Anesthesia Litigation

Clinical Basics and Current Liability Issues

By Walter J. Price III and Jennifer Devereaux Segers

The challenge faced by defense counsel is grasping the multiple elements involved in anesthesia litigation, as well as being able to apply this information to commonly presented claims.

It is notable that Oliver Wendell Holmes was the first, in 1846, to use the term "anesthesia" to describe the state of amnesia, analgesia, and narcosis, which made painless surgery possible. *Morgan & Mikhail's Clinical Anesthesiology* 1 (5th ed. 2013). This description, by the father of the American jurist Oliver Wendell Holmes, Jr., describes the combination of conditions created by various medications and agents. The description by the father of a United States Supreme Court justice is significant because commentators have noted that all anesthesia practitioners will have patients who experience unexpected and adverse outcomes, and those providers, in some fashion, will likely be involved in medical malpractice litigation in one way or another. *Id.* at 1,200. And anesthesia-related claims are quite costly. Kris Ferguson, *et al.*, *Anesthesia Related Closed Claims and Litigations at the Detroit Medical Center: Analysis, Lessons Learned, and Conclusions,* Open Journal of Anesthesiology, Vol. 4, 95 (2014). Most involve certified registered nurse anesthetist (CRNA) care. *Id.* at 91. Recently, these claims have involved allegations surrounding anesthetic care of the obese, residual neuromuscular blockade, and post-anesthesia care.

Historically, the first general anesthesia agents were inhalation agents or medicines in the form of gas or vapor that were inhaled. *Morgan & Mikhail's Clinical Anesthesiology* 2 (5th ed. 2013). After centuries of development, today sevoflurane is the most widely used inhalation agent in the United States. *Id.* at 3. Ultimately, as anesthesia medications continued to develop, intravenous anesthesia evolved, after the invention of the hypodermic syringe and needle. *Id.* at 4. Developed in 1962, ketamine is still used today. However, propofol, with its short duration of action, is the most used anesthetic agent for intravenous induction. *Id.*

To induce the condition described by Holmes, neuromuscular blocking agents are used, which relax muscles even without deep anesthesia. *Id.* Oftentimes, these are referred to as paralytics. Interestingly, the

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development of modern neuromuscular blockades can be traced to curare, the paralyzing poison used on arrows or blow gun darts by South American indigenous people. Albert M. Betcher, M.D., *The Civilizing of Curare: A History of Its Development and Introduction into Anesthesiology,* Anesthesia and Analgesia, Vol. 56, No. 2, 305–319 (1977). Analgesia is generally obtained through the use of opioids though concerns about respiratory depression and overuse of these medications has led to efforts to seek alternatives. *Morgan & Mikhail's Clinical Anesthesiology* 4 (5th ed. 2013).

Anesthesia Equipment

Anesthesia involves various breathing circuits that connect the patient either to a source of gas or the anesthesia machine. *Id.* at 29. One, insufflation, involves blowing anesthetic gases across the patient's face. During this process, the patient cannot rebreathe exhaled gases; however, the patient's ventilation cannot be controlled. Also, the inspired gas includes uncertain amounts of atmospheric air, making the mixture unpredictable. *Id.* at 30.

Ambu bags or bag mask valves or units are commonly used for emergency ventilation. *Id.* at 40. These devices are considered to be readily useable by non-physician providers, including, for example, emergency medical technicians. *Id.* Ambu bags are portable and able to deliver almost 100 percent oxygen. *Id.*

The anesthesia machine itself is used to control a patient's ventilation and oxygen delivery. *Id.* at 44. Further, it is used to provide inhalation anesthetics. *Id.* These machines use carbon dioxide absorbers to remove carbon dioxide from the circular circuit system so as to prevent a patient from rebreathing carbon dioxide. *Id.* Soda lime is the most common carbon dioxide absorber used, and the material changes colors over the course of the procedure from white to purple, indicating a need to replace the material. *Id.* at 37–38.

During anesthesia administration, the patient's oxygen and carbon dioxide levels are monitored. Pulse oximetry is used to measure the patient's oxygen saturation, which generally involves a SpO_2 of near 100 percent, with a level of 90 percent or lower representing hypoxemia. *Id.* at 124. It should be noted that inaccuracies in pulse oximetry may be caused by excessive ambient light, patient motion, a badly positioned sensor, methylene blue dye, and low perfusion, among other causes. *Id.* at 125; Tomoki Nighiyama, *Recent Advance in Patient Monitoring,* Korean Journal of Anesthesiology, Sept. 2010, at 153. Nonetheless, it is the usual means of assessing oxygen saturation during and after anesthesia. Pulse oximetry does not measure carbon dioxide elimination and therefore the sufficiency of ventilation. J.A.H. Davidson & H.E. Hosie, *Limitations of Pulse Oximetry: Respiratory Insufficiency – a Failure of Detection,* The BMJ, Aug. 7, 1993, at 372.

