Oncologic Emergencies: The Anesthesiologist’s Perspective

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Abstract
Cancer is the second leading cause of death in the United States. During the course of treatment, a cancer patient may present emergently to the hospital because of either the cancer itself or a manifestation of cancer therapy. Rarely, patients with cancer can present to the operating room with several emergent conditions that require the services of an anesthesiologist. The main oncologic emergencies affecting anesthesiologists relate to airway obstruction and cardiac-, neurologic-, gastrointestinal-, and endocrine-related conditions. Mismangement of these crises can increase morbidity and mortality. This article addresses emergencies in patients with cancer and how they relate to anesthetic care. (JNCCN 2007;5:860–868)

Despite the therapeutic advances in treatment, cancer is the second leading cause of death in the United States. Although they are rare, oncologic emergencies are defined as cancer-related events that require immediate medical intervention to minimize life-threatening risks. Anesthesiologists are increasingly challenged by cancer patients who present to the operating room with oncologic emergencies. Although fortunately most oncologic emergencies do not require surgical interventions, this article addresses some of the emergent situations that anesthesiologists may encounter, such as airway obstruction and cardiac-, neurologic-, gastrointestinal-, and endocrine-related emergencies.

Airway Emergencies
Respiratory distress in cancer patients can arise from various causes, such as the cancer itself, surgery, radiation, chemotherapy, sepsis, or aspiration. It is the most common cause of admission into the intensive care unit in cancer patients, and up to 76% of all cancer patients who are mechanically ventilated have fatal outcomes. Malignant airway obstruction occurs in 80,000 people in the United States annually. Airway obstruction can present as either an acute or a gradual process, with acute airway obstruction requiring immediate attention. Failure to promptly and strategically manage the airway could result in brain death or cardiac arrest.

Airway management in the oncologic emergency setting is one of the most challenging tasks for anesthesiologists, because oncologic airway emergencies are usually synonymous with a difficult airway. Failure to appropriately manage the airway results in significant consequences and is the leading cause of anesthesia malpractice claims. Death or brain damage occurred in more than 50% of the perioperative airway-related malpractice claims between 1985 and 1999. Furthermore, emergency surgical procedures were associated with more severe airway outcomes than were elective procedures. A closed claims review by the American Society of Anesthesiologists (ASA) of 179 claims (perioperative, n = 156; outside locations, n = 23) for difficult airway management showed that all of the death or brain damage claims occurred at locations outside of the operating room environment. In addition, even if a surgical airway was ultimately secured, the outcomes were poor. Thus, in 1993 the ASA assembled a task force that developed the Difficult Airway Algorithm (DAA) to systematically manage the difficult airway, with revisions based on evidence-based reviews.

The ultimate success of the DAA depends on the anesthesiologist’s clinical judgment and expertise in the
appropriate use of airway devices and techniques. In addition, Moorthy et al. illustrated that performing a preoperative evaluation of the airway with flexible fiberoptic bronchoscopy reduces airway emergencies in patients with airway tumors.

Airway obstruction can be classified either as upper or lower airway obstruction. In cancer patients, the most common causes of upper airway obstruction are an enlarging mass (e.g., tumor, hematoma) or chemotherapy- or radiation-induced changes (e.g., mucositis). Primary tumors of the base of the tongue, larynx, hypopharynx, trachea, thyroid, and lung may cause upper-airway obstruction through direct extension into the airway. Metastatic spread of tumors from the breast, esophagus, kidneys, and colon, and melanoma, sarcoma, and mediastinal lymphomas are infrequent causes of upper-airway obstruction. Noninfectious causes of airway obstruction include airway edema, severe tracheomalacia, and tracheal stenosis. Infectious causes include aspergillosis, epiglottitis, necrotizing laryngitis, and Ludwig’s angina. Other causes include drugs (e.g., docetaxal, paclitaxal, azathioprine), angioedema, and deficiency of C1 esterase.

