Anesthesia for the Cosmetic Patient: An American Perspective

A. Roderick Forbes

1 Introduction

"Primum non nocere"

According to American Society of Plastic Surgeons (ASPS) statistics, there were 12.1 million cosmetic procedures performed in the United States in 2008, of which 13.8 % were surgical. ASPS member surgeons saw an increase in surgical procedures of 234 % from 1992 to 2008. The most commonly performed surgical procedures were breast augmentation, rhinoplasty, liposuction, blepharoplasty, and abdominoplasty [1]. More of these procedures are being performed in an office setting. The advantages of office-based surgery (OBS) include personal service, privacy, ease of scheduling, lowered costs, efficiency and consistency of personnel, and the ability to monitor and influence infection rates [2].

2 Patient Safety

Despite earlier concerns over safety in the OBS setting [3], recent reviews have concluded that OBS and outpatient surgery is safe if performed in an accredited facility by Board Certified surgeons credentialed for the same procedure in a hospital [4–6].

Factors contributing to a low rate of problems are trained anesthesia providers, careful patient selection, full preoperative preparation, adequate intraoperative and postoperative monitoring, and appropriate postoperative care [7]. In light of this, and in view of the increasing proliferation of OBS, and attendant office-based anesthesia (OBA), the American Society of Anesthesiologists (ASA) has recently published a manual addressing the administration of OBA, stressing that the standard of care in OBS should equal that of a hospital [8].

The manual covers the areas of facility administration, quality of care, the facility and safety, patient and procedure selection, perioperative care, monitoring and equipment, and emergencies and transfers. It emphasizes the importance of preparedness and planning, in addition to the equipment and drugs necessary to deal with the unanticipated emergency, ranging from the difficult airway, to cardiac dysrhythmia or arrest, to local anesthetic toxicity, anaphylaxis, uncontrolled bleeding, or malignant hyperthermia. It stresses the importance of a transfer plan to an alternate care facility should the patient's condition warrant it.

3 Patient Selection

Careful patient selection and preparation is vital to the safe provision of anesthesia and surgery in OBS. Since not all patients are candidates for OBS [8], the suitability of a particular patient and procedure should be determined in advance by discussion between the surgeon and anesthesiologist. Examples of unsuitable patients might include unstable patients ASA 3 or greater, or those with recent MI, recent stroke, cardiomyopathy, uncontrolled hypertension, poorly controlled diabetes, morbid obesity, MH history, severe COPD/OSA, or those with pacemaker/AICD [7]. This might include also a patient with a recognized difficult airway, and one lacking a responsible adult escort home.

Patients should undergo a complete history and physical, preferably by their own physician, ahead of surgery, to elicit their previous and current health, comorbidities, family and social history, medications, allergies and reactions, and prior anesthetic exposures and outcomes. The history should include a systems review. Physical examination would include general appearance, height, weight, vital signs, and cardiopulmonary examination in particular. A sample history and physical form is given by Iverson [9]. Lab testing would include EKG in those over 50 [10], or those with cardiac disease, with further testing dictated by the patient's medical condition [9, 11]. Each patient is then assigned an ASA

A.R. Forbes, MBChB, FFARCS
Department of Anesthesia, California Pacific Medical Center, San Francisco, CA, USA

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Table 1 ASA physical status classification system [12]

P1	A normal healthy patient
P2	A patient with mild systemic disease
P3	A patient with severe systemic disease
P4	A patient with severe systemic disease that is a constant threat to life

Physical Status (Table 1) [12]. The majority of patients will be healthy, ASA Class P1 or P2, with a small number being P3, having a severe systemic disease which is stable. Examples of patients within these categories by Twersky are given by Iverson [9]. Such predictors of intraoperative or postoperative events as hypertension, obesity, smoking, asthma, and gastroesophageal reflux can be detected at this point [13], and treatment optimized preoperatively if necessary.