Carbon dioxide levels are monitored through the use of capnography. This process is used to determine the end tidal (occurring at the end of exhalation) Co_2 concentration. Such monitoring is suitable for all anesthetic procedures to confirm that a patient is adequately ventilated (the circulation and exchange of oxygen and carbon dioxide). *Morgan & Mikhail's Clinical Anesthesiology* 125 (5th ed. 2013). Capnography is important in that it shows changes in the elimination of carbon dioxide from the lungs. K. Bhavani-Shankar, M.D., *et al.*, *Capnometry and Anesthesia,* Canadian Journal of Anesthesia 39:6, 618 (1992).

The use of neuromuscular blockades requires monitoring to confirm the effectiveness of, and subsequent recovery from, neuromuscular blocking agents. *Id.* at 138. This is generally performed through peripheral nerve stimulation. *Id.* A peripheral nerve stimulator delivers current to pads placed over a peripheral motor nerve, and as mentioned, it is used to assess neuromuscular function, including recovery due to concerns about residual neuromuscular blockade. *Id.* at 139.

Train-of-four stimulation is a technique used to assess the status of the blockade. In this process, a current is delivered progressively to the nerves with the ratio of the muscular responses or twitches identifying the extent of the blockade. For example, visually observing the sequential disappearance of twitches provides information regarding the extent of the blockade. *Id.* Generally, disappearance of the fourth twitch represents a 75 percent block, while disappearance of the third sequential twitch equals an 80 percent block. In progression, disappearance of the second twitch indicates a 90 percent block. The degree of relaxation required for surgery is 75 percent to 95 percent; though, again, nerve stimulation is used to assess recovery from the blockade since residual blockage may affect respiration and emergence from anesthesia. *Id.*

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Anesthesia Agents

Various inhalation agents are used in anesthesia. *Id* at 154. The degree of anesthesia, and the recovery from it, depends upon the concentration of the anesthetic in the brain tissue. *Id.* at 159. Nitrous oxide was an early inhalation agent, though it is still frequently used in combination with other more potent agents. *Id.* at 163, 166. Such a combination is used to reduce the requirements of the other agents.

Isoflurane, desflurane, and sevoflurane are the most common inhalation agents used in the United States. Sevoflurane is rapid acting and non-pungent, and therefore, it is often used for rapid inhalation induction. *Id.* at 171. Rapid inhalation induction, also known as rapid-sequence induction, is a process undertaken to induce quickly and to intubate while reducing the potential for aspiration. This process is used to lessen the potential for aspiration, which may occur in situations of a "full" stomach, intestinal obstruction, hiatal hernia, obesity, pregnancy, reflux disease, or emergency surgery. *Id.* at 278.

Isoflurane is a potent anesthetic gas used for induction and maintenance of general anesthesia. *Id.* at 169. It is noted that patients with severe hypovolemia (decreased blood volume) may not tolerate isoflurane's vasodilating effects. *Id.* at 169–170. Desflurane, another anesthetic gas, is similar to isoflurane, though its awakening time is significantly less than seen with isoflurane. *Id.* at 170; Edmond I. Eger II, M.D., *et al.*, *The Effect of Anesthetic Duration on Kinetic and Recovery Characteristics of Desflurane Versus Sevoflurane, and on the Kinetic Characteristics of Compound A, in Volunteers,* Anesthesia and Analgesia, Vol. 86, 420 (1997).

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Various intravenous substances are used in anesthesia. For example, barbiturates provide a number of effects including unconsciousness. Thiopental (also known as sodium pentothal) (used for induction), methohexital (used for induction and sedation), and secobarbital (used for premedication) are commonly used. *Morgan & Mikhail's Clinical Anesthesiology* 178 (5th ed. 2013).

Benzodiazepines are generally used for sedation, and less commonly, they are used for induction. *Id.* at 179. These include diazepam (Valium), midazolam (Versed), and lorazepam (Ativan). *Id.* at 180. Other intravenous anesthetics include ketamine, etomidate, and propofol. *Id.* at 183. As indicated above, propofol is short acting and provides both sedation and amnesia. It is, again, commonly used for induction.

