



Anesthe advances in



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Anesthesia is 50 times safer today than it was in the 1980s.¹ With superior monitoring devices, ultra-short-acting agents, and more techniques to choose from, anesthesia care can be tailored carefully to almost any patient population. A study conducted by Mathis and colleagues involving 244,397 adult surgical outpatients had a complication rate for outpatient surgery of 0.095% (or 1 in 1,053).² Some of the larger cases reviewed in this study were laparoscopic cholecystectomies, laparoscopic gastric band placements, and partial mastectomy with axillary lymph node excision.

A brief history of anesthesia

Ether was used for the first time in January 1842 for a tooth extraction. The first public demonstration of ether to the public took place at Massachusetts General Hospital in October 1846 for an excision of a neck mass.³

In 1844, Horace Wells used nitrous oxide for teeth extraction. During one demonstration to the public, the patient (a medical student who volunteered for the tooth extraction) cried out. While he felt no pain, the audience interpreted the crying out as a failure of the agent. The Colton Dental Association was the forerunner of modern ambulatory surgery. Nitrous oxide was used for thousands of extractions in practice without any deaths. A hypoxic mixture (100% nitrous oxide) could be given, as there was

no method for mixing gases. Eventually, devices were designed that allowed for a mixture of oxygen and nitrous oxide.³

Chloroform was initially seen as an anesthetic in 1847. Its pleasant smell made it popular for obstetrics and pediatrics. Dr. James Nicoll, a pediatric surgeon, ran the first known ambulatory surgery center in Glasgow Scotland from 1899 to 1908. He noted that returning his pediatric patients home helped them to avoid healthcare-associated infections and that most mothers were able to care for their children at home postoperatively.³

Minor operations were performed in physicians' offices, in patient homes, and in clinics after World War I. The 1940s brought the advent of newer medications, such as neuromuscular blocking drugs, better anesthesia machines, and newer, nonflammable anesthetic gases. Spinal anesthesia became acceptable to the public after publication of a study that looked at over 10,000 spinal anesthetics and demonstrated the safety of that technique.³

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The concept of the modern ambulatory surgery center was established in 1962 by two anesthesiologists: Drs. David Cohen and John Dillon.³ They looked at quality control, preoperative assessment, and the availability of appropriate equipment. Processes were designed for safe patient selection, assessment, recovery, discharge, and case cancellation. In the 1970s and 1980s, ambulatory surgery grew to what it is today. Cases take place in free-standing ambulatory surgery centers (ASCs), physicians' offices, or ambulatory centers contained within hospitals. Furthermore, more efficient and safer surgical techniques and anesthetic agents make outpatient surgery a viable option for many patients today.

Malpractice claims tend not to be made as often for ambulatory cases and payouts not as large as they are for inpatient cases.⁴ Differentiation is made between claims for cases done in ASCs versus office cases;



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claims are much higher for cases done in offices than for those done in ASCs.⁴ It is postulated that the cause for the increased number of claims in office-based anesthesia is due to substandard care or insufficient monitoring. The postdischarge period may be more complicated regarding risk than one may think. More complex surgeries are being performed on an outpatient basis than were previously. In addition, patients with more complex disease processes and more comorbidities are having surgeries performed on an ambulatory basis than in the

past. This means that when they go home, care and observation must be more meticulous than with less complex patients who have less complex medical issues and procedures.

Special populations

Obstructive sleep apnea: Suitability for ASCs for patients with obstructive sleep apnea (OSA) is questionable due to the possibility of profound, often fatal consequences.⁵ Some examples include: difficulty with ventilation and endotracheal intubation, difficulty maintaining an acceptable oxygen saturation, pulmonary edema, exacerbation of cardiac problems (known and often unknown), stroke, increased hospital stay, and death (often post discharge). These patients often have comorbidities, such as diabetes mellitus, obesity, hypertension, and cardiovascular and/or cerebrovascular disorders. Patients with comorbidities (especially ones that are not optimized preoperatively) and who are going to receive opioids for postoperative pain may not be good candidates for outpatient procedures and anesthesia.

