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Perioperative Complications in Plastic Surgery

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Abstract

Anesthetic complications in the perioperative period in plastic surgery are extremely rare, although they can be catastrophic and sometimes fatal. The proper selection and correct preoperative assessment of patients are the key to stay away from unwanted events. Preanesthesia evaluation is mandatory in each patient and must include clinical history, complete physical examination, and routine and special laboratory tests in patients with associated pathologies. Anesthetic management is based on these results, type of surgery, experience of the anesthesiologist, and the operating environment. The anesthetic technique can be local, regional, or general with standard noninvasive monitoring. It is recommended that an anesthesiologist be present in all plastic surgery procedures. Complications are usually the result of moving away from the guidelines already established for an excellent practice or the result of sentinel events rather than human errors. Pulmonary embolism is probably the most feared complication, with soft tissue infections being the most frequent complication in plastic surgery. Less common complications include arrhythmias, overhydration, allergies, bleeding, skin necrosis, dehiscence of wounds, brain damage, and death. Anesthesiologists, surgeons, nurses, and all personnel involved in the care of these patients must work as a team of highly qualified and updated professionals.

Keywords: anesthesia, plastic surgery, perioperative complications

1. Introduction

Patients who consult a plastic surgeon do so with the purpose of improving their body appearance to achieve the image of a beautiful body, increase their self-esteem, and to be more competitive in a globalized world where appearance is a determinant of success. Most are people looking for various alternatives during long time; they search on the Internet, with friends, with

patients, in local or distant locations from their place of residence, inside or outside of their country. Some of them make face-to-face consultations with several plastic surgeons before deciding where to have surgery [1]. They seek perfection and full satisfaction to their demands, the best prices, and high expectations with each planned surgical procedure. Complications—small or catastrophic—have no place in the final results. Medical care for these people with special expectations is a continuous defy, a constant challenge that keeps us at the top of our professional practice and able to achieve excellent results while keeping us competitive in a growing medical market [2, 3]. Fortunately, complications in this clinical environment are rare but often are catastrophic and, to a lesser extent, can be fatal. As in other areas of surgery-anesthesia, adherence to existing guidelines and recommendations is mandatory to avoid any possible unwanted effects.

In recent years, there has been an increase in litigation against the medical profession—justified or not—increasing the costs of health care [4, 5].

The aim of this chapter is to review several aspects related to complications that may occur in the perioperative period of people who undergo plastic surgery procedures under anesthesia.

2. Significant general subjects

In this clinical setting, there are certain general features of paramount importance that should always receive proper attention to avoid unexpected complications. Like any other types of surgical patients, people who desire plastic surgery should be meticulously evaluated regardless of the opinion of the plastic surgeon or the anesthesiologist involved. Standards and guidelines have been described with loose criteria or very strict principles according to the experiences of their authors. The main idea is to study these patients regarding factors that may be important to prevent unfortunate outcomes and staying away from unorthodox practices of our profession [6].

2.1. Optimal preoperative evaluation

The preanesthetic-preoperative assessment is vital and of paramount importance in all patients who undergo plastic surgery. This clinical assessment is an easy, inexpensive, and essential way to decrease catastrophic incidents and complications. Unfortunately, these patients are often considered healthy by their doctors and are not adequately reviewed as determined by the respective certified standards.

During the preanesthetic evaluation, two major groups will be considered; the healthy people and the patients with systemic pathologies that modify their physical conditions (ASA). The evolution and marketing of plastic surgery have generated a third special group of patients—healthy or sick—who travel long distances in search of various aesthetic or reconstructive procedures. This group of patient-tourists has special characteristics that are challenging for the medical group, peculiarities that must be properly evaluated before the patients begin their trip to the surgical destination chosen by them or immediately after their arrival.

Preoperative assessment includes a complete medical history with physical examination. Laboratory and other exams are tailored to each patient depending on their past medical

history and findings on previous exams. The current trend is to minimize this type of tests; however, when a perioperative complication occurs and the so-called routine tests (CBC, blood chemistry, blood clotting, blood group) were not carried out, the plaintiffs will have arguments against the medical-surgical team, which is why it is prudent to perform routine exams, leaving the electrocardiogram for hypertensive patients, patients with history of heart disease, diabetics, and healthy people over 50 years old. **Table 1** lists the usual exams for all types of patients.

2.2. Informed consent

The patient, his/her relatives, or companions must be properly informed about the technical aspects and risks of surgery and anesthesia. This document is an indicator of communication between patients and their physicians and should be as complete as possible. While it is almost absurd to mention every risk inherent in each procedure, it is vital to mention the most frequent complications and talk about the possibility of catastrophic mishaps, always leaving

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, 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, and 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, and 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 1. Complete parameters in the preoperative assessment in plastic surgery.

open communication for any questions they might have. Although a well-informed consent does not exempt us from the responsibility of a serious failure, its absence has been a reason of demand in plastic surgery up to 43.8% [5].

2.3. The surgical unit

Surgical units located outside hospitals for outpatient and short-stay procedures in plastic surgery started in the 1960s [7] and rapidly expanded. Currently, most plastic surgeons want to have their own surgical unit. In these surgical units, surgical and nonsurgical procedures are performed; from Botox injection, fillers, CO₂ laser, minimally invasive surgeries such as hair transplantation to major surgeries such as abdominoplasty, breast reconstruction, body contouring procedures in post bariatric patients, and many more. Safety of each patient is the gold standard [8].

