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TOPICS IN THIS ISSUE

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Front Cover: Jennifer Willard, RN, BSN, a graduate student in the Wake Forest University Baptist Medical Center, University of North Carolina at Greensboro Nurse Anesthesia Program, induces a child during a medical mission in the Dominican Republic. Assisting her is Steve Crane, CRNA.

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Airway Management for the Morbidly Obese Patient

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Keywords: airway management, awake fiberoptic intubation, awake intubation, difficult airway, obesity

Obesity rates are on the rise globally as well as in the United States. In the 2003-2004 National Health and Nutrition Examination Survey, 32.2% of US adults were classified as obese.[1] Obesity is defined as a Body Mass Index (BMI) of greater than 30 kg/m^2, while morbid obesity is defined as a BMI of greater than 40 kg/m^2.[2] Airway management in the morbidly obese patient poses special considerations and requires thorough preparation. While it is still a topic of debate whether or not obesity is directly linked with difficult intubation, most anesthesia professionals approach this patient population with a heightened awareness of potential complications.

Case Report

A 37 year old, 242 kg, 65 in, female with a BMI of 89, presented for a laparoscopic gastric bypass procedure. The patient had recently lost 47 kg through diet and exercise. The past medical history included morbid obesity and seasonal allergies. The patient reported snoring at night and orthopnea. Allergies included latex and adhesive tape. Current medications consisted of biotin, acetaminophen, calcium plus vitamin d, and a multivitamin. Laboratory results and the electrocardiogram were within normal limits. Physical examination revealed clear breath sounds and regular cardiac rate and rhythm. The patient presented with a thyromental distance (TMD) of 7 cm, oral aperture of 5 cm, full neck range of motion, and a Mallampati (MP) class I airway. The patient was noted to have a large neck circumference. The patient had no prior surgical history.

In the holding room, a 20 gauge intravenous (IV) access was obtained and a lactated ringer's infusion was started. In the operating room, standard monitors were applied and the patient was placed in a 45° elevated head-of-bed position. Oxygen was administered at 100% via face mask. Incremental IV sedation was titrated over 15 minutes according to the patient's anxiety level for a total of midazolam 5 mg, fentanyl 75 mcg, and ketamine 40 mg. Airway blocks were performed including glossopharyngeal nerve block with a total of 4 ml 2% lidocaine, superior laryngeal nerve block with a total of 6 ml of 2% lidocaine, and recurrent laryngeal nerve block with 3 ml of 4% lidocaine. A fiberoptic scope with size 7.0 mm ID endotracheal tube (ETT) was introduced into the oropharynx. Vocal cords were visualized and passage of the scope into the trachea was confirmed with identification of tracheal rings. The ETT was passed and the fiberoptic scope removed. ETT placement was confirmed with positive end-tidal carbon dioxide and equal bilateral breath sounds. The ETT was secured at 22 cm at the lip. The patient maintained adequate spontaneous respiration and the ability to follow commands throughout the awake fiberoptic intubation (AFOI).

IV induction was achieved with lidocaine 50 mg, fentanyl 25 mcg, propofol 200 mg, and rocuronium 50 mg. The case progressed uneventfully. At the conclusion of the surgery while the patient was still under

general anesthesia, direct laryngoscopy was performed with a grade I view obtained. Neuromuscular blockade was antagonized. The patient was positioned in a 45° head-of-bed elevated position. She had spontaneous eye opening and was able to follow commands including a strong hand grip equal to her baseline strength and sustained head lift for greater than 5 seconds. The patient also had adequate spontaneous respirations as exhibited by a regular respiratory rate of 16 breaths per minute and consistent tidal volumes near baseline and greater than 450 ml. The patient's oropharynx was suctioned and she was extubated with positive pressure to 100% oxygen by face mask. Vital signs were stable including a pulse oximeter reading of 100% and the patient had a patent airway free of obstruction. The patient was transported with continued 45° head-of-bed elevated position in stable condition on 100% oxygen by face mask to the post anesthesia care unit. The patient had an uneventful hospital stay in a monitored bed and was discharged home on postoperative day three.

Discussion

Identifying the difficult airway in a morbidly obese patient begins with a thorough preoperative assessment. The surgical history should be reviewed to determine if there have been prior difficulties encountered with airway management or intubation. A complete airway assessment should be performed. The MP score approximates tongue size in relation to the oral cavity and indicates how difficult tongue displacement will be with the laryngoscope blade.[3] One study showed that a high MP score alone is not a reliable indicator of difficult intubation in the morbidly obese patient.[4] TMD indicates mandibular space and is the straight distance between the bony lower point of the mandibular border and the prominence of the thyroid cartilage with full neck extension and the mouth closed. A TMD of less than 7 cm is indicative of difficulty in intubation. Mouth opening is assessed by the anesthesia professional to determine the amount of temperomandibular joint mobility. An oral aperture of less than 4 cm is associated with difficult intubation. Head and neck movement assesses atlantooccipital function and indicates how the oral, pharyngeal, and laryngeal axes will align during laryngoscopy.[5] One study concluded that a combination of the MP test and the TMD most accurately predicted difficult intubation.[3] The anesthesia professional must consider the entire physical assessment of the patient when determining risk for difficult airway management and intubation.

Physical examination of the patient revealed a MP class I airway, TMD of 7 cm, oral aperture of 5 cm, and full neck range of motion – all findings suggestive for uncomplicated mask ventilation and intubation. However, the patient also presented with a large neck circumference. One study showed neck circumference as being the greatest single predictor of a difficult intubation.[6] In the obese patient, cervical adipose tissue causes neck flexion when the patient is lying supine. This exacerbates the challenge of mask ventilation and increases the likelihood of a difficult intubation. Obese patients also have increased adipose tissue in the pharynx which increases the probability that airway muscle relaxation could cause the oropharynx to collapse. This further compounds the challenge of mask ventilation.[7] The patient also had a high probability of undiagnosed obstructive sleep apnea (OSA). It is estimated that OSA is undiagnosed in 80-95% of all cases. Furthermore, OSA is posited to occur in as

much as 60-90% of obese patients. Moderate to severe OSA among morbidly obese patients scheduled for bariatric surgery has an occurrence rate of 50-70%.[7] OSA is linked with increased difficulty in both mask ventilation and intubation. Obese patients with OSA should be placed in the sniffing position with the head-of-bed elevated to minimize pharyngeal airway closure.[8]

Performing an AFOI for this patient provided many advantages over intubation under anesthesia. The maintenance of spontaneous respirations circumvented the challenge of mask ventilation and the possibility of failed intubation under direct laryngoscopy and also ensured a patent airway. Other alternative techniques to direct laryngoscopy include video laryngoscopes, lighted stylettes, intubating laryngeal mask airways, and as leep fiberoptic intubation. However, all of these techniques would expose the possibility of failed mask ventilation and/or failed intubation. Risks associated with performing an AFOI include laryngospasm, bronchospasm, gagging, vomiting/aspiration, nerve block-related injuries, oversedation/loss of airway, and recall by the patient.[9] After discussion between the patient and anesthesia team, it was decided that the benefits outweighed the risks.

Obese patients have decreased functional residual capacities and increased closing volumes that lead to ventilation-perfusion mismatch and a right-to-left shunt.[7] One study concluded that preoxygenation is more effective in the 25° head-of-bed elevated position than in the supine position in severely obese patients. The study demonstrated that preoxygenation in the 25° head-of-bed elevated position attained 23% higher oxygen tensions and a clinically significant improvement in the time to desaturation. This allowed greater time for airway management and intubation.[10] The patient in this case study was maintained in a 45° head-of-bed elevated position to maximize the patient's pulmonary function until the ETT could be secured.

Retrospectively, the patient in this case had a Class I airway and would likely have been an easy intubation. However, a cautious approach is often the best approach. The goal should always be to provide the patient with the safest anesthesia plan possible. Performing an AFOI in cases similar to this allows the anesthesia professionals to maintain control of the situation and thus promotes patient safety.

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Perioperative Hypothermia and its Effect on Patient Care

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Key words: hypothermia, elderly, cold, risk, anesthesia

Hypothermia is a very serious complication that is often over looked and inadequately addressed by anesthesia practitioners. Perioperative hypothermia is defined as temperature less than 36° C.[1] When assessing patients pre-operatively, one must identify risk factors such as age, body weight, blood pressure and pre-existing health conditions in order to determine who may be at increased risk for developing perioperative hypothermia.[2]

Case Report

A 92-year-old female with a history of dementia, Parkinson's disease, complete heart block, sick sinus syndrome and pacemaker dependency presented to the operating room for a dual chamber pacemaker insertion. Her weight was 52 kg and height 63 in. Prior to admission, the patient's current medications included, aspirin, Rasagline, Carbidopa-levodopa, and acetaminophen. Preoperative hemoglobin was 11.9 g/dL and hematocrit was 37%. Her platelet count was 203,000 mm^3, prothrombin and activated partrial thromboplastin times were 13.3 and 25.6 seconds respectively. Her echocardiogram showed an ejection fraction of 35% with abnormal left ventricular diastolic function.

Pre-anesthesia assessment was done in the preoperative setting and the patient was determined to be ASA III physical status. ASA standard monitors where placed upon arrival into the operating room. An arterial line was inserted to closely monitor blood pressure. Preoperative blood pressure was 184/66 with a heart rate of 66. The patient underwent a smooth IV induction with Lidocaine 40 mg, Propofol 100 mg and Fentanyl 25 mcg. A laryngeal mask airway

(LMA) was inserted without complication. The patient was maintained under general anesthesia with Sevoflurane. The procedure lasted three hours and seventeen minutes. Temperature was monitored by a probe placed inside the patient's nose. A lower body warming blanket was placed and a blanket was wrapped around the patient's head in addition to heated fluid administration. Ambient operating room temperatures ranged from 66 - 68 ^{o} F. The patient's body temperature ranged from 35.1^{o} C to 35.7^{o} C . Vital signs were monitored every one to three minutes and end-tidal carbon dioxide ($ETCO_2$) averaged between 44-48 mmHg. The estimated blood loss was 300 ml, which is significant for a pacemaker replacement. IV fluids were warmed and administered to keep up with blood loss, replacement and maintance values.