Patients with OSA who may be good candidates for ambulatory procedures and anesthesia are those whose comorbidities are well controlled and whose postoperative pain can be controlled with nonopioid drug classes, such as nonsteroidal anti-inflammatory drugs (NSAIDs), COX-2 inhibitors, and acetaminophen. A consensus statement was developed by the Society for Ambulatory Anesthesia in order to help practitioners discern what patients are suitable for procedures and anesthesia in an ambulatory setting.⁵

It recommends use of the STOP-Bang screening questionnaire as a component of the preoperative evaluation process for OSA. The STOP-BANG questions are:^{5,6}

S = Snoring. Do you snore loudly (louder than talking or loud enough to be heard through closed doors)?

T = Tiredness. Do you often feel tired, fatigued, or sleepy during the daytime?

O = Observed apnea. Has anyone observed you stop breathing during your sleep?

P = Pressure. Do you have or are you being treated for high BP?

B = BMI greater than 35 kg/m²

A = Age over 50 years

N = Neck circumference greater than 40 cm

G = Gender male

Morbid obesity: Patients with morbid obesity tend to have more comorbidities than other patients. Therefore, they are at increased risk for perioperative problems. Preanesthesia testing is done based on comorbidities and the proposed procedure. Pre-op cardiac assessments for morbidly obese patients include ECG, chest X-ray, and exercise testing with possible stress echocardiography. Two courses of action are possible if the morbidly obese patient is suspected to have OSA: One is that it can be assumed that the patient has the disorder and they are treated accordingly, or two, send him for a sleep study.^{5,7}

There are some questions with unknown answers. For example, what is the optimal time a patient should be on continuous positive airway pressure therapy to improve perioperative outcomes? In addition, does having OSA documented by sleep study actually improve perioperative outcomes (or suspecting it and treating the patient accordingly may have the same outcome)? Selection for ambulatory surgery should also take into consideration the proposed or required anesthetic technique, anticipated postoperative opioid requirements, and ability to comply with discharge instructions.⁵ Patients with BMIs between 40-50 kg/m² should be assessed for co-morbidities that may render them unsuitable for out-patient surgery. Examples of these conditions include: obesity-related hypoventilation syndrome, OSA, pulmonary hypertension, resistant hypertension, significant coronary artery disease, and resistant cardiac failure.

Intraoperative use of opioids and neuromuscular blocking drugs must be judicious so that the patient is in optimal shape from a respiratory standpoint for extubation at the end of the case. Likewise, neuromuscular blocking drugs must be fully reversed to assure that there is no residual neuromuscular blockade post extubation. Morbid obesity can also impact the post-op course due to the conditions it predisposes the patient for (for example, deep vein thrombosis).

The morbidly obese are also prone to gastric acid aspiration, so special care must be taken with their preoperative preparation regarding fasting, H₂-receptor antagonist or proton pump inhibitor administration, and nonparticulate antacid administration. Postdischarge avoidance of opioids for pain relief is preferable. NSAIDs, nerve blocks, COX-2 inhibitors, acetaminophen, or infiltration of local anesthetics at the operative site are all options that should be considered.

Pediatrics

One of the most difficult things about having surgery, for some patients, is the traditional "NPO after midnight" status. For children, it can be particularly difficult, especially since younger children do not understand why they cannot eat or drink. For parents, it can be frustrating. These guidelines have become more relaxed for children who are not at aspiration risk.⁸ Chiefly, clear liquids may be given up to 2 hours before general anesthesia is induced. Breast milk may be given up to 4 hours preinduction, and nonhuman milk or a light meal (for which no definition is offered) up to 6 hours.