Although this type of surgery/anesthesia is valid from a point of view of functionality, resulting in lower costs and generating a higher income, it is prudent to mention that not these surgical units meet the normative requirements, transforming into surgical taverns [7], which could increase the possibility of considerable risks. Performing anesthesia outside a traditional hospital surgical room has gained popularity, and high-risk surgeries on ASA 2 and even some ASA 3 patients are frequently intervened in this area. Sometimes these scenarios are comparable to performing anesthesia outside the operating room [9–11], it is normative to have well-equipped anesthesia machines, standard monitoring (noninvasive blood pressure, electrocardiogram, oximetry, capnography, temperature), monitored recovery area, and well-trained nursing personnel, which ensures a morbidity-mortality rate comparable to that expected in a hospital operating room [10]. It is advisable to have equipment to avoid perioperative hypothermia as well as noninvasive ventilatory assistance equipment. Implementing WHO recommendations in relation to a surgical safety checklist allowed Rosenberg et al. [12] to reduce complications from 11.9 to 2.72% ($p = 0.0006$). These investigators optimized medical resource from 90.9 to 99.5% ($p < 0.0001$). Verbal confirmation on precautions on toxicity by local anesthetics increased from 0 to 91.3% ($p < 0.0001$), among other improvements. These authors also evaluated patient satisfaction, which increased from 57 to 90.8% ($p < 0.0001$). The current surgical room team must balance the safety and comfort of the patient and the medical group; light, sound, climate, air, temperature, humidity, ventilation, drafts, and noise are having a safer, efficient, and more professional environment [13].

The staff of ambulatory surgical units must receive continuing education to keep their certification up-to-date: surgeons, anesthesiologists, nurses, secretaries, and well-qualified administrators are required to ensure excellence. Simulation and educational programs enhance safety and make medical-surgical care systems more effective. Shapiro and his group [14] used a high-fidelity simulator mimicking various critical scenarios in a plastic surgery setting with a special regard to equipment training, communication, crisis, adherence to evidence-based protocols, and regulatory standards. They observed a high degree of acceptance and validity, arousing the participant's interest in the importance of changing processes that improve patient safety and avoid errors. A prospective study on the safety of office-based surgery in Florida and Alabama, USA [15]—where reporting adverse events is mandatory—reviewed complicated events for 10 and 6 years, respectively, and found 46 deaths in Florida and 263 complicated procedures that required moving patients to nearby hospitals;

56.5% (26/46) were deaths and 49.8% (131/263) of the hospital transfers were related to cosmetic surgery. Of these, 67% of deaths and 74% of hospital transfers had been managed under general anesthesia. Liposuction, abdominoplasty with liposuction, and other cosmetic surgeries were related to 10 deaths and 34 hospital transfers. Only 38% of the units reporting adverse events were accredited, 93% of physicians were certified, and 98% had privileges in hospitals. Plastic surgeons reported the most events (45%). In 6 years, in Alabama, there were three deaths and 49 complications and hospital transfers; 42% (22/55) of the transfers and no deaths were associated with cosmetic surgery; 86% were done under general anesthesia. There were only two patients with complicated liposuction who were transferred to the hospital. Unlike units in Florida, 71% of units in Alabama were certified, with 100% certified surgeons. Plastic surgeons reported most events (42.3%). In both states, the complications of dermatologists were minimal or absent because their procedures are less invasive and with local or regional anesthesia. It is desirable that medical groups and health authorities establish a mandatory system that monitors deleterious events in this type of surgical environment to improve current guidelines based on the reality of each country or geographic region studied and can determine the permissible frequency of complicated events in plastic surgery [16].

There are several Government health agencies in charge of the certification of these surgical units that have the common goal of providing a similar and safe environment in this type of establishments. In Mexico, COFEPRIS and the Federal Sanitary System are responsible for verifying the functionality of this type of surgical units; from 2013 to February 2015, verified 1209 clinics provide cosmetic surgery services and found irregularities in 115, and 66 clinics were closed [17]. In the United States of America, the Joint Commission for Accreditation of Hospital Organizations (JCAHO), American Association for Accreditation of Ambulatory Surgery Facility (AAAASF), and American Osteopathic Association's Healthcare Facilities Accreditation Program (HFAP) [18] are the organizations that regulate these aspects.

2.4. Patient safety

Perioperative safety is the primary goal in the comprehensive care of all patients; anesthesiologists, surgeons, nurses, paramedical staff, and health system administrators have developed guidelines aimed at improving safety in this surgical environment by strengthening preventive measures, assessment, pre-trans, and postoperative care to avoid complications. Some groups go beyond the usual recovery time, using pharmacological programs to reduce the incidence of chronic postoperative pain.