Pacemaker insertion was completed and the patient weaned off all anesthetic agents. Once the patient was responsive, the LMA was removed and a nasal cannula with four liters of oxygen per minute was placed on the patient. The patient was transported to the recovery room and monitored for two hours. Vital signs remained stable with a temperature of 35.5^{o} C. The patient complained of being cold and was shivering. Additional warming blankets were placed on the patient until her temperature returned to within normal limits and shivering subsided.

Discussion

Perioperative hypothermia can pose many complications in patient care. Body temperature is regulated by central and peripheral thermal receptors. Those receptors become inhibited when anesthesia medication is administered. According to Buggy and Crossley, "maintance of normothermia is an important function of the autonomic nervous system."[1] Physiologic control of thermoregulation consists of peripheral and central receptors, which send signals to the hypothalamus, which then determines the mean body temperature from the efferent and afferent pathways.[1] It is important to remember that efferent and afferent control of temperature can be inhibited by regional and general anesthesia.[1]

Anesthesia practitioners must understand that there are many factors that play into the potential for developing hypothermia perioperatively.[1] Experts delineate multiple reasons why perioperative hypothermia occurs and what the consequences can be.[1,2] Immune system suppression, coagulopathy, post-op shivering, and increases in $ETCO_2$ are just some of the complications from perioperative hypothermia.[2,3]

According to Sessler, when a patient's body temperature is cooled below 36^{o} C, clotting factors become inhibited and allow for potential increased blood loss.[3] Furthermore, when patients lose significant amounts of blood, they become more susceptible to developing hypothermia. Despite the recent data, some surgeons are slow to recognize the need to be cognoscente of the effects of hypothermia throughout the perioperative period and further education may be needed.[4,5] Furthermore, immune responses are affected by perioperative hypothermia in two significant ways. First, hypothermia causes vasoconstriction of blood vessels which inhibits oxygen flow to tissues. Secondly, studies have shown evidence of mild hypothermia directly inhibiting immune response cells, such as T-cells and nonspecific bacterial killing cells which are active in fighting infections.[5] Therefore, interaction between the two makes patients more prone to infection and possibly

increasing length of hospital stays and costs.[4]

Longer and more complicated cases such as thoracic, abdominal or trauma surgeries can also increase one's risk for developing hypothermia. Thermal manipulations, such as minimizing the redistribution of body heat, warming fluids, warming blankets, and prewarming patients can all aid in preventing hypothermia perioperatively.[6]

In this case, the patient's age, blood loss, surgery duration, body weight and anesthetic technique all contributed to the patient's low body temperature. Elderly patients tend to have lower vasoconstrictive abilities[1]; therefore they have increased risk for developing perioperative hypothermia.[2] In addition, patients with less body mass, such as the one being presented in this case study, have a more profound redistribution of body heat.[2] The use of propofol causes significant arterial and venous dilation, which increases the loss of core body heat. Therefore, in this case, a smaller dose of propofol may have decreased the effect of the hypothermic state.[3]

According to Sitzwohl et al., solubility of CO_2 increases in response to hypothermia and as a result decreases the partial pressure of CO_2 in the blood.[7] The decreased $ETCO_2$ that was seen intraoperatively could have been in response to the patient's temperature, low cardiac output or due to the fact that the LMA used did not provide a tight seal around the larynx. The patient's preoperative blood pressure of 184/66 was the only factor that was not an increased risk for developing perioperative hypothermia.

The patient's recovery room time could have been shortened if she had not been hypothermic and shivering. Preoperative warming of the patient by use of forced air blankets has been shown to decrease postoperative complications such as infection, shivering and prolonged length of stay.[4]

Risk factors of increased age, low body weight, dehydration, decreased BMI, anesthetics used and low ambient operating room temperature should be addressed preoperatively and minimized. Furthermore, while understanding these obstacles, the anesthesia practitioner should implement protective measures early, such as wrapping the head in warm blankets and using a forced air warmer. Slowly titrating propofol to effect may allow one to place a LMA with smaller doses, limiting vasodilation and loss of body heat.

This case serves as a reminder to anesthesia practitioners. Continued education and increased awareness by anesthesia practitioners regarding perioperative hypothermia can improve quality of patient care and post-operative outcomes.

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Mentor: Kathleen Wren, CRNA, PhD

Anesthetic Management for Patients with Huntington's Disease

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Keywords: Huntington's chorea, Huntington's disease, autosomal, inherited degenerative disorder, nervous system, cachexia

Huntington's disease is a rare, autosomal dominant, inherited degenerative disorder of the nervous system.[5]The onset is usually around 35 to 45 years of age. Both women and men are equally affected. It has characteristic hallmark signs of dementia and progressive chorea.[5] Chorea is defined as a disorder of the nervous system marked by involuntary jerky movements, especially of the face and extremities. Behavioral changes such as depression, aggression and mood swings may take place before pharyngeal muscle involvement which predisposes these patients for increased risk of aspiration. The part of the brain that is most affected by Huntington's disease is the caudate and putamen regions of the basal ganglia. There is a decrease in gamma aminobutyric acid (GABA), glutamic acid decaboxylase and also reduced neurotransmitters such as substance P and enkephalin.[5]

Case Report

A 46-year-old, 5ft 4in., American Society of Anesthesiologist (ASA) classification II, female patient weighing 32 kg was scheduled for excision of a coccygeal mass. Her past medical history was significant for chronic confusion, depression, psychosis, gastroesophageal reflux, and Huntington's disease. Her surgical history included a percutaneous endoscopic gastrostomy (PEG) tube insertion. Physical assessment on the day of surgery was positive for intermittent aggressive behavior, rigid posture, and cachexic appearance. The patient was able to follow simple commands but was verbally unresponsive on assessment. The patient was moving all extremities and became agitated during assessment. Her PEG tube was clamped and feedings were discontinued at midnight before surgery. Airway was assessed as a Mallampati class II. Pre-operative labs were negative for pregnancy, lithium level was 0.8mg/dl and the pre-albumin level was 13mg/dl. This patient's pre-albumin level and physical assessment reflected her current state of

malnutrition. Allergies were noted to be penicillin, aspirin and sulfur which were documented to cause skin rash. Current medications were baclofen, buspirone, lithium, clonazepam, iansoprazole and oxcarbazepine.

Pre-operatively the patient was medicated with fentanyl 100 mcg intravenously (IV). Once in the operating room the patient was preoxygenated with 100% oxygen and monitors per ASA standards were applied. Induction continued with lidocaine 50 mg IV and propofol 110 mg IV. The trachea was intubated without using a muscle relaxant and cricoid pressure was used to reduce risk of aspiration. Once the endotracheal tube (ETT) was secured, the patient was placed on the OR table in prone position. General anesthesia was maintained with the inhalation agent sevoflurane and 100% oxygen. Ondansetron 4mg IV was given to prevent postoperative nausea and vomiting (PONV). The uneventful procedure lasted 29 minutes. At the end of surgery the patient was spontaneously breathing with tidal volumes of 3ml/kg, but was not arousable to verbal or tactile stimulation. The patient was taken to the post anesthesia care unit (PACU) intubated, breathing 100% oxygen. Thirty-five minutes following PACU admission, the patient became more awake and responsive and within forty-five minutes the patient was extubated with stable vital signs, maintaining acceptable oxygen saturation on room air.

Discussion

There are few case reports on Huntington's disease and anesthetic management. Therefore, the best anesthetic technique is yet to be defined for this population.[5] This case study illustrates the successful management of a 46- year-old patient suffering from this disease. There are several major concerns to consider for these patients under anesthesia care. This includes a potential for a difficult airway due to their rigid posture with hyperextension of the neck. These patients can be uncooperative due to their mental deterioration, and they can have frequent abnormal movements of the limbs and trunk which can pose certain challenges for the practitioner. Dysphasia increases the risk of aspiration and predisposes them to malnutrition. Malnutrition, coupled with aspiration complications, is the most common cause of death in this disease.[1]

For surgery in the lower abdominal and perineal area, spinal anesthesia is a possibility in this population but one must consider achieving proper positioning and avoiding trauma which remains a difficulty in these patients due to their irregular movements. Therefore, general anesthesia was provided in this case using an ETT due to pharyngeal involvement in this particular patient. Haloperidol is administered to these patients to reduce choreoathetoid movements by antagonizing dopamine receptors. Huntington's disease patients have a selective loss of GABA that could decrease inhibition of the dopamine nigrostriatal system.[4]

The effects of benzodiazepines could be exaggerated due to reduced GABA levels, so midazolam was avoided in this patient.[5] The only medication given pre-operatively was Fentanyl 100mcg IV. Propofol, an induction agent that has not been associated with prolonged apnea in this patient population, was incorporated into the anesthetic plan.[1] Although succinylcholine has been used successfully in other Huntington's disease patients without adverse effects; succinylcholine was avoided to minimize the risk of a prolonged wake up

time due to the risk of low plasma cholinesterase in these patients. [4] It is recommended to use specific anesthetic drugs in moderation such as succinylcholine or mivacurium which are metabolized by plasma cholinesterase. No neuromuscular blockade was needed for intubation or surgical relaxation in this case. If neuromuscular blockade had been necessary, the potentiating effect of lithium on both depolarizing and non-depolarizing neuromuscular blockers would have been taken into consideration.