Children with OSA pose the same challenges as adults with this diagnosis. A group of children, especially those less than 3 years of age, are more at risk for complications, including: apnea, oxygen desaturation less than 90%, atelectasis, pneumothorax, or pulmonary edema.⁸ These children should not be anesthetized in an outpatient center with the expectation of same day discharge.⁸ Children with a risk of apnea should be admitted overnight with monitoring (for example, apnea monitors and pulse oximetry). These patients include "former premature infants younger than 55 to 60 post-conceptual age, full-term infants younger than 44 weeks post-conceptual age who demonstrate any abnormalities, and certain children with sleep apnea who are recovering from tonsillectomy."⁹

Deciding which children are good candidates for surgery and anesthesia is important. Children with current medical problems, such as upper respiratory infections, must be evaluated for severity, symptoms, and duration of illness. Children with chronic medical problems must be evaluated as well. Is the chronic issue anatomic and/or physiologic in nature? If so, what is its impact on daily living? What influence will the surgical procedure and/or anesthesia have on it? Is this something the family can care for at home post-op? The sicker and more unstable a child is, the more depth must be applied to case analysis. Does the child need this procedure now? Can it be postponed, and if so, for how long? Has it already been postponed? Sometimes, social issues like travel, other children who need to be cared for at home, and work-related aspects need to be considered too.

Special considerations

Postdischarge nausea and vomiting (PDNV) occurs in about 37% of patients after they are discharged from the ASC.¹⁰ Five factors have been isolated as having predictive value of this occurrence: female gender, age less than 50 years, history of nausea and/or vomiting after past anesthetics, opioid administration in the post anesthesia care unit (PACU), and nausea in the PACU. The higher the number of these factors the patient has, the more likely he or she is to develop PDNV. Reducing risk is a primary goal of the anesthesia staff when caring for patients who are prone to postoperative nausea and vomiting (PONV) or PDNV.

Some strategies used are to avoid general anesthesia (especially inhalational agents), opioids, nitrous oxide, and dehydration. Some steps that can be taken to adequately anesthetize the patient and avoid PONV/PDNV include:

- Using a total I.V. technique if general anesthesia is necessary (for example, propofol, remifentanyl, and neuromuscular blocking drug infusions [the latter only if absolutely necessary due to surgical requirements])
- Trying not to use neuromuscular blockers, if possible, so that reversal can be avoided
- Using regional anesthesia techniques
- Using NSAIDs, COX-2 inhibitors, acetaminophen preparations for pain
- Careful management of fluid administration during the perioperative period.

One has to assess how many risk factors a patient has and base a prophylaxis regimen on that for PONV/PDNV prophylaxis. That is, the more risk factors a patient has, the more aggressive the provider should be in prophylaxis.¹¹ Five-hydroxytryptamine (5HT-3) receptor antagonists, such as ondansetron, are well known for their antiemetic capability. The Neurokinin-1 (NK-1) receptor antagonist, aprepitant, has been used increasingly for prevention of PONV, with some promising results, although more studies are needed to evaluate the drug for treatment of PONV/PDNV.

Butyrophenones, such as droperidol and haloperidol, have antiemetic properties and are used FDA off-label for PONV.¹¹ Droperidol has a black-box warning from the FDA because it is associated with electrocardiographic abnormalities, such as QT interval prolongation and torsade de pointes. Antihistamines (dimenhydrinate and meclizine) have antiemetic properties and have also been used for PONV.¹¹ Anticholinergics such as transdermal scopolamine may be used as well. Dexamethasone (used off-label) has become well known for its antinausea/vomiting abilities over the last decade as well.¹¹ Alternative methods of treatment, such as P6 meridian stimulation (“anti-nausea bracelets”), aromatherapy, ginger, and cannabis (in states where it is legal), may also be considered.

Difficult airway management

Difficult airways, both anticipated and unanticipated, are a part of anesthesia practice. It is important that the anesthesia provider is adept at using a variety of airway devices. It is also important that the anesthesia provider’s perioperative colleagues, including perioperative nurses, technicians, and surgeons, understand the complexity of the difficult airway situation and the role they play. Perioperative nurses, technicians, and surgeons are a vital part of the difficult airway experience when it is anticipated and are absolutely crucial when the unanticipated difficult airway emerges.

A systematic approach to airways is best.¹² The anesthesia provider must start with a careful airway assessment, look at the surgical procedure and how it will affect the airway and its management, and lastly, whether or not the ASC has the resources available to effectively deal with the difficult airway in question.

