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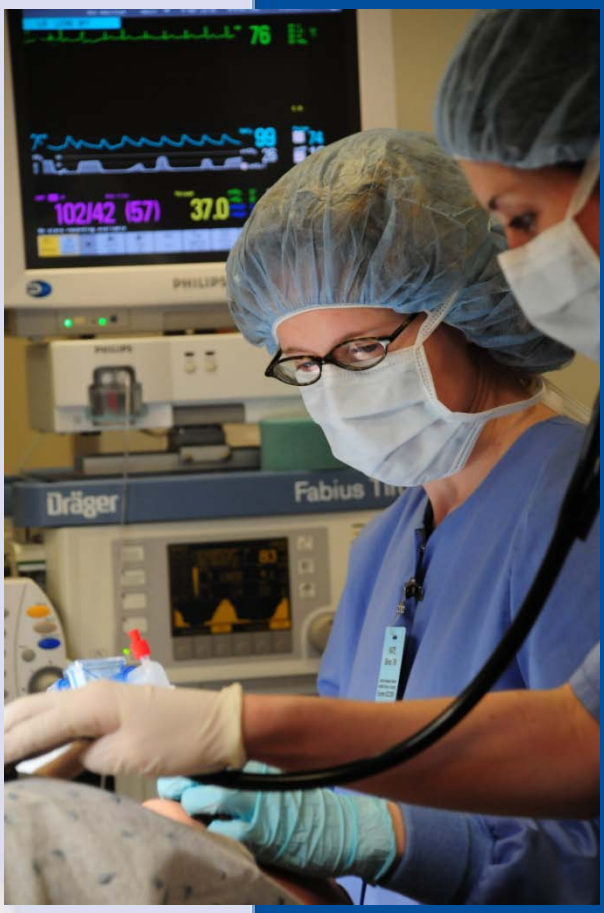

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Front Cover: Kate Silver, BSN (left) and Andrea Atkins, BSN (right), graduate students enrolled in the Goldfarb School of Nursing at Barnes-Jewish College, practice an induction sequence in a simulated OR setting. (Photo by Chris Tobnick, BA)

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Multiple Sclerosis and Electroconvulsive Therapy

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Key Words: Multiple Sclerosis, Electroconvulsive Therapy, Depression and Nervous System.

Multiple sclerosis (MS) is a demyelinating, autoimmune disease which damages the white matter of the brain and spinal cord and can lead to chronic inflammation and neural scarring (gliosis).[1, 2] MS is a progressive disease that affects people throughout their lives. Patients are predominantly women (2:1) between 20 and 40 years of age.[3] Multiple sclerosis affects Caucasians more than other ethnic groups and is more prevalent in populations living between the poles and 40 degrees north or south latitude.[4] In the United States, at least 350,000 people have MS and 10,000 new cases are diagnosed every year.[4] It is projected that 50% of patients diagnosed with MS will be bedridden within 15 years.[5] Mood disorders have been associated with multiple sclerosis and may require treatment with electroconvulsive therapy.[6] In 1999, the U.S Department of Health and Human Services estimated that 100,000 hospitalized Americans received electroconvulsive therapy (ECT).[7] Electroconvulsive therapy is most commonly used to treat unipolar depression, bipolar depression and mania.[8] Small electrical stimuli are applied to the cerebrum eliciting generalized seizures. A good therapeutic effect is commonly achieved after 400 to 700 seconds of seizure.[5] Patients are scheduled for a series of treatments, usually two to three per week (six to ten treatments total). Although the mechanism of action is not fully understood, it is proposed that levels of certain neurotransmitters are increased by direct stimulation of certain areas of the brain.[8] The following case report describes the unique considerations of patients with MS requiring electroconvulsive therapy.

Case Report

A 47 year old, 97 kg, 64 in, ASA 3 Caucasian female presented for her first electroconvulsive therapy session. The patient's past medical history was significant for hypertension, fibromyalgia, obesity, depression, diabetes, relapsing-remitting multiple sclerosis (RRMS) and smoking with an acute case of bronchitis two months prior. The patient was admitted to the psychiatric ward for an acute episode of major depression. The patient had prior uneventful anesthetics. A drug allergy to penicillin was reported to cause hives. Current medications included glipizide, hydrochlorothiazide, methylprednisolone, sertraline, gabapentin and aspirin. A complete blood count and basic chemistry were normal. Her heart rate was normal with a blood pressure of 140/80. Her lungs were clear, she had good neck extension, mouth opening and had a Mallampati class II airway exam.

The patient was transferred from the psychiatric ward to the postoperative unit where electroconvulsive therapy was performed in this institution. The postoperative unit was equipped with a mask and ambu-bag resuscitation set, code cart, suction, oxygen and monitoring for blood pressure, pulse, oxygen saturation and end tidal carbon dioxide. The anesthesia interview revealed that over the past week the patient developed symptoms of acute, relapsing MS.[6] The patient reported new onset muscle weakness that led to paralysis rendering the patient unable to ambulate with urinary incontinence, diplopia

and generalized fatigue. The planned anesthetic included Brevital® (methohexital) and Anectine® (succinylcholine). In order to proceed with electroconvulsive therapy, the anesthesia practitioners were prepared for possible intubation and mechanical ventilation. This might have required a post-procedural intensive care unit admission for monitoring and mechanical ventilation. After discussing the anesthesia risks and benefits the proposed ECT was postponed to provide resolution of MS symptoms.

Discussion

Relapsing-remitting and primary-progressive are two of the most common forms of MS.[5] RRMS affects 80% of people diagnosed with MS and is characterized by exacerbations or attacks lasting one to three months, followed by periods of remission lasting a year or longer. The remaining 20% of patients diagnosed with MS have primary-progressive MS which shows a steady increase in neurological symptoms without remission.[5] The cause of multiple sclerosis is unknown with a genetic correlation of 3% to 4% to a first relative diagnosed with MS.[4] Smoking and slow-acting viruses have also been correlated to MS.[4]

Major anesthetic considerations for multiple sclerosis include exacerbation of symptoms caused by temperature changes, autonomic instability and ventilatory compromise.[1] An increase in body temperature as small as one degree Celsius can lead to an exacerbation of MS symptoms.[5] Temperature increases may block demyelinated nerve conduction.[5] Also, patients with significant respiratory compromise or muscle weakness (rendering them bedridden), are at significant risk for prolonged ventilation after anesthesia.[1] In this case of acute MS exacerbation, anesthesia professionals have to consider the risks of using a depolarizing neuromuscular blocking agent on a patient with musculoskeletal paresis which may result in hyperkalemia. Due to unpredictable neuromuscular blockade seen with alternative, non-depolarizing neuromuscular blocking agents and MS, prolonged mechanical ventilation maybe required.[6] This response can be attributed to the increase in extrajunctional cholinergic receptors in upper motor neuron lesions seen in advanced, MS.[3]

Uncontrolled motor activity during ECT could result in musculoskeletal injury if general anesthesia is not used.[5] Airway management and mask ventilation are required throughout the treatment. The optimal anesthetic for ECT is a light, general anesthetic providing amnesia for the period of neuromuscular blockade that neither inhibits the seizure nor produces prolonged apnea. As previously mentioned methohexital is the agent of choice at this institution. Other induction agents such as propofol, benzodiazepines, barbiturates and etomidate have anticonvulsant properties.[5] Alternatives to depolarizing muscle relaxants could include a short acting non-depolarizing neuromuscular relaxant (NDNMR) such as mivacurium or combining an intermediate NDNMR with the rapid onset NDNMR antagonist sugammadex. Currently neither mivacurium nor sugammadex are available in the United States.

Electroconvulsive therapy has been shown to cause mild neurological defects in all patients.[9] Evidence that electroconvulsive therapy instigates an increase in the size and number of plaques thus causing further deterioration of multiple sclerosis symptoms has been debated.[10-12] Mattingly et al[11] demonstrated the possible value of gadolinium enhanced MRI scanning of white matter on cranial MRI as a predictor of ECT induced neurological dysfunction in MS patients, however, this case study only considered

one subject. Other case studies showed mild retrograde and antegrade amnesia that is a common side effect of bipolar ECT pulsing as opposed to unipolar pulsing in all patients.[8] The majority of case reports of MS patients undergoing unilateral and bilateral ECT pulsing showed minimal incidents of short term deterioration.[10, 13-16] However, the long term effects of ECT treatments on the neurological status of MS patients have yet to be determined.[13]

The systemic effects of electroconvulsive therapy on an MS patient are unpredictable. Patients with advanced MS disease may exhibit increased cardiovascular instability due to autonomic dysfunction. ECT is a significant hemodynamic stressor.[3] In a grand mal seizure, parasympathetic centers are activated, resulting in bradyarrhythmias and brief sinus pauses. This is followed by a sympathetic discharge with heart rate and blood pressure increasing up to 30% above baseline.[5] Because of the hemodynamic effects of ECT, contraindications include: recent myocardial infarction (less than three months ago), recent cerebrovascular accident (less than three months ago), intracranial mass, or elevated intracranial pressure, aortic aneurysm, angina, congestive heart failure, pheochromocytoma, recent intracranial surgery (less than three months ago) and retinal detachment.[8]

Multiple Sclerosis is multifaceted disease process with symptoms ranging from muscle spasticity, fatigue, sensory disorders, bladder and bowel dysfunction to significant motor disorders, paresis, cerebellar demyelination and ventilatory compromise.[6] When caring for patient with MS review any acute symptom changes and medical history that may put a patient at risk for neurological compromise, prolonged mechanical ventilation and autonomic disturbances. Careful assessment of the resources of the setting and support staff available during electroconvulsive treatment is important as it is commonly performed as an outpatient procedure and in remote anesthetic areas outside of the main operating room.