The risk of aspiration was minimized by using cricoid pressure during ETT insertion. In order to limit tracheal irritation, sevoflurane, which has minimal irritation to the airway, was used. Ondansatron 4mg IV was given for PONV in order to reduce any further risks of aspiration. Premedication with metaclopramide has been associated with increase choreiform movements and was avoided in this case. [1]

Anticholinergics are relatively contraindicated in this group of patients, being that there is a relative balance between dopamine and acetycholine in the striatum. Therefore, anticholinergic effects could worsen choreiform movement in this patient population. Glycopyrrolate, a quaternary ammonium compound that does not cross the blood brain barrier, may be preferred to atropine, a tertiary amine that can cross the blood brain barrier and affect the central nervous system. Another agent to consider avoiding is meperidine, which also has anticholinergic properties and crosses the blood brain barrier. [1]

Various anesthetic techniques have been suggested for patients with Huntington's disease but researchers continue to search for the ideal approach. Some anesthesia practitioners suggest a total intravenous anesthesia (TIVA) technique, which would avoid exposing the patient to inhalation agents that could precipitate postoperative shivering leading to generalized tonic spasms.[3] Others have used inhaled agents, as presented in this case study, without any issues. Of the studies noted, there were few case reports of successful anesthetics under spinal anesthesia. In patients with Huntington's disease frequent, irregular, sudden jerks of any of the limbs or trunk are major factors complicating positioning for spinal anesthesia. If technically possible in a particular patient, a spinal technique can be useful, comfortable and preferred over general anesthesia.

Management of patients with Huntington's chorea can be challenging for anesthesia care practitioners. This case study demonstrates that understanding the pathophysiology of Huntington's disease process and anesthetic management of the disease is necessary to provide a safe patient outcome. The technique of general anesthesia provided in this case with Fentanyl and Propofol on induction and Sevoflurane for maintenance are safe and effective for this population. There are many factors to take into consideration when caring for such a patient with a very complicated disease.

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Unanticipated Subglottic Stenosis

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Key words: Subglottic stenosis, tracheal stenosis, tracheal intubation, difficult airway, tracheal obstruction

Injury to the airway post intubation is a serious clinical problem. In healthy subjects the narrowest portion of the subglottic upper airway is at the level of the cricoid cartilage. Endotracheal tubes that are too large in diameter may damage the tracheal mucosa[1] or produce pressure which may result in subglottic stenosis.[2] Subglottic stenosis often goes unrecognized, is misdiagnosed, and can cause life threatening airway compromise.[3] Described below is a patient with subglottic stenosis below the vocal cords diagnosed during attempts to intubate the trachea.

Case Report

A 50-year-old male, 64 inches tall, weighing 68 kilograms presented for colostomy reversal. Past medical history was significant for diverticular disease, chronic obstructive pulmonary disease, tobacco abuse, anxiety, and depression. Past surgical history included a Hartmann's procedure approximately one year prior secondary to perforated diverticular disease. The patient's clinical course was complicated by septic shock requiring prolonged endotracheal intubation and mechanical ventilation. The patient had no known allergies and current medications included fluticasone propionate and salmeterol oral inhaler, trazodone, multi-vitamin, and oxycodone. Preoperative evaluation revealed American Society of Anesthesiologists (ASA) physical status II, Mallampati Class II pharyngeal visualization, full neck range of motion, and thyromental distance of 6 cm. Chest auscultations were clear in all fields. Heart rate and rhythm were regular. Preoperative vital signs were, blood pressure of 136/68, heart rate of 78, respiratory rate of 18, and oxygen saturation of 99%. Complete blood count and coagulation studies were within normal limits.

The patient was medicated with midazolam 2 milligrams (mg) and dexamethasone 4 mg while in preoperative holding and then transported to the operating room. ASA standard monitors were applied and the patient inspired 100% oxygen until the fraction of expired oxygen concentration measured 0.85. Intravenous induction proceeded with lidocaine 100 mg, propofol 200 mg, and fentanyl 250 micrograms in divided doses. Facemask ventilation was deemed to be adequate and rocuronium 50mg was administered. Direct laryngoscopy was performed with the vocal cords well visualized. A 7.5 millimeter (mm) endotracheal tube (ETT) was advanced through the vocal cords and then

met resistance. A 7.0 mm ETT was then advanced through the vocal cords and again resistance was met. A 6.5 mm ETT was successfully advanced through the vocal cords, the ETT balloon was then inflated with minimal occlusive pressure, and placement was confirmed by end-tidal CO_2 presence and auscultation of bilateral breath sounds. The ETT was secured and inspired concentrations of Desflurane 7% and oxygen 1 L/min flow was used to maintain anesthesia.

Immediately after fascia closure, the train-of-four (TOF) revealed 1:4 twitches. Neostigmine 5 mg and glycopyrrolate 1 mg were administered intravenously to antagonize the neuromuscular blockade. TOF was reassessed 15 minutes after neostigmine and glycopyrrolate administration and revealed 4:4 with sustained tetany. The patient initiated spontaneous ventilation. Desflurane was titrated off and oxygen flow was increased to 10 L/min. Once the patient maintained adequate spontaneous ventilation and tidal volumes with a regular respiratory pattern, the endotracheal tube was removed and oxygen 3 L/min was administered via nasal cannula. The surgery duration was 3.5 hours. The patient was transferred to the post anesthesia care unit.

Discussion

Subglottic stenosis can be caused by a multitude of pathological processes. The most common cause of acquired subglottic stenosis is prolonged intubation.[4] The incidence of post intubation adult subglottic stenosis is unknown.[5] It is important to recognize patients who may be at risk for subglottic stenosis. Any patient with a history of prolonged endotracheal intubation is at risk for subglottic stenosis and should trigger suspicion to the anesthetist. In cases where stenosis is severe, intubation may not be possible.

The patient's history of prolonged intubation placed him at risk for subglottic stenosis. Other clinical manifestations of subglottic stenosis may mimic asthma, such as expiratory wheezing, inspiratory stridor, and dyspnea. Subglottic stenosis should be considered in the differential diagnosis of any patient who has been intubated in the intensive care unit and presents with dyspnea or wheezing, especially wheezing unresponsive to bronchodilators.[3] Anesthesia personnel should be aware of the possibility of difficult intubation in this patient population.
If the anesthesia professional suspects subglottic stenosis and further work-up is not feasible at that time, he or she must be prepared for a difficult airway. Use of a short acting muscle relaxant is recommended with the fiberoptic cart in the operating room. The ASA practice guidelines for management of the difficult airway should be followed.

If the anesthesia professional suspects subglottic stenosis preoperatively, ultrasonography may be used to assess the smallest diameter of the airway, thus helping predict the size of ETT that may be needed. Height and weight cannot be used to reliably predicted ETT diameter in this population.[6] The ease of use, portability, and non-invasive properties of ultrasonography make it appealing to assess the transverse diameter of the trachea. Animal studies have confirmed that laryngeal lumen measurements via ultrasound are reliable.[7] Computed tomogram, magnetic resonance imaging and bronchoscopy can all be used to assess subglottic stenosis.[3]

The main cause of tracheal damage during prolonged intubation is excessive cuff

pressure. A cuff pressure of greater than approximately 30 mm Hg exceeds capillary mucosal pressure, causing ischemia, which leads to ulceration and chondritis of tracheal cartilages.[8] When these lesions heal, they cause fibrosis which leads to progressive tracheal stenosis.[3] The anesthesia professional must be vigilant about using minimal occlusive pressures when inflating the pilot balloon on the ETT, particularly in cases lasting greater than one hour. The use of nitrous oxide has been shown to steadily increase cuff pressure.[9] Nitrous oxide should be avoided if possible. To reduce the incidence of tracheal stenosis after intubation, an ETT with a high volume, low pressure cuff should be used. The use of high volume, low-pressure cuffs has become standard practice. However, tracheal stenosis may still occur. The anesthesia practitioner must be vigilant in preoperative assessment and always be ready for a difficult airway. If the preoperative assessment includes history of prolonged intubation, several sizes of ETT's should be prepared and the difficult airway cart should be readily available during induction, including laryngeal mask airways of assorted sizes.

The anesthesia practitioner should also consider regional anesthesia if possible. Regional anesthesia is an excellent alternative if the surgery permits and the patient is a candidate for regional anesthesia the possibility should not go overlooked. To maintain the patients spontaneous respirations is ideal, with regional this is possible. However one must be cautioned that complications from a regional can ultimately lead to conversion to a general anesthetic, which would require all the previously mentioned planning and preparation.

The anesthesia practitioner must conduct a thorough pre-operative assessment on every patient under his or her care. Planning and provisions must be in place as general anesthetic induction can progress into a difficult airway situation.

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Effects of Carbon Dioxide Insufflation

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Keywords: carbon dioxide insufflation, pneumoperitoneum, laparoscopic surgery

Although laparoscopic surgeries provide excellent results and offer less pain as a result of smaller incisions, shorter hospital stays, and a rapid return to normal activities, there are many pathophysiological responses that can occur.[1,2] The primary pathophysiological changes that happen with carbon dioxide insufflation are associated with the cardiovascular system and are linked with both the patient's position and amount of intra-abdominal pressure used during the procedure.[1] The effects of head-down (Trendelenberg) position and pneumoperitoneum on pulmonary functions have been studied extensively.[3] The following case report discusses an incident where a patient developed severe bradycardia and hypotension after insufflation of the abdomen.

Case Report

A 44-year-old, 80-kilogram, 5'6" female presented for a total laparoscopic vaginal hysterectomy. History of present illness was significant for excessive menstruation. Past medical history was insignificant except for two thyroid nodules that had been detected on ultrasound. These nodules did not impact the airway assessment. The patient was allergic to promethazine and paroxetine, and the only current medication was sertraline for mild depression. Preoperative lab values were unremarkable (hemoglobin: 12.9; hematocrit: 40; platelets: 352.) There were no thyroid studies available. Preoperative vital signs were blood pressure of 106/53mmHg, heart rate of 66 beats per minute, respiratory rate of 14 and oxygen saturation on room air was 100 percent. The patient had an intravenous catheter inserted preoperatively for hydration and midazolam 2mg was administered.

The patient was brought to the operating room, standard monitors applied, and oxygen was administered via mask at 10L/minute. Induction proceeded with Fentanyl 100 mcg, Lidocaine 80 mg, and Propofol 200 mg (all given intravenously). Easy mask ventilation was confirmed, and Vecuronium 8mg was given IV for muscle relaxation. The trachea was intubated without difficulty and positive bilateral breath sounds as well as end-tidal CO2 confirmed.