While some procedures, such as cataract extraction, lens implantation, carpal tunnel releases, and minor orthopedic procedures do not seem to require complex airway control on the surface, one must be cognizant of the fact that local anesthesia toxicity, inability to adequately localize patients who become uncooperative during a procedure lasting longer than anticipated may require sudden airway management. Patients should have their procedures performed in a hospital OR if the ASC is not adequately resourced with trained personnel and equipment.

Other procedures that must be considered are ones that deal with the airway itself, ones that require the airway to be dependent for a considerable portion of the surgery (such as the prone or Trendelenburg position) and may result in substantial airway edema by the end of the case. Even if the airway was able to be intubated at induction of anesthesia, it may present other challenges at the end of the case when extubation is anticipated (for example, endotracheal intubation may need to be maintained; something that is not compatible with an ASC case). Properly trained PACU nurses must be considered at this point. If the patient is able to be extubated at the end of the procedure, expert observation with the ability to readily call for help and intervene must be assured in the PACU.

The concept of “de-skilling” is of interest here.¹² This is where staff who exclusively work in facilities such as ASCs (places that usually do less complex surgeries on generally healthier patients) lose some of their skills, or their skills denigrate to some degree. Multifaceted training is recommended to prevent this. For example, in addition to manikin-based simulation, cadaver labs, lectures, workshops, and problem-based learning should be considered. These educational options can be used by anesthesia staff to regain lost or denigrated skills. They can also be used by OR/PACU staff to learn new airway management skills (for example, how they can assist the anesthesia provider manage a difficult airway).

Regional anesthesia/analgesia in ambulatory surgery

Regional anesthesia and analgesia play an important role in ambulatory procedures. However, careful planning is necessary. The techniques and agents used must be carefully considered so that

patients can have their procedure done in comfort, have some residual pain relief from the nerve block(s) postoperatively, and be discharged in a timely manner. Some advantages noted include: decreased stress hormone production, decreased opioids, decreased intraoperative anesthesia, and profound, but short-lived postoperative analgesia.¹³ It is important that if the patient is not being discharged with peripheral nerve block catheters, that he or she be converted over to some other form of pain medication, usually an oral agent(s) of some class.

Subarachnoid blocks (ISABs), also known as spinals) are a good technique for many outpatient cases. However, care must be taken that an appropriate agent is used so that the patient does not spend hours in the PACU waiting for the block to recede. Many orthopedic cases and some general surgical cases, such as hernia repairs, lend themselves nicely to this technique.¹⁴ Epidural anesthesia is also an alternative, particularly with cases that may have uncertain end times. There are certain untoward effects that are associated with SABs and epidural anesthesia: postdural puncture headache, transient neurologic symptoms, and urinary retention.¹⁴ These are not common in that they do not happen all the time, but when patients hear about these anesthesia options, they may have heard about these possible issues and will inquire about them.

Peripheral nerve blocks (PNBs) are useful for surgical anesthesia and postoperative pain management. In ASCs where time can be a factor, there must be a plan in place to efficiently place these blocks. The PNBs must also have a high success rate or else surgeon and patient satisfaction will decline. If the patient is meant to be discharged to home with an indwelling catheter for a continuous block, careful patient selection must be made so that the catheter and infusion are properly cared for so the patient reaps maximum benefit from this technique.

Moving forward

Patient selection, center readiness, and providers who understand the differences between inpatient and outpatient facilities strongly influence the success or failure of an ambulatory surgery center. A study that looked at predictors of morbidity and mortality in ambulatory surgery cases cited seven issues that

increased the likelihood of a problem: overweight and obese BMIs, extended operative times, COPD, hypertension, previous coronary procedures (such as percutaneous coronary interventions or open heart surgeries), and a history of cerebrovascular events, such as a transient ischemic attack and stroke.²

Patients and staff can find the ambulatory surgery experience to be very satisfying. Most patients and their families like the idea of not having to stay in the hospital overnight. However, patients must be selected for this experience who can care for themselves once they return home or have a support system in place to help them. **OR**

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