Early clinical presentation of upper-airway obstruction includes restlessness and exertional dyspnea. Late findings include wheezing, orthopnea, tachycardia, diaphoresis, sternal retraction, and stridor. In severe cases, bradycardia, cyanosis, obtundation, and death may ensue within minutes of initial presentation. In the event of an acute upper-airway obstruction, the airway is best secured with an endotracheal tube while maintaining spontaneous ventilation using either a topical or inhalational anesthetic. Neuromuscular tone in patients with spontaneous breathing is what prevents complete airway collapse; therefore, this tone should not be abolished by the administration of a neuromuscular blocking agent. Benumof clearly showed that administering even the short-acting neuromuscular blocker succinylcholine at a low dose of 1 mg/kg of body weight has an excessive duration resulting in critical hemoglobin desaturation before return to an unparalyzed state. With uncooperative patients, practitioners must consider the relative merits of preserving spontaneous ventilation versus using muscle relaxants if general anesthesia is being considered. If fiberoptic intubation is a possible option for securing the airway, a small dose of an anticholinergic agent may be given (e.g., glycopyrrolate, 0.2–0.4 mg intravenously) to minimize both vagal reflexes and secretions, unless it is contraindicated (e.g., tachycardia). In addition, having an experienced head and neck surgeon immediately available in case a surgical airway must be established is strongly recommended.

Various methods can be used to intubate, such as direct laryngoscopy, fiberoptic bronchoscopy, intubating laryngeal mask airway, or a Bullard laryngoscope or Upsherscope. If these methods are not successful, emergent tracheostomy may be necessary to rescue an airway obstruction. A tracheostomy performed in the operating room under local anesthesia is the ideal situation but requires some patient cooperation and verbal reassurance. Supplemental oxygen and standard monitoring of vital signs is essential. The benefits of preserving spontaneous ventilation versus inducing drug-induced apnea must be considered when administering sedatives such as dexametomidine, propofol, and opiates. Light sedation may be tolerated in some patients but should be avoided in patients with limited respiratory reserve or hemodynamic instability. Coughing during a tracheostomy may be decreased with intravenous lidocaine at 1.5 mg/kg of body weight.

Lower-airway obstruction in the absence of significant comorbid disease is rarely fatal but can result in significant morbidity. The most common cause of intrinsic bronchial obstruction is bronchogenic carcinoma. Patients are usually managed with flexible or rigid bronchoscopy with laser, cryosurgery, stenting of the tracheal bronchial tree, or bronchoplasty. Laser surgery is often used to debulk airway tumors. Inhalation agents (e.g., sevoflurane), propofol infusions, intravenous midazolam, and dexametomidine may be used to induce anesthesia. Spontaneous ventilation should be maintained, and therefore muscle relaxants should not be used unless it is certain that positive pressure ventilation can be performed. Selected adult patients undergoing flexible fiberoptic laser excision can be managed with sedation and topical anesthesia applied to the laryngotracheal area. Fire is the potential hazard in using laser, which the operating room team should be prepared to manage. To stent the bronchial tree after induction of general anesthesia, a laryngotracheoscope is inserted to provide a patent airway, a conduit for ventilation, and to allow passage of a bronchial stent.

Hemoptysis is another cause of airway obstruction, with neoplasm representing 7% to 19% of these cases. Bronchoscopy is the single most important technique
for determining the cause and location of the bleeding. When severe bleeding or hemodynamic instability occurs, patients should be transferred to the operating room, where flexible or rigid bronchoscopy can be performed in a controlled environment. General anesthesia is the most commonly used anesthetic technique. If bleeding cannot be controlled, the bleeding side can be isolated with lung separation using a double-lumen tube or bronchial blocker. Absolute indications for single lung ventilation include 1) isolation of the lung to avoid contamination, 2) control of ventilation, and 3) unilateral bronchopleural lavage. The relative indication for single lung ventilation is providing a quiet and optimal surgical field.

For patients with a mediastinal mass, anesthesia is associated with a high risk for airway collapse or obstruction, hemodynamic instability, and death. When possible, it is best to avoid general anesthesia, muscle relaxants, and positive pressure ventilation until after initiation of chemotherapy or radiation therapy to decrease tumor size. An endotracheal tube can be secured with an awake fiberoptic intubation in adults, and with an inhalational anesthetic and spontaneous ventilation in small children. Heliox, which is a mixture of 80% helium and 20% oxygen, has been used to reduce the work of breathing through reducing airway resistance. Polaner successfully relieved airway obstruction in a 3-year-old child using heliox and halothane as an induction regimen along with spontaneous ventilation for biopsy of an anterior mediastinal mass. With an acute airway obstruction or cardiovascular collapse, positioning patients laterally or prone may shift the mass off of the vital structures.