Also at this time patients are assessed for their risk of thromboembolism and pulmonary embolism, which is the leading cause of mortality in outpatient surgery, being responsible for 57 % of the 2.02 deaths per 100,000 procedures reported by Keyes et al. from 2001 to 2006 [6]. The procedure most frequently associated with death from pulmonary embolism is abdominoplasty [6]. Attention should be paid to predisposing factors such as history of contraceptive and hormone therapy, history or family history of thrombosis or embolism, genetic disposition to clotting disorders, history of smoking, and edema, swelling, or lower limb venous insufficiency. Patients can then be classified as low, moderate, or high risk, based on their risk factors [14]. In high risk patients, in addition to slight flexion of the knees, and the use of sequential compression devices (SCDs), hematology consultation and antithrombotic therapy should be considered [14–16].

4 General Approach

"Patients have come to expect an almost perfect anesthetic and surgical experience, with safety and comfort being their foremost concerns" [17]. Initially the patient's history and physical is reviewed by the practice nurse ahead of surgery, and any concerns raised with the surgeon and/or anesthesiologist at that time. If necessary, the patient is contacted for further information, consultation or testing. The anesthesiologist endeavors to contact each patient before surgery, address any concerns and allay any anxiety at that time. On the day of surgery, the patient, appropriately fasting [18], is met by the anesthesiologist who conducts a preoperative history and physical in the patient's room, and discusses the anesthetic approach and expectations, in addition to the risks involved, until the patient is satisfied. After the surgical interview, the patient enters a warm operating room, where the blanket, sheet, and intravenous fluid have been warmed. A choice of music is offered. The appropriate monitors, noninvasive blood pressure, EKG, pulse oximeter, are attached. An intravenous cannula is inserted after a skin wheal of lidocaine with a 30G needle. A small dose of midazolam is administered to allay anxiety. A pillow is positioned under the knees to flex them slightly, and, for all except those undergoing a short procedure under minimal sedation, sequential compression devices (SCDs) are applied, and their proper functioning verified. All pressure points are gel padded and arms positioned appropriately. The patient's comfort is verified prior to proceeding. All patients receive antibiotic prophylaxis, analgesics, and a combination of antiemetics at the appropriate times. Temperature is monitored and the patient kept warm throughout. At the conclusion, when awake and stable, the patient is transferred back to the room accompanied by the anesthesiologist and the nurse who will attend and continue to monitor her until she is fully recovered and ready to leave the office. A patient who has undergone rhytidectomy, or abdominoplasty, will commonly be released to a qualified nurse who will attend her overnight.

5 Anesthetic Approaches

The ASA has described the continuum of depth of sedation from minimal sedation to general anesthesia, shown in Table 2 [19]. A variety of anesthetic approaches along this continuum, in addition to regional and conduction anesthesia, can be employed in the care of aesthetic surgical patients.

5.1 Monitored Anesthesia Care (MAC)

MAC is not a technique, but rather a "specific anesthesia service in which an anesthesiologist has been requested to participate in the care of a patient undergoing a diagnostic or therapeutic procedure" [19], commonly to provide a state ranging from conscious to deep sedation, to supplement local or regional anesthesia [20]. The benefits of conscious sedation are quoted as avoidance of cardiopulmonary effects of general anesthesia, airway injury, postoperative nausea and vomiting (PONV), and positional nerve injury, and less risk of deep venous thrombophlebitis [21]. Several agents have been employed to provide analgesia, relief of anxiety, amnesia, and optimal safe operating conditions. Those commonly used are midazolam and propofol for sedation, anxiolysis, and amnesia, and ketamine, fentanyl, alfentanil, and remifentanil for analgesia [20]. Frequently these drugs will have synergistic effects on level of consciousness and depression of respiration, requiring particular vigilance on the part of the anesthesiologist [22]. Although surgery is regularly performed safely with the MAC approach [23, 24], an analysis of closed claims involving injury associated with

Table 2 Continuum of depth of sedation: definition of general anesthesia and levels of sedation/analgesia [19]

	Minimal sedation/anxiolysis	Moderate sedation/ analgesia ("Conscious Sedation")	Deep sedation/analgesia	General anesthesia
Responsiveness	Normal response to verbal stimulation	Purposeful[a] response to verbal or tactile stimulation	Purposeful[a] response following repeated or painful stimulation	Unarousable even with painful stimulus
Airway	Unaffected	No intervention required	Intervention may be required	Intervention often required
Spontaneous ventilation	Unaffected	Adequate	May be inadequate	Frequently inadequate
Cardiovascular function	Unaffected	Usually maintained	Usually maintained	May be impaired

