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Title
An Uncommon Complication with a Supraglottic Airway: The King LT

Authors
Sara M Brown¹, Verghese T Cherian², Kathleen Greco³, Elbert Mets⁴, Arne Budde²

Department and Institution
Anesthesiology and Perioperative Medicine at Penn State Hershey Medical Center

Introduction
The use of a supra-glottic airway¹,² is well established in clinical anesthesia and emergency airway management. However, it is associated with an assortment of complications ranging from failure (1.1%), dislodgement, pulmonary aspiration, laryngospasm, and oro-pharyngeal trauma.³-⁶ This report presents an unusual complication with the use of King Laryngeal Tube (King-LT), and a plausible explanation.

Case Presentation
General anesthesia was administered in an 18-year-old man for removal of hardware from his right knee using a King Laryngeal Tube supra-glottic airway. Standard procedure was used to site the King-LT, as recommended by the manufacturer. The cuff was inflated with 70ml of air using the syringe provided. The anesthetic circuit was connected and gentle ventilation commenced. Initially the bag felt tight and it was difficult to ventilate. So, while gently squeezing the bag, the tube was withdrawn slightly until the ventilation was easy with minimal airway pressure. The pressure in the cuff was checked with a ‘cuff-pressure’ monitor and found to be 70mmHg, which was promptly reduced to 60 mmHg. Anesthesia was maintained with sevoflurane in oxygen-air mixture (FiO₂- 0.5), with the patient breathing spontaneously. An hour after extubation, he reported inability to swallow with no respiratory distress. Examination showed an edematous uvula, which took 3 days to subside with anti-inflammatory medication.

Discussion
The purpose of a supra-glottic airway is to create a soft seal around the laryngeal opening. The king LT presses more cephalad than the LMA on to the soft palate, posterior pharyngeal wall and the base of the tongue. During the positioning of the King Laryngeal Tube, it was pulled back to ensure adequate ventilation. The inflated cuff could have dragged the uvula and folded it on itself, leading to venous congestion and edema.

The splinting of the uvula in that position for the duration of the surgery could be an explanation for the situation described here. The extra-glottic airway, with its wide range of indications, from short, day-care surgery to ‘difficult’ airway situation, has become commonplace in anesthesia. However, it is not without its own complications, with mechanical injury being common.

Consent was obtained from the patient for the purposes of this case report.

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Abstract

Title: Anterior spinal artery syndrome following spinal anesthesia for elective inguinal hernia repair

Authors: Youneun Cho, Manisha L. Trivedi

Department and Institution: Department of Anesthesiology, University of Pittsburgh Medical Center

Introduction: Neuraxial anesthesia is commonly used for many procedures and surgeries. Anterior spinal artery syndrome (ASAS) is a rare but disabling complication which has been reported to follow seemingly uneventful spinal and epidural anesthesia. Several case reports have been published but the exact cause was not always identifiable. Here, we present a case of ASAS following spinal anesthesia, review potential etiologies and discuss optimal management.

Case Presentation: A 47-year-old male with hypertension, poorly controlled type 1 diabetes mellitus, and coronary artery disease presented for elective left inguinal hernia repair under spinal and sedation anesthesia. Patient received spinal anesthesia at L3-4 in a sitting position with total 25 mcg of fentanyl and 1.75 mg of bupivacaine. The intraoperative course was uneventful other than relative hypotension with mean arterial pressure (MAP) of 77 mmHg compared to pre-induction MAP of 100 mmHg. Postoperatively, patient developed severe positional headache and received epidural blood patch. Patient was later noted to have flaccid bilateral lower extremity paralysis, diminished sensation below T10, no sensation below the knees, as well as urinary retention and saddle anesthesia with absent rectal tone. Proprioception and vibratory sense were preserved. MRI of the spine showed elevated T2 signal within the cord from T10 to the conus medullaris and slightly elevated T1 signal within the subarachnoid space of the thoracolumbar spine. Patient was monitored closely in intensive care unit and started on steroid therapy and vasopressor with goal MAP > 85 mmHg for permissive hypertension. Throughout the hospital stay, patient developed diminished but present sensation in bilateral lower extremities, normal bladder and bowel control, and slight improvement in motor function.

Discussion: Although it is not easy to pinpoint the exact etiology in this case, patient had several possible causes of ASAS. First of all, hypotension is a well-known risk factor of spinal cord ischemia. Pre-existing risk factors for peripheral vascular disease such as poorly controlled diabetes mellitus, hypertension and atherosclerosis further increase the risk of ASAS in the setting of hypotension, particularly in the watershed area. Hypotension can also lead to thrombosis of anterior spinal artery especially if pre-existing atherosclerosis was present. Epidural blood patch administration itself can lead to subarachnoid hemorrhage and thrombosis which theoretically can enter into the radical arteries feeding the anterior spinal artery and subsequently cause occlusion. Other less likely diagnosis includes direct traumatic needle injury, neurotoxicity from local anesthetics, arachnoiditis, and meningitis.

Neuraxial anesthesia is widely used for many different types of surgeries and procedures. Although rare, neurologic complications can arise even after successful and uneventful attempts, leaving devastating consequences to the patients and anesthesia providers. Thus, it is important to understand the pathophysiology of ASAS and prevent spinal cord ischemic injury and its consequences by minimizing risk factors and recognizing potential complications in a timely manner.

References:
Abstract 15
Fatal Malignant Cerebral Edema After Cranioplasty
Niraj K. Agarwalla, D.O.; Michael Mahla, M.D.; Elaine Kilmartin M.D.
Department of Anesthesiology, Sidney Kimmel Medical College, Thomas Jefferson University
(Philadelphia, Pennsylvania)

Introduction: Massive cerebral edema after cranioplasty has been rarely described in the surgical literature with few postulations of its etiology (1-8). All reported cases have resulted in patient mortality (1-8). This syndrome is insidious in its clinical course and difficult to diagnose. We describe a case of a young male who developed massive cerebral edema following a right-sided cranioplasty, ultimately leading to brain death. We also highlight the difficulty in recognizing this rare complication and present possible management strategies. There seems to be a need for further research in this area in order to understand the pathogenesis and generate effective management.