A mediastinal mass is more likely to have an increased risk for perioperative respiratory complications in pediatric patients than adults. This condition can be identified through the presence of cardiopulmonary symptoms (e.g., cough, dyspnea, chest pain, fatigue, vocal cord paralysis, orthopnea, stridor, venous distension in the neck veins, superior vena cava syndrome), tracheal compression greater than 50% based on computed tomography (CT) scan or magnetic resonance imaging (MRI), or pulmonary function tests.

**Cardiovascular Emergencies**

Two cardiovascular emergencies caused by malignant states are superior vena cava (SVC) syndrome, and malignant pericardial effusion with tamponade. Cancer is the cause of SVC syndrome in as many as 95% of these patients, with lung cancer the most common cause. However, malignant pericardial effusion occurs in 21% of cancer patients, and 50% of these patients present with pericardial tamponade. Cardiac tumors also may be associated with pericardial effusions or pericarditis. In addition, cancer patients are also at risk for the same cardiovascular emergencies as the general population, although these are not necessarily related to the patient’s cancer and will not be discussed here.

SVC syndrome may be associated with not only malignancy but also other conditions, such as aortic aneurysm or the use of intravascular catheters. Although lung cancer is the most common malignant cause, lymphoma and germ cell tumors also can produce SVC syndrome. SVC syndrome is usually associated with an onset of weeks to months, but can occur rapidly in children before cancer is diagnosed. SVC syndrome may be associated with not only malignancy but also other conditions, such as aortic aneurysm or the use of intravascular catheters. Although lung cancer is the most common malignant cause, lymphoma and germ cell tumors also can produce SVC syndrome. SVC syndrome is usually associated with an onset of weeks to months, but can occur rapidly in children before cancer is diagnosed.

SVC syndrome is diagnosed with a chest radiograph, CT, or MRI. Further investigations to obtain tissue samples are necessary, including fine needle aspirations, bone marrow biopsies, or surgical interventions such as bronchoscopy, mediastinoscopy, thoracoscopy, or thoracotomy. If a benign tumor is the cause, surgical intervention may be required. If malignancy is diagnosed, initial therapy consists of chemotherapy and/or radiation to shrink the tumor and improve blood flow. Intravascular stents for relieving symptoms have been shown to be a helpful adjunct to therapy.

SVC syndrome becomes an emergency when the airway becomes compressed. Anesthetic management of these patients requires first securing the airway. Edema, distorted anatomy, positional dependency, and response to neuromuscular blocking agents can all lead to disaster on induction of general anesthesia. Anesthesiologists should have experience in thoracic anesthesia and be competent in single lung ventilation techniques. The importance of monitor placement and intravenous access by way of the lower extremities
is also critical. Involvement of the innominate artery can render the right arm incapable of being used to monitor blood pressure or pulse oximetry.

Malignant pericardial effusion and cardiac tamponade occur in up to 21% of cancer patients.22 The most commonly associated malignancies are lung, breast, lymphoma, melanoma, and leukemia.23 Studies that may be used to diagnose pericardial diseases with or without effusion include chest radiograph (CXR), CT, and MRI.24,25 Pericardial effusion may lead to impairment of cardiac function, eventually leading to life-threatening tamponade. Shortness of breath is the most common symptom of tamponade and may be accompanied by tachycardia, cough, chest pain, elevated systemic venous pressure, or pulsus paradoxus.26 Echocardiography provides a rapid confirmation of pericardial tamponade.