While each of the elements of anesthesia is important, presumably no patient would want to undergo surgery without analgesia. Generally, opioids are used to reduce or to eliminate pain. Morphine, hydromorphome (Dilaudid), and fentanyl are generally used for post-operative pain and relief, though fentanyl is also used intraoperatively. *Id.* at 196. Sufentanil and alfentanil are used intraoperatively as well, though alfentanil is also used as a loading does as is remifentanil, which actually covers the full spectrum of intraoperative and post-operative analgesia, as well as maintenance infusion. *Id.* Opioids depress ventilation, and in particular, these medications depress the patient's respiratory rate. *Id.* at 194. Monitoring is essential, and monitoring respiratory rate is a "convenient, simple way of detecting early respiratory depression" in patients receiving these medications. *Id.* Sufentanil has been shown to produce less depression of respiratory drive than fentanyl, yet sufentanil is stronger and longer lasting. Peter L. Bailey, M.D., *et al.*, *Differences in Magnitude and Duration of Opioid-Induced Respiratory Depression and Analgesia with Fentanyl and Sufentanil*, Anesthesia and Analgesia, Vol. 70, 12 (1990).

As suggested above, neuromuscular blocking drugs or agents are also a component of anesthesia. Unfortunately for the patient, such medications do not ensure that he or she is unconscious, relieved of pain, or will not remember the procedure. *Morgan & Mikhail's Clinical Anesthesiology* 200 (5th ed. 2013). Nonetheless, there are two types of neuromuscular blocking agents, which are described based upon their manner of action. One type is the depolarizing muscle relaxant, which acts as an acetylcholine receptor agonist. *Id.* at 203. While an agonist binds with a receptor and activates the receptor to produce a response, an antagonist causes the opposite reaction. Nondepolarizing muscle relaxants function as competitive antagonists. *Id.* Depolarizing muscle relaxants include succinylcholine, which actually is the only depolarizing muscle relaxant used in clinical practice at this time. *Id.* at 204. It is, however, popular due to its very rapid onset of action and short duration of action. *Id.* at 205–206. The other type is the non-depolarizing muscle relaxant, which includes atracurium, pancuronium, cisatracurium, vecuronium, and rocuronium. *Id.* at 216–218. These medications vary by chemical structure, time of metabolism, the route of excretion (kidneys or liver), and the onset of the effect, as well as the duration of the effect. Different diseases may involve resistance or hypersensitivity to these neuromuscular agents, thus affecting the medication selected by the anesthesia provider. *Id.* at 215.

Reversal of neuromuscular blocking agents is essential. The failure to accomplish such is associated with post-procedure morbidity. *Id.* at 224. Cholinesterase inhibitors are used to reverse non-depolarizing muscle blockage. *Id.* These medications have potential side effects, including depressed heart rate, bradyarrhythmias, bronchospasm, and post-operative nausea, and vomiting, among others. *Id.* at 227. In fact, excessive doses of cholinesterase inhibitors can actually prolong recovery. Nonetheless, the side effects are generally minimized with prior or simultaneous use of anticholinergic medications such as atropine sulfate or glycopyrrolate. It is important that the anticholinergic medication "match" the reversal drug. For example, glycopyrrolate is the recommended response to neostigmine. It is also the appropriate response to pyridostigmine. On the other hand, atropine should be used in response to edrophonium, while physostigmine usually does not require an anticholinergic medication. *Id.* at 229.

The anticholinergic medications are generally not without side-effects. Atropine may cause tachycardia. *Id.* at 235. Scopolamine may cause sedation or drowsiness, as well as amnesia. *Id.* at 236. On the other hand, glycopyrrolate has few, if any, side effects.

Adjunct Medications

Other medications are used as adjuncts to anesthesia. Many of these are used to address the potential side effects or complications of anesthesia. For example, histamines are used to address allergic reactions, vertigo, nausea, and vomiting, among other conditions. These include diphenhydramine (Benadryl), dimenhydrinate (Dramamine), chlorepheniramine (Chlor-Trimetone), promethazine (Phenergan), and loratadine (Claritin), among various others. *Id.* at 279. Some use these medications due to their antiemetic and mild hypnotic effects. *Id.* at 280.

Recognizing that nausea and vomiting, and associated aspiration, represent a potentially fatal complication, other adjunct medications are often used to minimize these potential side effects. *Id.* at 278. These include, for example, antacids, which presumably reduce the harmful effects of aspiration and aspiration pneumonia. *Id.* at 282. Medications used include cimetidine (Tagamet), ranitidine (Zantac), famotidine (Pepcid), metoclopramide (Reglan), and others. *Id.* at 281. Similarly, proton pump inhibitors are often administered. *Id.* at 283.

Post-operative nausea and vomiting is a potentially serious complication, which also occurs very frequently. *Id.* This condition is also generally associated with the length of the period of anesthesia. *Id.* Anesthesia providers must assess the risk factors associated with postoperative nausea and vomiting as well as potential steps taken to reduce that risk. *Id.* at 283–284.

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Another important medication used in the anesthesia context is naloxone (Narcan). *Id.* at 289. This medication reverses the unconsciousness associated with opioid use and overdose, and it is important in trying to reverse the respiratory depressant effects of opioid use in the anesthesia setting. *Id.* at 289. In addition, flumazenil (Romazicon) is useful in reversal of benzodiazepine sedation. *Id.* at 290. A working knowledge of these various products is vital in understanding the use, and misuse, of these drugs as they are used in conjunction with anesthesia care.