Case Description: A 37-year old male presented from his nursing facility for a right-sided cranioplasty with polyether ether ketone custom implant. Four months prior to his presentation for a cranioplasty, the patient underwent an urgent aortic valve replacement with a ventricular septal defect repair and aortic root debridement complicated by an ischemic stroke requiring a decompressive hemicraniectomy. A head CT prior to the cranioplasty showed right-sided encephalomalacia, a ventriculostomy catheter, and 7.4 mm left midline shift. At the end of the cranioplasty surgery, the patient became hemodynamically unstable and gradually apneic. Head CT showed evolution of the right hemispheric infarction, extensive left-sided (contralateral) edema with a 23 mm rightward midline shift, and extensive subcortical hypoattenuation compatible with hypoxic ischemic changes. After immediately returning to the OR for removal of the implant and left-sided decompressive craniectomy, a postoperative head CT suggested global ischemia with impending tonsillar herniation. With absent brainstem reflexes, the decision was ultimately made to withdraw care and the patient expired soon after.

Discussion: This case report presents the rare complication of massive cerebral edema following an otherwise uneventful anesthetic and surgical cranioplasty course. Given this patient’s complex medical history, our differential diagnosis at the onset of his decreased blood pressure and increased heart rate was wide; it included pulmonary embolism, myocardial ischemia, stroke, and cerebellar herniation. Speculative etiologies for the massive edema that have been proposed include: impaired cerebral autoregulation of infarcted neural tissue (3,4,5,7,8), reperfusion injury (1), venous congestion (1,2), intraoperative cerebrovascular insufficiency (2), a ventriculo-peritoneal shunt association (4,7), and the effects of subgaleal suction drainage following cranioplasty on intracranial pressure dynamics (4,6,7,8). We believe that early recognition of this phenomenon by anesthesiologists, intensivists and surgeons, combined with timely surgical intervention, may alter the devastating outcome that seems to be the ultimate result of this complication.

References
Abstract 17

Title: Presentation of a Patient Undergoing an Emergent Pericardial Window for Treatment of a Large Pericardial Effusion with a History of Laryngeal Cancer, Radiation Therapy, and a Difficult Airway

Authors: Tyler McCambridge D.O., Jeffrey Derham M.D

Department: Temple University Hospital, Cardiothoracic Anesthesia

Introduction: The two physiologic expressions of pericardial disease include effusion and constriction. In the case of a loculated pericardial effusion causing hemodynamic instability, the management is almost always surgical. Fortunately, with an adequate understanding of the physiologic changes associated with pericardial disease, general anesthesia can be implemented safely during surgical drainage.

Case Presentation: A 58 year old male with a past medical history of squamous cell carcinoma of the oropharynx and larynx status post total glossectomy and radiation presented with shortness of breath and chest pain. A CT angiogram of the thorax showed cardiomegaly, pericardial thickening, and a large pericardial effusion. CT surgery decided to drain the effusion via a pericardial window under general anesthesia. Evaluation of the patient’s airway showed significant trismus, neck rigidity, and altered supraglottic anatomy. After placing radial arterial and femoral venous lines, we topicalized the patient’s oral pharynx with lidocaine and successfully performed an awake fiberoptic intubation. Induction then commenced with 50mg of ketamine, 150mcg of fentanyl, and 50mg of rocuronium. Epinephrine and norepinephrine infusions were titrated to a MAP >80 and HR> 90. The cardiothoracic surgeon performed a tissue biopsy and pericardial window that removed approximately 300ccs of serous, gelatinous material from the pericardial space. Extubation proceeded uneventfully at the conclusion of the case.

Discussion: Pericardial disease presents several challenges for the anesthesia team. The function of the pericardial space is to provide mechanical, membranous, and ligamentous support for the heart. However, because the pericardial space has very low compliance, acute increases in pericardial fluid can lead to tamponade with resultant cardiogenic shock and death. In this case, since the patient was known to have recurrent loculated pericardial effusions and associated constrictive pericarditis, the decision was made to perform a pericardial window under general anesthesia. Although the patient was hemodynamically stable upon arrival to the operating room, his comorbidities created additional challenges. First, the severely burnt and scarred down tissue of his oral pharynx, neck, and upper chest compromised both our ability to topicalize the airway for an awake fiberoptic technique. Second, the patient could not lie flatter than eighty degrees. Third, the pericardial effusion was large enough to potentially cause hemodynamic compromise upon initiation of general anesthesia. General anesthesia can precipitate tamponade physiology in the setting of a pericardial effusion secondary to a decrease in preload from vasodilation and positive pressure ventilation, a decrease in cardiac output secondary to myocardial depression, and a decrease in perfusion pressure secondary to a drop in systemic vascular resistance. To avoid this scenario, we followed the “full, tight, and fast rule”: volume resuscitation to improve right ventricular filling, inotropic/chronotropic support to maintain cardiac output in the face of compromised ventricular filling, and afterload augmentation to maintain mean arterial pressures.

References:
Abstract 19
Interdisciplinary Management of a Patient with IPH during Pregnancy

Mehreen Iqbal, MD, Shilpi Seth, MD, Christine Noble, MD, and Michael H. Entrup, MD

Department of Anesthesiology, Geisinger Medical Center

Introduction: Population based studies show a low incidence of only 0 to 6 in 100,000 cases of intracranial hemorrhage in the pregnant patient. This carries a high risk of maternal and fetal morbidity and mortality. We present a case illustrating the anesthetic management of a 31 year old patient at 28 weeks gestation who, at 24 weeks, was diagnosed with a left frontal intraparenchymal hemorrhage (IPH) with associated pseudoaneurysm and arteriovenous malformation (AVM) of the left anterior cerebral artery.