Pericardial tamponade may be treated with emergent bedside pericardiocentesis, placement of a pericardial drain or window, or pericardectomy. When treating patients for pericardial effusion or tamponade, anesthesiologists must be cognizant of the possible cardiotoxic effects of various chemotherapeutic agents and be prepared for thoracotomy or sternotomy. The vasodilation and myocardial depression seen with anesthetic agents may lead to profound hypotension and death on induction of general anesthesia. In extreme cases of tamponade, preinduction pericardiocentesis with local anesthesia alone may be necessary to partially relieve the tamponade and avoid life-threatening complications. Induction agents (e.g., etomidate, ketamine) that have minimal myocardial depressant effects should be selected. However, ketamine causes myocardial depression in patients lacking a sympathetic reserve. Maintaining an elevated heart rate and higher filling pressures will help maintain cardiac output, compensating for the lower stroke volumes seen with tamponade. Inotropic drugs and potent vasoconstrictors should be ready before initiation of anesthesia. After the tamponade is relieved, preparation should be made with vasopressors and fluid to address the sudden decrease in right-sided pressures. Having an anesthesiologist who is well versed in echocardiography is advantageous for managing these cases.

Lastly, cardiac tumors, such as angiosarcoma, myxoma, rhabdomyosarcoma, and malignant fibrous histiocytoma, may cause lethal arrhythmias, mechanical obstruction within the cardiac chambers, or embolic events leading to sudden death.27,28 These tumors may go unappreciated until found on postmortem examination. Cardiac tumors may lead to sudden death in 0.0025% of all cardiovascular disease-related deaths, and 0.06% of cardiovascular deaths in the 0- to 34-year-old age group.24 Malignant neoplasms are metastatic to the heart or pericardium at a rate of 10% to 12%.24 The most common metastatic tumors in men come from lung cancer, and in women from breast cancer. Cardiac tumors are most commonly discovered with CT, MRI, or echocardiography before death. Treatment for cardiac tumors may be curative or palliative and includes chemotherapy, surgical resection, or heart transplantation.29-31 Cardiac tumors should be treated as soon as possible after discovery because of their possible lethal nature if left untreated. The anesthetic management of cardiac tumors requires a specialist in cardiac anesthesia who is knowledgeable in the aspects of cardiopulmonary bypass and echocardiography.

**Neurologic Emergencies**

Neurologic emergencies are common in cancer patients, relating to either the tumor or treatment of the tumor. Anesthesiologists are frequently involved in 2 common neurologic emergencies: spinal cord compression and increased intracranial pressure. Although the treatment of oncologic pain is important and often occurs emergently, it is not addressed here.

Epidural cord compression occurs in 5% of cancer patients32 and 80% of these are related to extradural metastasis from carcinomas of the prostate, lung, and breast. Extradural metastasis affects the thoracic level 50% to 80% of the time.33 The remaining 20% of the cord compressions are from intradural metastasis, vertebral collapse, direct invasion, interruption of blood flow, and epidural hematoma. The earliest clinical finding of spinal cord compression is back pain, followed by late findings of neurologic deficit that include incontinence and impotence. MRI is the gold standard for diagnosis.4 Treatment is guided toward alleviating pain and preventing neurologic deficit. Treatment modalities vary and include different regimens of steroids, radiation, chemotherapy, and surgery.

The anesthesia preoperative evaluation should include a neurologic assessment, documentation of any preexisting deficit, and discussion with the neurosurgeon about steroid administration. The efficacy
of administering an adequate dose of steroids for reducing edema associated with tumors is well confirmed. Dexamethasone is the most commonly used steroid, although controversy exists regarding the optimal regimen. Commonly used doses are a loading dose of dexamethasone 10 to 100 mg intravenously followed by 4 to 24 mg every 6 hours. Higher doses of dexamethasone may be associated with slightly better outcome, but have a higher incidence of adverse effects.\textsuperscript{35-37} Patient positioning for surgery is usually prone, but transthoracic, intra-abdominal, and retroperitoneal approaches are other options. Normal spinal cord perfusion pressure should be maintained during the surgery. Spinal cord perfusion pressure is the difference between the mean arterial blood pressure and intracranial pressure. Maintaining normal blood pressure and avoiding increases in intracranial pressure prevent ischemic injury to the spinal cord. Posterior spinal cord function is evaluated continuously through somatosensory evoked potentials (SSEPs).

