurane Isoflurane	Vecuronium rocuronium, atracurium
Conscious sedation	Fentanyl Remifentanyl Morphine Buprenorphine	Midazolam, lorazepam	Propofol, ketamine, barbiturates	Clonidine, dexmedetomidine	No	No
TCI	Remifentanyl	No	Propofol	No	No	No

MAC = monitored anesthetic care; TCI = target-controlled infusion.

Table 5. Anesthesia techniques and examples of usual drugs.

dexmedetomidine), sedatives and analgesics intended for general anesthesia (e.g., propofol, ketamine, and etomidate), recovery care, and creation and implementation of quality improvement processes [22].

## 5.2. General anesthesia

General anesthesia can be used in all plastic surgery procedures if the location where they have been scheduled fulfills with all safety regulations. This rule should not be violated, especially in medical offices that have been supplemented with an operating room (office based). General anesthesia techniques are used in very short procedures, in patients who reject regional techniques, and as a complement to regional anesthesia when this is not sufficient. In prolonged surgeries of more than 3 hours, it is prudent to avoid the use of general anesthesia when this is possible to prevent risks and undesirable side effects such as nausea, vomiting, oropharyngeal discomfort secondary to the endotracheal tube or laryngeal mask, DVT, PE, postoperative pain, postoperative delirium, and so on. The costs of general anesthesia, although not a definitive factor, do influence the anesthesiological decision, particularly when the procedures are very long. The selection of patients for general anesthesia must be meticulous and exclude those cases with associated pathologies: angina, recent history of cardiac infarction, cardiomyopathies, uncontrolled arterial hypertension, terminal renal failure, sickle cell anemia, patients in need of organ transplantation, active multiple sclerosis, severe chronic obstructive pulmonary disease, difficult airway, malignant hyperthermia, abuse of illegal drugs, dementia, myasthenia gravis, obstructive sleep apnea, and etcetera [23, 24]. In some of these associated pathologies, it is possible to perform plastic surgery; however, precautions must be taken for each disease due to potential complications.

When general anesthesia has been chosen, the drugs to be used should be selected for safety and anesthetic efficacy, in accordance with the surgical location. The ideal technique does not exist, but it must be ensured that it is with a gentle and rapid induction, with adequate operative conditions, with great hemodynamic stability and fast recovery, without side effects, with good control of postsurgical acute pain, with emesis, and with preventive management of postoperative chronic pain. There is not enough evidence to select one drug over another; however, the halogenated anesthetics desflurane, sevoflurane, and isoflurane have demonstrated their versatility in outpatients with a minimum of differences that do not impact the transoperative evolution or the recovery of patients [23, 25]. It is convenient to avoid nitrous oxide due to the high incidence of postoperative nausea and vomiting. Propofol, ketamine, and remifentanyl have been widely accepted in this field, each of them having certain advantages. The combination of propofol-ketamine has been studied by Friedberg [25] and proposed as an alternative to inhalational anesthesia.

## 5.3. Regional anesthesia

Regional anesthesia has had an increasing resurgence since it favors several positive aspects in the trans, operative period, and in the recovery phase. Local anesthesia is performed by the plastic surgeon in cases of minimal invasion such as blepharoplasty, chin implant, and some small liposuction among other procedures. Neuraxial anesthesia, especially spinal anesthesia,

has been favored by its advantages (**Table 6**). Capdevila and Dadure [26] consider that the various techniques of regional anesthesia, including spinal anesthesia, are superior to general anesthesia in limiting adverse effects and readmissions to the hospital, with better control of postoperative pain [27]. In the following paragraphs, subarachnoid and epidural block are described, although the latter is less used because it has more possibilities of undesirable effects.

### 5.3.1. Neuraxial anesthesia

Neuraxial blocks offer several advantages over general anesthesia, as shown in **Table 6**. The decrease in metabolic response to trauma, postoperative analgesia, lower incidence of nausea and postoperative vomiting, and their low costs are just some of these advantages.

*Subarachnoid anesthesia.* Spinal anesthesia satisfies the current requirements of efficacy and safety that allow early home discharges. It produces an optimal anesthetic status, is easy to administer, has a quick start, and has a low cost. The recovery of the motor and sensory block can be manipulated according to the operative time when local anesthetics and adjuvant drugs available for clinical use are used rationally. Side effects are easy to manage, and complications are rare [27, 28]. There are multiple studies in various clinical scenarios that demonstrate the benefits of spinal anesthesia using small spinal needles (gauge 26–29), with cutting or pencil tip in patients undergoing ambulatory or short-stay surgical procedures [29–31]. Spinal anesthesia versus desflurane [32] in ambulatory patients demonstrated, in addition to a lower cost with spinal anesthesia, that 50% of those who received general anesthesia required postoperative analgesia versus 0% in those who were managed with subarachnoid block. Another research [33] found no cost difference between both techniques and showed that administering spinal anesthesia consumes more time ( $18 \pm 8$  min vs.  $10 \pm 3$  min), with more time in the postanesthesia recovery room ( $123 \pm 51$  min vs.  $94 \pm 48$  min). The antiemetic requirements were higher in general anesthesia (8% vs. 14%), while the need for analgesics in the immediate postsurgical period was only 25% in those who were treated with spinal anesthesia versus 75% in the group treated with general anesthesia. Carrada et al. [34] compared three spinal needles,

	General	Sedation	Peridural	Spinal	Combined	PNB*
Bleeding	++++	++	++	++	+ a ++	+ a ++
DVT/TEP risk	High	Low	Low	Low	Low	Low
Anesthetic toxicity	Remote	Remote	Feasible	Very remote	Feasible	Feasible
Hypoxia PO	Frequent	Possible	Possible	Possible	Possible	Possible
Analgesia PO	No	No	Yes	Yes	Yes	Yes
Technical difficulty	Remote	No	Possible	Possible	Possible	Frequent
Cognitive disorders	++++	++	++	++	+	No
Cost	High	High	Medium	Low	High	High

\*Peripheral nerve block.