Airway Management

A vital component of anesthesia care is management of the patient's airway. Of course, there are two openings to the airway. The nose leads to the nasopharynx, while the mouth leads to the oropharynx. *Id.* at 310. The epiglottis prevents aspiration by covering the glottis, which is the opening created in the larynx during swallowing. *Id.* The larynx houses the vocal cords and is located inferior to the division between the trachea and esophagus.

The initial phase of airway management includes review and classification of the oral opening. This involves application of the Mallampati score. *Id.* at 313. While this score does not necessarily define whether an intubation will be easy or difficult, it does provide useful data for an anesthesia provider for predicting the ease of intubation. *Id.* In general, the Mallampati classification involves the examination of the size of the tongue relative to the mouth and oral cavity. *Id.* There are four classifications, with the difficulty increasing based upon the greater difficulty in viewing the pharyngeal structures. *Id.* The ability to access these structures, and generally intubate the patient, may be complicated in morbidly obese patients, who often exhibit redundant pharyngeal tissue and larger neck circumferences. *Id.* at 314. Not only may this make it more difficult to intubate the patient, it may also affect the provider's ability to ventilate with a bag and mask. *Id.*

Patients lose upper airway muscle tone when anesthetized and often during emergence. This means that there are various interventions that may be undertaken to respond when the tongue and epiglottis come in contact with the posterior wall of the pharynx. These include a jaw thrust and chin lift and use of an artificial airway. *Id.* Beyond these measures, the next, more involved steps would be bag and mask ventilation, and potentially intubation.

Various devices are used to maintain an airway and assist in providing anesthesia care. These include supraglottic airway devices, the laryngeal mask airway, as well as an esophageal-tracheal Combitube. *Id.* at 317–20; Carin Hagberg, M.D., *Handbook of Difficult Airway Management,* 171–81 (2000). Generally, most consider endotracheal intubation as the expected means of maintaining the airway during anesthesia; however, the choice to intubate largely depends upon the nature of the involved procedure. The tracheal tube includes a cuff, which allows for a seal of the trachea, permitting positive pressure ventilation and reducing the likelihood of aspiration. *Morgan & Mikhail's Clinical Anesthesiology* 321 (5th ed. 2013). A laryngoscope is used to examine the involved structures and facilitate intubation. *Id.* at 322. In certain circumstances, including, for example, an unstable cervical spine or upper airway anomalies, and flexible fiber optic bronchoscopy can be used to assist in intubation. *Id.* at 324. The fiber optic bronchoscope includes coated glass fibers that convey images that allow the provider to visualize the larynx.

In cases in which intubation cannot be performed, surgical options are available including a cricothyrotomy. *Id.* at 332. This involves an incision through the skin and cricoid membrane allowing for introduction of a breathing tube. Various factors may make intubation more difficult, including, as noted above, obesity, as well as anatomic variations, the presence of tumors or foreign bodies, or trauma such as a laryngeal fracture, inhalation burn, or cervical spine injury. *Id.* at 336.

In any case, intubation is not without the potential for complications, some of which include inadvertently malpositioning the endotracheal tube, airway trauma, or some troublesome physiological responses such as hypoxia, hypercarbia, hypertension, or tachycardia. *Id.* at 334. Complications associated with the actual placement of the tube also include esophageal intubation, which is quite dangerous, as well as an endotracheal tube placed too distally in the trachea, resulting in intubation to the right main stem bronchi. *Id.* at 335. To assess placement, the provider should perform chest auscultation and undertake capnography. *Id.* Not unexpectedly, under "light" anesthesia, the patient may respond to intubation with hypertension and tachycardia.

Preoperative Assessment

An important component of anesthesia care is the preoperative assessment. In addition to airway assessment, as stated earlier, the anesthesia provider, at that time, must evaluate cardiovascular, pulmonary, endocrine, coagulation, and gastrointestinal issues. *Id.* at 297–99. The preoperative physical examination includes assessing the patient's vital signs (heart rate, blood pressure, respiratory rate, and temperature), as well as examining the airway, heart, lungs, and musculoskeletal system using inspection, auscultation, palpation, and percussion. *Id.* 299–300. The anesthesia provider will also examine the patient's airway dentition. *Id.* at 300. Of course, the preoperative assessment must be documented in the medical chart. After this assessment, an anesthetic plan will be finalized and then undertaken, which will consider whether sedative-hypnotic premedication will be useful, the types of anesthesia to be employed, any special intraoperative management issues, and the patient's postoperative management. *Id.* at 296.