Case Presentation: The patient presented to an outside hospital with a severe headache and underwent numerous scans, including two neuroendovascular procedures with contrast. She was discharged because she requested follow up closer to home. She was seen in our neurosurgery clinic two weeks later. She denied any neurological symptoms and had an unremarkable neurological exam. She was admitted given her recent intracranial bleed in the setting of gravida. An MRI and MRA of the brain revealed a subacute IPH in the corpus callosum and a distal aneurysm. The source of bleeding remained unclear despite comparison with outside scans. Multidisciplinary meetings were held with NICU, neurosurgery, obstetrics, maternal fetal medicine, and anesthesiology present. Interventional neuroradiology and neurosurgery were hesitant to submit the patient and fetus to additional radiation and contrast given her clinical stability. Recommendation was made for the patient to remain hospitalized until her delivery because she lived in a rural area, approximately 2.5 hours from a major medical center should she experience rebleeding. NICU was concerned with prolonging the pregnancy to as close to term as possible to reduce the risk of neonatal morbidity and mortality. The consensus reached was to have the patient remain in-house until delivery. The surgical plan was to perform a caesarean delivery to avoid increases in ICP associated with vaginal delivery. Delivery would be immediately followed by a diagnostic angiogram and possible intervention by neurosurgery. General endotracheal anesthesia was chosen because of the possibility of neurosurgical intervention. Delivery was performed at 37 weeks gestation. A radial arterial catheter was placed preoperatively prior to induction of GETA for strict hemodynamic monitoring to maintain normotension. The patient underwent a routine C-section. Newborn Apgar scores were 7 and 8 at one and five minutes, respectively. She remained intubated and was taken to the neuroendovascular suite for the diagnostic angiogram. It was negative for a pseudoaneurysm or any structural abnormality. Boluses of esmolol and nitroglycerin were given to maintain hemodynamic parameters. The procedure was uneventful and the patient was extubated. Both mother and baby were discharged on postoperative day three. A follow up diagnostic angiogram was scheduled in 6 weeks.

Discussion: Anesthetic planning in an obstetric patient with IPH and AVM requiring neurosurgical intervention utilizing a multi-disciplinary approach contributed to a successful outcome in the patient and the fetus. Cesarean delivery prior to neurosurgical intervention can help reduce concern for adverse pregnancy outcomes during maneuvers for cerebral protection. Anesthetic modalities can include general, spinal, epidural, and combined-spine epidural anesthesia for cesarean delivery. General anesthesia was preferred in this patient because the surgical plan was for neurosurgical intervention after delivery if needed. General was also chosen to avoid progressive increased ICP and to avoid hemodynamic fluctuations and unpredictability of regional techniques. Collaborative planning is essential for the successful management of a complicated patient.

References:

“Tension pleural effusion as a cause of Multiple Organ Dysfunction Syndrome in a patient with Cystic Fibrosis: A Case Report”

Robert S. Schoaps, M.D.; Venugopal S. Reddy, M.D.
Department of Anesthesiology & Perioperative Medicine, Penn State Hershey Medical Center, Hershey, PA

Introduction
Multiple organ dysfunction syndrome (MODS) is a severe manifestation of systemic inflammatory response syndrome (SIRS) characterized by the development of progressive and potentially reversible physiologic dysfunction in two or more organs or organ systems that is induced by a variety of acute insults, including sepsis. The etiology and manifestations associated with MODS are numerous and intertwined. Herein, we describe a patient we believe developed MODS after a tension pleural effusion.

Case Presentation
A 32-year-old male weighing 63 kg (BMI 24) with significant past medical history of cystic fibrosis, Crohn’s disease, and small bowel resection was admitted to our intensive care with wound dehiscence, evisceration of small bowel, and septic shock requiring mechanical ventilation and norepinephrine infusion. After repair of his surgical wound and adequate treatment for sepsis, the patient was extubated on day 14 and weaned to supplemental oxygen.

One week later, he developed hypercarbic respiratory failure requiring reintubation. Arterial blood gas after intubation revealed severe respiratory acidosis with pH 7.08, PaCO₂ 90 mm Hg, and PaO₂ 90 mm Hg. He developed hypotension requiring norepinephrine and vasopressin infusions to maintain MAPs above 65 mm Hg. In addition, he developed anuric renal failure, coagulopathy, and hepatic dysfunction with elevated transaminases and bilirubin; his respiratory status continued to decline requiring elevated peak airway pressures of 40 cm H₂O and FiO₂ of 1.00. A subsequent arterial blood gas showed pH 6.93, PaCO₂ 129 mm Hg, and PaO₂ 68 mm Hg with FiO₂ of 1.00. A chest CT revealed a large-volume right-sided tension pleural effusion; he underwent emergent placement of a 36 French chest tube which immediately drained 1400mL of straw-colored fluid. Immediately following drainage, his respiratory status improved with reduced FiO₂ to 0.50 and reduced peak airway pressures to <20 cm H₂O. Subsequent blood gas analysis showed improving oxygenation and decreasing CO₂.

The next day, his ABG was pH 7.41, PaCO₂ 45 mmHg, and PaO₂ 96 mmHg. His renal function, coagulation profile, and hepatic enzymes trended back toward normal the following week with supportive care only, and the patient was eventually discharged to a long-term acute care center for further recovery.

Discussion
Although MODS in the ICU is most commonly associated with severe sepsis, our patient developed MODS secondary to a large tension pleural effusion which in turn dramatically increased oxygen requirements, increased airway pressures, and decreased cardiac output resulting in multiple organ dysfunction.

References
Title: Electroconvulsive Therapy (ECT) in a Patient with Profound Cardiac Risk Factors

Brandon Fordham, DO, Mehreen Iqbal, MD, Xianren Wu, MD, and Dietrich Gravenstein, MD

Geisinger Medical Center, Department of Anesthesiology

Introduction: ECT is an established treatment for major depression refractory to medical management. Hemodynamic fluctuations represent the major cause of morbidity in patients with cardiovascular disease undergoing ECT treatment. The classic response to ECT is biphasic. A vagally-mediated transient episode of bradycardia and hypotension often are observed immediately after the shock. The seizure that follows causes sympathetic catecholamine release, leading to tachycardia and hypertension. The rate of ECT-associated cardiovascular complications is estimated to be 7.5% in healthy patients and 55% in those with preexisting cardiac disease. We present a case of a 79 year old man with a history of CAD (s/p CABG), ischemic cardiomyopathy with severe LV impairment (EF 25-30%, s/p AICD placement), pulmonary hypertension, abdominal aortic aneurysm (infrarenal, 3.2 cm), bilateral carotid artery stenosis (s/p CEA), CKD and recurrent major depression with suicidal ideation who was scheduled for ECT.