Anesthetic management should avoid anesthetic agents and parameters that interfere with SSEP monitoring. All inhalation agents, propofol, barbiturates, and benzodiazepines cause an increase in latency and a decrease in amplitude of the SSEP, whereas etomidate and opiates have minimal impact on SSEP. Several physiologic variables, including blood pressure, temperature, and blood gases tensions, also may affect SSEP recording. For example, decreases in mean arterial blood pressure below levels of cerebral autoregulation show a decrease in amplitude and no change in latency.\textsuperscript{39,40} Hypothermia causes a decrease in amplitude and an increase in latency. Hyperthermia is associated with a decrease in amplitude and loss of SSEPs at a temperature of 42°C.\textsuperscript{41,42} Decreased oxygen tension and oxygen delivery are associated with a decrease in amplitude and an increase in latency.\textsuperscript{43} A balanced anesthetic technique using opiates and nitrous oxide is often preferred, because it is less likely to interfere with the SSEP. A wake-up test may be performed during the procedure after spinal instrumentation to assess motor function. Surgery involving C3–C4 usually requires postoperative ventilatory support because of possible edema or compromise of the phrenic nerve. Lesions below C5–C6 may still cause as much as a 70% reduction in vital capacity and forced expiratory volume in 1 second, which impairs ventilation and oxygenation.

Increased intracranial pressure can be caused by a space-occupying lesion or hydrocephalus. Brain metastases are the most common intracranial tumors and are 10 times more frequent than primary brain tumors.\textsuperscript{45,46} Cancers most likely to metastasize to the brain are lung, breast, and melanoma. The cerebral hemispheres are most frequently affected (80%), followed by the cerebellum (15%), and the brain stem (5%).\textsuperscript{47} Clinical presentation includes headache, changes in mental status, nausea, vomiting, and neurologic deficit. MRI and CT scans are useful diagnostic tools. Treatment for increased intracranial pressure should be initiated immediately to avoid permanent deficit and brain herniation.

Anesthesia management for patients with increased intracranial pressure begins in the preoperative period with documentation of neurologic status. During induction of anesthesia, avoiding an increase in intracranial pressure and a decrease in cerebral blood flow is critical. Other efforts to decrease intracranial pressure include elevating the head, hyperventilating to maintain the partial pressure of carbon dioxide between 25 and 30 mm Hg, and using osmotic diuretics and anticonvulsants. Hyperventilation and hypocapnia decrease intracranial pressure through decreasing cerebral blood flow. Hypocapnia should be induced carefully and have a clear indication. Hyperventilation should be used to decrease intracranial pressure in cases of impending herniation. The effects of hypocapnia last 6 to 18 hours and reflect the changes in cerebral blood flow and its effects on cerebrospinal fluid pH.\textsuperscript{41} Hyperventilation and the resulting hypocapnia-induced vasoconstriction can also produce ischemia secondary to a reduction in blood flow.\textsuperscript{42-44} Recent studies using hypertonic saline solution 23.4% have been promising. Using a protocol involving a bolus of 23.4% hypertonic saline, Stevens et al.\textsuperscript{45} reversed transtentorial herniation in 75% of patients with impending herniation. Several mechanisms are responsible for the beneficial effects of hypertonic saline. In addition to its beneficial osmotic effect on edematous tissue, hypertonic saline increases blood pressure and cardiac output, and may counteract vasospasm.\textsuperscript{41}

Barbiturates and propofol are first-choice agents for decreasing the cerebral metabolic requirements; however, anticonvulsants have been used also. During anesthesia, the goals are to maintain cerebral perfusion pressure, decrease the cerebral metabolic rate of
oxygen consumption, and ultimately be able to assess the patient’s neurologic status after surgery.

Gastrointestinal Emergencies

Gastrointestinal (GI) emergencies, such as bleeding, obstruction, and perforation, are common in patients diagnosed with cancer. Significant upper-GI tract bleeding occurs in 12% to 23% of patients with cancer. The most common cause of GI bleeding is peptic ulcer disease, occurring in 27% to 40% of all upper-GI bleeds. Risk factors include the use of nonsteroidal anti-inflammatory drugs, corticosteroids, alcohol, and concurrent medical conditions. Acute lower-GI tract bleeding in cancer patients is likely caused by a benign lesion. One study found an 11% incidence of massive lower-GI bleeding related to a cancer or polyp. The treatment principles for managing a GI bleed in patients with cancer are the same as those for patients without cancer. Most GI bleeds do not require surgery, but occasionally resection is needed.