Intraoperative and Post-Operative Documentation

Intraoperative documentation on the anesthesia record is vital. Generally, various elements of the anesthesia care provided to the patient are included, beginning with documentation of a preoperative check of the anesthesia machine and other involved equipment. *Id.* at 304. In addition, the provider should note whether there has been a reevaluation of the patient before introducing anesthesia. *Id.* As one would expect, the record should include reference to the drugs given intraoperatively, including the time of administration, dosage, and route. *Id.* The anesthesia provider also should note estimated blood loss and urinary output. *Id.* If laboratory tests are obtained during the procedure, the anesthesia provider should include the results of those tests. *Id.* Similarly, the documentation should reflect intravenous fluids and any blood products that were provided during the procedure. Unusual or specialized intraoperative techniques should be noted, as well as any unexpected events or complications. The time of key events such as induction, positioning, surgical incision, and extubation should be included, as well as the condition of the patient at the time of transfer to post-anesthesia or intensive care unit nurse providers. *Id.* These components should be considered in a review of the anesthesia record. If an adverse event occurs, an analysis of the exact timeline of events may be vital to the defense of the claims.

Regarding the patient's disposition, the Centers for Medicare and Medicaid Services require that specific information be included in the anesthesiologist's postoperative notes. These elements include the patient's respiratory function (respiratory rate, airway patency, and oxygen saturation), cardiovascular function (pulse rate and blood pressure), mental status, temperature, pain, nausea and vomiting, and postoperative hydration. *Id.* at 305; Centers for Medicare and Medicaid Services, Revised Anesthesia Services Interpretive Guidelines (Dec. 2009).

Generally, the anesthesia provider has responsibility for the care of the patient until the patient has recovered from the effects of anesthesia. Thus, he or she should remain in the post-anesthesia care unit (PACU) until the patient has normal vital signs and is deemed to be in stable condition. One of the more common issues faced by both patient and provider is delayed emergence. This may be the result of residual anesthetic, sedative, or the effects of analgesic drugs. *Morgan & Mikhail's Clinical Anesthesiology* 1260 (5th ed. 2013). In most cases, the patient is transferred from the operating room to the PACU. This usually brief journey includes potential hazards since monitoring equipment is not available during the course of transfer. There also may be limited access to medications and resuscitative equipment. *Id.* at 1261. In any event, the patient should not leave the OR until he or she has a patent airway, adequate ventilation is noted, and the patient is hemodynamically stable. *Id.* During transfer and while in the PACU, the bed or stretcher should generally be capable of being placed in a head-down (Trendelenburg) or in a back-up position. *Id.* Upon arrival in the PACU, involved personnel should assess airway patency, vital signs, oxygenation, and level of consciousness. *Id.* Customarily, in the PACU, blood pressure, heart rate, and respiratory rate are assessed every five minutes until the patient is identified as stable, followed by assessment every 15 minutes. Pulse oximetry is continuously monitored. *Id.*

Additional efforts in the post-anesthesia care unit include assessment of neuromuscular function through, for example, requesting that the patient lift his or her head and by evaluating the patient's grip strength. *Id.* Pain, the presence or absence of nausea and vomiting, and fluid input and output should be noted, as well as any drainage or bleeding. Pain may manifest itself as patient restlessness. In addition, nausea and vomiting occurs in 30 percent to 40 percent of post-anesthesia patients. *Id.* at 1263. Supplemental oxygen is also provided to patients in the PACU, generally as a matter of course. *Id.* at 1262.

Claims Against Anesthesia Providers

No matter the aspect of anesthesia care at issue, the nature of the alleged failure to provide good anesthesia care generally falls into one of three categories: failure to monitor, failure to document, or failure to make the correct medical decision. Monitoring claims involve the assessment, the appropriate interpretation of signs and symptoms, and the associated failure to respond or take action. Documentation claims can involve both the failure to review existing documentation and the failure to document the

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patient's status and response to various interventions. Decision-making claims may involve the failure to follow hospital protocol, or in the case of a nurse anesthetist or nurse, the failure to follow physician orders or to timely call the physician. These claims may also involve allegations that the provider made the wrong decision by, for example, providing the wrong medication, administering an incorrect or inappropriate agent, or failing to intervene when the patient's condition changes.

Recently, three categories of claims have become more common, and each may involve the above-described acts or omissions. First, anesthesia-related litigation involving obese patients has grown substantially. One may consider that this is a function of the prevalence of obesity at this time; however, there are also inherent difficulties associated with anesthetizing obese patients that can lead to adverse outcomes and subsequent litigation. As explained elsewhere, "despite strict adherence to practicing the best standard of patient care, this anesthesia-related adverse event can result in medico-legal claims." Ferguson, *supra*, at 89. Secondly, another category of current claims involves occurrence of respiratory insufficiency associated with alleged failure to reverse the neuromuscular blockade that was used adequately. Finally, PACU-related claims are common, too. Of course, there may be an overlap of the issues that are shared among each of these types of claims.