General anesthesia was maintained with 2.0% sevoflurane and 100% oxygen. The patient was then placed in a lithotomy/steep Trendelenberg position and the surgeon made the incision and insufflated the abdomen to create a pneumoperitoneum. Pressure control ventilation was used and tidal volume and respiratory rate were adjusted to keep end-tidal CO2 between 32-36 mmHg and peak airway pressures

between 24-35mmHg. Approximately 10 minutes after CO2 insufflation of the abdomen, the patient's heart rate decreased to 37 beats per minute. The patient was given an anticholinergic (glycopyrrolate 0.2 mg IV) to counteract the vagal traction reflex. The patient then developed a brief period of asystole that lasted approximately 3 seconds followed by return of a spontaneous heart rate of 32. Compressions were not needed to assist in circulating the medications. The end-tidal CO2 also decreased from 35 to18mmHg and blood pressure decreased to 60/30mmHg. The surgeon stopped the procedure; the patient was placed back in the supine position and was given atropine 0.4mg IV. Almost immediately, the heart rate returned to 72 beats per minute and blood pressure increased to 90/66mmHg.

The surgeon proceeded with the surgery and the patient remained stable throughout the remainder of the procedure. The estimated blood loss at the end of the surgery was 250ml. The neuromuscular blockade was antagonized with neostigmine and glycopyrrolate. Extubation criteria were met and the trachea was successfully extubated. Oxygen was administered to the patient via mask at 10L/minute and then a nasal cannula was placed on the patient at 3L/minute and the patient was transported to post anesthesia care unit. Vital signs were stable and patient was discharged to home the same day.

Discussion

Laparoscopic procedures have become increasingly popular in clinical practice. Although laparoscopies have been recognized as safe procedures and are minimally invasive to patients, many complications have been reported with a mortality rate of 8 per 100,000.[4,5]The insufflation of carbon dioxide combined with the lithotomy and steep Trendelenberg position have potential respiratory and hemodynamic effects (such as increased systemic and pulmonary vascular resistance, increased central venous pressure, and increased mean arterial pressure leading to increased left ventricular afterload).[6-9] A pneumoperitoneum affects the patient's entire body and is created by insufflating the abdomen with carbon dioxide at a rate of 1-2 L/minute through a trocar cannula and Veress needle.[4,10]The pressure over the diaphragm is almost 50kg which maintains an intraabdominal pressure (IAP) of 15mmHg in a Trendelenberg position once peritoneum has been achieved.[4,11] There is a cephalad shift in the diaphragm and abdominal viscera as a result of this position. Respiratory compliance, total lung volume, and functional residual capacity (FRC) will be decreased.[12,13] Due to the high solubility of CO2, the pneumoperitoneum can cause an increase in CO2 absorption and impaired ventilation (due to distension of abdomen) resulting in hypercarbia and acidosis if CO2 cannot be excreted by increasing the ventilation.[4,12,14,15] Neurohumoral sympathetic stress responses (including vagal reflexes), an increase in IAP, and variations in temperature (hypothermia) also may occur.[1,4] There is an increase in peak inspiratory pressure and a decrease in lung compliance as a result of the diaphragm being displaced cephalad from the increased intraabdominal pressure. Pulmonary shunting, diminished FRC, atelectasis, and ventilation/perfusion mismatch all play a role in decreasing the arterial oxygen level.[12] Surgical manipulation of abdominal contents can also cause a change in heart rate and a decrease in arterial blood pressure, which is what happened to the patient in this case report.[16]

According to the literature, cardiac arrhythmias have been reported to occur in up to 47% of cases with bradyarrhythmias

(including asystole) having been described in as much as one-third to one-half of laparoscopic procedures.[10] Cardiac arrest has been documented in 2-20 out of 100,000 laparoscopic surgeries.[1] Contributing factors include Trendelenberg position, patient anxiety, insufflation of carbon dioxide (usually occurs when IAP exceeds 20mmHg as a result of compressing the inferior vena cava), gas embolism, hypercapnia, traction on pelvic structures and manipulation of the abdominal peritoneum, and anesthetic drugs.[1,5] Research studies have demonstrated that reflex bradycardia is the result of a vagally-mediated reflex from traction on the pelvic structures, and medications such as halothane, succinylcholine, fentanyl, atracurium, and vecuronium that may predispose a patient to this vagal reflex. In order to prevent or minimize this occurrence, recommendations have been made to premedicate patients with an anticholinergic such as glycopyrrolate.[16] It is important to immediately inform the surgeon to stop or release the carbon dioxide insufflation and release pelvic traction to reverse these serious arrhythmias. The anesthesia professional should also return the patient from a steep Trendelenberg to supine position and stop the anesthetic.[17] Although these are usually short-lived episodes, they may require treatment with atropine intravenously (as the patient did in this study) to prevent deterioration leading to asystolic cardiac arrest.[5]

It's interesting to note for this case report that research studies have described asystolic and bradycardic episodes with the use of vecuronium (a nondepolarizing muscle relaxant). This is surprising since vecuronium has a high selectivity for the acetylcholine receptor at the neuromuscular junction and is known to have an insignificant effect on the cardiovascular system.[18] Vecuronium was used for muscle relaxation in this case study. Rocuronium is another nondepolarizing muscle relaxant with a similar duration of action as vecuronium. It binds to acetylcholine receptors at other sites in addition to the neuromuscular junction more quickly than vecuronium and is therefore prone to producing other anticholinergic effects. According to literature, when low doses of rocuronium are used for muscle relaxation in gynecological laparoscopies, there is improved cardiovascular stability compared with an estimated equal dose of vecuronium. Statistically fewer rescue boluses of atropine were required and fewer bradycardic episodes occurred less often when rocuronium was used. Transient asystolic events have also been reported when a combination of fentanyl and vecuronium are used for laparoscopic procedures.[18]

In summary, it is extremely important for the anesthesia professional to remain vigilant in monitoring for the variety of hemodynamic changes that can take place during a laparoscopic surgery, recognize events as they occur, and provide treatment without delay. It is imperative for anesthesia professionals to be vigilant and not let the variety of hemodynamic and pathophysiological changes turn into complications. It is also essential for the surgeon to be cognizant that a low insufflation pressure avoids most complications and reduces laparoscopic pathophysiological responses.[1]

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Submental Approach to Management of the Airway

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Keywords: Submental, Maxillofacial Trauma, Maxillofacial Surgery, Alternative Airway, Submental Intubation

Patients presenting for maxillofacial surgery with an unstable airway pose a particular challenge with respect to establishing a secure airway. Several alternative approaches to traditional orotracheal intubation exist.[1] Each approach to securing the airway is accompanied by specific risks and benefits.[2]

Indications for the submental approach to managing the airway include the need for surgical access to both the oral and nasal cavities, avoidance of transtracheal dissection, and systemic pathology that precludes the nasal route.[2-6] This case report discusses submental airway management in a patient with facial trauma requiring surgical access to both the oral and nasal pharynx.

Case Report

A 32-year-old, 86kg male presented for open reduction internal fixation of Le Fort II facial fractures and closed nasal reduction with septal repair. Medical history was significant for tobacco use of one pack per day for 15 years and gastroesphogeal reflux. He was taking no medications. He had been involved in a motor vehicle accident seven days prior to surgery with loss of consciousness and memory loss.

The patient's face was edematous including bilateral orbital edema and ecchymosis. Airway exam revealed a full cervical range of motion and greater than 6 cm thyromental distance. The patient had a one fingerbreadth mouth opening due to significant discomfort, however, following administration of 50 mcg of intravenous fentanyl a three fingerbreadth mouth opening was achieved and the airway was graded as a Mallampati II.

The patient was premedicated with midazolam and fentanyl, standard monitors were applied and preoxygenation was initiated. The surgeon was present in the operating room during induction with 200 mg of propofol. The patient was successfully ventilated by mask using the least amount of pressure required to obtain an acceptable seal. Intravenous succinylcholine, 100 mg, was administered followed by direct laryngoscopy. The trachea was successfully intubated with a 7.0 oral RAE endotracheal tube (ETT), confirmed by the presence of $ETCO_2$ and equal bilateral breath sounds. Following orotracheal intubation, the surgeon made a 1.5 cm incision in the left submental triangle. The surgeon then passed a Vanderbilt clamp through the incision into the lingual area of the mouth. The ETT pilot balloon was guided into the clamp and then pulled through the incision. The breathing circuit was then disconnected from the ETT and the 15 mm connector removed. The clamp was again passed through the incision and the proximal end of the ETT was guided into the clamp. The ETT was subsequently pulled through the incision and the 15mm connector and breathing circuit was reconnected. (Figure).[5] Endotracheal tube placement was reconfirmed by the presence of $ETCO_2$ and equal bilateral breath sounds, and secured with 2-0 silk sutures.

Following repair of the facial fractures, the sutures securing the ETT were removed, the tube was disconnected from the breathing circuit and the 15 mm connector removed. The ETT and the pilot balloon were pulled back through the submental incision and then repositioned to exit the oral cavity, reattached to the 15 mm connector and reconnected to the breathing circuit. Upon emergence from anesthesia, the trachea was extubated and the patient taken to the post anesthesia care unit.

Discussion

The first attempt at submental airway management was reported by Hernandez Altermir in 1986.[5] Since that time use of the submental approach for airway management has been cited sporadically in the literature. A variety of techniques for the submental approach to airway management have resulted in positive outcomes.[2-6] The submental route is appropriate for surgical procedures requiring access to both the nasal and oral cavities, systemic pathology precluding other routes, avoidance of transtracheal dissection, temporary intermaxillary fixation in the intraoperative period, and simultaneous orthoganthic and plastic procedures.[2-6] However, the submental intubation route is not appropriate for patients requiring long term ventilation.[2,3] Additionally, expected multiple staged procedures, also preclude the submental route as the primary option for airway management.[2]

Thorough airway assessment is vital in patients with facial trauma. The patient described here presented with facial edema, multiple unstable fractures and limited mouth opening. Therefore, determination of the degree to which limited mouth opening was due to pain versus actual physiological limitation was imperative. Any mouth opening limitation may make direct laryngoscopy and intubation difficult or impossible. Judicious use of pain medication in our patient demonstrated his limited mouth opening was due to discomfort. If a difficult airway is expected, as in this case, a surgeon with the ability to create an emergent surgical airway should be present throughout induction and a difficult airway cart should be readily available. Communication between the anesthesia practitioner and surgeon must be continuous and include open disclosure of the anesthesia plan, potential complications, and respective roles. The thought process and rationale for the airway management plan must also be communicated to both the patient and the operating room staff.