[a]Reflex withdrawal from a painful stimulus is NOT considered a purposeful response

MAC revealed that 40 % of claims involved death or serious injury, a percentage comparable to that of general anesthesia, with respiratory depression from sedative or opiate drug being most commonly responsible [25]. The authors considered nearly half the claims to have been preventable by better monitoring, carbon dioxide sampling, improved vigilance, or audible alarms. Underscoring this is the finding in a recent review of mortality in accredited facilities, which showed one death only attributed to an intraoperative event, when propofol, midazolam, and fentanyl were administered without a qualified anesthesia professional in attendance [6].

Further along the continuum of sedation, the combination propofol-ketamine, described as dissociative anesthesia, has been reported to result in a low incidence of postoperative nausea and vomiting (PONV), and a reduction in the need for opioids [26]. A more recent approach in the combination of agents is that of adding dexmedetomidine to a regimen of propofol, fentanyl, ketamine, and midazolam [27]. Dexmedetomidine is an α2 adrenergic agonist, which induces sedation and analgesia when administered as an infusion, lowering blood pressure and heart rate, reducing narcotic and sedative requirements, resulting in fewer episodes of oxygen desturation, and resulting in less antiemetic and narcotic use postoperatively [27, 28]. Some of the same agents can be used also in combination to produce total intravenous anesthesia (TIVA), predominantly relying on propofol [20], an approach which results in a lowered incidence of PONV compared to volatile anesthetic agents [29, 30].

5.2 General Anesthesia

In complex, combined, or prolonged procedures, general anesthesia (GA) confers several advantages, including control and protection of the airway, and reduction of the risk of inadvertent patient movement or pain perception, allowing the surgeon to focus on the operation without distraction. This can be accomplished at minimal risk to the patient in an accredited facility with qualified staff [17, 31]. A comparison of the recovery profiles of propofol, isoflurane, sevoflurane, and desflurane revealed that, with the exception of a lower incidence of PONV after propofol, the differences among agents were small, and the differences in recovery times to discharge were 5–15 min [30], not likely to be relevant in a setting where patients remain under observation in the office for some time. Gupta noted that the concomitant administration of other drugs may well have negated the advantage in awakening and recovery of the newer inhaled agents.

5.3 Low Flow Anesthesia

In the office setting, when administering inhaled anesthesia, a technique utilizing a low fresh gas flow (FGF) offers several advantages, chiefly those of less waste of agents, reducing costs [32], and lowering environmental pollution, obviating the need for an expensive waste scavenging system. The waste anesthetic gas can be removed by a simple disposable activated charcoal filter [33]. Low flow also retains heat and moisture in the patient's airway. Since a low FGF approach is not commonly utilized in a general hospital-based practice, it is worthwhile explaining what is entailed. A detailed discussion is beyond the scope of this chapter, but may be found by Hendrickx & De Wolf in Modern Anesthetics [34].