In the operating room, patient safety is a shared responsibility between professionals and staff who interact directly or indirectly with patients. As anesthesiologists, our responsibility ranges from patient assessment, anesthesia technique, and immediate recovery, although it can be extended beyond this moment when we use drugs with prolonged pharmacological effects, either as a delayed action or as chronic damage as is the case of arachnoiditis, chronic postoperative pain and perhaps CNS effects of general anesthesia for neonates could be included. Adequate monitoring (cardiorespiratory, temperature, neurological, metabolic, or neuromuscular blocking effects), the position of the patient in the operating table to avoid neurovascular compression injuries, the placement of antiembolic devices, maintenance of normothermia, facial and ocular protection, positioning the head, and avoiding burns and fires are just some

of the aspects of which we are responsible during the trans and postoperative period [19–21]. Proper management of the airway is a challenge since there is always the possibility of anatomical anomalies in a patient, which makes it difficult and even impossible to secure an airway.

WHO began its safe surgery program, where checklists have proven their importance in reducing errors. No matter the surgical procedure—small or large—these recommendations list 10 essential objectives: (1) correct surgery site, (2) safe anesthesia, (3) airway management, (4) bleeding management, (5) avoid known allergies, (6) minimize risk of operative infections, (7) prevent the retention of foreign bodies, (8) correct identification of biopsies, (9) effective communication between the surgical team, and (10) systematic surveillance of surgical results. It is advisable to stick to this simple and very effective list. Its implementation is not easy, and it is necessary to understand the nature of the errors, the dynamics that exist between the systems and the people, as well as to create a culture that stimulates the patient's safety [22–24]. In plastic surgery, it should be emphasized that it is important to identify the risks of deep vein thrombosis and pulmonary embolism (DVT/PE) and to establish that patients can benefit from prophylactic anticoagulation. Patients with hypertension should also be identified because of the implications not only in the cardiovascular and CNS systems but also in the perioperative bleeding. Another important factor is to understand the importance of reducing and treating hypothermia [25].

2.5. Surgery time

The time a patient remains anesthetized is directly related to the frequency of complications; hypothermia, deep venous thrombosis, pulmonary thromboembolism, changes in coagulation, bleeding, alterations in the immune system, and neurovascular compressions are some of the usual drawbacks in prolonged surgery-anesthesia [26]. In plastic surgery, there are procedures that require prolonged times such as patients with combined surgeries and post-bariatric cases with large weight loss. Unfortunately, there is not enough information on these possible complications. Phillips et al. [27] retrospectively studied the relationship between the anesthetic time and the incidence of deleterious effects in 2595 plastic surgery procedures performed under general anesthesia and found that the majority were women with a mean age of 41 years. These authors divided their patients into two groups (less than 4 or more than 4 hours of anesthetic time): nausea and vomiting (2.8 vs. 5.7%, $p = 0.0175$) and urinary retention (0.7 vs. 7.6%, $p < 0.0001$), and 2.5% required reoperations due to surgical complications without statistical differences between the two groups. They had one patient with PE and one with DVT in the group of less than 4 hours of anesthesia. Five (0.19%) were admitted to a hospital for medical or surgical treatment (3 hematomas, 1 PE, and 1 DVT). There were no deaths in this series. Another study of 1200 patients with facial plastic surgery [28] performed under general anesthesia compared the patients with anesthetic time of less than 4 hours (14%) vs. longer anesthesia (86%). There were no catastrophic complications, and the morbidity in 100% of the patients was minimal: one respiratory failure, one patient CNS deficit, one drug allergic reaction, and one patient requiring hospital transfer. There were six cases of prolonged anesthetic recovery time. The incidence of morbidity was similar in both groups. These two studies demonstrated that the time of general anesthesia was not a major determinant in the immediate evolution of these patients operated in ambulatory surgery units.

2.6. Surgeon without anesthesiologist

This is a controversial context where plastic surgeons consider themselves qualified to perform some procedures with local anesthesia and superficial sedation without the presence of an anesthesiologist. Examples to these procedures are variable according to the routines and interests of each surgeon, such as, blepharoplasties, small volume liposuction, coronal and facial rhytidectomies, filler injections, and hair implants, to mention a few. The fact is that each surgical procedure should be properly monitored by the anesthesiologist in charge of patient safety (monitored anesthetic care), and let the surgeon concentrate on his procedures without distracting his attention in monitoring the patient, or administer sedative medications, analgesics, or anesthetics with a very narrow therapeutic window. Although complications are rare, there is no way to predict with certainty when a patient will have a sentinel event or a negative incident, for example, drug toxicity, overdose, drug interaction, hypertensive crisis, anxiety, airway obstruction, and broken heart syndrome, just to mention some of the many possibilities. These are complications that few surgeons are qualified to solve and are part of the anesthesiologist's usual practice. In a series of catastrophic events in ASA 1 and 2 patients, we found a case of death during a rhytidoplasty performed without the presence of the anesthesiologist [29]. The frequency of these events is not known, and it is advisable to avoid surgical procedures without the presence of an anesthesiologist, which is classified as negligence.

2.7. The tourist patient

People who travel from one country to another to receive medical attention are called tourist-patients, and their characteristics have different aspects that can modify their risks: cultural traditions, language, common diseases in their region of origin, and physiological adjustments from their recent voyage, especially when being by plane longer than 6 hours. Their preanesthetic evaluation is done shortly after they arrive, and there could be special conditions that are not known by the treating doctors. This type of patient has proliferated in plastic surgery. In our practice, we consider them a management challenge, emphasizing an effective communication that facilitates preoperative assessment, professional care, and a safe return to their place of origin [30].