**Table 6.** Advantages and disadvantages of the different techniques in anesthesia for plastic surgery.



Atraucan 26, Quincke 26, and Whitacre 27, in young patients and found a very low incidence of post-dural-puncture headache (PDPH), without statistical significance among the three groups. In plastic surgery spinal anesthesia is used for surgical procedures involving the abdomen, perineum, and lower extremities. Any surgical procedure below the sixth dermatome is viable to be managed with spinal anesthesia. In some ambulatory plastic surgery procedures, it is possible to use lumbar subarachnoid block with diffusion up to T2–T3 dermatomes, for breast surgery and chest liposuction [7, 8, 27, 28]. **Tables 7** and **8** list cosmetic surgery procedures and the doses of local anesthetics in which it is possible to use subarachnoid anesthesia, including the cases mentioned up to T2–T3 dermatomes. In some circumstances, it is prudent to use the combined epidural-intrathecal technique to ensure enough duration in some procedures [7].

When the scheduled plastic surgery is longer than 2 hours, it is advisable to add an adjuvant drug such as clonidine in doses of 75, 150–300 µg, fentanyl 12.5–25 µg, or sufentanil 5–10 µg [27, 35]. It is imperative to consider that the operative time could be longer than the surgeon’s estimate since there are many “dead times” that prolong the total time required to complete the surgery. **Table 9** shows the possibilities of mixtures of local anesthetic plus adjuvants according to the expected surgical times. Note that the possibility of 1-hour surgeries is included, which is rare in this field: scar reviews, small areas of liposuction, perineal plasties, etc. The combination of procaine + clonidine + fentanyl is excellent. Low doses of local anesthetic of the family pipercoloxylidide (PPX) (bupivacaine, mepivacaine, ropivacaine, and levobupivacaine) are good but usually last longer, and in a very busy environment, they could prolong the time of home discharge. For surgeries lasting up to 2 hours, local anesthetic PPX in low doses and added adjuvant drugs are an ideal combination.

The local hyperbaric anesthetics have an ampler intrathecal cephalic diffusion than the isobaric ones, which is useful in the operative procedures in high dermatomes (upper abdomen and thorax). On the other hand, isobaric local anesthetics are better in the pelvis and lower extremities. Opioids, especially fentanyl, improve the quality of anesthesia without affecting recovery.

Surgery	Spinal		Epidural		APEC	
	Anesthetic	Adjuvant	Anesthetic	Adjuvant	Anesthetic	Adjuvant
Liposuction	L, B, LB, R, M	C, F	L, R, B, LB, M	C, F	L, R,B, LB, M	C, F, S
Liposculpture	B, LB, R, M	C, F	L, R, B, LB, M	C, F	L, R,B, LB, M	C, F, S
Buttocks implants	L, B, LB, R, M	C	L, B, LB, R, M	C	L, R,B, LB, M	C, F, S
Calf implants	L, B, LB, R, M	C	L, B, LB, R, M	C	L, R,B, LB, M	C, F, S
Breast with liposuction	B, LB, R, M	C, F	L, R, B, LB, M	C, F	L, R,B, LB, M	C, F, S
Breast	—	—	L, R, B, LB, M	no	—	—

APEC = combined peridural-spinal anesthesia; L = lidocaine; B = racemic bupivacaine; LB = levobupivacaine; R = ropivacaine; M = mepivacaine; C = clonidine; F = fentanyl; S = sufentanil.

**Table 7.** Frequent procedures and regional techniques in ambulatory cosmetic surgery [20].



Surgery	Concentration of local anesthetic and total dose in mg			
	Ropivacaine (0.75%)	Levobupivacaine (0.75%)	Bupivacaine (0.5–0.75%)	Lidocaine (2%)
Liposuction	10–22.5	7.5–18	7.5–15	50–100
Liposculpture	10–22.5	7.5–18	7.5–15	50–100
Buttocks implants	15	10	10	100
Calf implants	15	10	10	100
Breast with liposuction	22.5	18	18	No

\*Local hyperbaric anesthetics. The addition of adjuvants will depend on the expected time of surgery. Lumbar approach, with local hyperbaric anesthetic. With or without high lumbar epidural catheter.

**Table 8.** Outpatient plastic surgery procedures and doses of intrathecal local anesthetics\* [20].

Approximate duration	Drugs and recommended doses	Observations
Surgery up to 1 hour	Lidocaine 30–100 mg	The use of lidocaine tends to disappear due to the possibility of local neurotoxicity
	Lidocaine 30–50 mg + clonidine 75 µg	
	Lidocaine 30–50 mg + fentanyl 25 µg	
	Bupivacaine 5–7.5 mg + clonidine 75 µg or fentanyl 25 µg	Local anesthetics of the PPX family used in low doses tend to replace the use of lidocaine in brief procedures
	Levobupivacaine 5–7.5 mg + clonidine 75 µg or fentanyl 25 µg	
	Ropivacaine 7.5–10 mg + clonidine 75 µg or fentanyl 25 µg	
Surgery from 1 to 2 hours	Procaine 100–200 mg + clonidine 75 µg or fentanyl 25 µg	Its short duration improves with the addition of adjuvants
	Bupivacaine 10–15 mg + clonidine 150 µg and/or fentanyl 25 µg	
	Levobupivacaine 10–15 + clonidine 150 µg and/or fentanyl 25 µg	
Surgery greater than 2 hours	Ropivacaine 15–20 + clonidine 75 µg and/or fentanyl 25 µg	The duration of the average doses of PPX local anesthetics is prolonged with the addition of clonidine in a dose-dependent manner
	Bupivacaine 15–20 mg + clonidine 150–300 µg and/or fentanyl 25 µg	
	Levobupivacaine 15–20 mg + clonidine 150–300 µg, and/or fentanyl 25 µg	
Surgery greater than 2 hours	Ropivacaine 20–30 mg + clonidine 150–300 µg and/or fentanyl 25 µg	High doses of clonidine favor spinal anesthesia that can reach 3–5 hours of surgical anesthesia, with excellent postoperative analgesia
	Bupivacaine 15–20 mg + clonidine 150–300 µg and/or fentanyl 25 µg	