The circle absorber system is the most commonly used anesthesia breathing circuit. Fresh gases, oxygen, nitrous oxide and air, start at the rotameters of the anesthesia machine, then pick up the selected anesthetic vapor, isoflurane, sevoflurane, or desflurane, at a concentration determined by the dial on the vaporizer. These enter the inspiratory limb of the circuit as the inspired gases. They are taken up by the lungs during induction and maintenance of anesthesia. The expired gases, a mixture of alveolar gas and dead-space gas from the airway which has not taken part in gas exchange, are then directed by one-way valves to the expiratory limb, then to the breathing bag during spontaneous respiration, or the ventilator bellows during controlled ventilation. Carbon dioxide is removed by the soda-lime absorber. Excess gas is vented to the atmosphere, typically through a scavenging system. When the FGF exceeds the patient's minute volume, i.e., high flow anesthesia, the inspired concentration will be the same as that delivered in the FGF, and all the expiratory gas will be vented. When the FGF is less than the minute ventilation, i.e., low flow anesthesia, the inspired gas will be a mixture of fresh and expired gas with a lowered concentration of oxygen and vapor, from which the expired carbon dioxide has been removed. When the FGF is lowered to 500 ml/min, approaching the sum of oxygen uptake, around 240 ml/min [35], anesthetic uptake, and sampling gas removed by the gas analyzer, around 200 ml/min, this becomes very low flow (VLF) anesthesia. Because at this point the bulk of minute ventilation now consists of expired gas with a lower oxygen concentration than that delivered by the anesthesia machine, and because anesthetic uptake can vary considerably between patients [36], it is mandatory that the anesthesiologist monitors, and pays close attention to, inspired and alveolar (end-tidal) concentrations of oxygen and anesthetic agent measured by the gas analyzer at the patient connection, Y-piece, of the circuit. Because anesthetic uptake varies with time, being maximal initially, falling to a slowly decreasing level thereafter, a higher FGF during induction will be necessary for a few minutes to establish an adequate alveolar and, hence, brain concentration before initiation of minimal flow. Various flow patterns have been developed to achieve a constant concentration rapidly [37–40].

Although nitrous oxide may be utilized in low flow anesthesia, it is not adsorbed by the scavenging charcoal filter, and for this, and its effect on PONV and other complications [41, 42], there are those who question its use [43, 44]. To avoid prolonged exposure to 100 % oxygen, nitrogen may be restored to the circuit, by introducing a low flow of air to the FGF mix, e.g., oxygen 400 ml/min, and air 100 ml/min, which results, at equilibrium, in an inspired oxygen concentration of 71 % [45]. Because the inspired concentration of oxygen will be lower than the fresh gas concentration, close attention must be paid to the measured inspired oxygen level [45], and vigilance and appropriate alarms are necessary.

The takeaway from this is that low flow, and very low flow anesthesia, with the help of recent knowledge and study, and with accurate and reliable gas analyzers, can be successfully utilized in the OBS setting, with considerable benefit.

6 Specific Procedures

6.1 Rhytidectomy

As always, individual practitioners should choose their technique and approach based on training and experience, and the particular needs of their patients. For the reasons previously discussed, and according to the preference of the surgeon, our approach is to provide general anesthesia, accompanied by infiltration of lidocaine and epinephrine in saline. We employ a volatile anesthetic, except in patients at very high risk of PONV. After a premedication of midazolam and fentanyl, and preoxygenation, fluid replacement is instituted, and induction accomplished with propofol. Endotracheal intubation, with a lubricated small diameter endotracheal tube, is achieved after a small dose of rocuronium, and commonly no further muscle relaxant is administered. The position of the endotracheal tube is verified, and the tube clearly marked at the lips, so that it is visible at all times. The eyes are protected with sterile lubricant, and subsequently covered with a clear sterile dressing. Ventilation is controlled, and the initial phase of higher gas flow of oxygen and volatile anesthetic begun. When the end-tidal anesthetic concentration has reached the desired level, very low flow (VLF) is instituted, and the vaporizer setting adjusted to maintain the desired level. During this time typically one side of the brow, face, and neck, as appropriate, will be infiltrated by the surgeon with a solution of lidocaine 0.2 % and epinephrine 1:250,000 in saline. Any shortfall in the depth of anesthesia at this point can be augmented by propofol and/or fentanyl. During this time close attention is paid to blood pressure, first to guard against hypotension on induction, treated with a small dose of ephedrine as necessary rather than fluid challenge [46], and subsequently to lower blood pressure as necessary to facilitate dissection and minimize bleeding. A moderate reduction only is sought, to a level above that defined as controlled hypotension (mean arterial pressure 50–65 mmHg, or 30 % reduction from baseline) [47]. If an adequate anesthetic level does not achieve this, fentanyl and labetalol are added as necessary. Since there is no appreciable third space loss, fluid administration is generally minimal after replacement of the fasting deficit. The fasting deficit itself may be less than previously assumed, since intravascular volume is normal even after an overnight fast [46]. This approach results in a modest fluid administration, tailored to the patient's needs [48], avoiding bladder distension in shorter procedures. In prolonged procedures a urinary catheter is inserted during anesthesia.