Case Presentation: The patient presented to our emergency department with worsening depression. He reported anxiety, hopelessness, insomnia, loss of appetite and admitted due to two attempts at suicide with firearms. He had been hospitalized months before for suicidal ideation and was discharged after optimization of his psychiatric medications. During that admission, the scheduled ECT was cancelled by the patient and family when the cardiac risks with each treatment were contemplated. Now that medical treatment had failed, they desperately requested ECT to be reconsidered. Cardiology ensured that the management of his cardiac issues was optimized. In spite of high cardiac risks, ECT was agreed upon by the patient and family after a multidisciplinary meeting involving members from cardiology, psychiatry, and anesthesiology. A right radial arterial catheter was placed preoperatively for strict hemodynamic monitoring. A magnet was placed on the AICD. General anesthesia was induced with 70 mg propofol (0.1 mg/kg) and 100 mg ketamine (0.8 mg/kg) and muscular paralysis was produced with 100 mg succinylcholine (1.1 mg/kg). His initial blood pressure was 137/63 mmHg. He was ventilated with 100% oxygen via facial mask. The systolic blood pressure decreased to the low 100s mmHg and the heart rate remained in the 60s bpm. He was treated with phenylephrine. His hemodynamics improved, with the systolic blood pressure returning to 120s mmHg. Upon muscle relaxation, ECT was performed by bilateral pulse stimulation and the seizure duration was 36 seconds. Immediately before and after the seizure, there were no changes in blood pressure or heart rate. The magnet was removed from the AICD, returning it to full function. He awakened rapidly and was recovered in PACU without agitation, nausea/vomiting, or other complications. He underwent three additional ECTs without event. His psychological symptoms were substantially improved at the time of this writing.

Discussion: Generally, cardiovascular risk for ECT is low, but it may be substantially increased in patients with compromised cardiac function. Anesthesia management for this group of patients could be particularly challenging because of unsecured airway, biphasic cardiovascular responses, and requirement for minimal seizure threshold alteration. Propofol has been proven to have hemodynamic stability; ketamine, with desired hemodynamic profile, is known to have certain antidepressive effects in patients treated with ECT. We attribute the good outcome to interdisciplinary planning and the deep anesthesia provided by the ketamine and propofol combination.

References:

Abstract 26

Title: A Combined Heart-Liver Transplant in a Patient with Latent Tuberculosis: Basic Management and Control of Post-operative Events

Author: Christian S. Balabanoff Acosta MD, Mikaela Jayashekaramurthy MD, Darsi Pitchon MD, Jessica Reardon DO

Combined heart and liver transplant surgeries are uncommon. In the United States there have been a total of one hundred eighty four combined heart and liver transplants since 1988 (1). Statistically, the male to female ratio is roughly 2:1 and the most common age range is from fifty to sixty-four years. There are currently no reports on critical care management of patients who have had a combined heart and liver transplant. Recently a combined heart and liver transplant was performed at our center. A forty-two year-old male was admitted to the cardiac intensive care unit after receiving an orthotopic heart and liver transplant. His past medical history was significant for ischemic cardiomyopathy with a left ventricular ejection fraction of fifteen percent, cirrhosis secondary to hepatitis C (MELD of sixteen), arterial hypertension, atrial fibrillation, diabetes, stroke, chronic kidney disease and latent tuberculosis on treatment prior to surgery. After transfer of the patient from the operating room to the ICU, hemodynamic monitoring was initially performed using a pulmonary artery catheter, arterial lines (radial and femoral), electrocardiogram, bladder pressure monitoring, urinary catheter and scheduled hourly nursing evaluations and labs. Fluid status was a delicate balance so as to maintain adequate preload for the transplanted heart and liver but not congest either at the expense of the other. Pulmonary artery catheter numbers (maintaining a cardiac index greater than 2.0), urine output, heart rate and blood pressure guided the pressor and fluid administration. Post-surgical cardiac function was also determined using transthoracic echo. He was placed on nitric oxide immediately post-op secondary to mild right ventricular dysfunction and elevated pulmonary artery pressures. The patient had both episodes of ventricular tachycardia and atrial fibrillation that were controlled pharmacologically. Liver ultrasound with Doppler analysis of arterial and venous flow was performed on postop day one and ten. Kidney function was determined using intermittent labs, urinary electrolytes and evaluation from the transplant nephrology service. Coagulation disorders are common after cardiopulmonary bypass and liver transplantation. The patient developed heparin induced thrombocytopenia and was started on bivalirudin. Transplant infectious disease was consulted for adequate antibiotic, antifungal and antiviral therapy as the patient was being treated not only for transplant prophylaxis but also for latent tuberculosis. Isoniazid was restarted once liver function tests started to normalize. Later in his postoperative course, the patient presented with sepsis of unknown origin and was treated with broad-spectrum antibiotics. After the patient spent 16 days in the ICU he was transferred to the general hospital floor. Few of these cases have been done worldwide. It is of utmost importance that all of the teams in charge of the patient maintain a good line of communication. The use of specialized services such as transplant surgery (both heart and liver), intensive care, gastroenterology, nephrology and infectious disease is an asset that needs to be available in centers performing this type of procedure.

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Abstract 28

Vasoplegia During Pulmonary Thromboendarterectomy in Patient on Remodulin for Chronic Thromboembolic Pulmonary Hypertension

Authors: Nicole Imbriale-Townsend, DO, Ali Hamadani, DO, Matthew McConnell, MD
Anesthesiology, Allegheny Health Network. Pittsburgh, PA.

Introduction
Remodulin can be used as a bridge to pulmonary endarterectomy (PEA) in patients with chronic thromboembolic pulmonary hypertension (CTEPH). However, little has been reported about its perioperative use or intraoperative effects. We present a case of severe intraoperative vasoplegia in an adult female on Remodulin undergoing PEA for CTEPH.