**Table 9.** Local anesthetics and coadjuvant drugs in spinal anesthesia [20].

Subarachnoid anesthesia in plastic surgery procedures can be done with a single injection, with or without adjuvant drugs, usual doses, low doses or high doses, or combined with extradural anesthesia. The single injection with spinal anesthesia with mono-dose is an easy,

safe, and economic technique that produces a deep anesthetic and motor block, with a low incidence of failure and undesirable side effects. It is the procedure most used in short- and medium-length surgeries, being able to be used in some prolonged procedures such as abdominoplasties with or without breast surgery. It is recommended to use small spinal needles G26, G27, and G29, with blunt tip, cutting tip, or special cutting tip. Low doses of long-acting local anesthetics play an important role in outpatients [27, 28]. A comparative study with 6 mg of hypobaric bupivacaine (0.5% in 1.2 mL) versus 6.1 mg of almost hypobaric bupivacaine (0.18% in 3.4 mL) had similar effects on the anesthetic level, duration of sensory, and motor block [36]. Dosage of 6 mg of bupivacaine versus 7.5 mg of bupivacaine [37], both doses added with 25 µg of fentanyl, has similar results in terms of diffusion, duration, and regression of the sensory block. Doses between 5 and 8 mg of ropivacaine, levobupivacaine, or bupivacaine provide up to 150 minutes of intrathecal anesthesia, enough time for most outpatient procedures in cosmetic surgery, time that can be prolonged with the addition of 150–300 µg of spinal clonidine up to 3–5 hours. The most used doses vary from 10 to 15 mg of hyperbaric bupivacaine, being possible to increase these doses up to 20–25 mg in special cases. Drowsiness, bradycardia, and hypotension of easy control are the most frequent effects.

*Epidural block.* The epidural block is indicated in the same type of surgery as spinal anesthesia, although there are some important considerations: (a) The doses of local anesthetic should be monitored since in prolonged procedures or those in which local anesthetics are injected by the surgeon, there is the possibility of systemic toxicity when the recommended total doses are exceeded or in a delayed form by absorption from the injection site. It is important to remember that lidocaine metabolites have a neuro- and cardiotoxic systemic effect. (b) The initial epidural test dose with local anesthetic should always be repeated before applying a booster dose, especially when the patient has been repositioned in the surgical table (a frequent situation in plastic surgery), due to the possibility that the epidural catheter may be moved from its initial epidural placement [38]. (c) Apparent or unnoticed accidental dural puncture and subsequent PDPH is a possibility, even in the most experienced hands. (d) The quality of the anesthesia is not as deep as that produced by the subarachnoid injection. On the other hand, extradural blockade has the advantage of being able to be prolonged during several days for postoperative analgesia in patients who require it. Ropivacaine, levobupivacaine, and racemic bupivacaine, added with clonidine, fentanyl, sufentanil, or morphine, are recommended, according to the expected surgical time. Hafezi et al. [39] compared 24 cases of tummy tuck-liposuction performed with general anesthesia versus 371 patients managed with epidural block and found a case with PE in the first group (4%). No cases of DVT/PE were found in the second group. The authors attribute this finding to the differential blockade with epidural bupivacaine that allows transoperative movements of the lower extremities which could be a prothrombotic factor of DVT and resultant PE.

*Combined subarachnoid-epidural anesthesia.* In cases with prolonged surgeries, it is advisable to place an inert lumbar epidural catheter with a cephalad direction to guarantee that in case surgery is prolonged, the anesthetic time can be amplified [7]. When this technique is used, an epidural test dose should always be injected since it is possible that the catheter may migrate to the subdural or subarachnoid space, or there may be migration of the anesthetic or adjuvants through the previous dural orifice [38].

*Contraindications of neuraxial anesthesia.* Contraindications of neuraxial anesthesia have been modified and are currently reduced to well-defined situations as shown in **Table 10**. In addition to these general contraindications, there are few situations in which it is not appropriate to use spinal anesthesia in this group of patients. Patients planning a flight in the days immediately following their surgery should not receive spinal anesthesia, since pressure changes in the aircraft cabins could facilitate the exit of cerebrospinal fluid through the hole in the dura mater. Patients who live far from the site where they are anesthetized and who are not willing to return to the surgical location should not be managed with spinal anesthesia since in both instances the patient could develop PDPH. Although this is not likely to occur, the mere fact of not being able to return to the place where they were anesthetized could imply that they should be treated by other anesthesiologists in their place of origin, which could facilitate unnecessary legal medical problems [28].