Frequent obstruction occurs when cancer invades the bowel lumen, extrinsically compresses the bowel, or disrupts the neurologic supply. Advanced ovarian and colorectal cancers are particularly associated with bowel obstruction. All patients with malignant bowel obstruction who fail to recover bowel function with supportive care should be considered for surgical management. Unfortunately, in most patients with advanced cancer, the obstruction cannot be relieved. Lastly, GI perforation in cancer patients is most often caused by weakening of the gut wall at the site of a tumor, followed by tumor necrosis during radiation therapy or chemotherapy, or perforation caused by peptic ulcers associated with the use of nonsteroidal anti-inflammatory drugs or corticosteroids.

Anesthetic management of a GI emergency must consider that cancer patients with advanced malignancy are poor surgical candidates. Patients with an abdominal cancer have a 19.8% chance of experiencing a cardiovascular complication, a 19.4% chance of experiencing a pulmonary complication, and a 5% hospital mortality rate.

Placement of large-bore intravenous catheters, an arterial line, and often a central line is essential to assess a patient’s volume status. Anesthesiologists should treat patients as having a full stomach and thus perform a rapid sequence induction. These patients should be considered volume-depleted, with resulting tissue hypoxemia and organ dysfunction, until proven otherwise. The decision to fluid resuscitate is simple compared with the many choices for how to accomplish this goal, such as which fluid to use, how much to use, how quickly to infuse it, how to minimize postoperative complications of fluid resuscitation, and determining the end points of fluid resuscitation. Crystalloids, colloids, blood, and blood products can all be used as resuscitation fluids.

The goal of resuscitation is to provide adequate oxygen delivery, nutrient delivery, and removal of metabolic waste to maintain cellular integrity across all tissue beds. Currently, measuring these phenomena is clinically impossible; however, surrogate markers are used, such as measuring and monitoring hemodynamic variables. Simplistically, the target end point of resuscitation is heart rate and blood pressure normalization, achieved through optimizing intravascular volume. However, patients can have a normal blood pressure and heart rate and be intravascular-volume depleted. More sophisticated measurements, such as central venous pressure, mixed venous oxygen saturation, pulmonary systolic and diastolic pressures, cardiac output, cardiac index, systolic pressures of the right side of the heart, and pulmonary capillary wedge pressure, provide more information.

Endocrine-Related Emergencies

Paraneoplastic syndromes are disorders produced by neoplastic cells that secrete various peptides that exert their actions locally and distally from the site of the tumor. They are probably more common than is generally appreciated. Many types of paraneoplastic syndromes exist, including endocrine, autoimmune, hematologic, and neurologic. This article discusses several of these, such as hypercalcemia of malignancy, hyponatremia, pseudohyponatremia, syndrome of inappropriate antidiuretic hormone secretion (SIADH), adrenal insufficiency, and Eton-Lambert syndrome.

Hypercalcemia is one of the most common metabolic complications of malignancy occurring in 10% to 30% of patients with cancer. A patient’s condition can range from asymptomatic to life-threatening. In malignancy, hypercalcemia is caused by increased bone resorption and, occasionally, decreased renal excretion of calcium. The most common origin of hypercalcemia of malignancy is the production of a parathyroid hormone–related peptide. The major malignancies associated with hypercalcemia are myeloma, lung cancer, and renal cancer.
Patients with severe hypercalcemia have a mean survival of 1 to 6 months, and therefore carry a high anesthetic risk during surgery.\textsuperscript{61} Treatment of hypercalcemia involves volume expansion, loop diuretics, bisphosphonates, corticosteroids, calcitonin, plicamycin, and gallium nitrate. Significant hypercalcemia is a true metabolic emergency requiring aggressive therapy during the initial 24 to 48 hours. In patients with clinically significant hypercalcemia, the risks associated with delaying surgery while normalizing calcium levels must be weighed against those associated with anesthesia. If surgery is emergently required, patients are invariably dehydrated and require aggressive preoperative hydration. Invasive monitoring with an arterial catheter and a central venous catheter allows the anesthesiologist to volume expand the patient while minimizing fluid overload risks. The central venous catheter allows the option of inserting a pulmonary artery catheter. The infusion of packed red blood cells replaces the red blood cell mass, aids in intravascular resuscitation, and has the advantageous effect of lowering the serum calcium levels. Dialysis is a preoperative option if renal failure is present or the patient is unable to tolerate a fluid load.\textsuperscript{60}