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Cardioprotection: The Role of Volatile Anesthetics

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Key Words: volatile agents, cardioprotection, total esophagectomy, non-cardiac surgery, myocardial ischemia

Anesthetic management for high risk surgery can be challenging, especially when a patient presents with significant cardiac risk factors. Ischemic heart disease is present in an estimated 30% of patients who undergo surgery annually in the United States.[1] A thorough history is essential in the detection of diseases that would place the patient in a high surgical risk category. Once significant cardiac risk has been established preoperatively, certain cardioprotective actions can be taken to prevent ischemia.

Recent data imply volatile agents such as sevoflurane and desflurane offer cardioprotection when utilized. Conclusive studies find these agents to have cardioprotective effects that decrease morbidity and mortality.[2]

Case Report

A 56 year old, 107kg male, scheduled for a total esophagectomy presented with distal esophageal cancer. Past medical history included; hypertension, hypercholesterolemia, sleep apnea, depression, gastroesophageal reflux, obesity, and a smoking history of one pack per day for 45 years. The patient could perform activities of approximately 5 metabolic equivalent tasks. An electocardiogram on the day of surgery revealed normal sinus rhythm, a rate of seventy-five beats per

minute, and a possible old inferior wall myocardial infarct. The patient denied chest pain or shortness of breath on exertion. Heart tones were normal and regular in rate and rhythm. Current medications included escitalopram 20mg once daily, atorvastatin 10mg once daily, and metoprolol 100mg twice daily. The last dose of metroprolol was taken on the morning of surgery.

A few days prior, this patient was scheduled for a total esophagectomy. However, the anesthesia team recommended the surgery be cancelled, and the patient see a cardiologist for further cardiac evaluation and thallium imaging and stress testing. A cardiologist evaluated the patient and denied the need for further testing. The cardiologist report claimed the patient only required beta blockade at this time, and no further testing was needed for this surgery. The decision was made to proceed with the surgery with general anesthesia at that time. The patient was not given the option of an epidural due to initial abnormal PT/PTT results, which were later refuted by repeat testing which indicated normal PT/PTT values.

After pre-oxygenation, induction was performed utilizing lidocaine 50mg intravenous, fentanyl 250mcg intravenous, propofol 160mg intravenous, and rocuronium 50mg intravenous. The trachea was intubated utilizing the GlideScope® video laryngoscope for proficiency purposes. Bilateral breath sounds were confirmed, and continuous end tidal carbon dioxide was confirmed present. A left radial arterial line and right internal jugular central line with central venous pressure monitoring capabilities were placed without complications. The patient had an initial drop in blood pressure after induction to a low of 65/40 mmHg. Incremental administration of phenylephrine 100mcg intravenous and ephedrine 10mg intravenous were administered. Phenylephrine 400mcg intravenous and ephedrine 20mg intravenous were administered without return to baseline blood pressure levels. Epinephrine 85mcg IV was then administered, and the blood pressure then returned to within 20% of baseline and remained adequate throughout the case.

Anesthesia was maintained with sevoflurane at an end tidal concentration of 1.6-2.4% and 1.0 liter/min flow of air and oxygen. Fentanyl was utilized throughout the case, totaling 800mcg IV. A peripheral nerve stimulator was utilized to titrate pancuronium in 2mg IV boluses to maintain adequate muscle relaxation. Estimated blood loss totaled 650mls. Fresh frozen plasma 480ml and homologous red blood cells 700mls were administered for a drop in hematocrit (hct) level from an initial 38.8% to 33%, respectively. Fluid replacement was based on urine output, blood pressure, and estimated third space loss. A total of 7500mls crystalloid was administered, and urine output totaled 1125mls. The patient was taken to the intensive care unit and mechanical ventilation was maintained. The patient's trachea was extubated on postoperative day one, and he was discharged on postoperative day four without cardiac complications.

Discussion

The two most important risk factors for development of atherosclerosis involving the coronary arteries are male gender and increasing age. Additional risk factors are hypercholesterolemia, systemic hypertension, and smoking.[1] This patient's preoperative risk factors suggest he may have significant coronary artery disease and may be at risk for myocardial ischemia.
Since the patient was already taking metroprolol for his hypertension, beta blockade therapy, a significant cardioprotective intervention, was already in place preoperatively.

The American Heart Association (AHA) recommends beta blockade for patients in whom preoperative assessment identifies coronary heart disease or high cardiac risk, as defined by the presence of more than one clinical risk factor, who are undergoing intermediate-risk or vascular surgery.[3] Beta-blockers reduce cardiovascular morbidity and mortality in patients with hypertension, heart failure, and post-myocardial infarction.[4] However, despite the help of beta blockade in preventing ischemia, recent data suggest beta blockade alone is not enough for adequate cardioprotection.[5]

The AHA recommends using volatile agents during non-cardiac surgery for maintenance of general anesthesia in hemodynamically stable patients at risk for myocardial ischemia.[3] Volatile anesthetics produce a preconditioning-like effect, short periods of transient myocardial ischemia which appear to protect the heart from subsequent longer periods of myocardial ischemia.[6] Many studies indicate Sevoflurane and Desflurane allow better control of hemodynamic and sympathetic response to stimuli than isoflurane and other agents. One study reports a lower incidence of myocardial ischemia in patients anesthetized with sevoflurane than isoflurane while undergoing cardiac surgery.[2]

A meta-analysis of pooled data from several studies was performed and showed desflurane and sevoflurane significantly decreased the rate of myocardial ischemia and death in patients undergoing cardiac surgery. Since the mechanisms of anesthetic preconditioning are not fully understood, it cannot be excluded that the protective effects of sevoflurane and desflurane observed may be caused by properties other than preconditioning alone.[2]

Desflurane and sevoflurane reduce vascular resistance and enhance coronary, hepatic, intestinal, and skeletal muscle blood flow, whereas halothane and isoflurane decrease regional tissue perfusion in these vascular beds to varying degrees during systemic hypotension.[2] One study compared the effects of sevoflurane and propofol on myocardial function during and after coronary artery surgery. Before coronary pulmonary bypass (CPB), all hemodynamics were similar between the two groups. However, after CPB, patients who had received sevoflurane had preserved cardiac performance, and the need for inotropic support in the postoperative period was significantly less. This was confirmed in a subsequent study in a group of elderly high-risk patients with documented impaired myocardial function. Sevoflurane and desflurane preserved myocardial function after CPB with less evidence of myocardial damage and better postoperative myocardial function compared with an intravenous regimen.[6]

Non-cardiac surgery, in this patient's case, a total esophagectomy, is also associated with risk of perioperative cardiac morbid events. The observation that anesthetic cardioprotection with sevoflurane and desflurane is also observed during off pump coronary surgery may suggest this phenomenon is also present in patients at risk for myocardial events undergoing non-cardiac surgery.[6] The AHA practice guidelines identify a number of procedures with a more than 5% risk of perioperative cardiac morbidity; such as procedures associated with large fluid shifts or blood loss, as in a total esophagectomy.[6] Overall, physiologic considerations and considerable clinical data argue for the use of volatile agents in patients at risk for cardiac events.[2]

Considering the increased risk for cardiac events due to both the patient's risk factors and the surgical procedure, sevoflurane was chosen for use of maintenance anesthesia.

Hemodynamic parameters remained stable throughout the procedure, despite large fluid shifts and considerable blood loss. The post induction hypotension could have been related to the chosen induction agent, propofol. Etomidate 0.3mg/kg for induction of general anesthesia is a viable option to prevent this phenomenon due to the fact intravenous administration of up to 0.6mg/kg of etomidate to patients with severe cardiovascular disease has little or no effect on myocardial metabolism, cardiac output, peripheral circulation or pulmonary circulation.[7]

The choice of a volatile agent may be another factor that assists in protecting the myocardium. This in combination with strong fluid management, maintaining hemodynamic stability, and pre/ perioperative beta blockade may decrease the incidence of a cardiac event.