Case Description
A 50 yo female with idiopathic pulmonary emboli and CTEPH presented for bilateral PEA. Despite management with continuous intravenous (IV) Remodulin as a bridge to PEA, she presented with worsening cardiopulmonary function, severe dyspnea, low cardiac index, and right ventricular decompensation. Remodulin infusion was discontinued upon arrival to the operating room before radial arterial line placement. Pre-induction blood pressures were 90-100 systolic and decreased to 70-80 systolic post-induction with volatile anesthetic use. A 9Fr central line, Swan Ganz catheter, and cerebral oximeter were placed. Cerebral oximetry values remained stable for the entire procedure. The patient was started on an epinephrine drip at 0.01 mg/kg/min post-induction until surgical incision, after which pre-cannulation blood pressures were in the 70-80s systolic. With cardiopulmonary bypass (CPB), the patient’s MAPs ranged from 30-60 despite max doses of phenylephrine given by the perfusionist. Because of the intense vasoplegia during and post CPB, the patient was started on epinephrine 0.02 mg/kg/min, Levophed 0.02 mg/kg/min, vasopressin 0.04 units plus a 5 unit bolus, and Dopamine 5 mcg/kg/min. Systolic pressures remained in the 60s-80s despite the above mentioned drips. There was no major blood loss and her hemoglobin was stable for the duration of the case, with a starting Hgb of 10.8 and a final Hgb of 8.4 with an otherwise normal blood gas after receiving only 250cc from cell saver.

Discussion
In addition to chronic thromboembolic obstruction of the pulmonary vascular bed, CTEPH is marked by constriction of non-occluded pulmonary vessels secondary to decreased levels of the vasodilator prostacyclin, as in pulmonary arterial hypertension (PAH). Remodulin, a synthetic prostacyclin, has been shown to decrease pulmonary vascular resistance, increase cardiac output, and improve survival in patients with CTEPH.(1) Because Remodulin is a direct vasodilator of pulmonary and systemic vascular beds, hypotension is a known complication.(2) Despite discontinuing Remodulin immediately prior to surgery, our patient experienced a pronounced and refractory intraoperative hypotension and vasoplegia with CPB. The elimination half-life of Remodulin is 4 hours and symptoms of pulmonary hypertension do not occur until 3-4 hours after discontinuation; thus, we would recommend discontinuing the medication 4 hours prior to surgery to avoid these vasoplegic effects while maximizing the treatment of PAH.(2) In studies using continuous IV prostacyclin where the infusion was continued perioperatively and only discontinued on bypass, no significant hypotension was encountered. Prostacyclin affords greater titratability due to its short half life of a few minutes.(3) As such, it may also be appropriate to transition patients on chronic Remodulin therapy to a shorter acting agent prior to surgery.

References


Abstract 29
Anesthetic Management of Emergency Repair of Incarcerated Umbilical Hernia Repair in a Patient with Child C Cirrhosis Utilizing Surgical Transversus Abdominis Plane Nerve Block

David Yui MD, Catalin Ezaru MD, Shashank Saxena MD
Department of Anesthesiology, University of Pittsburgh School of Medicine, Pittsburgh, USA

Introduction
Transversus Abdominis Plane (TAP) nerve blocks can provide postoperative analgesia for anterior abdominal surgery. However, published literature on their use as surgical blocks or as primary anesthetics is limited. Case reports have shown the successful use of TAP blocks as primary anesthetics for inguinal hernia surgery in patients with cardiomyopathy.1,2 This case demonstrates the use of surgical TAP blocks in a male with end-stage liver disease (ESLD) undergoing an emergent inguinal hernia repair.

Case Presentation
A 58 year-old male with a history of Child-Pugh Class C ESLD was admitted for an emergent incarcerated umbilical hernia repair. Comorbidities included hepatic encephalopathy, esophageal varices, type II diabetes, hypertension, and GERD. Laboratory data showed his platelet count was 139x10^3/dL and INR was 1.4. Given his ESLD, a surgical TAP block with minimal sedation was chosen for anesthesia. After identifying the internal oblique and transversus abdominus muscles under ultrasound guidance, 20mL of 0.375% bupivacaine was injected into the lateral parts of the abdomen bilaterally using a 22G stimuplex needle (Figure 1). Injections were given in 3-5mL increments with separation of the two muscle layers observed on ultrasound. He tolerated blocks well with no apparent complications. Intraoperatively, an infusion of propofol at 25mcg/kg/min was supplemented with a total of 100 mcg fentanyl and 25mg of ketamine intravenously during the surgery. Throughout the surgery, the patient’s blood pressure remained stable, with the mean arterial pressure ranging from 61 to 75 mmHg. The surgery length was 69 minutes. Postoperatively, the patient reported no pain without any need for analgesics. Estimated nerve block duration was 39 hours per patient based on residual numbness and the pain score of 0/10 during this period. At the time of discharge, the pain score was 2/10.

Discussion
Although case studies have reported the use of TAP blocks as primary anesthetics during abdominal muscle surgery, this case demonstrated the efficacy of a surgical TAP block in ESLD. Jensen et al demonstrated the use of a bilateral TAP block (1% lidocaine with epinephrine) for revision of abdominal wall defects without the use of sedation.1 Singh et al. similarly reported its use (1% lidocaine/0.25% bupivacaine with epinephrine), but noted some pain intraoperatively.2 Here we demonstrate the successful use of a surgical TAP block with 20mL of 0.375% bupivacaine in a patient with ESLD resulting in minimal post operative pain.

References
2) Singh et al. The Indian Anaesthetists’ Forum. 2012
Abstract 34

Title: Ketonemia in the perioperative period – A CASE REPORT

Authors: Monique Mostert, M.D, Anthony Bonavia, M. D.

Department and Institution: Department of Anesthesiology and Perioperative Medicine, Penn State Milton S. Hershey Medical Center

Introduction
The incidence of metabolic acidosis secondary to asymptomatic ketonemia during surgery has not been well described. While this phenomenon may be inconsequential in an otherwise healthy patient, it may confound the differential diagnosis and influence anesthetic management in a patient with multiple comorbidities. We describe the perioperative workup and management of a young woman presenting for elective back surgery, who was found perioperatively to have a significant anion gap metabolic acidosis secondary to ketonemia.