2.8. Anesthesia technique

The choice of anesthesia method is the responsibility of the anesthesiologist, although patients and surgeons must be aware and consent with the anesthetic plan. In general terms, we can use any kind of anesthesia, although the anesthesiologist should be adapted to factors such as diverse as his/her own experience and knowledge, the characteristics of the surgical unit and the surgeon, the type and duration of surgery, and in particular the characteristics of each patient. It is noteworthy to mention that the *best anesthesia is not the one that is best handled by the anesthesiologist, but the anesthesia procedure that engages better to each patient*. In ambulatory patients, general anesthesia has a preponderant role due to its quick recovery [31], although its immediate side effects are more common when compared to regional anesthesia and have been linked to increased frequency of DVT/PE. When general anesthesia is given, protective

ventilation should be used (a tidal volume of 6–8 mL/kg of ideal body weight, less than 30 cm H₂O peak pressure, and PEEP 6–8 cm H₂O), which prevents lung damage, specifically in prolonged surgery.

In our ambulatory and short-stay surgical unit, regional procedures are preferred, especially subarachnoid anesthesia with a lumbar approach for surgeries below T6 segment. We also use spinal anesthesia in some patients with combined surgical procedures up to T4. Single injection of spinal anesthetics and adjuvants is safe, rapid, easy to administer, inexpensive, with a certain degree of postoperative analgesia, and fewer immediate and late residual effects than general anesthesia [32, 33]. We do not use subarachnoid anesthesia with a thoracic approach. In breast, nose, and arm surgeries, we prefer general anesthesia. For facial surgery, we use conscious sedation mixed with local anesthesia [34], and we have just adopted Friedberg's recommendation [35] with propofol or ketofol for facial surgery and sometimes as a sedative complement at the end of spinal anesthesia. The characteristics of propofol make it a safe drug when administered by an anesthesiologist and BIS (60–70) monitoring is recommended, although the Ramsey scale (3–4) can also be used [33, 35].

Monitored anesthesia care is a safe technique in ambulatory and short-stay units. It must be done by an anesthesiologist and goes from simple monitoring of the patient to the use of intravenous drugs and local anesthetics for longer procedures as rejuvenation facial surgery. The most used drugs are propofol, ketamine, midazolam, fentanyl, sufentanil, remifentanyl, and dexmedetomidine always supplemented with nasal oxygen [34–39].

Figure 1 shows a schema where the difference between alertness, conscious sedation, deep sedation, and general anesthesia are shown. The vertical line delimits the most relevant clinical data and the appropriate management [34]. Attachment to this scheme is a simple guide to avoid anesthesia complications, especially the airway and cardiovascular and central nervous systems.

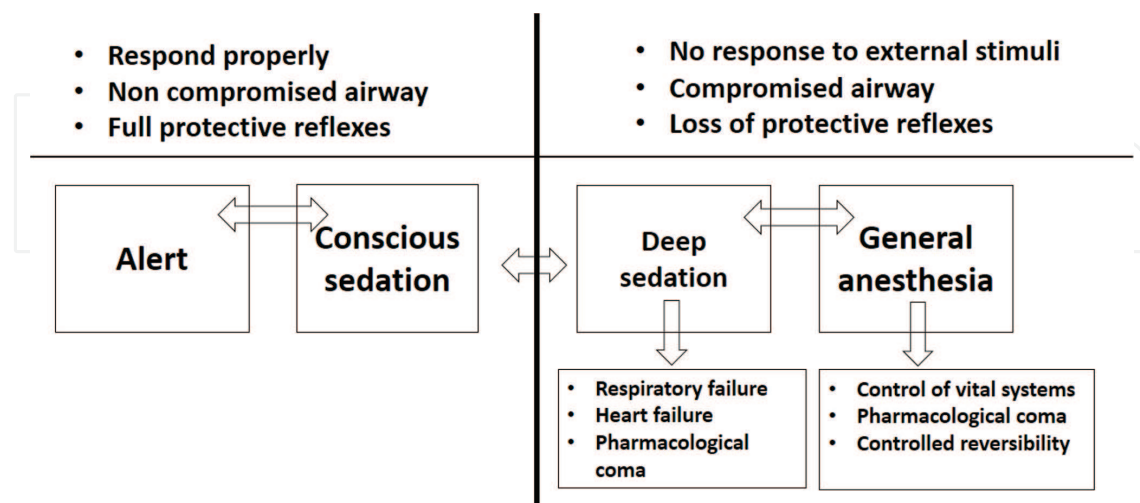


Figure 1. Scheme showing the differences and limits of alertness, conscious sedation, deep sedation, and general anesthesia.

3. Complications

A patient may be complicated by anesthesia, surgery, or a combination of both, for example, infections, venous thrombosis, thromboembolism, bleeding (anemia or hematomas), inadequate scarring, neural damage, overhydration, postoperative emesis, or burns, just to name a few. It is usually impossible to attribute these complications to one single member of the team; therefore, all professionals should function as a teamwork and must share responsibilities as in those patients complicated with DVT/PE. In this chapter, we review the expected complications in anesthesia-plastic surgery and a group of rare incidents that could occur in this clinical setting of which we have observed some.