*Complications of neuraxial anesthesia.* Although spinal anesthesia started with a complicated case of PDPH more than 100 years ago, it has been shown to be safe in outpatient and non-ambulatory patients. Its complications include (a) The immediate ones that include failure of the procedure, total spinal anesthesia due to high doses, direct trauma to the spinal nerves, and injury to the conus medullaris or the spinal cord. Arterial hypotension and bradycardia are frequent, especially in young patients, which can progress to cardiac arrest if not managed in a timely manner. In 1988, Caplan [40] drew attention by publishing 14 cases of unexpected cardiac arrest during spinal anesthesia, an event that continues to occur with an incidence as variable as 1.3–18 cases in 10,000 or  $6.4 \pm 1.2$  in 10,000 spinal anesthesia. The decrease in preload volume promotes bradycardia mediated by three different reflex mechanisms: decrease in the frequency of the cardiac pacemaker due to a decrease in the distension of its fibers, decrease in the trigger pressure of the baroreceptors of the right atrium and the vena cava superior, and the involvement of the Bezold-Jarisch reflex when the receptors of the left

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#### Absolute

- Patient rejection
- Severe coagulation disorders
- Cutaneous sepsis at the possible puncture site

#### Relative

- Septicemia
  - Pre-existing diseases of the central nervous system
  - Multiple sclerosis
  - Spina bifida
  - Neoplasms
  - Derived hydrocephalus
  - Anticoagulation
  - Thrombocytopenia and thrombasthenia
  - Severe anatomical alterations
  - Conditions dependent on the preload
  - Aortic stenosis
  - Obstructive hypertrophic cardiomyopathy
  - Travel by plane in a postanesthetic medium
- 

**Table 10.** General contraindications for neuraxial anesthesia.

ventricle are stimulated by the fall of the ventricular volume. The vagal response to the preload decrease produces even more bradycardia that can be accompanied by nausea, vomiting, diaphoresis, and syncope, which can progress to cardiovascular collapse and death. (b) Later complications occur when the anesthetic block has ended and within a month of evolution: transient irritation syndrome of posterior roots, PDPH. Other uncommon complications are bleeding, neuroinfections, arachnoiditis, and low back pain. Complications of epidural anesthesia are due to inadequate technique: perforation of the dura, PDPH, injection of drugs into extradural veins with systemic manifestations of acute toxicity, inadequate anesthesia, rupture or knot in the catheter, retention of the epidural catheter, local infections, etc.

*Peripheral nerve blocks.* This type of regional anesthesia is rarely used in plastic surgery since most of these surgeries are bilateral. However, some blockages such as thoracic paravertebral, intercostal approaches have been recommended in breast surgery because, in addition to anesthesia, they produce excellent postoperative analgesia, reduction in postoperative opioid consumption, less nausea and vomiting, as well as decrease in length of hospitalization time. Interfacial plane blocks, although they do not produce adequate surgical anesthesia, are recommended techniques for postoperative analgesia. Some of these blocks are discussed later and in other chapters of this book.

## 6. Anesthesia for most common plastic surgeries

Without pretending to exhaust the topic, this section reviews the usual anesthesia techniques for most common procedures in plastic surgery: breast implants, liposuction, abdominoplasty, rhytidoplasty, combined cosmetic surgeries, and fat transfer.

### 6.1. Breast implants

Breast implant surgery occupies the first place among cosmetic surgery procedures in the USA, and it is likely that the same happens in other countries. Most patients are healthy, but there are some cases of women with breast reconstruction and implants who have a history of surgery for breast cancer. Several anesthesia techniques have been described for this procedure such as general inhaled or intravenous anesthesia, cervicothoracic epidural block, intercostal blocks, facial plane blocks, and tumescent injection with lidocaine. The advantage of regional techniques is that it produces less nausea, vomiting, postoperative pain, and has a lower cost [41, 42]. Cervicothoracic epidural block with approach in C7–T1 and T3–T4, with lidocaine 1%, ropivacaine 0.75%, bupivacaine 0.5%, or levobupivacaine 0.5% (8–12 mL), produces enough anesthesia with better postoperative analgesia than general anesthesia. A single dose of one of the mentioned local anesthetics is adequate in most cases, and when required, a second epidural dose must be injected through the epidural catheter. Epinephrine 1:80,000 can be added (except when ropivacaine is used) to prolong duration of local anesthetics. The most common side effects include transient elevation of blood pressure with tachycardia, tremor, nasal congestion, and nausea. Hypotension and difficulty breathing are rare [42]. It is also possible to use paravertebral or intercostal nerve blocks. Since Blanco et al. described ultrasound-guided

interfacial plane blocks for postoperative breast analgesia; modifications to the initial technique have been published [43–45]. Interfacial blocks score over traditional regional anesthetic procedures as they have no risk of sympathetic blockade, intrathecal or epidural spread which may lead to hemodynamic instability, and prolonged hospital stay [44]. These blocks are not an alternative to general anesthesia, epidural anesthesia, or paravertebral blocks since they do not produce adequate regional surgical anesthesia. However, they can be supplemented with intravenous sedation techniques, general anesthesia, or neuraxial anesthesia. Postoperative pain not only involves the breasts; it can extend to the sternum, lateral aspect of the thorax, armpits, and middle back, being more severe when the implants are submuscular. Postoperative pain can be managed with NSAIDs such as parecoxib, ibuprofen, ketoprofen, ketorolac, or diclofenac combined with low doses of opioids. Tramadol is recommended because of its dual mechanism of analgesic action. Methocarbamol can be associated with the previous scheme. Some investigators have found adequate analgesia with the continuous or intermittent administration of local anesthetics through catheters implanted during surgery [46, 47]. It has not been defined if paravertebral blocks decrease the incidence of chronic postoperative pain in breast surgery [48].

## 6.2. Surgeries for abdominal contour

The evaluation of candidates for abdominal contour surgery allows patients to be classified according to the possibilities of surgery taking in consideration the skin, fat, and muscles. This group includes liposuction, abdominoplasty, abdominal muscle repair, and various combinations that lengthen the operative time such as a 360° liposuction and mommy makeover.