Obesity and Anesthesia

Statistics show that clinically severe obesity in the American population is increasing at an alarming rate. With severe obesity comes a marked increase in the number and degree of comorbidities experienced by this growing class of patients. More specifically, in 2003, one out of four adult Americans would be considered obese, based upon their self-reported weight, and one in three adult Americans would be considered obese, based upon objectively measured weight. R. Sturm, *Increases in Morbid Obesity in the USA: 2000-2005*, 121 Public Health 492–96, 493 (2007). These rates have tripled in the past 20 years. *Id.* Interestingly, the increase in bariatric surgery to address weight and weight control has seemingly had no effect on these rates of obesity in this country. *Id.* at 492.

Statistics show that the increased rate in obesity has brought with it a corresponding rise in the diagnosis of comorbidities, including hypertension, COPD, diabetes, and sleep apnea. The increased rate of OSA (obstructive sleep apnea) in obese patients can have a very significant effect on patient success with anesthesia. Of course, it is common for a patient who has sleep apnea to have had the physician prescribe the use of a CPAP (continuous positive airway pressure) machine to keep the patient's tongue and pharynx from closing off the airway while the patient is lying down asleep at night. Unfortunately, approximately half of the patient population that have been prescribed a CPAP machine for sleep apnea in reality stop using it as instructed. *Attitude and Expectations, the American Sleep Apnea Association,* available at https://sleepapnea.org/.

Thus, anesthesia providers who are evaluating obese patients, and particularly those with OSA requiring use of a CPAP, will routinely make adjustments to the anesthesia plan to address this increased risk, which will likely include modifications to the choice of anesthesia, the positioning of the patient, the management of the airway, and the monitoring of the patient intraoperatively. Anesthesia providers will also likely increase post-operative monitoring and provide additional discharge instructions that take into account the patient's OSA. For example, anesthesia providers may require a patient who otherwise could be released and sent home after a procedure that involved anesthesia to be admitted to the hospital for continuous monitoring in case any post-anesthesia complications surface. American Society of Anesthesiologists, *Practice Guidelines for the Perioperative Management of Patients with obstructive Sleep Apnea*, 120 Anesthesiology 1–19, 6–7 (2014).

Furthermore, the higher number of patients who are morbidly obese has made the delivery of anesthesia to patients more difficult because the increase in body mass has such a significant effect on how the body responds to the anesthetic agents as well as how anesthesia is delivered. For example, it is more difficult to mask a patient for the delivery of anesthesia because the larger facial size and jaw line of obese patient prevents the anesthesia provider from obtaining a good seal with the anesthesia mask. These patients have an increased Mallampati score, the tool that anesthesia providers use for pre-operative assessment as described above. This creates certain challenges for intubation. Obese patients have less pulmonary reserve so they desaturate more quickly, leading to increased risk of hypoxemia. Emergence from anesthesia is also more challenging because there is a direct correlation between the body mass and the dosage amount of the drugs given.

Not only does the obesity issue have a direct effect on the amount of anesthesia medications used, but it also has a direct effect on the positioning of the patient during the particular procedure. Anesthesia beds are quite narrow and have weight limitations defined by the manufacturers. As patients get heavier, the beds become less able to safely bear the weight of obese patients. Thus, the actual positioning of the patient becomes more difficult. Manufacturers have had to address the growing size of the patients, for example, by altering uses of particular beds and designing newer beds with higher weight limits. Manufacturers of the devices used by anesthesia providers in intubation are developing instruments that increase visibility for the providers when they are presented with airways that are more difficult to manage due to the increase in the physical size of the patient population.

Furthermore, the size of a patient will more than likely have an effect on intraoperative positioning by both surgeon and anesthesia provider. Depending upon the degree of obesity, an air-transfer mattress device may be required to move an obese patient from stretcher to operating table to prevent possible injury to both patient and staff. Roberta L. Hines, Robert K. Stoelting & Katherine E. Marschall, *Stoetling's Anesthesia and Co-Existing Disease (Anesthesia and Co-Existing Disease)*, 16:326 (6th ed. 2012). There is also a higher rate of pressure sores and nerve injuries to obese patients, especially those with diabetes; therefore, additional care may be required to protect a patient's pressure areas and to try and prevent an injury to the brachial plexus, the sciatic, or the ulnar nerves. *Id.*

Because intubation in obese patients is more challenging, "proper patient positioning is essential to successful intubation of the trachea." *Id.* at 327. The effect that a dramatic increase in physical body weight has on the tissues and structure of the neck can have a significant effect on an anesthesia provider's ability to visualize and maneuver the airway so that a successful intubation can be achieved. Thus, the provider may need to use additional pillows or supportive devices to assist with positioning for intubation. *Id.* Again, various methods of positioning have been used to address the correlation between obesity and decreased pulmonary reserve. The traditional Trendelenburg position, which involves placing the body flat on the back with the feet higher than the head by 15–30 degrees, is routinely changed to reverse Trendelenburg, where the body is tilted in the opposite direction, which results in a higher respiratory compliance and improved oxygenation. Jahan Porhomayon *et al.*, *Alteration in Respiratory Physiology in Obesity for Anesthesia-Critical Care Physician*, 3 HSR Proceedings in Intensive Care and Cardiovascular Anesthesia 109–118, 111 (2011).