The use of premedication in this setting requires careful consideration. If the patient's airway is stable, typical drugs and dosages used for premedication may be administered. However, if a difficult or unstable airway is expected, it is prudent to withhold any premedication until a secure airway is established. This patient was experiencing a significant amount of preoperative pain and anxiety and therefore was given 50 mcg of intravenous fentanyl. Administration of this small amount of opioid made it possible to assess the true degree of mouth opening.

Mask ventilation in patients with maxillofacial trauma requires the anesthetists to be aware of the facial anatomy and the patient's presenting injuries. Nasofrontal fractures may affect the sinuses, the anterior wall alone or may involve the posterior wall leading into the cranial fossa[1]. Forceful or difficult mask ventilation in patients with unstable maxillofacial fractures has the potential to extend the injury. Review of the patient's computed topography scan demonstrated he

had multiple unstable fractures including bilateral lateral orbital walls, anterior maxillary antrum, bilateral posterolateral maxillary sinus, pterygoid plate, communicating nasal, bilateral inferior orbits, nasal septum and bilateral zygomatic arches. Nasal intubation was precluded in this patient due to the possibility of inserting a nasaltracheal tube into the cranial fossa through an unstable posterior wall fracture[1]. Moreover, the need to access both the nasal and oral cavities for the surgical repair made the submental route a viable option.

Positioning concerns in the case included the OR table being turned 180 degrees. Extensions for ventilator tubing, monitors and invasive lines are required and should be in place prior to turning. Because the surgical procedure involves both the oral and nasal cavities, caution must be taken to protect the eyes. While a single 18 gauge intravenous line was inserted in this patient, turning the table 180 degrees and the potential for large blood loss would make insertion of a second intravenous line prudent.

The submental route is a reasonable alternative airway management technique for maxillofacial trauma with unstable fractures and for surgical procedures requiring access to both the nose and mouth.[2-6] Contraindications to the submental airway management include an uncooperative patient, bleeding, disrupted larygnotracheal anatomy, the need for long-term postoperative airway control, poor communication between the anesthetists and surgeon, and lack of familiarity with the technique.[2] The technique is simple, rapid and relatively free of the complications associated with other alternative airway techniques.[2-6] Submental routing of an ETT is generally preceded by securing the airway by oral intubation. Good communication between the anesthetist, surgeon, patient and the surgical team is critical to a positive patient outcome.

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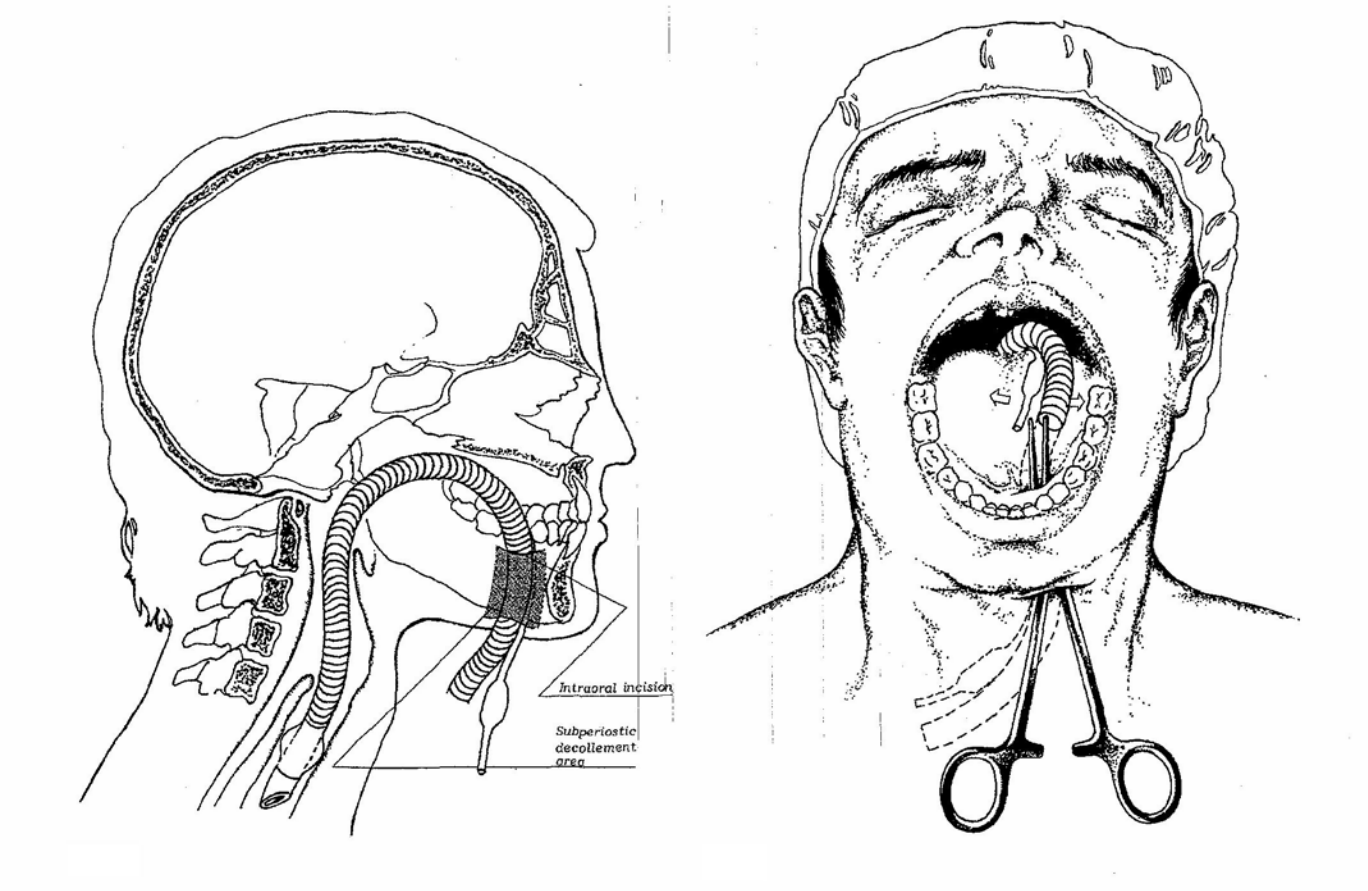

Figure. Submental Orotracheal Intubation.

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Perioperative Fluid Management in Renal Transplant Recipients

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Keywords: renal transplant, end stage renal disease (ESRD), focal segmental glomerulosclerosis (FSGS), perioperative fluid management

End stage renal disease (ESRD) is the irreversible damage to or deterioration of the kidneys causing a failure to function. Although ESRD is considered a rare condition, the incidence in the United States has increased over the last 3 decades.[1] In the United States, focal segmental glomerulosclerosis (FSGS) is responsible for up to 5% of ESRD in adults, and 11% in children.[2] The cause of FSGS is multifactoral and has been linked to genetic alteration. ESRD prevents the kidneys from being able to excrete and secrete appropriately and requires management through renal replacement therapy, dialysis

or kidney transplantation. Donor kidneys can come from cadavers or from a related or genetically unrelated living donor.[3] Unfortunately the recurrence of FSGS in the allograft after renal transplantation is between 20%-30%.[4]

Case Report

A 23 year old male presented for renal transplantation. He weighed 73 kilograms and his height was 70 inches. At age 14, he had been diagnosed with FSGS. His kidney disease progressed to ESRD by the time he was 22 years old. He was initially maintained on peritoneal dialysis (PD) for 12 months. As his ESRD progressed, PD became ineffective. For the final month prior to his scheduled renal transplant, he was maintained on hemodialysis three times per week. Other medical history included hypertension, anemia, and hyperphosphatemia. Previous surgical history included hand and ankle orthopedic surgeries and a recent parathyroidectomy. His only known medication adverse reaction was to lisinopril which had resulted in angioedema. His medications included labetalol 200mg daily, amlodipine 10mg daily, and erythropoetin with hemodialysis.

Pertinent laboratory studies on the morning of surgery included potassium (K) 4.4 mEq/L, sodium (Na) 143 mEq/L, hemoglobin (Hgb) 8.9g/dl and hematocrit (HCT) 27.9%. The patient's physical assessment was notable for bilateral hand tremors. His hemodialysis access was through a right subclavian central double lumen tunneled catheter, and was used for central access throughout the case. Prior to flushing and infusing through the hemodialysis catheter, 10cc of heparin was removed and discarded from each of the ports. Hemodialysis catheters are routinely avoided for infusions due to the risk of infection. However, the tunneled catheter was scheduled to be removed on postoperative day 1, therefore minimizing the chance of infection. In the preoperative area, a 20 gauge right radial arterial line and a 16 gauge left arm peripheral intravenous catheter were inserted.

Immediately prior to entering the operating room, midazolam 2mg was administered intravenously. General anesthesia (GA) was induced with the intravenous administration of lidocaine 70mg, propofol 200mg, fentanyl 250 micrograms and rocuronium 60mg. After successful tracheal intubation, end tidal measurement of isoflurane was titrated up to, and maintained at 1.2%.