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Hyperthermic Intraoperative Intraperitoneal Chemotherapy

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Key words: mesothelioma, cytoreductive surgery, hyperthermic intraoperative intraperitoneal chemotherapy, chemotherapy, anesthesia

Malignant mesothelioma is a rare form of cancer originating from the serosal lining of cavities such as the pleural, pericardial, or peritoneal cavities and is most frequently associated with exposure to asbestos.[1] Approximately 2500 patients are diagnosed with malignant mesothelioma each year.[2-3] Malignant mesothelioma is generally diffuse and can progress asymptomatically for several months. The median survival rate from the time of malignant mesothelioma diagnosis is one year with current treatment involv-

ing surgery, chemotherapy, radiation, radiotherapy, immunotherapy, gene therapy, and palliative care.[4] In order to decrease morbidity and mortality, multimodal treatment approaches are increasingly being sought. One such treatment is cytoreductive surgery with hyperthermic intraoperative intraperitoneal chemotherapy.[5]

Case Report

A 53 year old male with diffuse malignant peritoneal mesothelioma (DMPM) was scheduled for exploratory laparotomy with lysis of adhesions, cytoreductive surgery, and hyperthermic intraoperative intraperitoneal chemotherapy (HIIC). The patient's surgical history included a previous cytoreductive surgery in 2006 with HIIC with doxorubicin and cisplatin and early postoperative intraperitoneal paclitaxel. The patient's medical history was otherwise negative. The patient's admission height was 5'11 and weight 234 pounds. The patient's preoperative assessment including electrocardiogram and pulmonary function was normal. The patient's preoperative hemoglobin and hematocrit were 13.8 g/dL and 41.4%. Platelets were 374,000 mm^3, serum creatinine was 1.0 mg/dL, and potassium was 4.1 meq/L.

Anesthesia was induced through an 18-gauge peripheral intravenous catheter (PIV) with midazolam 2mg, fentanyl 100 mcg, rocuronium 5mg, propofol 200mg, and succinylcholine 120mg. An 8.0 mmID endotracheal tube (ETT) was inserted into the trachea. A right radial arterial line, second PIV (16-gauge), and a right internal jugular central catheter were inserted. A nasogastric tube and an esophageal temperature probe were inserted. A thermal blanket was placed on the upper body and initiated at 43°C. Intravenous fluids were warmed with fluid warmers. Anesthetic depth was maintained with end tidal isoflurane, 1-1.3%, oxygen, 1 liter, and air, 1 liter. Vecuronium was administered throughout the case (23 mg total). A total of fentanyl 600 mcg and hydromorphone 2mg were given throughout the case.

Prior to the administration of HIIC, the patient received diphenhydramine 50mg , ondansetron 4mg, famotidine 20mg, and an infusion of dopamine at 3 mcg/kg/min was initiated to maintain urine output. The room temperature was placed at 55°C, the thermal blanket and fluid warmers were discontinued. The patient's temperature prior to HIIC administration was 36.3°C. The patient's International Normalized Ratio (INR) was 1.2 and partial thromboplastin time (PTT) was 33.4. HIIC with melphalan 138mg at 42.5°C was initiated 4 ½ hours into the operation. Personal protective equipment for chemotherapy administration was donned. During the HIIC, the patient's urine output was maintained at 150 ml per 15 minutes. Urine and blood samples were collected every 15 minutes. Ringer's Lactate was infused at approximately 1,500 ml/ hour. The patient received 200 ml of 25% albumin. Arterial blood gases were obtained throughout the procedure. The patient was repleted with potassium 50 meq throughout the case. Magnesium 2 gms HIIC was terminated after 90 minutes. Dopamine was discontinued. The patient's maximum temperature reached 38.5°C, vital signs remained stable. The patient was taken, intubated and sedated with midazolam 2 mg, to the post anesthesia care unit 1 hour later.

Discussion

Current treatment of DMPM involves surgery, chemotherapy, radiation, radiotherapy, immunotherapy, gene therapy, and palliative care.[4] To decrease the morbidity and mortality associated with this disease a combination

of treatments may be utilized.[5] Cytoreductive surgery with hyperthermic intraoperative intraperitoneal chemotherapy (HIIC) is one of the combined treatment options for those diagnosed with diffuse malignant peritoneal mesothelioma. The anesthesia practitioner must be aware of the unique considerations for anesthetic management for the cytoreductive surgery as well as HIIC, including blood loss, fluid shifts, electrolyte imbalances, coagulation abnormalities, and heat related problems.[6] Additionally, the anesthesia practitioner must be aware of safety precautions during chemotherapy administration. Other than the DMPM, this patient was relatively healthy. This allowed for adherence to these considerations and the standards of care.

Patients with DMPM may have been managed in the past with chemotherapy, surgery, and/or radiation. A thorough review of past treatments, particularly chemotherapy agents, should take place preoperatively. The anesthesia professional needs to be aware of possible organ damage associated with chemotherapeutic agents such as anthracyclines (doxorubicin) and cardiotoxicity, bleomycin and pulmonary toxicity, and cisplatin and renal toxicity.[7] The patient in this case was treated with doxorubicin and cisplatin; however, the patient's cardiac and renal functions were normal preoperatively.

In the case of DMPM with HIIC, cytoreductive surgery is followed by the administration of HIIC. Muscle relaxant was utilized to keep the patient fully relaxed. This patient had a BMI of 32.6. A modified rapid sequence induction was performed to avoid prolonged muscle relaxation should the patient have a difficult airway. A defasciculating dose of rocuronium was utilized prior to succinylcholine administration. The patient was maintained fully relaxed with vecuronium throughout the cytoreduction and HIIC administration.

During the cytoreductive portion of the procedure the patient may encounter fluid shifts, blood loss, coagulopathies, and electrolyte imbalances. These parameters, especially coagulation panels, must be evaluated and corrected prior to the administration of HIIC. Intravascular volume should be optimized prior to the initiation of HIIC, as during the administration of HIIC, urine output is maintained at 400cc per hour during HIIC and for 1 hour afterwards.[6] Urine output may be maintained by fluid bolus, furosemide, mannitol, and/or a renal dose dopamine infusion. Additionally, intravascular volume should be maintained to offset heat related problems associated with hyperthermia. Intravascular volume may be maintained with crystalloids, blood products, or albumin. Hespan is strongly contraindicated in this procedure due to associated dose related coagulopathies.[6] These parameters for monitoring and care were met during this case with pre HIIC electrolyte and coagulation evaluation, adequate intravenous fluids, and a dopamine infusion throughout HIIC.

Prior to the administration of HIIC, cooling measures must be taken to offset the hyperthermia encountered with HIIC. These cooling measures include reducing the room thermostat to the lowest setting and discontinuing all heating devices including thermal blankets and fluid warmers, as was performed in this case. Problems associated with hyperthermia include primarily peripheral vasodilatation, followed by hypotension, decreased urine output, and tachycardia.[6,8] These issues may develop into a heat stroke like syndrome in which the patient's temperature could remain elevated even after cessation of HIIC. Treatment for this heat stroke like syndrome include administering cool saline irrigation to the abdo-

minopelvic cavity and surrounding the patient's head with ice.[6]

Safe handling of blood and body fluids should be enforced during administration of chemotherapy and for 48 hours following chemotherapy administration.[5] The basic principle of safe handling of blood and body fluids contaminated with cytotoxic agents is Universal Precautions including gowns, gloves, masks and eye shields when the possibility of contact with contaminated blood and body fluids is present. The anesthesia practitioner should double glove to provide a better barrier against contact with cytotoxic agents.[9] In addition to wearing 2 pairs of gloves, the gloves should be changed every 30 minutes and powderless latex gloves should be utilized as they are less permeable and provide a better barrier.[6] Additionally, a smoke evacuator should be used to remove vapors, a chemotherapy spill kit should be available, and all waste accumulated after the initiation of chemotherapy should be specially labeled and stored for 48 hours prior to disposal to an appropriate hazardous waste facility.[5- 6, 9-10] During this case, these guidelines were strictly utilized.

In addition to anesthetic implications regarding cytoreductive surgery, management of a patient receiving HIIC following cytoreductive surgery requires a unique knowledge of chemotherapy administration, hyperthermia, and safety precautions.

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The Role of the Intubating Laryngeal Mask Airway

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Keywords: Difficult airway, laryngeal mask airway, alternatives, intubation.

Practice guidelines are established by the American Society of Anesthesiologist's (ASA) Task Force for the management of the difficult airway. Revisions occur with the development of new technology, research, and clinical practice. Components of the airway evaluation and the patient's past medical and surgical history may be indicative of a difficult airway. While the comparative benefit of a particular approach is difficult to conclusively establish, the consensus is that a systematic approach may lead to improved patient outcomes.[1]

Case Report

A 75 year old female presented for revision of an occipital cervical fusion. Past surgical history included an anterior cervical fusion for C1-C2 subluxation and posterior cervical fusion of C2-C4. She recently began to experience increased neck pain without neurological deficit. Radiograph of the c-spine revealed unstable hardware at C1-C2. She was placed in Halo traction for stabilization and scheduled for surgery the following day.

The patient had a past medical history of osteoarthritis, cervical stenosis, and hypertension. Routine medications consisted of Candesartan and Oxycodone. At 62 inches she weighed 52 kilograms and had nothing by mouth for 12 hours prior. Her preoperative labs, electrocardiogram and chest radiograph were unremarkable.

Airway evaluation revealed a mouth opening of 3 cm and a Mallampati classification of III. The traction device rendered the c-spine immobile. Based on her evaluation, a difficult airway was anticipated. The patient strongly opposed awake tracheal intubation.

Two large bore intravenous (IV) lines and arterial line were placed prior to induction. The room was equipped with an AIRTRAQ® Laryngoscope, an Air-Q Intubating Laryngeal Airway (ILA), fiberoptic scope, and a cart with additional adjuncts. The surgical team was present at induction and prepared to place an emergency surgical airway if needed.