Case description
A 24-year-old, 64kg, ASA Physical Status I, female with no prior medical history presented with new onset lower back pain, numbness and tingling bilaterally in her lower extremities. A CT scan revealed a primary bone neoplasm affecting the lumbar spine and requiring surgical removal. Her preoperative workup was remarkable for an anion gap metabolic acidosis and ketonuria. After induction of anesthesia with 1.5mg/kg propofol, 1.5mcg/kg fentanyl and 0.6mg/kg rocuronium, she became hypotensive with mean arterial pressures in the mid to low 50’s. Arterial blood gas revealed a metabolic acidosis with a pH of 7.3, PCO2 39.9, base deficit 6 and bicarbonate 19.6 meq/L. Her glucose was 55 mg/dL. Ketonemia was confirmed. Anesthesia was maintained with total intravenous anesthesia and the case length was 8 hours. Throughout the procedure, she experienced persistent metabolic acidosis and hypotension with a pH <7.3, requiring the administration of 50mEq sodium bicarbonate. In addition, she presented polyuria with an average urine output of 5ml/kg/hr. Hypotension was treated with goal-directed fluid therapy (4L of intraoperative fluids), norepinephrine infusion at 0.02 – 0.05mcg/kg/min and 150mg hydrocortisone. Given her metabolic derangement and hemodynamic instability, the patient was taken to the surgical intensive care unit while still intubated and sedated. The concern was that a persistent or worsening metabolic acidosis would increase her work of breathing and lead to postoperative respiratory failure. She was extubated later that evening after improvement in her acid-base disturbance and has been well at follow-up, with no further complications.

Discussion
In clinical practice, fasting is seldom suspected as the cause of metabolic acidosis (1). In an otherwise healthy individual, mild ketosis generally develops after a 12- to 14-hour fast and pH usually remains above 7.3 , but under some conditions, as when combined with physiologic stress or when there is a large glucose requirement, starvation may cause a severe metabolic acidosis (2). In our case, the diagnosis of fasting metabolic acidosis was made upon ruling out other conditions, assisted by an elevated anion gap with ketones in the urine and ketonemia. This case is unique on account of the extreme severity of ketoacidosis in the setting of acute starvation and absence of other comorbidities. As is evident in our case, it is important to recognize starvation ketonemia as a perioperative entity.

References:
Abstract 35

Title: Perioperative Radial Nerve injury after interscalene catheter placement and shoulder arthroplasty

Authors: Monique Mostert, M.D, Sanjib Adhikary, M.D.

Department and Institution: Department of Anesthesiology and Perioperative Medicine, Penn State Milton S. Hershey Medical Center

Introduction
Neurological complications following interscalene nerve block are rare, ranging from 0-5% (1). The suspected mechanism of injury during nerve block may be a direct needle trauma, local anesthetic toxicity or hematoma formation. Often, surgical factors lead to neurological complications, while the nerve block is erroneously implicated as the cause for the injury.

Cases description
CASE 1: A 68 year-old female, 92 kg, underwent a reverse total shoulder arthroplasty with involvement of her rotator cuff tendons, secondary to failure of hardware placed after reverse shoulder hemiarthroplasty 6 years prior. A preoperative interscalene catheter was placed by ultrasound guidance and nerve stimulator with no local anesthetic delivered through the catheter. No complications or difficulties placing the nerve catheter was documented. The surgery was performed in the beach chair position, and lasted 5.5 hours. An upper extremity immobilizer was placed immediately after the surgery. Postoperatively, she had an intact neurologic examination and a 0.2% ropivacaine infusion was started through the catheter. The catheter was removed on postoperative day 1, after which the patient complained of parasthesia in the distribution of the radial nerve, as well as the inability to extend thumb, fingers, or wrist. One month after her surgery, electromyography (EMG) showed right-sided radial nerve palsy distal to the innervation of the triceps muscle.

CASE 2: A 77 year-old female, 72 kg, underwent left shoulder arthroplasty, secondary to osteoarthritis. Preoperatively, an interscalene catheter was placed by ultrasound guidance and nerve stimulator with no local anesthetic delivered through the catheter. No complications or difficulties placing the nerve catheter was documented. The surgery was performed in the beach chair position and lasted approximately 1 hour 45 minutes. An upper extremity immobilizer was placed after the surgery. Immediately postoperatively, the patient reported radial nerve motor weakness as well as parasthesia in her right hand in the distribution of the radial nerve. The symptoms were attributed to the nerve block, so the catheter was removed immediately.

CASE 3: A 79 year-old female, 45 kg, underwent a reverse total shoulder arthroplasty, secondary to a massive rotator cuff tear. A preoperative interscalene catheter was placed by ultrasound guidance and nerve stimulator with no local anesthetic delivered through the catheter. No complications or difficulties placing the nerve catheter was documented. The surgery was performed in a beach chair position, and lasted 1 hour, 45 minutes. No intraoperative complications were documented. An upper extremity immobilizer was placed immediately postoperatively. After an intact neurologic examination, a 0.2% ropivacaine infusion was started. The nerve catheter was removed on post-operative day 1, and later that day the patient presented weakness in thumb and wrist extension, and decreased sensation in radial and ulnar distribution. One month postoperatively, an EMG was consistent with a right radial neuropathy across the spiral groove and with ongoing denervation. A repeat EMG 5 months later showed interval improvement with no active denervation.

Discussion
All three cases described above had ultrasound and nerve stimulator-guided interscalene nerve catheters placed preoperatively and all three cases presented postoperative distal radial nerve injury. Given the location of the nerve blocks and the locations of the nerve injuries, it is more likely that the etiology of the nerve injuries are secondary to a more distal insult, such as the shoulder immobilizer or patient positioning intraoperatively.