Central venous pressures (CVP) were monitored through the distal port of the central venous catheter. Initial CVP measurements were 4-6 mmHg. During the first 3 hours of surgery, 700mL of 0.9% normal saline (NS) was infused. Prior to implantation of the donor kidney, an arterial blood gas (ABG) and electrolytes were analyzed. At that time, the patient's potassium level was 4.9 meq/L, HCT was 28%, and ABG values were within normal limits. Mannitol 12.5g and furosemide 40mg were administered intravenously. Immediately prior to implantation of the donor kidney, 0.9% NS was given rapidly through the peripheral intravenous catheters as well as through the central catheter. Rapid infusion of IVF continued until after the clamp was removed from the renal artery, and CVP increased to 12-15mmhg, which was the end point of rapid infusion. CVP was then maintained between 12-15mmhg for the duration of the surgery. The patient received a total of 3500cc of 0.9% NS. At the end of the case, neuromuscular blockade was pharmacologically antagonized. After meeting extubation criteria the patient's trachea was extubated and the he was transferred to the post-anesthesia care unit (PACU).

Discussion

Research has shown the best way to prevent acute renal failure (ARF), post renal transplant, is intervening before evidence of delayed graft function (DGF). Intravenous fluid therapy has been shown to be the most advantageous method of prevention of ARF.[5] Therefore, it is imperative to provide adequate fluid resuscitation and maintenance in the perioperative phase of renal transplantation. Busque, Melcher, Desai and Esquivel suggest maintaining a CVP 10-15mmhg to provide adequate blood pressure and vascular volume.[3] Prior to transplantation of the donor kidney, intravenous fluids should be given judiciously to avoid fluid overload. With a goal CVP of 10-15mmhg, the rate of IVF should be increased prior to the release of the renal artery clamp to promote flushing out of preservatives in the newly transplanted kidney. This minimizes the chance of hyperkalemia and cardiac arrest related to high levels of potassium in the preservative solution. After successful transplantation of the donor kidney, IVF infusion should be continued aggressively to promote perfusion. Phenylephrine or other vasoconstrictors should be avoided to maximize renal perfusion and minimize vasoconstriction.[3]

It has been shown in animal models that renal perfusion is directly related to the mean arterial pressure (MAP). Also, it has been shown that a low MAP can cause vasoconstriction, though researchers are unclear as to the exact mechanism by which this occurs. In addition, the transplanted kidney has lost its ability to autoregulate its perfusion given the fact that it is now denervated and any decrease in the MAP can lead to a severe decrease in renal perfusion in the transplanted kidney.[5] Loss of autoregulation leaves the kidney dependent on blood pressure to provide adequate perfusion and unable to adjust to changes in perfusion pressure with normal flow.

During renal transplantation, it is important to trend CVP. Inadequate or excessive fluid resuscitation are both associated with adverse outcomes.[6] Inadequate fluid resuscitation potentially diverts blood and circulating volume toward the brain and heart and thus away from the kidney. Grocott, Mythen and Gan suggest that adequate fluid resuscitation leads to an improvement in tissue perfusion and a decrease in the activation of inflammatory responses.[6] Both of these are paramount in prevention of kidney dysfunction. Conversely, aggressive fluid resuscitation could lead to increased cardiac demand and ultimately myocardial ischemia.[5]

Isotonic crystalloid solutions (normal saline or Lactated Ringer's solution) are preferred for fluid management in surgical patients. These solutions are not toxic to the kidney and do not generally have any side effects. However, fluids containing potassium should be avoided in patients with ESRD due to the risk of hyperkalemia with impaired kidney function. For this reason, normal saline is generally preferred over Lactated Ringer's solution (which contains potassium) in ESRD patients. Lactated ringer's solution should be used cautiously with close monitoring of serum electrolytes.[5]

According to Schnuelle and Johannes van der Woude, mannitol offers protection against renal ischemia through several mechanisms: it expands intravascular volume, decreases tubular obstruction, increases the tubular flow rate, and acts as a free radical scavenger by facilitating the release of vasodilatory prostaglandins. The authors report that due to these mechanisms,

there is a decrease in incidence of ARF in patients who receive mannitol. However, no effect on long term renal function was seen.[5] Furosemide is routinely administered intraoperatively to renal transplant recipients to counteract the release of antidiuretic hormone. Despite the trend to administer furosemide, it has not been shown to improve outcomes, decrease incidence of ARF, or prevent the need for postoperative dialysis.[5]

Intravenous fluid management in this case study was done according to the Tufts Medical Center Kidney Transplantation Policy. The patient discussed in this case study experienced no symptoms of ARF, and had an uncomplicated recovery. The fluid regimen and diuretic medications given in the case study were similar to other renal transplant recipients. Using the patient's tunneled central access catheter may have lead to inaccurate readings of CVP. It would have been preferable to place a new central venous line to avoid using the dialysis venous access for intraoperative monitoring. Although the patient in this case study experienced no perioperative or postoperative complications, a more consistent and accurate CVP measurement could have provided for a more precise fluid resuscitation. Current literature supports the choice of fluid management provided to this renal transplant recipient. Anesthesia professionals need to avoid giving the "recipe book approach"[6] and must be aware of a patient's specific physiologic needs and tailor the fluid management for each individual while timing administration to afford optimal surgical outcomes.

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One-Lung Ventilation for Video-Assisted Thoracic Surgery

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Keywords: one-lung ventilation, double-lumen endotracheal tubes, fiberoptic bronchoscopy, lung isolation, video-assisted thoracic surgery (VAT)

One-lung ventilation (OLV) is used during various surgical procedures such as: cardiac, thoracic, mediastinal, vascular, esophageal, or orthopedic procedures involving the chest cavity. Specialized equipment facilitates lung separation. The unique circumstances that surround OLV result in challenges to the anesthesia practitioner. This case describes management of OLV during Video-Assisted Thoracic Surgery (VAT).

Case Report

A 73year old female, ASA 2, 5'¾" and 78 kg, presented to the operating room pre-operative holding area for a left video assisted wedge resection thoracoscopy (VAT) of two lung nodules. The patient had been seen in the pre-operative center several days before. She reported adverse gastrointestinal symptoms with oxycodone and ciprofloxacin. Her past surgical history included a right radical mastectomy, parathyroidectomy for primary hyperparathyroidism, and Mohs' procedure to remove basal cell cancer from nose. She did not report any problems with prior anesthesia. Past medical history included hypertension for 35 years, nonalcoholic fatty liver, and breast cancer diagnosed in 1996 that was staged IIB. Two large bore intravenous catheters and an arterial line were placed into the left arm. Informed consent for general anesthesia was obtained. The patient was premedicated with midazolam 2 mg for anxiolysis and transported into the operating room. Once in the operating room the patient was positioned and oxygen and monitors were applied. Induction of general anesthesia was initiated with fentanyl 100 mcg, lidocaine 60 mg, and propofol 150 mg intravenously. Once mask ventilation was confirmed, 8mg vecuronium was given. A 35 French left sided double lumen endotracheal tube (DLT) was positioned to a depth of 29 cm on the second attempt using Macintoch 3 blade to view the larynx. After ventilation was confirmed the position of the tube was evaluated using a fiberoptic bronchoscope in which the DLT was found to be in the right mainstem bronchus. Using the fiberoptic bronchoscope for visual guidance the DLT was repositioned into the left mainstem bronchus, the tracheal cuff was inflated and ventilation was confirmed through auscultation, and presence of expired carbon dioxide as well as bronchoscopy. The patient was then moved into the right lateral decubitus position. The DLT position was again verified with the fiberoptic bronchoscope, bilateral breath sounds were auscultated and respiration was controlled by a mechanical ventilator using 100 percent oxygen. Once the patient was prepped and draped, the surgeon asked for the left lung to be deflated. Sevoflurane was used as the maintenance inhalation agent for the case.

A baseline ABG, obtained when the arterial line was placed showed the following results on room air: pH 7.45, $PaCO_2$ 34, PaO_2 94, SaO_2 98%, Hct 39%, Hb 13.1 g/dL. A second ABG was obtained after approximately 15 minutes of OVL with

100% oxygen with the following results: pH 7.45, $PaCO_2$ 31, PaO_2 361, SaO_2 99%, Hct 36%, Hb 11.9 g/dL. OLV was used for a total of 97 minutes. During the case the patient received fentanyl 200 mcg and dilaudid 0.6 mg intravenously. She also received ondansetron 4 mg and dexamethasone 4 mg. Once the neuromuscular blockade was antagonized and extubation criteria were met, the trachea was extubated while the patient remained in the right lateral decubitis position. She was then transferred to the bed and transported to PACU with supplemental oxygen by mask.

Discussion

Lung isolation ventilation can be achieved through the use of several different methods: Double-lumen tubes (DLT), bronchial blockers, or single-lumen endobronchial tubes have all been used in clinical practice. DLT are the most common device employed today when needing lung isolation. A left sided DLT is often preferred due to the ease of placement and greater safety margin.[1] The second method of blocking the mainstem bronchus is through the use of bronchial blockers. These devices are often indicated when there is a patient with a difficult airway present or a DLT will not advance and the need for one lung ventilation exists. The third method of advancing single-lumen endobronchial tubes into a main bronchus is not commonly used in current practice.[2] This discussion focus will be on the use and placement of DLTs.