In the operating room, midazolam 1 mg IV and fentanyl 25 mcg IV were given while standard monitors were placed. After 3 minutes of preoxygenation with 100% FIO2, induction consisted of lidocaine 40 mg and propofol 40 mg IV. With loss of consciousness and successful mask ventilation, rocuronium 30 mg IV was administered and ventilation was assisted for 90 seconds. Initial attempt at tracheal intubation (TI) was unsuccessful with an AIRTRAQ®. Mask ventilation was resumed to optimize oxygenation before a subsequent attempt. An Air-Q ILA size 2.5 was then inserted with ease.

The cuff was inflated and connected to the circuit, placement confirmed with ventilation that produced chest rise and an end tidal carbon dioxide ($ETCO_2$) tracing. The circuit was then disconnected and a 6.5mmID endotracheal tube (ETT) was blindly passed through the ILA conduit. The ILA was removed after cuff deflation. The ETT cuff was inflated, chest excursion and appropriate $ETCO_2$ were noted, and equal breath sounds heard.

Fentanyl infusion at 25 micrograms/hour and 0.6% Isoflurane were used for maintenance of general anesthesia. At the conclusion of the case, the trachea was extubated after adequate tidal volumes and a regular respiratory rate and pattern were noted. The patient was able to follow commands with equal strength in the upper extremities. She was awake, without deficit and at baseline hemodynamics. She was discharged on the fifth post operative day following an uneventful hospital course.

Discussion

When evaluating the airway, limited mouth opening may alter visualization during laryngoscopy.[2] Airway difficulties have been associated with a Mallampati classification greater than II. While no single component of the airway evaluation is a sole predictor, suspicion should arise if multiple indicators are noted. Formulation of alternative plans can improve success and reduce patient risk.

Surgical history of prior cervical fusion indicates profound limitation of extension in the c-spine, therefore making laryngoscopy extremely challenging. The use of traction by halo-thoracic fixator is most effective for short term stabilization, but presents an obvious challenge, making airway instrumentation and TI cumbersome.[2] By minimizing neck flexion; mechanical insult may be avoided, as well as compromise of blood flow to the spinal cord.[3] The difficult airway algorithm can provide a safe approach to airway control. The choice of device lies with the anesthesia practitioner's preference, experience level, and comfort. Anesthesia professionals agree that the focus lies on limiting injury, rather than the use of any particular device.[4] Each technique has disadvantages or contraindications. One example, the flexible fiberoptic scope cannot be utilized if the patient is uncooperative or refuses. Blind nasotracheal intubation is contraindicated if basal skull fracture is suspected.[4] Laryngeal Mask Airway (LMA) is contraindicated whenever there is a risk of aspiration of gastric contents, whether due to gastroesophageal reflux disease, inappropriate fasting times, gastroparesis or morbid obesity. Other contraindications include low pulmonary compliance requiring peak inspiratory pressures greater than 20 cm H20. The LMA was selected as the patient had no contraindications and she refused awake fiberoptic intubation. The 2003 ASA algorithm suggests several non invasive alternatives if face mask ventilation is adequate and the non emergent pathway is followed. Among these are the LMA as an intubation conduit with or without fiberoptic guidance.[1] The LMA is also a primary consideration under the emergency pathway if mask ventilation is inadequate.

Although inexperienced operators using the ILA achieve a lower intubation success rate than skilled clinicians performing direct laryngoscopy and TI, patients can be ventilated between intubation attempts.[5] One study proposed that ILA could be safely used after induction of general anesthesia. All patients were successfully ventilated with the ILA. Blind TI was accomplished in 50%, and an additional 25% with Fiber Optic (FO) guidance with the initial ILA. With reinsertion of the ILA another 15% were in-

tubated with FO assistance. The remaining 10% could not be intubated by the primary anesthesia professional but intubation was successful by another anesthesia professional.[6] Of important note is that the primary anesthesiologist had significantly more experience with AFOI compared to ILA. Minimum oxygen saturation was higher in the ILA group at 97.5% compared to 94.5%. Oxygen saturation dropped to 62% and 84% in two patients in the AFOI group.[6] Both methods of TI were highly successful and there were no adverse events with participants. It concluded that ILA is a suitable alternative, especially when AFOI is not possible.[6] In this case study, oxygen saturation decreased from 99% to 98%, correlating with the findings of Joo, et al.

Securing the airway, assuring adequate gas exchange, and stabilizing circulation are initial priorities in anesthetic management. Vigilant practitioners must have the ability to recognize a potentially difficult airway, anticipate the problem and have alternative plans in place. The purpose of this case study was to explore the ILA as a reasonable approach to TI in the face of patient refusal of AFOI. The ASA recognizes the LMA as a primary airway management device in an emergency situation and the ILA as a conduit to blind TI. Further research is needed to explore this approach as a reasonable alternative to AFOI in difficult airway management.

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Airway Management in Pierre Robin Syndrome

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Keywords: Pierre Robin syndrome, laryngeal mask airway, tracheal intubation, children, fiberoptic intubation

Pierre Robin anomaly is a congenital malformation of craniofacial development which may present challenging airway management issues throughout the perioperative period. This birth defect is a relatively rare condition with an incidence of 1 in 50,000 births.[1] Pierre Robin syndrome is characterized by an unusually small jaw (micrognathia), posterior displacement or retraction of the tongue (glossoptosis), and upper airway obstruction. Incomplete closure of the roof of the mouth (cleft palate), is present in the majority of patients, and is commonly U-shaped.[2] This case presentation describes the anesthetic and airway management of a patient with Pierre Robin syndrome undergoing cleft palate repair.

Case Report

A 2.5 year-old boy, weighing 12 kilograms, diagnosed with Pierre Robin syndrome presented for cleft palate repair. The patient's history of sleeping on two pillows and snoring was suggestive of upper airway obstruction during sleep. On physical examination, he appeared to be in no acute distress. His airway exam showed a complete cleft palate, mouth opening of three centimeters, and full range of motion of his neck. Other physical findings included a thyromental distance of two centimeters consistent with micrognathia, and glossoptosis associated with cleft palate. All other physical findings, laboratory results, and anesthetic history were unremarkable.

On arrival to the operating room, intraoperative monitors were placed and the patient was pre-oxygenated via facemask. Inhalational induction was initiated with nitrous oxide at 6 L/min and oxygen at 4 L/min, while sevoflurane was rapidly titrated to 8%. Spontaneous ventilation was maintained. A 70millimeter oropharyngeal airway was inserted to avoid airway obstruction. After reaching a sufficient depth of anesthesia, direct laryngoscopy was attempted twice with cricoid pressure, first using a size 1 Miller blade and a second attempt with a size 1.5 Wisconsin blade. The vocal cords could not be easily visualized under laryngoscopy. Both Miller and Wisconsin blades provided views of the epiglottis only. After an unsuccessful attempt at blind endotracheal intubation to secure control of the airway, a #2 disposable Laryngeal Mask Airway (LMA) was placed. Effective ventilation was verified by adequate chest expansion and capnography. An Omeda 2.2 mm fiberoptic bronchoscope was inserted through the lumen of the LMA and we were able to visualize the vocal cords. The fiberoptic bronchoscope was removed and an uncuffed 4.0 oral RAE tracheal tube was threaded over the bronchoscope. The bronchoscope was then reinserted through the LMA. After the vocal cords were visualized, the endotracheal tube was inserted without difficulty through the vocal cords and into the trachea. The position of the tube above the carina was fiberoptically verified. The LMA was gently removed with long tipped forceps holding the oral RAE tube in place. The endotracheal tube position was again verified with capnography, bilateral breath sounds, and condensation seen in the endotracheal tube.

General anesthesia was maintained with nitrous oxide at 2 L/min, oxygen at 1 L/min and sevoflurane at 3%. Intravenous dexamethasone 6.5milligrams was given after intubation to prevent airway edema. Vital signs remained stable throughout the case. At the end of the case, the neuromuscular blocker was antagonized. When the patient was awake and met extubation criteria , the trachea was extubated. The patient was placed in a sitting position where he was breathing without signs of respiratory distress or obstruction. The child was observed for postoperative respiratory complications in the recovery room before he was discharged to the ward.

Discussion

Patients with Pierre Robin syndrome may present to the anesthetist for a variety of procedures from infancy to childhood. The airway problems are less likely to be life threatening with increasing age and usually, after six months of age, are not a cause of significant concern.[3] Although the upper airway obstruction in these patients improves as they grow, they may be difficult to mask ventilate at any stage of their development and may be impossible to intubate by direct laryngoscopy.[4]

The pathophysiology of airway obstruction in patients with Pierre Robin is primarily due to a posteriorly situated tongue which significantly reduces the size of the posterior pharyngeal area. Each time the infant inhales, the tongue is drawn more posteriorly and downward by the force of negative intrapharyngeal pressures generated by respiration.[5] This "ball and valve" effect of the tongue produces inspiratory obstruction of the airway which, according to Mallory et al., can usually be improved by placing the infant prone, in a head down position, or in a sitting position leaning forward.[4] These maneuvers encourage slightly forward movement of the tongue in response to gravity which improves the obstruction.