3.1. Anesthesia complications

Complications of anesthesia can be classified into four different etiological categories: (1) health personnel errors; (2) adverse events to the anesthesia technique; (3) the physical condition of the patients; and (4) sentinel incidents or events. Anesthesia morbidity and mortality rates are approximately the same in countries with a similar life expectancy. The anesthesiologic community of a given country reduces their anesthesia morbidity and mortality data by an acceptable range for their societies using techniques according to their medical culture and historical traditions [40]. Although complications will always exist since erring is human [41], preventive measures are obligatory to reduce complications of anesthesia and to regulate our professional activity to reduce morbidity and mortality statistics [6]. Complications related to anesthesia are rare in plastic surgery, ranging from simple events to catastrophic outcomes, including death.

3.1.1. *Unplanned hypothermia*

It is the most frequent complication in plastic surgery. Under normal conditions, human thermoregulation mechanisms maintain body temperature from 36.5 to 37.5°C. This homeostasis is achieved by thermoregulatory defense mechanisms such as vasoconstriction, vasodilation, sweating, or chills. Hypothermia is considered when body temperature drops below 36°C. It can occur in the perioperative period; preoperative phase is defined as 1 hour before induction (when patients are prepared for surgery), during the intraoperative phase (total anesthetic time) and postoperative phase (24 postoperative hours) [42, 43]. Unintentional intraoperative decrease in body temperature occurs in a large percentage of surgeries and is secondary to multiple factors. In anesthetized patients, body temperature usually drops 2°C but can drop up to 6°C due to changes done by general anesthesia at the center of thermoregulation, a thermal decrease depending on the dose of the anesthetic. Other important factors of hypothermia are the exposure of the patient to the cold environment of the operating rooms and the failure to actively warm patients. Hypothermia has negative effects such as increased infections, delayed healing, increased intra and postoperative bleeding, increased blood transfusion requirements, increased cardiac morbidity, prolonged duration of anesthetics, and coagulopathies [44, 45]. Therefore, it is necessary to use different methods to avoid it, to reduce its intensity, and to manage it with opportunity; mattresses with forced air or water

heating, electrical devices, heating of the intravenous or irrigation solutions, room temperature, and thermal blankets, among others, have shown different degrees of efficacy [46–49].

Some body contouring procedures such as liposuction of various regions, extended or circular abdominoplasty, and multiple surgeries expose body surface in a way that facilitate heat loss. If this is added to the fact that some surgeons are accustomed to utilizing antiseptic solutions in the skin area that will be operated minutes before positioning the patients in the operating table, it accelerates and increases the hypothermia and can be an incident that affects the patient outcome.

Perioperative hypothermia is a complication that must be anticipated, detected early, and treated in a timely manner.

3.1.2. Toxicity and side effects to drugs

Side effects to drugs used during anesthesia are sporadic. A background of allergies or hypersensitivity should be investigated at the time of the anesthetic evaluation and avoid its use. Among other drugs, there have been reports of allergies to local anesthetics, muscle relaxants, sugammadex, and propofol, with the most severe reactions to latex. Opioids, especially remifentanyl, may induce hyperalgesia. There are undesirable reactions like malignant hyperthermia secondary to halogenated and succinylcholine. These patients must be managed with total intravenous anesthesia or regional anesthesia because local anesthetics are safer and have rarely been associated with this entity [50].

For a couple of decades, local anesthetic toxicity has been the subject of multiple publications. In plastic surgery, there is a controversy over the total doses accepted as safe. Since the original description by Klein [51, 52], various data on safe doses of lidocaine 0.1–0.05% plus epinephrine 1:1,000,000 in tumescent liposuction have been published. Segmental infiltration of reduced lidocaine concentration 0.02% has been used in broader liposuctions [53]. The latest research done in 14 human volunteers has shown that 28 mg/kg without liposuction and 45 mg/kg (dose range 9.2–52 mg/kg.) after liposuction are safe dosages. The authors reported serum lidocaine concentration below levels associated with mild lidocaine systemic toxicity. The probable risk of lidocaine toxicity without liposuction at a dose of 28 mg/kg and with liposuction at a dose of 45 mg/kg was ≤ 1 per 2000 [54]. Timely diagnosis and management of local anesthetic toxicity with intravenous lipids in severe cases are essential. Lipids in initial dose of 1.5 mL/kg, followed by infusion of 0.25–0.50 mL/kg for 30–60 min. This infusion can be increased if hypotension or asystole persists [55]. After the infusion of iv lipids is stopped, a recurrence of local anesthetics toxicity can happen, so these patients need to be observed for at least 24 hours more.

3.1.3. Trigeminal cardiac reflex

Rhinoplasty is a frequent, relatively simple outpatient procedure that can be catastrophically complicated. The trigeminal cardiac reflex is defined as sudden onset of parasympathetic dysrhythmia, bradycardia that can progress to sudden asystole in addition to hypotension, apnea, and gastric hypermotility. This reflex can be initiated with stimulation of the trigeminal nerve during infiltration of the local anesthetic in the nasal columella or during osteotomy [56–59].