*Liposuction.* Liposuction is the second most common procedure in plastic surgery, and it is perhaps the one with the highest morbidity and mortality [49]. Liposuction consists in removing fat from unwanted areas to build and improve contour. It can be performed in most subcutaneous fat deposits, being more frequent in the abdomen, hips, waist, torso, neck, and extremities. In men, it is usually done also in the pectoral region. The selection of patients is a determining factor since there are people who want to sculpt their silhouette because they have failed in weight loss and are looking for massive liposuction as a fast track to their false expectations of a suitable silhouette without taking into consideration that this procedure is not an alternative for the management of obesity. The pre-anesthetic assessment should be meticulous and must reject patients with moderate or severe cardiomyopathies or pneumopathies and those with thrombophilia or a history of pulmonary embolism. It is advisable not to associate liposuction with non-plastic procedures such as gynecological surgery. Surgeon and anesthesiologist must make a comprehensive management plan to meet the goals of patients, when possible. **Figure 3** is a plasticine model developed by one of our patients to inform the surgeon of her esthetic goals with liposuction and fat gluteal grafting.

There are two types of liposuction: the dry technique and the tumescent one. The latter is defined as the removal of subcutaneous fat under anesthesia infiltrated with large volumes of saline solution added with epinephrine and a local anesthetic, usually lidocaine. The original definition excludes the use of another type of anesthesia, whether it is neuraxial or general, as well as the fact that it is done without the presence of an anesthesiologist. However, currently





**Figure 3.** Plasticine model made by the patient to accurately show us the shape and size that she wants for her buttocks.

this type of liposuction is frequently done with epidural block, with spinal anesthesia, or with general anesthesia, in addition to infiltration with Klein's solution (50 mL of 1% lidocaine solution (500 mg), 1 mL of 1:1000 epinephrine (1 mg), 1000 mL of 0.9% saline, and 12.5 mL of 8.4%  $\text{NaH}_2\text{CO}_3$  solution (12.5 mEq)) [50]. This type of anesthesia involves a dose of lidocaine 35–55 mg/kg of body weight and added epinephrine to achieve concentrations of 0.25–1.5 mg/L, without exceeding total adrenaline total dose of 50  $\mu\text{g}/\text{kg}$ . These high doses make it obligatory to perform these procedures in surgery rooms that have all the facilities for monitoring, cardiac resuscitation, ventilatory support, and, always, recovery area under the care of an anesthesiologist. It is an apparently low-risk procedure, which can be complicated by systemic toxicity from local anesthetics, hypothermia, fat embolism, electrolyte imbalances with fluid overload, and/or acute anemia [51, 52]. One of the limitations during cosmetic surgery, especially during tumescent liposuction, is the total dose of the local anesthetic. For this reason, it is advisable not to combine liposuction with other procedures that require the injection of local anesthetics as the maximum dose of these drugs can be exceeded. There is no informed agreement in the literature on what is the top dose of lidocaine; the literature written by dermatologists and plastic surgeons mentioned 55 mg/kg of weight [50, 52–54], whereas the literature that comes from investigations carried out by anesthesiologists mentions 5 mg/kg of weight. In Europe, it is considered safe to use a total of 200 mg of lidocaine without epinephrine, and up to 300 mg is allowed in the United States of America. When epinephrine is added, the lidocaine dose in both regions is 500 mg. Epinephrine 1:200,000 reduces absorption of subcutaneous lidocaine by 50% and intercostal, epidural, and brachial in 20–30% [55]. PPX local anesthetics should never be used in tumescent liposuction. There is no agreement on the best anesthetic technique for liposuction, whether it is the modality under local anesthesia with the Klein solution or with general anesthesia or neuraxial block. With both procedures deaths have been reported [49, 56, 57], and the reports are not completely reliable.

The total volume of fat removed should not exceed 5 L in a single intervention or not be greater than 5% of body weight [58, 59]. Higher volumes increase the risk of complications, especially hypovolemia due to bleeding and acute hydro-electrolytic alterations. Another topic of interest in the management of these patients is the replacement of fluids during the trans-anesthetic period; Trott et al. [60] recommended the following scheme: (a) liposuction of small volumes (<4 L of aspirate) = maintenance liquids + the volume of the injected subcutaneous solution and



(b) liposuction of large volumes (aspirated  $\geq 4$  L) = maintenance liquids + the volume of the solution injected + 0.25 mL intravenous crystalloids per mL of aspirate extracted after 4 L. These authors emphasize that this fluid replacement guide does not replace a good clinical criterion and communication between the surgeon and the anesthesiologist is always fundamental. The goal is to maintain a normal intravascular volume with a postanesthetic hematocrit above 30% and albumin levels above 3 g.

The so-called 360° liposuction has become fashionable. It is a procedure that combines liposuction of the entire truncal midsection to accomplish a complete curvier contour figure from every angle. It can be combined with dermolipectomy, with plication of the rectus abdominis muscle, and with or without umbilicoplasty or gluteal fat grafting [61, 62].

*Abdominoplasty.* Surgery of the abdominal wall usually involves resection of skin excess and can be done with or without liposuction (lipoabdominoplasty) and with or without plication of the rectus abdominis muscle [63]. The most common patients include those that have had multiple pregnancies or patients that have lost a lot of weight either by dieting and exercise or after bariatric procedures.