Anesthetic management for patients with Pierre Robin should begin with a thorough preoperative history, with special attention to the cardiac and respiratory systems and associated congenital anomalies. Sleep apnea, snoring, and/or inspiratory stridor may be present. Feeding difficulties, obstructive symptoms, and congenital heart defects may also complicate the clinical presentation of these patients.[2] A careful review of the patient's medical and anesthetic records is extremely helpful in assessing the patient's risk for a difficult intubation.

Physical examination should include a careful evaluation of the child's airway. Nasal flaring, accessory muscle retractions, stridor, dyspnea, and an increased anterior-posterior diameter of the chest would suggest the presence of significant upper airway obstruction. Chest auscultation may reveal cardiac murmurs, pulmonary rhonchi or wheezing. Preoperative sedatives should not be given to patients who have symptoms of significant airway compromise.

During intubation, multiple attempts at direct laryngoscopy may cause edema and bleeding with subsequent difficult mask ventilation. When faced with a difficult airway, an alternative technique to achieve successful placement of a tracheal tube without traumatizing the larynx should be sought. According to Rasch et al, awake intubation would be the safest method for securing the airway.[2] This may be possible in a smaller infant, but may be difficult to accomplish in the older infant or child in whom an inhalational induction may be preferred. With the child breathing spontaneously, breath sounds and air bubbles in the pharynx could be a useful guide to intuba-

tion. Use of muscle relaxants should be avoided as airway obstruction is more likely to occur when soft tissues are relaxed.[6]

Several effective techniques for the management of difficult airways in adults and children have been reported. One example is using an LMA to facilitate a fiberoptic intubation. Patel et al. intubated the trachea of an infant with Pierre Robin using a pediatric fiberscope, OD 2.2mm, mounted with a 3.0 endotracheal tube through a #1 LMA.[7] The use of an LMA allows control of the airway before and during placement and manipulation of the fiberoptic scope.[8] Osses et al. reported successful endotracheal intubation through an LMA in 6 children with craniofacial malformations undergoing head and neck reconstructive plastic surgery. Instead of using a fiberoptic scope to intubate, they passed an endotracheal tube blindly via the LMA and, after confirming placement, maintained the tube in position with the aid of an adult stylet. The LMA was then gently removed while holding the endotracheal tube in place with the stylet.[9] A case report by Ofer et al. demonstrated using an LMA to intubate a 6 year-old child with Pierre Robin syndrome by placing a normal stylet guide into the tube to remove the LMA.[10] Mullick et al. reported the case of a twenty-one-month-old boy with Pierre Robin syndrome who was intubated through an LMA. The endotracheal tube was held in place with the use of an adult intubating stylet modified with a thick band of leucoplast applied to the middle of the stylet. The leucoplast prevented tracheal injury that could have been caused by the stylet migrating beyond the tip of the endotracheal tube at the time of removal of the LMA.[6] An intubating "Fastrach" LMA has been used successfully to facilitate difficult airway intubation in adults. Currently there are no case reports of using a pediatric size intubating "Fastrach" LMA to manage difficult intubations in children.[6,11]

At the conclusion of surgery, a decision must be made regarding the feasibility of extubation. This depends largely on the operative site and any trauma occurring to the airway during intubation. If the trachea is extubated, the patient should be closely observed for postoperative complications of airway obstruction. Use of a nasal trumpet can help avoid postoperative airway obstruction. One should be cautious of administering postoperative analgesia because of the potential for respiratory depression.

Children born with craniofacial anomalies such as Pierre Robin syndrome often have anesthetic airway management difficulties. If tolerated, an awake intubation would be the safest method of securing the airway.[2] Based on current literature review, the use of an LMA for managing difficult airways in children has proven to be reliable. Fiberoptic-guided endotracheal intubation via the LMA can successfully be used to secure the airway of a child with Pierre Robin syndrome. Recent case reports have demonstrated that the use of an adult intubating stylet to maintain the endotracheal tube in place while the LMA is removed enables this technique to be used on children. The use of the intubating "Fastrach" LMA, which has facilitated difficult airway intubation in adults may be another option for children in the future.

Important aspects in the anesthetic management of patients with Pierre Robin include a thorough preoperative evaluation of their medical conditions and physical evidence of airway obstruction, and close postoperative observation for late complications of airway obstruction. In addition, safe and effective methods using an LMA for facilitating endotracheal intubation in the Pierre Robin popu-

lation have been illustrated. In this case, our findings suggest that the LMA was a valuable device to assist in the tracheal intubation. When a potentially difficult airway presents in a pediatric patient, the fiberoptic intubation via an LMA has demonstrated to be an efficacious first line technique for airway management.

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Alpha Thalassemia and General Anesthesia

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Keywords: altered hemoglobin, anemia, dental restoration, erythropoesis, thalassemia,

There are several forms of thalassemia, all affecting the normal production of hemoglobin. Alpha thalassemia is a genetic disorder caused by mutations in any, or all four of the alpha chains of the hemoglobin molecule. It is reported that more than 15 million people worldwide have clinically apparent thalassemias.[1] Alpha thalassemia is most frequently seen in the Southeast Asian, southern Chinese, Middle Eastern, and Mediterranean populations.[2] Anesthetic implications for patients with alpha thalassemia

are guided by the severity of the disorder. Thorough airway assessment, evaluation of preoperative hemoglobin levels, and assessment of any additional physiologic anomalies or potential risk factors are indicated.

Case Report

A 21 month old, 9 kg, American Society of Anesthesiologists (ASA) Class 1 African American female was admitted for outpatient dental restoration under general anesthesia. Review of her history and physical revealed a diagnosis of alpha thalassemia trait with no other significant medical history noted. The patient was receiving no routine medications and had no known medical allergies or previous surgeries. Family members did smoke in the patient's home. A preoperative blood cell count revealed a mild anemia with a hemoglobin of 10.2 g/dL and hematocrit 32.9%. The patient was asymptomatic despite this anemia with all vital signs within normal limits. The airway assessment revealed dental decay, but no other significant airway abnormalities. No preoperative medication was administered.

In the operating room, pulse oximetry, noninvasive blood pressure, and electrocardiogram monitors were applied and preoxygenation was followed by an inhalation induction with 8% sevoflurane. A 22 gauge IV catheter was placed in the left antecubital vein with fentanyl 30 mcg administered IV. The right nare was prepped with neosynephrine nasal spray and 1% lidocaine jelly. Visualization of the vocal cords was obtained with a Robert Shaw laryngoscope blade and a 3.5 mm nasal Rae tube was utilized for intubation. The endotracheal tube was inserted into the trachea with the assistance of Magill forceps. The patient's head was placed in a gel donut headrest and the eyes covered. Maintenance of anesthesia was continued with end-tidal sevoflurane at 2.3% to 3.7%. Dexamethasone 9 mg and ondansetron 4 mg were administered intraoperatively. A lactated Ringers microdrip was utilized to give a total of 350 mL throughout the case.

The dental restoration was completed in 48 minutes. The patient's oxygen saturation was maintained at 100% with spontaneous ventilation and the endotracheal tube removed without any adverse events. The patient was taken to the recovery room and a unit dose albuterol nebulizer treatment ordered and administered for coarse lung sounds upon auscultation. After a routine recovery course the patient returned to the outpatient surgery area and was discharged to home that same day.

Discussion:

There are several known classifications of thalassemia with varying degrees of symptoms. These include alpha, beta, and sickle cell thalassemias. Alpha thalassemia is a deletion or mutation in the alpha chain of the hemoglobin molecule. The alpha gene is located on chromosome #16 and the number of genes altered determines the severity and type of anemia.[3] The patient in this case report had alpha thalassemia trait, or a heterozygous form where two alpha chain genes are deleted and two are present. The most common symptom of this form of alpha thalassemia is mild anemia unresponsive to iron therapy with microcytosis. When all four alpha chains are deleted, the homozygous form, or alpha thalassemia major is present. This form is incompatible with life and results in hydrops fetalis. Beta thalassemia occurs when there is an excess of alpha chains, and usually presents with elevated levels of hemoglobin A_2.[4] Symptoms can range from mild anemia to the need for chronic blood transfusions or splenectomy.

These two types of thalassemia are differentiated only through laboratory tests.

A concern for patients with thalassemia is facial deformity from ineffective erythropoesis due to the genetic disability to produce useful hemoglobin.[4] Additional airway anomalies may also be unseen and only evident upon laryngoscopy. Careful airway assessment is necessary in patients with known thalassemia. Some alpha thalassemias are associated with an X-linked mental retardation with vertebral and upper airway anomalies. These anomalies can include many causes for airway obstruction such as an enlarged tongue.[5] Of most concern with these patients is airway obstruction or airway management issues that may compromise ventilation.[5] Careful positioning of the airway during, and after intubation is important to prevent possible nerve injury or movement of the endotracheal tube. In addition, renal disorders secondary to agenesis can be present in these patients and should be monitored and closely followed.[5] A renal function test was not done preoperatively on this patient, but could be a consideration in future procedures.