3.1.4. Nausea and vomiting

Postoperative emesis is a serious complication in plastic surgery as it may interfere with the results. It occurs after general or neuraxial anesthesia and has been associated with the use of opioids, being more frequent in young women, nonsmokers, and patients with a history of postanesthetic emesis. Prevention is necessary using preoperative medication such as dexamethasone and/or serotonergic antagonists. Metoclopramide has fallen into disuse because of its side effects.

3.1.5. Overhydration

It is associated in tumescent liposuction with large volumes and generous intravenous administration of hydro saline solutions that can induce arterial hypertension, pulmonary edema, and even death.

3.1.6. Deep venous thrombosis and pulmonary thromboembolism

Although these events are not directly attributable to the anesthetic technique, this is one of the factors that may be involved. They are the most feared complications in surgery and are more frequent in liposuction and abdominoplasty [60]. The embolus can be hematic or fatty. The risk factors are young women, contraceptives, air travel of more than 6–8 hours, prolonged surgeries, and thrombophilic pathologies such as factor V Leiden [61, 62]. Preventive measures with elastic stockings and pneumatic compression, early mobilization, antiplatelet agents, heparins, and/or oral anticoagulants are mandatory in high risk patients since this complication is the leading cause of mortality in plastic surgery. In 1,141,418 outpatient surgery procedures, there were 23 fatal events, being the pulmonary embolism the cause in 13 patients. Abdominoplasty was the surgery most commonly associated with death from pulmonary embolism in an office-based surgery facility [63].

3.1.7. Uncommon complications

Most of these types of complications are sentinel incidents that make prevention, diagnosis, and management difficult. The following paragraphs describe some patients seen in our professional practice or referred by colleagues.

3.1.7.1. Postanesthesia-surgery blindness

This entity occurs in ~1:60,000 to 1:125,000 anesthetics procedures and is more frequent in cardiovascular and orthopedic surgery, although there are cases described in plastic surgery [64, 65]. It has been associated with prolonged prone position with the head positioned lower than the thorax, anemia, use of vasoconstrictors, or glycine [66, 67]. Transient or permanent postoperative blindness has also been described following facial injections of fillers as described later.

In our practice, we had a 38-year-old patient who underwent abdominoplasty, liposuction, and fat transfer in her buttocks under spinal-general anesthesia. She developed total blindness manifested in the immediate postanesthetic recovery. MRI showed occipital cortical edema (**Figure 2**), establishing the diagnosis of cortical blindness.



Figure 2. Blindness secondary to cerebral occipital cortical edema.

3.1.7.2. *Transient deafness*

This rare effect has been reported in subarachnoid anesthesia attributing to sudden changes in endolymph. We had a young patient from Russia who lost her auditory acuity during 5 days after spinal anesthesia for liposuction-gluteal lipoinjection.

3.1.7.3. *Broken heart syndrome*

Takotsubo's cardiomyopathy or broken heart syndrome is a stress-induced heart disease with sudden left ventricular failure without coronary damage [68]. A young woman developed this syndrome few minutes after nasal infiltration with lidocaine and epinephrine under anesthesia with sevoflurane. The surgery was canceled, and the patient was transferred to a nearby hospital where she was successfully managed.

3.1.7.4. *Awakening during general anesthesia*

It is a very rare entity with an estimated incidence of 0.1–0.2% but has the potential to cause adverse evolution in the psychological area inducing posttraumatic stress [69]. A 43-year-old patient who underwent transoperative awakening during general anesthesia with enflurane.

3.1.8. Attempted murder

Anecdotal situation has been reported on few occasions. We had a case where the spouse tried to assassinate his wife at the end of conscious sedation for rhytidectomy. He injected her with vecuronium, but the timely resuscitation initiated by the recovery area nurse and the clinical suspicion followed to the administration of neostigmine reversed the respiratory failure. The patient was transferred to intensive care unit where the husband made two failed attempts to reinject muscle relaxants.

3.2. Surgical complications

Some surgical complications are listed because of their importance and relation to anesthesia.

3.2.1. Surgical infections

Infections are frequent in plastic surgery, from 4% up to 14%, including local infections, blood-borne infections, and distal infections such as pneumonia or infective endocarditis. Breast surgery—implants or reconstructions—body contouring procedures such as liposuction and abdominoplasty, or multiple procedures have been described with more risks of postoperative infections, especially if there are predisposing factors such as diabetes, HIV, cancer, or immunosuppressive treatment. Infections in plastic surgery can be minor due to microbial skin flora to severe cases affected with atypical or multiresistant opportunistic bacteria [70, 71]. The type of infection varies depending on the surgery and the patient. Choice of antibiotics must be meticulous based initially on the clinical suspicion, escalating the antimicrobial when the bacterium is isolated, and its sensitivity is known. The most isolated germs in implant-based reconstruction infections are *Staphylococcus epidermidis*, *Staphylococcus aureus*, *Serratia marcescens*, *Pseudomonas aeruginosa*, *Enterococcus*, *Escherichia coli*, *Enterobacter*, *Group B streptococcus*, *Morganella morganii*, *Propionibacterium*, and *Corynebacterium*. Initial cellulitis can be managed with oral fluoroquinolones. If this treatment fails, intravenous imipenem, gentamicin, and/or vancomycin must be prescribed [72, 73]. Severe infections with methicillin-resistant *Staphylococcus aureus* (MRSA) should be treated aggressively with vancomycin, teicoplanin, or tigecycline, in addition to draining infected sites. Cases with nontuberculous mycobacterial infections are fairly atypical, difficult to diagnose and treat [74–79]. The antimicrobial treatment must be aggressive and prolonged, and when there are implants, these must be removed. **Figure 3** shows a patient infected with *Mycobacterium chelonae* after liposuction.