Prior to closure of the first side, the blood pressure is allowed to rise to preinduction levels, assisted by a small dose of ephedrine if necessary, so that adequate hemostasis may be assured. Turning of the head, and infiltration of the second side, is anticipated with a dose of fentanyl. Infiltration of the second side at this point will typically result in a total dose of lidocaine around the recommended limit of 7 mg/kg, although a recent study showed that doses three times that resulted in peak plasma lidocaine levels well below 5 mcg/ml [49]. Again, prior to closure of the second side the blood pressure is allowed to rise. Restoration of neuromuscular function is confirmed, and spontaneous respiration allowed to resume if it has not already done so. Then, to facilitate a smooth emergence without excitement or coughing, a dose of narcotic is titrated, the anesthetic level allowed to wane, and propofol administered as small bolus doses or as an infusion until completion of surgery [50]. Gentle suction of the pharynx is performed, and the endotracheal tube removed when the patient responds appropriately to voice. There is a significant reduction in incidence and severity of coughing at extubation in patients emerging from propofol compared to sevoflurane anesthesia [51]. During this time too, labetalol is given as necessary to forestall or attenuate any rebound hypertension, a major determinant of postoperative hematoma [52].

6.2 Abdominoplasty

An approach similar to the above is utilized for abdominoplasty. No skin infiltration is employed, but a continuous local anesthetic release device may be employed in postoperative pain management. Adequate analgesia is assured prior to awakening. In view of the importance of avoiding coughing and straining during emergence when the rectus muscle sheath has been imbricated, the following maneuver may be considered [53], provided the patient is not at risk of gastroesophageal reflux, and no difficulty with the airway has been encountered or is anticipated. With the patient flexed, in the head up position, the stomach and pharynx are suctioned. With the patient breathing spontaneously at an appropriate depth of anesthesia, a laryngeal mask airway (LMA) is inserted behind the larynx, the cuff inflated, and the endotracheal tube removed. Subsequent awakening and removal of the LMA result in fewer respiratory complications than seen with tracheal extubation alone [53].

6.3 Breast Augmentation/Reduction

Submuscular placement of an implant will require adequate muscle relaxation to allow stretching and dissection, and an adequate view to achieve hemostasis in the pocket. If this cannot be achieved with depth of anesthesia alone, then muscle relaxant may be required. Because of anticipated muscular pain and spasm, adequate analgesia is administered prior to a smooth awakening. The simple expedient of instilling bupivacaine for ten minutes, and subsequent removal through the drains at closure, has been shown to help in postoperative pain management in reduction mammaplasty [54].

6.4 Liposuction: "Superwet" Technique

This surgical technique involves the injection, in the ratio of 1:1 with the anticipated volume of fat to be removed, of a solution containing lidocaine 0.04 %, and epinephrine 1:1,000,000 in saline. This is typically a volume of 2–3 l, well below the threshold of 5 l considered large volume liposuction, and within the commonly accepted dose of 35 mg/kg of lidocaine [8]. The procedure is usually neither extensive nor prolonged, factors cited as presenting a greater risk of complication, particularly pulmonary embolus [55]. Commonly it involves truncal liposuction, with a position change from prone to supine. This can be accomplished with MAC [24], or GA, but lends itself to the use of MAC for the flank approach in the supine position, with CO_2 monitoring per nasal cannula, and with the level of sedation tailored to allow the patient to cooperate in the position change to supine. After this the sedation may be deepened, to GA if necessary and desired, and the airway secured, for the more extensive anterior approach. This requires appropriate patient selection, and a thorough explanation to, and consent from, the patient preoperatively. SCDs are utilized throughout, regardless of approach, in a warm environment, and a warming blanket applied where possible. Although fat is removed in a 1:1 ratio with the fluid injected, up to 70 % of the injectate will be absorbed, and blood loss is reported to be around 1 % of the aspirate volume. Fluid administration under these circumstances should be at maintenance levels only [56].