A preoperative hemoglobin in this patient was obtained secondary to the thalassemia diagnosis, as hemoglobin levels are not routinely obtained, especially in minor procedures for healthy patients. The patient's history did not state how the diagnosis of alpha thalassemia was made, but it is often found by chance during evaluation for another procedure.[1] Due to the changing demographics related to immigration, the incidence of alpha thalassemia has increased in California and is now included in newborn screening in the state.[2] Though it has been determined that preoperative hemoglobin testing in healthy pediatric patients undergoing minor procedures is not needed, careful pre-operative assessment should be taken.[6] The anesthesia practitioner should consider diseases associated with anemia, especially in African-American patients. Pallor and cyanosis are difficult to detect with dark skin tones, and many times the color of the mucous membranes is obscured by the dental pack. If the preoperative hemoglobin is unknown, diligent observation should be maintained.

This case is an example of a type of procedure common among patients with thalassemia. It has been found that dental caries are more common in thalassemic patients. In a 2006 study by Gomber and Dewan, it was suggested that patients with beta thalassemia will require restorative dental care more often than the healthy patient.[7] The anesthesia practitioner may also encounter a thalassemic patient undergoing a splenectomy, as this is one of the treatments for thalassemia major, a form of beta thalassemia.

Careful preoperative assessment for possible airway complications and anemia should be done when caring for a patient with known thalassemia. An understanding of the type of thalassemia and changes associated with the disorder are important when providing anesthesia care. In this case report, general anesthesia was appropriate with careful assessment of the airway and observation of possible complications related to chronic anemia.

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Latex Allergy in the Spina Bifida Patient

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Key Words: Latex allergy, spina bifida, neural tube defects, anaphylaxis, anesthesia

The prevalence of spina bifida in the United States is one out of every 1,000 live births, making the condition the most common neural tube defect.[1] First reported in 1979, latex sensitization is currently on the rise, accounting for 6% of the general population and as high as 67% of spina bifida patients.[1,2] Latex allergy is the second most common cause of anaphylaxis in anesthesia, accounting for 16.6% of cases.[2] Early preoperative identification and prevention of latex exposure in high risk patients can lead to a reduction in the overall morbidity and mortality associated with latex anaphylaxis.

Case Report

A 24 year old, 61.5”, 135 kg, female patient presented for a laparoscopic cholecystectomy for a two month history of right upper quadrant pain associated with eating fatty foods. Her past medical history consisted of spina bifida with spine closure as an infant and multiple other surgeries throughout her lifetime including; colostomy, colostomy takedown, bladder reconstruction, and ileal conduit formation. Other history included renal insufficiency with atrophic kidneys, frequent urinary tract infections, cesarean section, morbid obesity, and seasonal allergic asthma. Her only medication was an albuterol inhaler used intermittently. Preoperative laboratory values were within normal limits except an elevated creatinine at 2.0mg/dL consistent with her renal insufficiency. Allergies included latex and suprax. Past reactions to latex included a systemic red rash with hives. Her reaction to suprax, a cephalosporin, was a generalized rash.

Upon review of the patient’s medical information, latex allergy precautions were taken in the set up of anesthesia for the case. A latex-free head strap was obtained, and all anesthesia supplies including the reservoir bag, circuit, mask, endotracheal tube, and monitoring equipment were checked for latex content and replaced if necessary. Additionally, non-latex examination gloves replaced the gloves normally stocked on the anesthesia cart, and all medications were drawn up after removal of the rubber stop-

pers and lids. Emergency medications were also readily available.

Physical examination revealed an obese female with a Mallampati I classification, natural dentition, greater than 6cm thyromental distance, and full cervical range of motion. Vital signs were 109/68, 79, 14, and 98% saturation on room air. Breath sounds were clear to auscultation in all lung fields. The cardiac exam revealed a regular rate and rhythm with no murmurs, rubs, or gallops noted. An ileal conduit stoma was appreciated on the left abdomen, and the patient last catheterized herself at 5:30 am that morning. Non-latex examination gloves were used for the exam, and a latex-free tourniquet was used for intravenous access. Lactated ringers solution was started, and midazolam 2mg IV was given upon transfer to the operating room. A general endotracheal anesthesia was planned for this patient.

After transferring to the operating table, standard monitors and oxygen at 10 L/min by face mask were applied. Intravenous induction consisted of fentanyl 150mcg, lidocaine 100mg, propofol 150mg. Mask ventilation was attempted and successful with an oral airway and two-handed technique. Rocuronium 50mg was given and after 60 seconds and 0/4 train-of-four, a 7.0mm endotracheal tube was inserted into the trachea by direct laryngoscopy. Placement was confirmed by bilateral equal breath sounds and $ETCO_2$, mechanical ventilation was started, and anesthesia was maintained with desflurane, rocuronium 5mg, and morphine sulfate 10mg throughout the case. Ciprofloxacin 400mg and metrondiazole 500mg were given intravenously for prophylactic antibiotics.

The case was uneventful without incidence of anaphylaxis. Hemodynamic stability was consistent throughout the case. Emergence from anesthesia was smooth, and the patient transferred to the post anesthesia care unit (PACU) with oxygen delivered by face mask. Report was given to the PACU RN, and the patient's latex allergy was relayed immediately. The patient was discharged to home later that day with no symptoms of an allergic reaction.

Discussion

Spina bifida is a condition associated with the failure of spine closure during the first two months of gestation. It is thought to be due to a genetic predisposition or a deficiency of folic acid in the first six weeks of pregnancy and may result in a range of abnormalities including; paralysis, hydrocephalus, scoliosis, or bowel and bladder problems.[1] Children with spina bifida have a great degree of exposure to natural rubber latex due to repeated surgical procedures, implanted latex-containing materials, and catheterizations.[3] This can lead to a latex sensitization and allergy, which may worsen with age. Survival into adulthood is less common in spina bifida, with only a 50% survival rate at 30 years of age predominantly due to renal failure.[4] It is common to treat any patient with spina bifida as latex sensitive due to the high correlation of latex sensitization and development of a life-threatening latex allergy at any time.

In latex sensitization, there is a presence of immunoglobulin E (IgE) antibodies to latex with a lack of clinical manifestations, whereas, latex allergy is an immune-mediated reaction to latex with clinical manifestations.[2] The two types of latex allergy are Type IV cell-mediated hypersensitivity reaction and Type I IgE mediated hypersensitivity reaction. A Type IV response is a 48 to 96 hour delayed reaction to latex exposure causing contact dermatitis with no systemic

symptoms, while a Type I response is an immediate sensitization and interaction of IgE with the allergen leading to an allergic response ranging from mild to severe.[5] Clinical manifestations may range from contact dermatitis, itching, uticaria, rhinitis, conjunctivitis, bronchoconstriction, dyspnea, or anaphylactic shock leading to bronchospasm, laryngeal edema, circulatory collapse, hypotension, tachycardia, arrhythmias, or cardiac arrest.[5]

Latex allergy as a causative agent for anaphylaxis during anesthesia is second only to neuromuscular blockers.[6] The most common features of anaphylaxis under anesthesia are cardiovascular symptoms such as hypotension and tachycardia, cutaneous symptoms, laryngeal edema and bronchospasm which usually occur within 30 minutes of induction of anesthesia.[2] These symptoms may be due to other conditions that resemble anaphylaxis or by the anesthesia and medications given during the procedure; therefore, careful assessment and timing of symptoms must be considered. Latex should always be included in the differential diagnosis of anaphylaxis during anesthesia.[2] Treatment of latex anaphylaxis consists of maintaining the patient's airway, breathing, and circulation. Instituting oxygen, IV fluids, removal of latex containing products and agents, discontinuation of all anesthetics and non-emergency medications, and administering resuscitative medications such as epinephrine, antihistamines, bronchodilators, H-2 blockers, and corticosteroids as needed are various interventions for anaphylaxis.[1,2]

Prevention is the best management for anaphylaxis. The potential severity of anaphylaxis during anesthesia necessitates a reduction in incidence by performing a thorough preoperative assessment.[6] Confirming a latex allergy can be accomplished by a comprehensive interview and focused history on previous sensitivity, skin testing for latex sensitivity, and a positive radioallergosorbent test (RAST).[7] The anesthetic preparation and plan can be altered to take precautions for the patient with a confirmed latex allergy. Avoidance of latex is the best prevention against anaphylaxis. One of the most important items to replace is latex examination gloves due to the frequent contact with the skin and mucous membranes.[5] In addition, the operating room should be latex free and all medical equipment should consist of latex-free materials. A latex allergy protocol, emergency medications, and equipment should also be readily available.[2]

In this particular case study, the patient had an uncomplicated surgical intervention without incidence of latex anaphylaxis. Without the proper precautions to provide a latex-free environment, the outcome may have turned out differently. Understanding the correlation between spina bifida and latex allergy and the prevalence of latex allergy to anaphylaxis is of great value to the anesthesia practitioners. Performing a thorough preoperative assessment and instituting prophylactic measures to prevent latex anaphylaxis is vital to providing quality anesthesia care for the latex allergy patient.