It is important to keep in mind that obesity carries so many increased risks when it comes to delivering anesthesia safely and effectively that these patients are already at a much higher risk of experiencing an adverse event during anesthesia, even in face of reasonable and prudent anesthesia care. Thus, when defending these cases, it is important to confirm that steps were taken by the anesthesia provider to minimize these risks to the extent possible.

Residual Neuromuscular Blockade

Plaintiffs' attorneys often attempt to link PACU respiratory events with residual neuromuscular blockade. This is not unexpected as the residual effects of those blockades have been associated with significant morbidity. F. Donati and D. Bevan, Neuromuscular Blocking Agents, *Clinical Anesthesia* (P. G. Brash, *et al.* eds., 6th ed. 2009). Indeed, it has been reported that 33–64 percent of patients arriving in the PACU have signs of inadequate neuromuscular recovery. Glenn S. Murphy, M.D., *et al.*, *Residual Neuromuscular Blockade and Critical Respiratory Events in the Post Anesthesia Care Unit*, Anesthesia & Analgesia, Vol. 107, No. 1, 130 (2008). Various factors may contribute to resulting respiratory distress, including, for example, the patient's age, gender, and medical history, specifically regarding the presence of chronic obstructive pulmonary disease, diabetes, and obesity. *Id.* at 134. Surgical factors include the location of the procedure (abdominal or orthopedic surgery), whether the procedure is emergency in nature, and perhaps most important, the length of the surgical procedure. *Id.* The agents and medications used during the procedure may also play a role.

Aside from the obvious potential respiratory effect of inadequate diaphragm recovery, residual paralysis from the blockade presents other risks. For example, it increases the risk of passive regurgitation of gastric contents. A. Srivastava and J.M. Hunter, *Reversal of Neuromuscular block*, British Journal of Anaesthesia, May 2009, at 117. Specific potential complications include atelectasis and pneumonia. *Id.* Airway obstruction, one of the more common and dangerous post-surgical complications, is also a possibility. Murphy, *supra*, at 135. An important aspect of this concern is evidence that the diaphragm recovers more quickly than pharyngeal muscle function, meaning that the ability to breathe independently may not confirm control of the airway. T. Fuch-Buder, *et al.*, *Monitoring Neuromuscular Block: An Update,* Anaesthesia, Vol. 64, 84 (2009).

Steps available to reduce the potential for the residual effects of neuromuscular blockade include using as little of the blockade during surgery as possible, early reversal of the blockade, and appropriate monitoring. Murphy, *supra*, at 136. Assessment may include clinical tests such as a head lift, though, as noted, such may not assess full recovery of the pharyngeal muscles. Bertrand Debaene, M.D., *et al.*, *Residual Paralysis in the PACU After a Single Intubating Dose of Non-depolarizing Muscle Relaxant with an Intermediate Duration of Action,* Anesthesiology, May 2003, at 1047. An objective means of assessment such as acceleromyography may be superior to clinical tests and train-of-four assessment. Murphy, *supra*, at 134.

From the litigation perspective, various issues should be considered in defense of such claims. First, were steps such as those described above taken to reduce the potential for complications associated with residual neuromuscular blockade? From a broader standpoint, one should also consider what can be ruled in, and out, as potential causes for complications such as respiratory distress, including, for example, involved anesthetic agents and drugs, as well as the patient's specific comorbidities. Analysis of the blockade used, the reversal agent, if any, administered, the type and length of the procedure, and neuromuscular assessment must be reviewed. Regarding the assessment, the presence of documented train-of-four or similar detection and quantification of neuromuscular blockade may support the defense position that placing blame on residual neuromuscular blockade is nothing more than speculation.

Returning to the general types of anesthesia-related claims, the failure to monitor the blockade status may well serve as a claim, as would the failure to document. Of course, to the extent that any of the involved medications were physician ordered, a nurse anesthetist may face liability for failure to follow those orders.