There are two techniques used for inserting a DLT. The first method is considered a blind technique even with direct laryngoscopy since a left DLT is turned 90 degrees counterclockwise once the endobronchial cuff is passed the vocal cords.[2] Placement is then verified with a fiberoptic bronchoscope. The other method is considered a direct technique since it uses a fiberoptic bronschoscope to guide the DLT into the correct bronchus.[2] An average patient's height is used to determine how deep the DLT should be inserted in addition to resistance felt upon contact with the carina. If the DLT is inserted too far or vigorously injury to the mainstem bronchus could occur.[3]

When the left DLT is thought to be in the correct position, the anesthesia practitioner should follow a sequence of steps to ensure placement allows lung isolation ventilation. The first step is to inflate the tracheal cuff and confirm the ability to ventilate by ascultation of both lungs and the presence of expired carbon dioxide. The next step is to clamp the right side, remove the right cap from the connector, and inflate the bronchial cuff slowly with 2 mL of air. Remove the clamp and check that both lungs are being ventilated while both of the cuffs are inflated. Carefully clamp each lung and observe that lung for the absence of breath sounds while the unclamped lung ventilates normally. Lastly, verify placement with a pediatric fiberoptic bronchoscope. When a left DLT is placed, the bronchoscope is first passed through the tracheal lumen so that the carina is visualized along with the upper surface of the blue bronchial cuff seated right below the tracheal carina. After tracheal positioning is conformed the bronchoscope is passed through the bronchial lumen to confirm endobroncheal placement and visualization of the bronchi to the lung’s lobes. If a right DLT is placed, the carina should also be visualized through the tracheal lumen, however it is also important that the orifice of the right upper lobe is lined up with the Murphy eye lateral orifice so that ventilation of the right upper lobe can occur. This makes placing a right sided DLT more difficult with less margin

for error in placement and more prone to becoming dislodged after placement.[1]

Depending on the operation requirements the DLT can be used to isolate, selectively ventilate, or collapse the right or left lung independently. The DLT is therefore efficacious and versatile.[3] There are several advantages to using a DLT, including ease of placement, the ability to conduct bronchoscopy, and apply suction to the isolated lung. CPAP is easily added and one can alternate OLV to either lung quickly. Most importantly, placement of the DLT is still possible if bronchoscopy not available.[2] Despite all of the advantages of using a DLT, there are still potential disadvantages including difficult size selection and challenging placement in patients with difficult upper airway anatomy or tracheal abnormalities. DLTs are not optimal for postoperative ventilation and generally are changed to a single lumen tube as required. The greatest disadvantage to using DLTs is potential laryngeal trauma or bronchial trauma during positioning.[2]

There are differing views regarding repositioning of the DLT. Some believe that the DLT rarely requires repositioning after initial confirmed placement in the trachea and appropriate bronchus.[2] One study found that 35% of the DLT placed needed to be repositioned when examined with a fiberoptic bronchoscope.[3] Another randomized trial studied the success rate of proper placement of either DLT or bronchial blockers for those in anesthesia with limited thoracic experience. There was a high rate of initial placement failure that was quickly corrected once identified by the independent observer.[4] Their results showed that the most important factor in successful placement was knowledge of endoscopic bronchial anatomy.[4]

Video assisted thoracic surgery is routinely done in the lateral decubitus position, so DLT placement must be reconfirmed in the surgical position since is it common for movement of the DLT to occur. According to many researchers, there is strong evidence that auscultation alone is unreliable for confirmation of proper DLT placement.[4-6] Therefore, use of a fiberoptic bronchoscope is considered the best method to assure proper DLT placement and provides many advantages.[5] Fiberoptic bronchoscopy allows for guidance of the endobronchial lumen into the bronchus with visualization of the endobronchial cuff edge and the distal tip of the endobronchial lumen.[5] The right and left main bronchi can easily be distinquished . The use of fiberoptic bronchoscopy is recommended prior, during, and at the conclusion of placement of a DLT.[7] In order to ensure proper placement of the DLT the anesthesia practitioner should be proficient in a complete fiberoptic bronchoscopic examination.[7]

The DLT remains the best device for absolute lung separation with conversion from two to one lung ventilation being easy and reliable. Proper verification and placement of a DLT is vital and is optimally achieved by auscultation confirmed with fiberoptic bronchoscopy. In our patient an initial blind malposition was easily and safely corrected once fiberoptic visualization was available. This patient tolerated one lung ventilation without hypoxia or other difficulty, however knowing the steps in order to analyze and remediate problems is imperative. The unique challenges that one-lung ventilation presents requires communication with the surgical team, familiarity with the equipment required and vigilance when providing anesthesia care.

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Laryngeal Mask Airway in Outpatient Laparoscopic Surgery

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Introduction

Laparoscopic surgery, also known as minimally invasive surgery, or keyhole surgery, is a rapidly advancing method of surgery that has nearly replaced many traditionally open procedures. The mainstay of laparoscopy is establishing a pneumoperitoneum by inflating the abdominal cavity with carbon dioxide (CO_2). This creates a clear view of internal abdominal contents. The laparoscopic approach is particularly appealing to patients and institutions for several reasons: 1) reduced incidence of hemorrhage, which reduces the incidence of blood transfusion, 2) smaller incisions, which reduces pain and shortens recovery time, 3) less pain, which leads to less medication administration, 4) shorter hospital stays, often with a same-day discharge, 5) reduced exposure of internal organs to external contaminants, reducing the incidence of acquired infections.[1] The sum of these factors results in reduced morbidity and mortality, shorter hospital stay, and lower costs of healthcare.[2]

The major complications during laparoscopic surgery are: elevated peak airway pressure, CO_2 subcutaneous emphysema, pneumothorax, endobronchial intubation, gas embolism, and unintentional injuries to intra-abdominal structures.[3,4] The anesthetist is presented with a unique ventilation challenge in laparoscopic surgery, which is a result of the pneumoperitoneum. A temporary decrease in pulmonary compliance and a reduction in functional residual capacity occurs with an insufflated abdomen. This can lead to hypoxemia.[5] Endotracheal intubation with controlled mechanical ventilation has been the gold standard for airway management because of the need for significant positive pressure ventilation.[6,7]

Traditional endotracheal intubation is not a benign intervention. The physiological stresses placed upon patients with a tracheal tube in place during laryngoscopy, tracheal intubation, and emergence, are well documented. Polypharmacy is required to blunt the sympathetic nervous response to the noxious stimuli of intubation. Hohlreider et al. also found that intubated patients have a higher incidence of sore throat, postoperative nausea and vomiting, and a greater need for postoperative opioids.[8]

The primary alternative to endotracheal intubation during general anesthesia is insertion of the laryngeal mask airway (LMA). The LMA established its place in clinical practice in the late 1980's and its applications are expanding.[9] It is quickly becoming a reliable alternative to intubation in many outpatient surgeries. Benefits of using an LMA in this setting include: 1) fewer medications required at induction, 2) increased speed and reliability of placement, 3) stable hemodynamics during induction and emergence, 4) decreased incidence of coughing and bronchospasm on emergence, 5) decreased postoperative nausea and vomiting, pain requirements, and sore throat. Theoretically, these benefits lend to decreased time spent in the operating and recovery rooms, and greater patient satisfaction.

In situ, the LMA creates a seal around the laryngeal inlet and allows controlled

ventilation at moderate levels of positive pressure.[10] The distal end of the inflated cuff penetrates and seals the upper esophageal entrance. A modification of the original LMA is the ProSeal laryngeal mask airway (PLMA), which provides an esophageal vent to allow aspiration of gastric contents and increased airway pressures without leaks.[11,12]

There are several looming theoretical concerns when using a supraglottic device, such as a LMA. The most disconcerting of these is the risk of pulmonary aspiration. It has been theorized that gastric insufflation could result from excessive positive pressure ventilation using a LMA. With laparoscopy, this risk is amplified secondary to higher airway pressure requirements (to ventilate against the pneumoperitoneum). This could lead to regurgitation of stomach contents. Since the trachea is not as protected from pulmonary aspiration as it is with an ETT, traditional thought is that LMA use carries an inherent risk of this serious complication. For this reason, the LMA is considered controversial in the setting of laparoscopic surgery. However, if established to be safe and effective, there may be several advantages in using the LMA in laparoscopic surgery. These include: less postoperative morbidity, shorter hospital stay, increased use of the day surgery setting, and lower costs.[7]

Methodology

Evidence-based Practice Model
The Iowa Model of Evidenced-based Practice to Promote Quality Care was used to guide the evidence search. Framing a clinical question using the PICO format identified the problem-focused trigger. Relevant research and related literature was assembled, critiqued, and synthesized for use in clinical practice. The following parameters were considered: P (patient population) = Healthy adult patients undergoing outpatient laparoscopic surgery
I (current intervention) = Airway management utilizing endotracheal intubation
C (contrasting intervention) = Airway management utilizing laryngeal mask airway
O (outcome of interest) = Pulmonary aspiration

Purpose
The purpose for the review of the evidence was to determine the safety and efficacy of using a LMA during laparoscopy. The questions that guided the review of evidence were:

1. Is the laryngeal mask airway a superior alternative to endotracheal intubation in outpatient laparoscopic procedures on healthy adults?
2. Is there an increased incidence of pulmonary aspiration with LMA versus endotracheal intubation in laparoscopic surgery?

Search Terms
LMA, laryngeal mask airway, PLMA, ProSeal laryngeal mask airway, laparoscopy, laparoscopic surgery, LMA and laparoscopy, LMA and laparoscopic surgery, endotracheal intubation, intubation complications, pulmonary aspiration, Mendelson's Syndrome

Search Methods
The Cochrane Library, CINAHL/MEDLINE, OVID, reference lists of relevant articles retrieved by the electronic search

Levels of Evidence
The primary evidence cited in this review was obtained from 5 randomized clinical trials (Level I evidence), a meta-analysis, and a recent 2-year survey.

Literature Review

Critique of the Evidence

Although LMA use in general surgery has been widely studied over the last decade, there have been fewer studies conducted specific to laparoscopic procedures. The results of seven randomized controlled trials published between 1994 and 2007 are summarized in Table 1 with a total sample size of 5,174 anesthetics. It may be noted that there is no evidence to suggest that the occurrence of pulmonary aspiration is increased by the use of the LMA in laparoscopic surgery. In addition, Miller and Maltby reported a decreased incidence of postoperative sore throat.[13,14] Maltby also reported a significantly lower incidence of coughing on emergence with the LMA.[14] Shroff et al. observed that insertion times were shorter when using an LMA, and that hemodynamic responses were not exacerbated as with endotracheal intubation.[16]

Publication	Description	Type of laparoscopy	Inclusions/ Exclusions	# of anesthetics	# of pulmonary aspirations	Other Findings
Miller 2006 [13]	PLMA vs. ETT	gynecology	GERD excluded	150	0	↓ incidence of sore throat, ↓ operating room time
Maltby 2003 [14]	LMA-C (BMI<30) or PLMA (BMI>30) vs. ETT	gynecology	ASA 1-3 included	209	0	↓ incidence of sore throat, 10-fold increase in coughing w/ ETT, no difference in gastric distension
Chakraborty 2007 [15]	PLMA vs. ETT	chole-cystectomy	ASA 1 included	60	0	Face mask ventilation prior to intubation cited for ↑ gastric distension w/ ETT
Bapat 1997 [17]	LMA	any laparoscopy	ASA 1-3, GERD included, obese/morbid obese included	100	0	Regurgitation in one pt, no aspiration
Shroff 2006 [16]	PLMA vs. ETT	any laparoscopy	ASA 1-2, no GERD, no BMI>35 kg/m2, no HH	121	0	Significant ↑ in HR & BP w/ ETT, ↓ insertion time w/ PLMA, O_2 & $EtCO_2$ values comparable
Brimacombe 1996 [18]	LMA	gynecology & chole-cystectomy	ASA 1-3	1534	0	No clinical evidence of regurgitation or aspiration
Malins 1994 [19]	LMA	any laparoscopy	ASA 1-3, GERD included, obese/morbid obese included	3000	0	No serious morbidities reported

Table 1. Recent literature demonstrating the incidence of pulmonary aspiration and other morbidities with LMA use in laparoscopic surgery.