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Mentor: Vicki Coopmans, CRNA, PhD

Intubation of the Distorted Upper Airway

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Key words: tracheal mass, difficult airway, difficult intubation, airway assessment, gum elastic bougie

A large thyroid mass can cause significant tracheal deviation and compression rendering perioperative airway management difficult. A thorough preoperative airway evaluation and review of the patient's history must be completed prior to administration of anesthesia to decrease the risk of mortality and morbidity. Critical airway incidents are responsible for 50% of anesthesia-related deaths.[1] When upper airway distortions cause difficult direct laryngoscopy, other non-invasive airway techniques should be utilized.[2] A gum elastic bougie-assisted intubation is a simple technique that can be particularly useful for patients with upper airway abnormalities, such as those occurring in the presence of a large thyroid goiter.[2,3]

Case Report

A 77-year-old, 109-kilogram, 64-inch female patient with a large right thyroid goiter presented to the preoperative area for a right thyroidectomy. She was euthyroid at the time, but had a long medical history of hyperthyroidism. Her ASA physical status was classified as a 3, with significant medical history including coronary artery disease requiring placement of three coronary stents, hypertension, dyslipidemia, gastroesophageal reflux disease, obesity (BMI 41 kg/m^2), and cervical spine osteoarthritis. Her medications included metroprolol, quinapril, diltiazem, hydralazine, acetylsalicylic acid, alprazolam, and acetaminophen. Recent chest radiography revealed a large right neck mass protruding into the mediastinum with trachea displacement to the left and narrowing of the trachea at the level of the thoracic inlet.

Physical examination revealed an obese woman with a large right neck mass appearing slightly smaller than a baseball. The patient had a Mallampati class III airway with a thyromental distance of 3 cm. She had limited cervical spine range of motion with decreased neck flexion and extension. The patient was unable to touch the tip of her chin to her chest. Her trachea was palpated and clearly deviated to the left. She had noisy respirations at rest, but denied shortness of breath or sleep apnea. Her oxygen saturation on room air was 96%, and breath sounds were clear to auscultation in all lung fields. Her heart was in normal sinus rhythm with no murmurs or rubs noted.

An 18-gauge peripheral IV was inserted, and lactated Ringers was started. The patient was premedicated with midazolam 2 mg IV and glycopyrrolate 0.1 mg IV in the preoperative area and then transferred to the operating room suite. A rapid sequence induction with Sellick's maneuver was planned. A fiberoptic bronchoscope was ready for use and the difficult airway cart was present in the operating room. Anesthesia practitioners present included an SRNA, CRNA, and attending anesthesiologist.

In the operating room, the patient moved herself to the table. While standard monitors were being applied, the patient received oxygen at 10L/minute via facemask. The patient was instructed to breathe deeply and slowly. After approximately five minutes of pre-oxygenation, her oxygen saturation was 99% and a rapid sequence induction was performed by administration of fentanyl 100 mcg IV, followed by lidocaine 100 mg IV, propofol 150 mg IV, and succinylcholine 80 mg IV. When fasciculations stopped, laryngoscopy was attempted using a #3 Miller blade. A Cormack and Lehane grade 3 glottic view was obtained. Despite visualization of the epiglottis, intubation was unsuccessful, with three failed attempts to pass the endotracheal tube through the vocal cords. Within 60 seconds, the patient's oxygen saturation decreased to 85%, the blade was removed and manual mask ventilation with oxygen at 10L/min was attempted. Mask ventilation was initially unsuccessful with oxygen saturations continuing to decrease to 80%. After prompt head repositioning and insertion of an oral airway, successful mask ventilation was achieved. Chest rise and positive end-tidal carbon dioxide ($ETCO_2$) were noted, and oxygen saturation began increasing. Rocuronium 30 mg IV and an additional dose of propofol 100 mg were administered. When oxygen saturations increased to 96%, a second laryngoscopy was performed using a #3 Miller blade. Again, a grade 3 glottic view was obtained. A gum elastic bougie was used to guide a 7 mm oral endotracheal tube through the glottic opening.

Endotracheal intubation was successful and placement was confirmed by bilateral equal breath sounds and $ETCO_2$. General anesthesia was maintained with desflurane in oxygen at 2L/minute flows. Dexamethasone 10 mg IV and ketorolac 30 mg IV were given during the case as it continued uneventfully.

Emergence was smooth, and extubation occurred without difficulty. The patient was transferred to the post-anesthesia care unit with an oxygen saturation of 96% on 6 L/min oxygen via nasal cannula. This patient was discharged the following day.

Discussion

Patients with large thyroid goiters often present with distorted upper airways. Large upper airway masses with tracheal compression and deviation are predictive of a difficult intubation requiring alternative airway management strategies.[4] The American Society of Anesthesiologists (ASA) defines a difficult airway as "the clinical situation in which a conventionally trained anesthesiologist experiences difficulty with face mask ventilation of the upper airway, difficulty with tracheal intubation, or both."[2] Several preoperative findings, in addition to the presence of a large tracheal mass, were predictive of a difficult intubation in this patient. Although the predictive value of any single component of an airway assessment is uncertain, multiple assessment components considered collectively improve prediction of the difficult airway. Preoperative assessments that may be associated with difficult intubation include a Mallampati classification greater than II, thyromental distance

less than 6 cm, sternomental distance less than 12.5, and mouth opening of less than 5 cm. It is suggested that Mallampati classification and thyromental distance may be the most accurate combination of factors useful for predicting difficult intubation.[5] All of these components were addressed preoperatively as indicated, and confirmed the anesthesia practitioner's suspicion of a potentially difficult intubation in this patient. The patient's previous anesthetic records were obtained, and information about prior airway management was reviewed. Upon review, they were devoid of prior intubation difficulty.

In congruence with the ASA practice guidelines of difficult airway management, several basic preparation steps were taken prior to transfer of the patient to the operative suite.[2] First, the patient was informed of the special risks and procedures that may have occurred with her potentially difficult airway. Next, it was ensured that multiple anesthesia practitioners were immediately available during induction and intubation. Finally, a difficult airway cart was placed in the operating room and supplies within were prepared for immediate use.

In this case, rapid sequence induction of general anesthesia with administration of a low dose of succinylcholine was chosen, as it would have quickly allowed the patient to return to spontaneous ventilation if needed after failed initial intubation attempts. According to the ASA difficult intubation guidelines, after induction of general anesthesia fails and initial intubation attempts are unsuccessful, face mask ventilation should be attempted. If face mask ventilation is adequate, anesthesia practitioners should attempt one of a variety of non-invasive approaches to successfully intubate the patient.[2] Face mask ventilation with insertion of an oral airway was ultimately successful in this patient. This allowed time to attempt non-invasive approaches to tracheal intubation.

Non-invasive approaches to difficult intubation with adequate ventilation include use of different laryngoscope blades, a laryngeal mask airway as an intubation conduit, fiberoptic intubation, intubating stylet or tube changer, light wand, retrograde intubation, and blind oral or nasal intubation.[2] In this case, a gum elastic bougie was chosen first. With the second attempt at laryngoscopy, the bougie was inserted just under the epiglottis until resistance was met. The tracheal tube was easily threaded over the bougie and endotracheal intubation was successful.

Gum elastic bougie-assisted intubation was helpful in this patient because the airway anatomy was abnormal and laryngoscopy provided a limited view. The gum elastic bougie is one of several non-invasive alternative approaches described within the difficult airway algorithm recommended by the ASA.[2] It has been used for a significant period of time as a common tool when direct laryngoscopy is difficult. A review of the literature reveals successful use of the gum elastic bougie in cases when anatomical landmarks of the upper airway are not recognizable due to significant upper airway distortion.[3]

The presence of a thyroid goiter predicts the possibility of a difficult patient intubation. A thorough preoperative airway physical assessment and review of the patient's history is crucial in determining the appropriate technique for airway management. If intubation is unsuccessful after induction of general anesthesia, but face mask ventilation is adequate, many alternatives can be considered as non-invasive approaches to tracheal intubation. A gum elastic bougie is one that may be considered if upper trachea distor-

tion and compression results in a limited direct laryngoscopy as in the case of a significant tracheal goiter.

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Mentor: Vicki Coopmans, CRNA, PhD

LETTER TO THE EDITOR

Student Registered Nurse Anesthetist Volunteer Experience in Honduras

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Key words: volunteer, Honduras, anesthesia, limited resources, problem solving

Through my 27 months as a nurse anesthesia student, much of my time was spent on basic science, anesthesia fundamentals, and clinical skills. In the final month of my education at Georgetown University, I had the unique opportunity to spend a week in Honduras with the Virginia Hospital Center Medical Brigade. This volunteer opportunity not only allowed me to help in an underserved community, but was also a practical culmination of my nurse anesthesia education. I was able to assess the tools necessary for anesthesia administration, apply problem-solving skills to my knowledge of the anesthesia machine, and improve clinical focus on the patient (while gaining perspective on my reliance on technology). Additionally, this experience taught me the balance of administering a safe, quality anesthetic while preserving resources.