*Mommy makeover.* The combination of two or more simultaneous cosmetic surgeries has become fashionable, particularly breast surgery and tummy tuck [64]. In our plastic surgery group, the most usual combination is breast-abdominoplasty, liposuction, and gluteal lipoinjection. For abdominal body contour surgeries (liposuction, abdominoplasty, and mommy makeover), we prefer spinal anesthesia with lumbar approach, taking the block up to T4. Due to the length of the procedure, it is prudent to use some adjuvant that prolongs the anesthetic time up to 4–5 hours. Bupivacaine 0.5% 15–20 mg added with clonidine 150–300  $\mu$ g is strongly recommended [27]. Ropivacaine or L-bupivacaine can also be used. The combination of two or more surgeries of the body contour is now safe, having overcome the complications of the individual procedures. It is vital to establish measures to prevent DVT, PE, infections, and postoperative pain, to name a few [64].

*Rhytidoplasty.* Cosmetic facial surgery involves several procedures, some of which are performed under local anesthesia injected by the plastic surgeon [65]. Surgeries in which the intervention of the anesthesiologist is required involve generally prolonged interventions, in healthy patients or with added pathologies, in which plastic surgeons request the support of an anesthesiologist to guarantee suitable transoperative care. Local anesthesia (subcutaneous and nerve blocks) combined with conscious sedation is the technique most used in our clinic [6]. Pre-anesthetic medication is the key to have a patient in optimal conditions: sedation, anxiolysis, and preventive analgesia. We recommend 10 mg oral melatonin, 2 mg sublingual lorazepam, and 0.1–0.2 mg of oral clonidine administered 1 hour before taking the patient to the operating room. A low dose of an opioid (morphine 5–10 mg, fentanyl 25–50  $\mu$ g, buprenorphine 150–300  $\mu$ g) may be given. To prevent nausea and vomiting, it is recommended to add dehydrobenzoperidol 1.25 mg, dexamethasone 4–8 mg, or any of the 5-HT<sub>3</sub> receptor antagonists or setrons (ondansetron, granisetron, dolasetron, and palonosetron). For maintenance, one or more drugs may be used in infusion: ketamine-midazolam, ketamine-propofol, and dexmedetomidine with or without low doses of opioid [6, 25, 66]. These drugs should be infused and diluted, in separate i.v. bags solutions to adjust the sedative, analgesic, or dissociative dose with appropriate doses of each drug to maintain adequate sedation

(Ramsay 3–4, BIS 80–70). Nasal oxygen should be administered throughout the procedure to maintain normal O<sub>2</sub> saturation. The patient must be monitored, as well as corneal protection to avoid abrasive injuries. It is mandatory that the surgical group looks out frequently the total dose of local anesthetic administered to avoid exceeding the recommended top doses. In the first hour of surgery, the previous fast fluid deficit should be replaced and then administer adequate volume to obtain diuresis of 0.5 mL/kg/hour.

In our opinion, general anesthesia should be avoided and reserved for very select, complex cases or for patients who cannot tolerate or cooperate with conscious sedation [6]. The selection is indistinct and must be based on the physical conditions of the patient. In Lotus Med Group, we use isoflurane, sevoflurane, or desflurane and avoid or minimize the use of muscle relaxants. When the patient is extubated, special attention should be paid to avoid coughing and bowing that may facilitate bleeding in the surgical site.

*Autologous fat grafting.* Autologous fat grafting refers to the transfer of fat from one or more areas to other areas to improve body contouring. It is in vogue among plastic surgeons and their patients. It is a natural filler, available, and easy to obtain, which is usually reintegrated in the receptor sites, although it has an unpredictable percentage of resorption. The most frequent areas where fat is transferred include the hips, buttocks, breast, face, and hands. A typical grafting procedure is done in three phases: harvesting of adipose tissue from the donor area; processing of the lipoaspirate to eliminate cellular debris, acellular oil, and excess of infiltrated solution; and reinjection of the adipose tissue at the receptor site [67–69]. Lumbar approached subarachnoid anesthesia is the technique of choice when the fatty tissue to be extracted is below T4–T6, to be subsequently grafted to the buttocks, breast, and/or hips. We have observed that spinal anesthesia decreases bleeding at the donor site when compared to general anesthesia and facilitates rapid recovery, with less postoperative pain and home discharge on the same day without complications.

## 7. Postoperative pain control

Acute postoperative pain is an unresolved issue, including plastic surgery patients. Most plastic surgery procedures are accompanied by moderate/intense postoperative pain that can be disabling and prolong the hospital stay. The multiple neural ending injuries in liposuction and tummy tuck, even muscle elongations during breast implants, are just some examples that make it necessary to plan a rational analgesic scheme. The ideal analgesia should start from the pre-anesthetic phase using preemptive and preventing drugs. The combined use of opioids with NSAIDs is the cornerstone in the prevention and management of pain after plastic surgery. The controversy not clarified about the utility versus the negative effects of cyclooxygenase inhibitors has favored multiple investigations whose results allow the safe use of these drugs. Celecoxib 400 mg preoperatively followed by 200 mg every 12 hours reduces pain; total dose of opioids facilitates early recovery [70]. Parecoxib 40 mg i.v. every 12 hours is effective, and when methylprednisolone 125 mg intravenously is associated before surgery, it significantly reduces emesis [71]. This combination also reduces postoperative fatigue. The combination of tramadol with ketorolac is part of our routine, being able to replace acetaminophen with codeine. Mild pain can be treated with acetaminophen-codeine or sodium metamizole (dipyrone). Pregabalin and gabapentin may have a preventive

analgesic effect. Sener et al. [72] found that in patients of septorhinoplasty lornoxicam (25 mg/day) has better tolerability and postoperative analgesia than dipyrone (5 mg/day) administered with a system of analgesia i.v. controlled by the patient. Gabapentinoids (gabapentin, pregabalin) and ketamine have additive or synergistic effects that decrease the doses of anesthetics in the transoperative and opioids in the immediate postoperative period.