Necrotizing fasciitis is a rare, potentially fatal, complication in plastic surgery that occurs more in liposuction. It requires extensive, repetitive debridement, and appropriate antimicrobial scheme. The most common germ is *Streptococcus pyogenes* [80].

3.2.2. Transoperative bleeding and hematoma

These are uncommon complications, although it does occur in patients undergoing prolonged procedures, especially in the postbariatric ones. A hematoma is present in up to 6% of patients



Figure 3. *M. chelonea* after liposuction.

after breast surgery. Facial surgery is rare but compromises long-term results. Most patients are reluctant to hemotransfusion. It is possible to correct moderate anemia without hemodynamic compromise with iron, folic acid, and erythropoietin. **Figure 4** shows typical cases of bleeding that may complicate the definitive outcome of surgery.

3.2.3. Neural damage

Nerve ending injuries are common in liposuction and abdominoplasty and manifest as neuropathic pain. Preventive use of gabapentinoids is useful. Major nerve damage can be seen



Figure 4. Transoperative active bleeding and residual postsurgical hematomas.

in facial and breast surgery. Inappropriate scarring is an unpredictable risk and sometimes produces neural entrapment with secondary chronic postoperative pain.

3.2.4. *Other injuries*

Liposuction is one of the procedures that are performed more frequently, and its complications are minimal such as seromas, deformities, and lymphoedema. Serious complications are rare, for example, hematoma (0.15%), pulmonary complications (0.1%), infection (0.1%), and PE (0.06%). When it is combined with other procedures, complication rates are higher. It has also been associated with catastrophic lesions such as pleuropulmonary, abdominal viscera, and vascular damage [81, 82].

3.2.5. *Cosmetic filler complications*

Soft tissue volumetric augmentation with filler injections is the second most frequent non-surgical procedure performed in plastic surgery, being the face and buttocks the areas more frequently injected. The increased use of a wide range of fillers has shown that they are not harmless, so it is crucial to briefly review possible complications. The transfer of autologous fat in the facial regions is the most used filling substance. There are a great variety of synthetic fillers that can be atoxic and nonimmunogenic or act as a foreign body and induce an immune reaction, granulomas, infections, fibrosis, and long-lasting or permanent body deformities [83–85]. Although very rare, transient or permanent blindness and cerebrovascular emboli are the most devastating complication of forehead and facial injection of synthetic fillers or autologous fat. It is believed that the injected filling can act as a retrograde embolus upon entering the ophthalmic artery or through the normal anastomosis between frontal branch of superficial temporal artery from external carotid artery and supraorbital artery from ophthalmic artery [86]. Cannata et al. [87] described a patient who was injected with polymethylmethacrylate microspheres in the legs, soon after developed infection at the site of injection, followed by postinfectious glomerulonephritis. Kidney biopsy revealed translucent, nonbirefringent microspherical bodies compatible with the injected filler. **Figure 5** shows facial deformations



Figure 5. Severe facial deformities secondary to an unknown illegal filler.

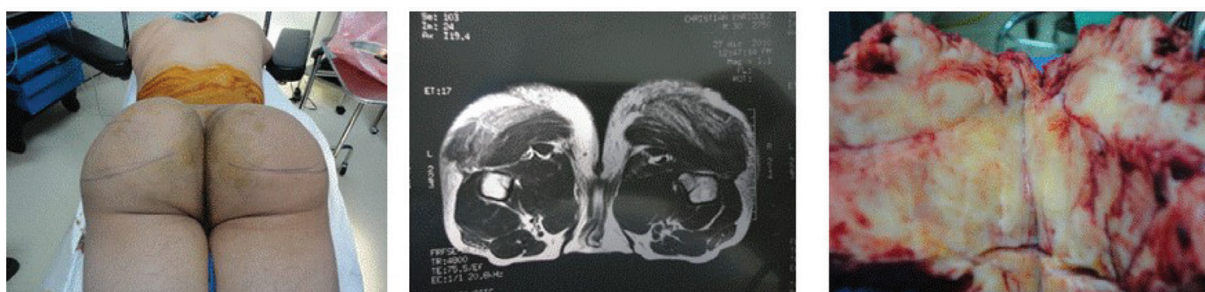


Figure 6. Deformities in the buttocks secondary to unknown substances. Observe extreme fibrosis.

secondary to injection of unknown filler, and **Figure 6** is an MRI that shows fillers injected in the buttocks, which produce fibrosis and deformations of the region by erratic migration, which are very difficult or impossible to correct.