The Virginia Hospital Center Medical Brigade has traveled to Honduras for one week every year since 1999 (with the exception of 2001), focusing not only on delivery of medical and surgical services, but also on providing education and supervision for Honduran community health workers in rural villages. This past year, members of the brigade worked with community members to build a water system, which now provides clean water for 1,800 members of a remote mountain village.[1] I was able to work on the surgical team administering general and regional anesthesia with a group of three sea-

soned certified registered nurse anesthetists (CRNAs) and an anesthesiologist. Almost all of the anesthetics were performed by the CRNAs. We managed anesthesia for 78 patients with primary surgeries including strabismus correction, hernia repair, cholecystectomy, hysterectomy and caesarean section.

Prior to arriving in Honduras, there was a coordinated effort by Betsy Koop, CRNA to obtain and organize the anesthesia supplies. These were sent by ship to our destination two months before the trip. Anesthesia machines were donated and available for each of the operating rooms (ORs). There was one extra machine in the supply warehouse. Upon arrival to Santa Teresa Regional Hospital, we began to assess the equipment including the anesthesia machines, supplies, and gas supply. The machines were older than I expected to see and included some settings that I had not worked with in the past. For example, one of the ventilators required a setting of the respiratory rate and the minute ventilation (as opposed to tidal volume). I enjoyed calculating the settings in a new way. Instead of the machine giving me the calculated numbers, I was able to utilize calculations had I learned from my anesthesia courses.

The anesthesia machinery was mostly in working condition and every room had a working pulse oximeter; however, there were issues such as ventilator malfunction, machine alarm malfunction, unavailable scavenging, inaccurate gas monitoring and malfunctioning blood pressure monitoring.

We were able to circumvent the ventilator malfunction by utilizing laryngeal mask airways (LMAs), regional anesthesia, or by manually ventilating the patient. The solution for fixing a malfunctioning OR machine alarm was to disassemble the extra machine and use the parts to fix the OR machine. For one fix in particular, the CRNA called on the services of the local auto mechanic, who had the only tools available to fix the machine. For scavenging, we ran a scavenging hose to an outside hallway or did without and tried to minimize exposure with a tight mask fit for inhalation inductions. For cases with the scavenging hose running to the hallway, I continuously made sure that the hose did not become kinked or stuck in the door to avoid barotrauma to the patient.

We primarily utilized manual blood pressure cuffs or store bought automatic cuffs for blood pressure readings. Inaccurate gas concentration monitoring was the most challenging situation for me. We used sevoflurane, isoflurane and enflurane; however, at times the gas monitoring would read the primary gas and also halothane and/or nitrous oxide (neither of which was available). To obtain the appropriate depth of anesthesia, instead of reading my end tidal gas or calculated minimal alveolar concentration (MAC) from a monitor the method that I had been so reliant on in the past, I had to keep in mind the dialed concentration, flow rate, respiratory rate, and carefully monitor vital signs. I quickly found that I stopped relying on monitors and numbers; instead, I really started to focus more on my patient.

I began to realize the extent to which I rely on monitors. Part of this, I attribute to studying anesthesia now, in a time of technological dependence and advancement. I firmly believe in utilizing technology as an adjunct to the clinical picture, indeed, technology has made anesthesia safer for patients.[2] However, in Santa Teresa Regional Hospital, where access to state of the art equipment was not available, I found I was more attuned to the patient's condition. For instance, at the start of a procedure in which

an LMA was used, I noticed that the patient's chest was rising inconsistently. The LMA needed to be repositioned. In the US, I more than likely would have noticed a drop in my end tidal carbon dioxide ($EtCO_2$) first, rather than the chest rise.

An additional lesson learned was the balance of giving a safe and quality anesthetic while keeping in mind the necessity of preserving limited anesthesia resources. As expected, in Honduras, the standards of giving anesthesia are different from in the United States. Many supplies, such as LMAs, breathing circuits, and oxygen delivery supplies are reused. The anesthesia practitioners in this hospital sometimes performed as circulators or scrub technicians. Also, they sometimes left the rooms during the anesthetic! We strived to provide anesthesia to our American Association of Nurse Anesthetists (AANA) standards.[3] The trip anesthesia coordinator was able to secure needed medications and anesthesia supplies. We did not reuse endotracheal tubes, breathing circuits, syringes, and/or needles. However, there were some supply limitations. We did need to reuse LMAs (after thoroughly cleaning) and we did draw medications more than once from single dose vials (using aseptic technique).

There were a few technical limitations, particularly with oxygen supply. Oxygen was supplied from an H cylinder in each room. I had to be vigilant about turning my flow rates down in a timely manner and remembering to turn the oxygen off at the end of the case. I was mindful of using resources only when needed i.e. not every patient went to the post-anesthesia care unit (PACU) with a nasal cannula or facemask. This practice was a deviation from my clinical experiences at large teaching facilities in the United States, where resources appear limitless and little thought is given to the fact that we might run out of a necessary supply.

I went into this experience hoping to help in an underserved community, and indeed the services were needed and the patients were grateful. I did not expect that this opportunity would enhance my anesthesia education as much as it did. The CRNA professionals, Betsy Koop CRNA, MS, Donna Jasinski CRNA, PhD, and Tracy Coverdale CRNA, MS, were instrumental in mentoring me not only with volunteering and anesthesia, but also with professional development. They really helped me to build my anesthetic technique from the ground up; to assess the tools necessary to provide a safe, quality anesthetic, to problem solve the anesthesia machine, and to maintain focus on the patient, while preserving resources. This experience allowed me to pool my anesthesia knowledge and problem solve, both of which are important for developing a more in-depth scope of knowledge. I highly recommend this type of opportunity to anyone who is interested.

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Recommendations for Student Registered Nurse Anesthetists Volunteering

1. Obtain all of the information you can from the organization you are traveling with including trip details and details about the anesthesia supplies/equipment available. If there are supplies, such as clipboards, tape, baskets for organization, etc. that are not available, consider bringing these items.
2. Visit the Centers for Disease Control and Prevention website to determine what vaccinations you will need for travel.
3. Register with the US Department of State prior to your trip. Know the location of the local embassy in the country to which you are traveling. Registering with the US Department of State will allow the local embassy to know you are in the country; any assistance you might need will be facilitated if they know you are there (lost passport, need to leave country emergently, etc.).
4. Learn about the location where you will travel- safety of water and food, lodging, local customs, acceptable dress, personal security issues, etc.
5. Extensively review the anesthesia machine inner workings.
6. Review or have a resource for inhaled agents not commonly used.
7. Bring your own stethoscope, scrubs, and monitor devices when possible. (Portable automatic/manual blood pressure monitoring and pulse oximeter devices are especially useful.)
8. Bring small anesthesia reference books.
9. Bring hand sanitizer.
10. Consider bringing donated toys for pediatric patients.
11. Consider bringing OR shoes that you can leave/ donate to the hospital.
12. Keep a cheat sheet of a few common anesthesia phrases in the language of the location in which you will be volunteering.

Mentor: Elizabeth Koop, CRNA, MS

EDITORIAL

Bon Voyage

When my daughter was very young I remember the emotion I had when I set her on the floor and instead of sitting, she stood and walked away from me without my assistance. It is with a similar, albeit not as intense emotion that I set the *Student Journal* down and let it walk away into new hands.

The *Student Journal* started more than eight years ago as a case report writing assignment for Georgetown students during the clinical phase of their anesthesia program. Their case reports were so interesting that instead of putting them in a filing cabinet I had them copied for every student in the class to read each other's work. The moment I stapled them together it dawned on me that we had a little "journal". My office-mate, Julie Pearson, subsequently showed this to our

Dean and she had the foresight see its potential. She funded a graphic artist for a cover design and formal publication of the first year's work. We sent it to every program in the country and invited them to join us in this endeavor. We had a slow beginning and then Baxter Healthcare, Inc. saw it and decided to fund it as an educational grant. We then printed copies and mailed them to every SRNA in the country – free. For economic reasons, Baxter had to end that support after a few years but AANA graciously allowed us to use space on its website. We have been there ever since, and very timely as many journals are going paperless.

Despite being online, which may give the impression of being less than a quality journal, every article of ***The International Student Journal of Nurse Anesthesia*** is given two blind reviews by experienced CRNAs, most of whom are program faculty members and many are Program Directors. We have also contracted for the Indexing of the articles so they should soon be searchable on Medline and other major database search engines.

The Editorial Board now has almost as many members as the first issue had authors. Since the cost of printing and mailing paper journals is not of concern, the Journal can look to publishing research abstracts, capstone papers and other scholarly writings, but this is for the new Editor and Editorial Board to nurture.

I am confident that this Journal will not just continue to walk but will run smoothly with Vicki Coopmans, CRNA, PhD as the new Editor in Chief and Julie Pearson, CRNA, PhD remaining as an active Associate Editor. Many thanks to each of you dedicated Editorial Board members who have willingly taken on more work from you own program responsibilities by not only reviewing articles for the Journal, but mentoring your own faculty into a reviewer role while also mentoring articles from students in your own programs.

Many thanks to so many of you who patiently mentored articles for your students and did so selflessly, without the recognition and credit as a co-author.

Thank you to all student authors whose enthusiasm for this great profession has been jumping off of every page of every article since the first of the 286 we have published to date.

I wish the Journal a successful voyage into the future.

Ron Van Nest, CRNA, JD

Editor-in-Chief