Although the analgesic mechanism of esmolol (ultrashort-acting cardio-selective  $\beta_1$ -adrenergic receptor antagonist) is not well known [73], some clinical studies have resulted in a decrease in propofol during the induction of general anesthesia, a reduction of general anesthetics during maintenance, and a reduced dose of transoperative opioids, as well as it reduces immediate postoperative pain [74–76]. Its use in rhinoplasty seems to reduce the dose of opioids in the intraoperative period and the intensity of immediate postoperative pain [77, 78].

Regional analgesia, as mentioned before, has a very important role: local anesthesia infiltrations and interfacial, paravertebral, intercostal, or epidural blocks.

## 8. Criteria for home discharge and home follow-up

Outpatient or short-stay plastic surgery patients should observe home discharge criteria that have been established for other types of surgery. These basic criteria establish the home discharge of patients in a safe manner and avoid readmissions due to complications.

<b>Hemodynamic stability</b>	<b>The return of vital signs to pre-anesthetic figures is mandatory</b>
Alertness	Patient awake, well oriented. Spinal anesthesia favors this state of alert which facilitates optimal home discharges
Permeable oral route	Tolerate the intake of liquids or solids without nausea or vomiting
Analgesia	Controlled postoperative pain (EVA $<2/10$ ) with oral analgesics. Subarachnoid anesthesia with adjuvants provides a prolonged period of analgesia that facilitates early home discharge and reduces the dose of analgesics. It is convenient to prescribe a combination of opioid and non-opioid analgesics according to the expected postoperative pain and the profile of each patient
Spontaneous micturition	This is a controversial requirement. Some centers consider it as mandatory to avoid readmissions by bladder balloon. In our practice we do not consider this requirement as indispensable, and the patient is informed of the remote possibility of difficulty urinating. We avoid the use of intrathecal morphine to reduce this risk
Ambulation	Complete regression of the motor block is convenient. The patient can try to walk when he/she has recovered the perianal sensitivity and can flex and extend the foot. In some cases, it is feasible to discharge without 100% recovery
Headache	Although the classic CPPD is presented as of the second post-block day, there are patients who can develop it in the immediate postoperative period. It is prudent to investigate it with the patient semi-seated or standing
Other	Absence of bleeding at the operative site, ensure company, stay and transport to patients who do not drive, establish possible means of communication such as telephone, FAX, email

**Table 11.** Criteria for home discharge.

Uncontrolled pain, nausea, vomiting, and urinary retention are examples of frequent readmission to the surgical unit or hospital. In some patients it is not necessary to meet 100% of these discharge criteria, but they should be warned of the natural evolution of the gradual disappearance of the side effects of anesthesia and facilitate telephone communication with the surgical unit, the surgeon, and the anesthesiologist. They require appropriate postanesthetic and postsurgical indications, transportation, and occasional professional company. Each ambulatory surgery unit/hospital must have its own discharge criteria, in accordance with the published guidelines and with its own characteristics and needs of their patients: from simple scales to more elaborate procedures such as the new Postoperative Quality Recovery Scale (PQRS) assessment that evaluates six areas: physiological, nociceptive, emotional, daily activities, cognition, and general patient perspective [79]. **Table 11** shows the usual discharge home criteria. The proper information on the patient evolution at the recovery house or patient home favors the prevention and the opportune diagnosis of complications [80].

## 9. Preventive methods and complications

Medical ethics and government regulations emphasize excellent care and safeguard the health needs of patients. The correct and sensitive communication of this carefulness is essential for a correct anesthesiological care. The lesions associated with anesthesia are a frequent cause of morbidity and litigation, so it is mandatory to identify the common factors associated with peri-anesthetic injuries and thus reduces possible demands. In anesthesia for plastic surgery, as in other surgical procedures, cardiopulmonary events are the most common errors or incidents that cause severe neurological damage or death. The keys to prevent legal action against the anesthesiologist are simple acts such as establishing an adequate relationship with the patient and his family from the pre-anesthetic period, appropriate pre-anesthetic evaluation, filling out the informed consent, always using the correct monitoring, performing the best anesthesia, and postanesthetic care [14].

The complications in plastic surgery are due to four general factors: (a) characteristics of the establishment where the procedure is performed, (b) type of surgery and surgeon, (c) physical condition of the patient, and (d) quality of anesthesiological care. The study by Clayman and Caffè [81] conducted in Florida, USA, with deceased patients who had been operated in office-based surgery facilities found 36 deaths in 5 years, 18 related to plastic surgery, 3 of which were seen by non-plastic surgeons, and 12 under general anesthesia, 10 of which were administered by anesthesiologists and 2 by nurse anesthetists. Seven of these cases died before discharge and 11 after apparent appropriate discharge. The deaths that occurred before patients were discharged from hospital were due to bronchospasm, deep sedation, one related to illicit drug use, and the other to fatty embolism. Of the 11 patients discharged, seven died due to possible thromboembolism. In the rest, the cause of death was not determined. Most of these deaths could be avoided with simple measures such as adequate trans-anesthetic surveillance, prophylaxis of DVT/PE, and optimal patient selection.