4. Recommendations to reduce complications

Undoubtedly, the meticulous selection of each patient is the key to success in plastic surgery. When a patient does not have a physical and mental state required to undergo plastic surgery, the procedure should be deferred or canceled regardless of the interests of the patient and/or the medical group. When the complexity and risk of the procedure exceed the capacity of the surgical unit and/or the medical group, it is appropriate to refer the patient to a surgical unit or hospital with adequate resources [9, 86–89]. No anesthesia procedure should be considered as a minor method, and it is always necessary to work in a safe and effective surgical facility, following established guidelines, and in permanent communication with surgeons and nurses.

A study conducted in Havana Cuba [90] with 26 patients from that country found that personality traits can determine poor choice of people who apply for cosmetic surgery, some with psychosis and dysmorphophobia that induce expectations higher than the real ones.

5. Legal aspects

We live in a society of litigation where the doctors are easy prey to the ambition of the lawyers and some patients, a society where the governments create groups that exaggerate the rights of the patients making them believe that the improper results of the medical procedures are by negligence. There is a social environment—especially in government hospitals—where physicians are forced to work with multiple deficiencies as a routine practice, where health workers do not have adequate equipment and supplies, with long hours of work and few or no rights at all. There are few and inadequate preventive or curative programs [91]. The syndrome of professional exhaustion (burnout syndrome) has not been considered as a professional disease. To err is human and in this inadequate situation, it becomes a potential threat.

Anesthesiology is a science, with a high risk of undesirable events secondary to the use of drugs and techniques with narrow safety margins that facilitate unexpected complications. On the other hand, plastic surgery is a specialty where the unrealistic high expectations of many patients mean that despite adequate results—surgeons and anesthesiologists can trigger demands—when these results are not what the patient expects, and even when there are no complications. A growing number of patients establish negligence or malpractice claims—justified or not—and our practice tends toward an environment with a high incidence of litigation that sometimes forces specialists to search for geographic areas with a lower incidence of lawsuits [92]. Frequently, decisions of the legal system do not depend on the opinions of medical experts, or medical experts are not properly trained to review the events of a lawsuit in all specialties of medicine and surgery. Patients, their families, and lawyers usually make demands that do not progress due to lack of elements that support malpractice. An attorney should not file a lawsuit without the opinion of a physician skilled in the subject [93].

Park et al.'s [94] study of negligence claims in plastic surgery found responsibility between 30 and 100% of the cases, although the courts recognized that the economic compensation should be adjusted according to the victim, especially when there are associated pathologies which limit and make fairer compensation. Paik et al. [5] reviewed 292 cases of verdicts and liquidation reports in cosmetic breast surgery; the most common lesion was breast disfigurement in 53.1%, and negligent misrepresentation was 98% more likely to be resolved in favor of the complainant, while fraud was 92% more amenable to the complainant. The most common causes of citation were negligence in 88.7% and lack of informed consent in 43.8%. About 58.3% of the cases were in favor of the defendant and 41.7% in favor of the plaintiff. The compensation percentage agreed was 33.4 and 8.3% settlement. Payments ranged from \$ 245,000 to \$ 300,000 USD. A study with 88 cases of demand found in the west legal database [95] examined facial surgery procedures and found that 62.5% were decided in favor of the surgeon, 9.1% made agreements out of court, and 28.4% went to court for damages due to medical malpractice. The average payment was \$ 577,437 USD, and the jury average was \$ 352,341 USD, with blepharoplasty and rhytidectomy being the most litigated. In 38.6% of these cases, there were faults in the informed consent. There were also quarrels and disfigurements, functional considerations, and postoperative pain. The authors emphasize the importance of communication between patients and physicians regarding expectations as well as document benefits, alternatives, and specific risks. These studies show that negligence favors the demands in this clinical environment and emphasize that adequate transparency and communication are the key in the doctor-patient relationship, as mentioned in a previous publication [6].

Lawyers have promoted the lawsuit as a part of their *modus vivendi*. "Have you suffered as a result of a cosmetic procedure that you believe is due to the negligence of the surgeon? If you believe that your surgeon acted negligently and outside of his/her duty to care for you as a patient, we can help you." This type of information is found on the Internet, and it is associated to websites that guide patients on how to formulate their demands. In Colombia, doctors have expressed their concerns about the rigidity of their penal system [96], which temporarily suspended a plastic surgeon, in addition to imposing a prison for less than a year and compensation to the patient for 150,000,000 Colombian pesos (approximately 52,290 USD) in a complicated liposuction with necrotizing fasciitis. The authors discuss different

legal, ethical, and surgical, among other topics, and at the end, they argue the possibility to stop practicing surgery due to legal imputations every time a complication occurs. Although this would be an extreme measure, there are many colleagues who have retired after an incident. Well-qualified and experienced anesthesiologists and surgeons are not exempt from perioperative complications.

6. Conclusions

Perioperative complications of patients undergoing plastic surgery are infrequent when the medical group adheres to established guidelines and recommendations. Although these complications cannot be avoided at 100%, it is mandatory to establish preventive programs, and when these events happen, the diagnosis and timely management are imperative. Preanesthetic assessment is mandatory including meticulous search for risk factors; less than 10% of physicians working in the surgical room have disruptive behavior, and up to 98% of clinicians have observing troublesome conduct. It has been mentioned that this inappropriate behavior can facilitate complications. As in hospitals, ambulatory surgery units and all personnel must be properly certified and maintained on a permanent basis [97, 98].

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Conflict of interests

None.

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