7 Postoperative Nausea and Vomiting

In office-based aesthetic surgery, PONV is undesirable from all points of view, and aggressive preventative measures are appropriate. Apfel's simplified score for prediction of risk [57] shows patient risk factors of female gender, nonsmoker, postoperative requirement for opioids, and a history of PONV or motion sickness. The corresponding risks of PONV for patients having 0, 1, 2, 3, or 4 of these factors are approximately 10, 20, 40, 60, and 80 %, respectively. Apfel subsequently found that each of the four interventions, ondansetron, dexamethasone, droperidol, and substitution of propofol and nitrogen for volatile agent and nitrous oxide, was equally successful in reducing the incidence of PONV in the 24 h after surgery [58]. Each intervention reduced the risk by 26 %, all worked independently, and combinations had additive effects. In lieu of droperidol, which has fallen out of favor, metoclopramide could be considered [59]. A patient at moderate risk might receive a combination of two prophylactic antiemetics at the appropriate times, and one at high risk might receive two or three antiemetics, or a multimodal approach including those plus a TIVA of propofol and low dose ketamine, e.g., to reduce narcotic requirements [60]. A comparable multimodal approach, including anxiolysis and hydration in addition, has come close to eliminating PONV [61]. Rescue therapy, if required, would then be from a different group from the prophylactics, e.g., prochlorperazine or promethazine [60].

8 Special Situations

8.1 Operating Room Fires

The face is the second most common area of the body damaged by fire in the OR. In a closed claim analysis of injury associated with MAC, 17 % of claims involved burn injuries to the face from electrocautery in the presence of supplemental oxygen [25]. The problem of OR fires was addressed in an ASA Practice Advisory, which includes an algorithm for prevention and management [62]. For a fire to occur, the classic triad of components must be present; an ignition source, e.g., electrocautery; fuel, e.g., drapes, alcohol prep; and an oxidizer, e.g., oxygen, nitrous oxide. These conditions are commonly present in aesthetic facial surgery performed under MAC, with supplemental nasal oxygen. In addition to the preventive measures in the algorithm, where the airway is not secured, the concentration of oxygen around the face may be reduced in other ways. One such is the approach described by Taghinia [27], involving use of dexmedetomidine to minimize respiratory depression, and hence the need for supplemental oxygen. Another is to deliver oxygen to the posterior pharynx via a cannula inserted through a soft rubber nasopharyngeal tube, which has been shown to reduce oxygen concentration over the face to that of ambient air [63].

8.2 Malignant Hyperthermia (MH)

Although every effort should be made to identify a patient at risk of MH, any site where triggering anesthetics and/or succinylcholine are administered should be equipped to manage MH. This means personnel must be ready to diagnose and treat an episode with the appropriate supplies and drugs, particularly dantrolene, and have in place an emergency transfer plan [8]. A current approach to the emergency treatment of MH can be obtained from MHAUS [64].

8.3 Local Anesthetic Toxicity

Since large volumes and doses of local anesthesia can be administered in aesthetic surgery, a protocol should be in place for the treatment of toxicity. Guidelines for the management of severe local anesthetic toxicity are posted on the website of the Association of Anaesthetists of Great Britain and Ireland [65].

8.4 Anaphylaxis

Although rare, anaphylaxis can be catastrophic, presenting suddenly as cardiovascular collapse and bronchospasm [66]. In the perioperative period where a large number of drugs are given in a short time, those most commonly involved are muscle relaxants, latex, and antibiotics, in that order [67]. Management consists in discontinuation of the anesthetic and drugs and immediate administration of epinephrine [66, 68]. Airway support with 100 % oxygen; intravenous fluid replacement; histamine blockers, both H1 and H2; bronchodilators; and corticosteroids will also be required. In cases refractory to epinephrine, norepinephrine, metaraminol, or glucagon are recommended, and vasopressin may be an alternative 68].

Conclusion

The trend towards office-based procedures in aesthetic surgery is likely to continue. If attention is paid to proper patient and procedure selection, careful preoperative evaluation, adequate intraoperative and postoperative monitoring, and appropriate postoperative care with minimal pain or nausea, the same techniques of anesthesia that apply in the hospital may be tailored to the needs of the patient and procedure in an accredited office setting to provide a safe and pleasant experience for the aesthetic surgical patient.

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