*Deep vein thrombosis and pulmonary thromboembolism.* These two entities are complications frequently related to plastic surgery (liposuction and tummy tuck). The frequency of PE is



variable: circular abdominoplasty (3.4%), simple tummy tuck (0.35%), tummy tuck plus another plastic surgery procedure (0.79%), and abdominoplasty plus an intra-abdominal procedure (2.17%) [82, 83]. The plication of the rectus abdominis and the use of abdominal strips favor the increase of intra-abdominal pressure, decrease in venous flow, venous dilatation, and loss of normal biphasic venous flow at the popliteal level. The true impact of compression garment devices on DVT is still unknown [84], and pharmacological and mechanical protocols for thromboembolic prophylaxis in abdominoplasty seem to have similar results. This type of patients must be managed with a perioperative prophylactic scheme including graduated compression stockings, intermittent pneumatic compression tools, venous foot pumps, and drugs such as low molecular weight heparin or low-dose unfractionated heparin (20 mg of enoxaparin or equivalent daily for a week). Aspirin has been used successfully in major orthopedic surgery [85] and could have utility in plastic surgery with the risk of DVT/PE. The use of direct and indirect factor Xa inhibitions and thrombin inhibitors may be contraindicated since they induce greater postoperative bleeding [86, 87]. There is controversy about the risk of combining two or more plastic surgery procedures or other types (hysterectomy, colpoplasty, cholecystectomy). From anesthesia view, it is known that if there is longer operative time there are more possibilities of complications (bleeding, atelectasis, DVT, PE, alterations of the immune response, among others). The surgical literature is contradictory, and there are studies that favor combinations [83, 86, 87] and others that do not support this procedure [86].

*Emesis.* Postoperative and post-discharge nausea and vomiting remain the common and upsetting complications after plastic surgery. These symptoms interfere with the comfort of patients; they can have harmful effects on the results of surgery favoring bleeding, delaying discharge, and increasing costs [74]. There are several preventive schemes that have shown their effectiveness at low costs; the most usual combinations are dehydrobenzoperidol-dexamethasone and dexamethasone-ondansetron. The setrons (ondansetron, dolasetron, granisetron, tropisetron, and palonosetron) belong to a group of antiemetics with selective and potent antagonist action on the serotonin receptors, which also have an action on gastrointestinal motility and which lack antidopaminergic activity. Propofol 10 mg administered at the end of anesthesia has an antiemetic effect. Metoclopramide continues to be used, although its low effectiveness compared to other drugs and its side effects has decreased its use. The combination of transdermal scopolamine with intravenous ondansetron is another effective management option [87]. Brattwall and his group [88] found an antiemetic effect of smoking in breast augmentation. A prophylactic multimodal antiemetic regimen, suitable hydration, and opioid-sparing postoperative analgesia will decrease postsurgical emesis.

Chapter 7 of this book discusses the most frequent and unusual complications of anesthesia and plastic surgery.

## 10. Challenges

The challenges in anesthesia for plastic surgery patients are multiple since it is about people with perfectionist ideas that seek to improve their self-esteem through showing a better figure. This special personality makes them to search for a surgical medical team that guarantees their

idealized success, which is based on information lacking scientific basis. On the other hand, the increasing sites offering plastic surgery has favored a demand not only for quality but also for more accessible prices. This nonmedical challenge is combined with the challenges of anesthesiological care in healthy patients, in apparently normal cases, and in people with systemic comorbidities. Each of these groups always requires a scrupulous comprehensive preoperative medical assessment and the development of a modifiable anesthetic plan. Another problem is the short and mediate term follow-up of these patients, since one way to improve our anesthesiological techniques is to study the evolution outside the operating room. The anesthesiologist rarely can see this type of outpatient or short-stay patient. So, it is prudent to establish a means of communication from the time of the pre-anesthetic visit to a long postanesthesia period. The Internet is by far the most viable way to determine what kind of evolution each of these patients have, especially the study of complications.

Patient-tourists represent a significant challenge very little studied in plastic surgery. They are people who have traveled for several hours or days, who come from other countries and who usually have not had a surgical or pre-anesthetic evaluation. They must be evaluated quickly and correctly to determine their viability to the procedures they want. It is common to see uncommon pathologies that do not contraindicate anesthesia, but can influence perioperative pharmacological management [2, 89].

## 11. Conclusions

Ambulatory and short-stay plastic surgery is growing logarithmically around the world. Anesthesiologists are more often subjected to the challenge of providing anesthesia to these patients, who on the other hand are scheduled every day for longer procedures and high risks that previously disqualified them for outpatient procedures. To favor an adequate outcome in this group of ambulatory patients—healthy and not so healthy, anesthesiologists should be oriented to the rational use of short and intermediate action drugs, with the goal of reducing morbidity and mortality. Techniques to prevent pain, nausea and vomiting, and early ambulation will be the most accepted procedures. The anesthetic techniques for outpatient surgery differ greatly from the procedures for short-stay patients, since the latter are scheduled to remain hospitalized for a minimum of 24 hours, unlike outpatient in which to prolong their stay beyond 5 pm can be considered as a failure in the anesthetic plan. A short recovery time after anesthesia is very important for the patient, his doctors, and the surgical unit.

Plastic surgery performed in ambulatory surgery units has some potential benefits such as ease of programming, reduced costs, and comfort for the patient and surgical staff. On the other hand, the inconveniences of ambulatory anesthesia should be considered, such as nausea and vomiting, uncontrolled postoperative pain, unplanned hospitalization, and, finally, occasional death. The latter is the most feared and should not happen.

Ambulatory cosmetic surgeries can potentially be managed with any anesthesiological technique. Although most anesthesiologists use general anesthesia for these procedures, regional anesthesia techniques have shown certain advantages such as better pain control, attenuation



of the response to operative stress, preserving perioperative immune function, better preservation of oxygenation and lung residual functional capacity, improvement of visceral vascular flow, early recovery of postoperative ileus, and reduction of venous thrombotic disease and pulmonary embolism.

## Acknowledgements

We thank the images of [www.anestesia-dolor.org](http://www.anestesia-dolor.org) for allowing us to publish it.

## Conflict of interest

None.

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