It is important to note that obese, morbidly obese, and patients with gastroesophageal reflux disease were included in some studies and excluded in others. These patient conditions have traditionally been absolute contraindications for LMA use for some anesthesia practitioners. When LMA's were tested in the obese populations, the Classic laryngeal mask airway (LMA-C) was successfully used for body mass index

(BMI) less than 30 kg/m^2, and the PLMA was used for BMI greater than 30 kg/m^2.

Discussion

The LMA has rapidly become a commonly used adjunct to airway management in anesthesia practice worldwide. The scope of its use is continually expanding as evidence builds to support its efficacy. The LMA offers distinct advantages in certain patient populations because of its rapid placement, maintenance of hemodynamic stability during placement and removal, and decreased incidence of coughing and sore throat postoperatively.[8] An abundance of literature is available to support its use with PPV, with or without muscle relaxation.

Pulmonary Aspiration

The primary concern for the anesthetist when using an LMA during general anesthesia is the theoretically heightened risk of pulmonary aspiration. Pulmonary aspiration is defined as the entry of acidic secretions or particulate matter into the trachea and lungs, which can severely damage delicate lung tissue. Overall incidence of aspiration during general anesthesia is estimated at 2.9 per 10,000 and associated mortality is very low.[20] This is primarily due to preoperative precautions taken by the anesthetist prior to induction of anesthesia. In his groundbreaking study in 1946, Curtis Mendelson closely examined the etiology of aspiration pneumonia during general anesthesia for his labor and delivery patients, which subsequently became known as Mendelson's Syndrome. Mendelson suggested a patient is at increased risk for aspiration peumonia if their gastric volume is greater than 0.4 mL/kg and their gastric pH is less than 2.5.

In a landmark meta-analysis of all published literature from 1988 to 1994, Brimacombe evaluated the incidence of pulmonary aspiration associated with LMA, reviewing and coding 547 publications. Standard contraindications were followed (gastrointestinal pathology, obesity, untreated gastroesophageal reflux disease (GERD), morbid obesity in trendelenberg or lithotomy position, poor lung compliance, and emergency surgery). The study reported three cases of aspiration in 12,901 anesthetics, with an overall incidence of 2.3 per 10,000.[21] No death or permanent disability occurred. The evidence suggests that pulmonary aspiration with the LMA is uncommon and comparable to that for outpatient anesthesia with the face mask and tracheal tube.

It is difficult to estimate the actual incidence of pulmonary aspiration when an LMA is used in laparoscopic surgery secondary to lack of adequate studies. Table 2 compares the reported incidences of pulmonary aspiration during general anesthesia. As previously presented, the 5,109 anesthetics cited in this literature search reported no pulmonary aspirations. However, more studies are needed to formulate a truly accurate incidence. The best available evidence indicates that incidence of pulmonary aspiration using a LMA in elective laparoscopic patients is approximately 1 in 5,000 to 1 in 12,000,[18,22] which is roughly 1.2 to 2.4 per 10,000 anesthetics. Of course, this number is comparable to the suggested incidence with LMAs in any surgery with standard contraindications implemented (2.3 per 10,000 anesthetics).[21] Researchers from the Mayo Clinic indicated that the overall incidence of pulmonary aspiration in adults is 3.1 per 10,000 anesthetics.[22] This would indicate that there is no increased risk of pulmonary aspiration using a LMA in elective laparoscopic surgery when standard contraindications are implemented.

Type of Airway	Type of Surgery	Reported Incidence of Aspiration
any airway	any surgery	3.1 per 10,000 anesthetics
LMA only	any surgery	2.3 per 10,000 anesthetics
LMA only	laparoscopy only	1.2 – 2.4 per 10,000 anesthetics

Table 2. Comparison of reported incidences of pulmonary aspiration.

Esophageal Regurgitation

It has been well established that esophageal regurgitation occurs frequently during general anesthesia. Ng described regurgitation as a common occurrence during all general anesthetics using any airway device.[23] Rabey reported that the LMA reduces the barrier pressure by reducing the lower esophageal tone, which may increase the risk of gastroesophageal reflux.[24] Joshi monitored hypopharyngeal pH in 28 patients breathing spontaneously through the LMA and observed no episodes of hypopharyngeal regurgitation (pH<4) during the course of measurement.[25] Akhtar and Street used methylene blue as a marker of regurgitation in a series of 50 patients anesthetized with an LMA and found that 2 (4%) patients regurgitated dye during the operation.[26] There are many other studies that confirm the occurrence of reflux in the lower esophagus during LMA use; however, none have correlated reflux with clinical evidence of pharyngeal regurgitation or aspiration.

The pneumoperitoneum created during laparoscopy should theoretically increase the incidence of regurgitation and risk for tracheal aspiration. However, many studies have demonstrated the efficacy and safety of LMA use in laparoscopic surgery.[16,17,18,25,27,28] Since laparoscopy provides the most challenging test for the efficacy of supraglottic airway devices, LMA-C should also be effective during PPV with other types of surgery in non-obese patients. The PLMA and ETT appear to be equally effective in obese patients, but larger numbers of studies on obese patients are required to confirm this.

Gastric Insufflation

Gastric insufflation is an important risk in laparoscopic surgery for two reasons. First, a distended stomach poses the risk of puncture during trocar insertion. Second, gastric distension renders the patient at higher risk of regurgitation or vomiting. However, Chakraborty postulated that PPV with a LMA device does not routinely result in gastric insufflation.[15] Rather, the leaked air follows the path of lower resistance, escaping to the atmosphere. This hypothesis was confirmed by direct observation of the stomach using a laparoscopic camera while PPV was applied. In fact, more gastric distension was noted when ventilation by facemask was implemented prior to tracheal intubation, indicating that LMA use may be the safer alternative when this complication is considered. In a study which included obese patients, Maltby concluded that "a correctly placed LMA-C or PLMA is as effective as an ETT for positive pressure ventilation without clinically important gastric distension in non-obese and obese patients".[14]

Conclusions

Based on current evidence, use of the LMA in elective laparoscopic surgery appears to be as safe and effective as using an ETT. Additional benefits to selecting this airway device include: decreased time to secure the airway, hemodynamic stability during placement and removal, decreased incidence

of coughing and bronchospasm on emergence, decreased incidence of postoperative nausea, and less pain medication requirements postoperatively. These advantages are significant and nicely complement the overall goals of outpatient laparoscopic surgery, which are to repair the problem with minimal invasiveness, minimal hospital stay, and minimal morbidity.

It has been previously established that PPV is effective with the LMA, however the pressure required for ventilation should guide the choice of LMA device. From this literature review, the LMA-C was successfully used with BMI < 30 kg/m^2 and PLMA for BMI >30 kg/m^2. In general, LMA-C is effective for airway pressures <20 cmH_2O and the PLMA is more than capable of allowing for positive pressure >20 cmH_2O with no leak.

Meticulous attention to selection of low-risk patients is imperative. Recommended contraindications to using an LMA remain: gastrointestinal pathology, untreated GERD, morbid obesity in trend/lithotomy position, poor lung compliance, and emergency surgery. Avoidance of light anesthesia is also very important (as with tracheal intubation) in preventing untoward complications.

Even though the incidence of pulmonary aspiration and its sequelae appear to be similar between LMA and ETT use, it will take time before the traditional concern of aspiration is put to rest. For instance, despite overwhelming evidence for its efficacy with positive pressure ventilation, many anesthesia providers still consider the LMA controversial in this setting. Although current comparison studies favor the LMA over ETT in elective laparoscopy, more research must be done to verify the validity of this trend. The fact of the matter is that pulmonary aspiration is going to occur in rare instances regardless of which airway device is used. Until there is a clearly established recommendation for the use of the LMA during laparoscopic procedures, it is likely practitioners will continue to avoid the LMA in this setting for litigious reasons.

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Mentor: Donna Scott Tilley, RN, PhD

EDITORIAL

It is with sadness and great respect that I announce the 'retirement' of Ron Van Nest, founder of the International Student Journal of Nurse Anesthesia. Ron recently asked me to accept his resignation as Associate Editor, knowing the journal "is in good hands". I appreciate his confidence in me and the rest of the Editorial Board. This now leaves one of the two Associate Editor positions open. Julie Pearson, remaining Associate Editor, and I will be actively searching for an individual to fill this role.

Another significant change to the ISJNA is the addition of Evidence Based Practice (EBP) Analysis Reports to the Guide for Authors, and I thank all who provided assistance and feedback in the development of these guidelines. You will find the first EBP Analysis Report published in this issue.

A meeting of the ISJNA was held at the Assembly of School Faculty, with both familiar and new faces. It is my goal to encourage and increase involvement in the ISJNA. Please contact me if you are interested in serving as a reviewer, or have questions about mentoring and submitting case reports, EBP analysis reports, or abstracts.

Vicki C. Coopmans, CRNA, PhD
Editor