Complications in the Post-Anesthesia Care Unit

The rate of post anesthesia care unit complications varies though it has been reported at 23.7 percent and 33 percent. Roberta Hines, M.D., *et al.*, *Complications Occurring in the Post Anesthesia Care Unit: A Survey,* Anesthesia & Analgesia, Vol. 74, 503 (2008); D. Keith Rose, M.D., *Recovery Room Problems or Problems in the PACU*, Canadian Journal of Anesthesia, Vol. 43, 117 (1996). The most common issues include hypertension, hypotension, bradycardia, drowsiness, confusion, or agitation, shivering, excessive pain, desaturation, and nausea and vomiting. *Id.* Hypertension is a common post-anesthesia complication. It has been linked with various potential factors, including pain, emergence excitement, reaction to the endotracheal tube, excess fluid administration, hypothermia, hypoxia, and the patient's historical hypertension. Thomas J. Gal and Lee H. Cooperman, *Hypertension in the Immediate Postoperative Period,* British Journal of Anesthesia, Vol. 47 (1975). As such, the general approach to such hypertension is to treat the underlying factors. *Id.* at 73.

Various causes of these findings may be associated with an airway obstruction. This condition often presents with labored breathing, chest wall retraction, nasal flaring, and associated "snoring" or "grunting" noises, as well as paradoxical movement of the chest wall. John L. Atlee, *Complications in Anesthesia* 877 (2nd ed. 2007). For liability purposes, in the face of an airway obstruction, the first response is usually a head tilt and jaw thrust, potentially followed by an oral airway, bag and mask, and even reintubation. *Id.* The obstruction may be the result of a laryngospasm, airway edema, wound hematoma, or again, residual neuromuscular blockade. Hagberg, *supra*, at 382–83.

Post-extubation pulmonary edema may be a serious complication. It is often seen in the PACU because it has been reported that while the symptoms may appear in minutes, on occasion they may develop later. It frequently is secondary to a laryngospasm. Z. Mulkey, *et al.*, *Postextubation Pulmonary Edema: A Case Series and Review,* Respiratory Medicine, Vol. 102, 660 (2008); Philip N. Cascade, M.D., *Negative Pressure Pulmonary Edema After Endotracheal Intubation*, Radiology, Mar. 1993, at 674. Oddly, this occurrence often occurs in young, healthy adults, presumably because their

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condition and musculature allows for generation of excessive negative intrathoracic pressure. James R. Holmes, M.D., *et al*., *Postoperative Pulmonary Edema in Young, Athletic Adults,* The American Journal of Sports Medicine, Vol. 19, No. 4, 365 (1991).

Other PACU complications involve delayed emergence and hemodynamic instability. Atlee, *supra,* at 885, 899. There is no way to predict the former, which is treated with reversal agents. *Id.* at 885–86. Treatment of hemodynamic instability involves identifying the potential causes with cause-specific treatment. *Id.* at 900.

Again, the general elements of PACU litigation may be present, including whether the patient was appropriately monitored and whether the physician was timely contacted in the event of a complication. Documentation is vital since a number of elements are to be checked with most assessments taking place on a periodic basis. These include, for example, airway patency, respiratory rate, oxygen saturation, pulse, blood pressure, neuromuscular function, mental status, temperature, pain, nausea and vomiting, hydration, input and output, as well as drainage and bleeding. *Practice Guidelines for Post Anesthetic Care*: *An Updated Report by the American Society of Anesthesiologists Task Force on Post Anesthetic Care,* Anesthesiology, 7 (Feb. 2013).

PACU care claims may also involve questions about whether the appropriate clinical response was undertaken. As noted above, there are classically accepted initial responses to postoperative respiratory insufficiency or airway obstruction, including the head tilt, jaw thrust, and placement of an oral airway, followed by more invasive techniques. Management of other conditions must be addressed also. For example, the primary response to hypoxemia is evaluation and establishment of the airway, followed by condition-specific interventions. For example, oxygen and diuretics would likely be provided if the hypoxemia results from pulmonary edema. Atlee, *supra,* at 879; Z. Mulkey, *et al*., *Postextubation Pulmonary Edema: A Case Series and Review,* Respiratory Medicine, Vol. 102, 1,662 (2008). Likewise, hypercarbia, or excess carbon dioxide, is often first addressed by asking the patient to breathe more deeply. Atlee, *supra,* at 879. Titrated Narcan may be provided if the hypercarbia is the result of the effects of opioids, though, as described above, residual neuromuscular block may be the cause as described previously. *Id.* at 880. Even shivering presents a real hazard associated with excess carbon dioxide. This seemingly benign annoyance calls for a response.

Conclusion

As with most medical liability claims, the first challenge faced by defense counsel is grasping the involved medicine. Given the multiple elements included, anesthesia claims are demanding and require fundamental understanding of these components. Likewise, it is important to be able to apply this information to the claims now commonly presented. Also, given the continued surge in obesity, as well as the focus on reducing recovery and hospital admission times, claims involving obese patients and recovery-related issues will likely continue.