References
Abstract 36

A Novel Approach for Remifentanil PCA in High Dose Brachytherapy

Natalia Martinez Acero, MD and Shannon Grap MD

Department of Anesthesiology & Perioperative Medicine, Penn State Hershey Medical Center, Hershey, PA

Introduction

High dose rate (HDR) brachytherapy is a vital part of definitive chemo-radiation treatment for cervical cancer. Each radiation treatment cycle requires approximately 5 sessions, with each session taking approximately 5-7 hours. Use of the split ring applicator (SRA) has become popular and includes a tandem and two half rings that must be inserted into the patient’s cervix and uterus for each radiation session. Patients describe excruciating pain during insertion and removal of the split ring and the tandem, as well as a significant amount of discomfort during the hours required to have the device in place while awaiting their radiation. This generates a real pain management challenge for the anesthesiologist, especially considering that treatment takes place in an ambulatory setting where multiple sessions are performed within the same week, and the patient population is already dealing with chronic pain related to their oncologic disease.

We describe an anesthesia technique, using a remifentanil patient-controlled analgesia (PCA) in conjunction with long-acting narcotics and propofol infusion, for use during a HDR treatment cycle for a patient with cervical cancer. This was successful in controlling pain and spared the patient repeated intubations and/or neuraxial anesthesia.

Case Presentation

A 34 y/o female presented with cervical cancer, having had prior chemotherapy. The patient was scheduled to undergo 5 sessions of HDR using tandem split ring brachytherapy. In the pre-operative area, she described a baseline pain score of 9/10 related to her disease, and had no prior opioid use. After peripheral IV placement, IV midazolam was administered for anxiolysis and the patient was taken to the procedure room, where her vital signs were monitored. Using a combination of intravenous propofol infusion, ketamine, fentanyl, and morphine boluses, the split ring and tandem were inserted. The patient adequately tolerated this part of the procedure and maintained spontaneous ventilation. After placement confirmation of the device by CT scan, the propofol infusion was stopped and the patient recovered while the radiation dose and target calculation were completed (~2 hr). Following emergence, a remifentanil PCA was started once the patient verbalized a pain score of 10/10. PCA settings used were: basal rate, 80 mcg/hr and bolus dose, 20 mcg with a 3 minute lockout, which reduced her pain score to 0/10 after initiation. She remained comfortable for the next 2 hours while awaiting her radiation treatment.

The remifentanil PCA was discontinued immediately prior to sedation for the radiation treatment. Anesthesia was achieved using the same combination of propofol infusion with ketamine, fentanyl and morphine boluses during the twenty minute radiation treatment and device removal. Spontaneous ventilation was maintained and the propofol infusion was discontinued once the split ring and tandem were removed. The patient was transferred to the recovery area and had mild perineal discomfort following emergence, but reported a pain score of 0/10. She was prescribed oral acetaminophen-oxycodeone as needed for pain at home following discharge.

The patient returned for 3 additional sessions of radiation using the same technique of combined intravenous anesthesia and remifentanil PCA.

Discussion

The patient tolerated each treatment session with adequate pain control and the avoidance of intubation and prolonged anesthesia. The benefit of using the remifentanil PCA is that it allows for faster patient recovery with adequate analgesia, and timely outpatient discharge with the avoidance of longer acting IV opioid medications. This anesthesia technique has been used for subsequent patients for the same procedure and has been similarly successful.
Abstract 42

Title: Extracorporeal Membrane Oxygenation For Lung Rest From Complications After Double Lung Transplant

Authors: Daniel, A., Eskinazi and Kathleen, M., Tyson

Department and Institution: Department of Anesthesiology, Temple University Hospital

Introduction: Venovenous extracorporeal membrane oxygenation (VV ECMO) can benefit adults with lung injury due to reversible causes. This case describes a lung transplant patient who underwent three ECMO cannulations related to different complications: primary graft dysfunction (PGD), acute respiratory distress syndrome secondary to pancreatitis, and bronchial dehiscence.

Case Presentation: A 59 year old female with pulmonary fibrosis and pulmonary arterial hypertension secondary to CREST scleroderma was listed for lung transplantation in April of 2015. The patient was hospitalized two months later for acute hypoxic respiratory failure and underwent a double lung transplant during that hospitalization.

On postoperative day three, the patient became hypoxemic with evidence of lung edema. VV ECMO was instituted for presumed PGD. After five days of lung rest, ECMO was successfully weaned off. Two days after initial decannulation, she developed pancreatitis with oliguric acute kidney injury and ARDS. The decision was made to reinstitute VV ECMO as part of her supportive care. She was stabilized during five more days of ECMO and successfully weaned again. Over one week later, she demonstrated recurrent hypoxemia with a continued need for mechanical ventilation. Bronchoscopy revealed a left partial bronchial anastomotic dehiscence and VV ECMO was again placed, and successfully weaned over two weeks later.

The patient was eventually discharged to acute rehabilitation with minimal ventilator support. The patient currently follows up as an outpatient, breathing room air.

Discussion: The application of ECMO in adult patients is growing. During the 2009 H1N1 flu pandemic case reports demonstrated successful ECMO utilization for refractory disease. The 2010 CESAR trial proposed a benefit of ECMO over conventional treatment for severe adult respiratory failure.

While some patients require repeated ECMO for the same complication, our patient required ECMO for three different complications. Treatment for ARDS secondary to both PGD and pancreatitis depends upon the degree of tissue injury and clinical deterioration. Initial management is supportive and ECMO has been reserved for severe cases. Our patient also developed dehiscence, perhaps not surprising given the prolonged mechanical ventilation and PGD. Treating profound hypoxia in the setting of bronchial dehiscence has been difficult and is not standardized. In this case, emergent ECMO was chosen early as the mainstay of therapy and successfully allowed the dehiscence to heal.

ECMO has advantages over ventilator support in the poorly oxygenating patient. Blood is oxygenated without relying on diffusion through lung parenchyma. Ventilation can be minimized to decrease lung trauma. If ECMO continues to be successfully implemented in cases of severe respiratory dysfunction, new indications may continue to arise and further utility of ECMO realized.

References:

Abstract 43

**Title:** Perioperative Diagnosis and Treatment of Serotonin Syndrome Following Administration of Methylene Blue

**Authors:** James Francescangeli MD, Sonia Vaida MD, Anthony Bonavia MD

**Institution and Department:** Penn State Milton S. Hershey Medical Center, Department of Anesthesiology and Perioperative Medicine

**Introduction:** Serotonin syndrome (SS) involves serotonergic hyperactivity caused by excessive activation of 5-HT2A receptors. The diagnosis is made on the basis of current serotonergic medication use in conjunction with certain clinical signs. As the use of antidepressants increases, the population of patients at risk of developing this complication has increased. The severity of the clinical presentation may vary, especially when the condition occurs under general anesthesia. As a result, the incidence of SS is likely underreported and treatment may be delayed, leading to life-threatening complications.