Hyponatremia is the most common electrolyte abnormality in cancer patients. Signs and symptoms are primarily neurologic and correlate with the severity and rapidity of development. Life-threatening symptoms are almost invariably present with sodium concentrations below 105 mEq/L.\textsuperscript{62} Patients with sodium levels above 125 mEq/L are generally asymptomatic. More severe symptoms may require administration of furosemide concomitant with normal saline to maintain euvoolemia and effect a net free water clearance. The rate of correction of hyponatremia is controversial, but a rate of 0.5 mEq/L/h, with not more than a 12 to 15 mEq increase in the first 24 hours, is recommended. Coincident hypokalemia requires repletion, because plasma potassium elevation can raise the serum sodium concentration.

Pseudohyponatremia occurs when a decrease in the measured plasma Na\textsuperscript{+} concentration occurs with a normal or increased plasma osmolality. Each liter of plasma normally has approximately 930 mL of water with the remaining 70 mL consisting of plasma proteins and lipids. However, the plasma water may fall to as low as 720 mL per liter of plasma in severe hyperlipidemia or hyperproteinemia.\textsuperscript{61} Anesthesiologists may encounter artifactualy low plasma Na\textsuperscript{+} concentrations in several instances, such as in patients with multiple myeloma who have hyperproteinemia. Patients undergoing a transurethral resection of the prostate or bladder can have an iatrogenic addition of isosmotic but non-Na\textsuperscript{+}-containing fluid to the extracellular space. The administration of mannitol can draw intracellular water out of the cell in sufficient quantities to reduce the plasma Na\textsuperscript{+} concentration.\textsuperscript{44} In pseudohyponatremia, therapy should be directed toward the underlying disease and not the decline in plasma Na\textsuperscript{+} concentration as in hyponatremia. The offending agent should be discontinued; excretion of excess fluid will eventually restore the Na\textsuperscript{+} concentration.

Ectopic secretion of antidiuretic hormone occurs in 1% to 2% of all patients with cancer, with 60% of all cases associated with small cell lung cancer.\textsuperscript{65} Regardless of the origin, SIADH consists of hyponatremia, less-than-maximally dilute urine, excessive urine sodium excretion (>30 mEq/L), and decreased serum osmolality.

Adrenal insufficiency may be related to the replacement of the adrenal gland through metastases or from suppression through exogenous glucocorticoid administration. Adrenal crisis with vasomotor collapse may be sudden and fatal. The stressed and steroid-dependent patient should empirically be given intravenous steroids with both glucocorticoid and mineralocorticoid effects.

Eton-Lambert syndrome is a presynaptic disorder of the neuromuscular junction caused by autoantibodies that impair release of acetylcholine from the nerve terminals. The malignancy often associated with this syndrome is small cell lung cancer, which is believed to trigger the autoimmune response.\textsuperscript{66} Patients with Eton-Lambert syndrome are sensitive to the effects of succinylcholine and nondepolarizing muscle relaxants and also can experience decreased responsiveness to muscle relaxant reversal drugs, such as neostigmine and edrophonium. Increased vigilance when using muscle relaxants is necessary to successfully paralyze a patient while maintaining the ability to fully restore muscle tone postoperatively.

Conclusions

Although rare, oncologic emergencies can arise from either the cancer itself or the therapy. Statistically, anesthesiologists participate in caring for cancer patients undergoing emergent procedures. To provide quality care, anesthesiologists must be cognizant of...
oncologic emergencies that impact a patient’s physiologic or anatomic state. The goal of this article is to increase awareness and educate the cancer care team about these emergencies as they relate to anesthesia care.

References


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