**Case Presentation:** A 67 year-old, ASA Physical Status 3 male with multiple medical comorbidities including anxiety/depression and chronic neck pain presented for an elective laparoscopic total abdominal colectomy for colonic inertia. His intraoperative course was significant for SS likely triggered by the administration of methylene blue, but which only became clinically apparent during anesthetic emergence. We considered and systematically ruled out other potential causes of his clinical condition. His management was primarily supportive using hydration and benzodiazepine administration, and resulted in full neurologic recovery.

**Discussion:** SS is an underdiagnosed condition with limited treatment options beyond symptom management. Thus, vigilance, early diagnosis and cessation of offending medications are of utmost importance. Anesthesiologists managing at-risk surgical patients must have a high clinical suspicion of perioperative SS if their patients exhibit tachycardia, hypertension and hyperthermia together with clonus, agitation, diaphoresis or hypertonia. These signs may be masked by general anesthesia and may only manifest themselves upon anesthetic emergence.

**References:**

Abstract 44

Title: A challenging case of ganglion impar block in a female patient with a resected coccyx from childhood injury and rectal resection for metastatic rectal cancer

Author(s): Kevin Wong, DO, and Brian R. Monroe, MD

Department and Institution: Department of Anesthesiology and Pain Management, Geisinger Medical Center, Danville, Pennsylvania

Introduction

Chronic perineal pain (CPP) is a frequent complaint among patients with advanced stages of pelvic cancer.1 Cancer pain is a complex mix of somatic, visceral, and neuropathic entities and in 5-15% of patients, this cannot be controlled with conventional medications leading to poor function and decreased quality of life.2,3 The perineum is composed of diverse anatomical structures with sympathetic and somatic innervations.4 The ganglion impar is a solitary retroperitoneal structure anterior to the sacrococcygeal junction.2 It receives nociceptive inputs from visceral afferents that innervate the perineum, distal rectum, anus, distal urethra, vulva, and distal vagina.4 We report a challenging case of ganglion impar block secondary to the absence of rectum and a deformed coccyx in a patient with metastatic rectal cancer suffering from CPP.

Case Presentation

A 65-year-old female who had undergone multiple abdominoperineal surgeries and chemoradiotherapy for metastatic rectal adenocarcinoma complained of persistent sacral pain in the posterior vaginal wall and vulvar area. The pain was described as “a red hot poker in my vagina” and like “sitting on a ball.” The pain was 10/10 in severity and significantly impacted her quality of life despite multimodal analgesia. Lateral imaging of the sacrum revealed a deformed coccyx. Computerized Tomography demonstrated significant scarring within the pre-sacral space. The abnormal anatomy, significant scarring, and inability to lay prone due to abdominal pain and colostomy made the case technically challenging. The patient was placed in lateral decubitus position. A 22-G, 5-inch curved spinal needle was introduced caudad to the coccyx and advanced to the anterior aspect of the coccyx under fluoroscopic guidance. Placement was confirmed using radiopaque dye. Injection was difficult due to significant scarring. A test dose of 1% lidocaine was used to confirm placement. The ganglion impar was blocked using 2 ml of 0.5% bupivacaine and 80 mg of methylprednisolone acetate. She tolerated the procedure well and recovered uneventfully. Upon follow-up 4 weeks later, she reported that her pain had subsided for a week, then the burning pain returned, although she continued to sleep well and required minimal PRN opioids. The ganglion impar block was repeated and her CPP resolved for the following 6 months.

Discussion

In our patient, conventional medical management had failed and interventional therapy was sought. The ganglion impar block was challenging due to several anatomical abnormalities. First, the patient had no anus secondary to surgical resection of the rectal tumor, removing an exterior landmark. Second, the anterior coccyx could not be accessed through the sacroccygeal ligament due to trauma and surgical abnormalities. Third, the presence of large sacral mass following anterior perineal resection and radiation induced fibrosis made the insertion of spinal needle and administration of drugs extremely difficult. Last, the patient was not able to lay prone due to significant amount of abdominal pain and the presence of ostomy. These anatomical challenges limited us to proceed with the less desired anococcygeal approach. Despite these challenges, the ganglion impar block was successful and she regained maximal functional restoration and reduction in opioid consumption. The ganglion impar block should be considered as a treatment for CPP in cancer patients, and in palliative care settings chemical ablation can be considered.4

References:

Abstract 48

Multiple Anesthetics for a Patient with Stiff-Person Syndrome

Jessica M Cassavaugh and Todd M Oravitz
Department of Anesthesiology
University of Pittsburgh Medical Center

Introduction:
Stiff-Person Syndrome is a progressive disease of muscle rigidity and spasticity due to a deficiency in the production of γ-aminobutyric acid (GABA). Because of the rarity of the condition, little is known about effects of anesthesia on patients with Stiff-Person Syndrome especially with respect to neuromuscular blockade and volatile agents. Current literature reports conflicting data regarding use of neuromuscular blockade with several reports observing post-operative weakness severe enough to require prolonged intubation and ICU admission. This report aims to describe uncomplicated use of skeletal muscle relaxants in a patient with Stiff-Person Syndrome.

Case Presentation:
A 45 year old female with past medical history significant for hypertension and hyperlipidemia presented for three separate general anesthetics within two years. At the time of her first anesthetic, she was undergoing treatment for presumed Multiple Sclerosis. However, as symptoms progressed, a diagnosis of Stiff-Person Syndrome was made; this was based on her clinical symptoms as well as an elevated glutamic acid decarboxylase (GAD) antibody level. Her subsequent two anesthetics were carried out while she was being treated both pharmacologically with baclofen and benzodiazepines and with IVIG. Her only anesthesia complication for all three anesthetics was one incidence of post-operative nausea and vomiting. She tolerated depolarizing and non-depolarizing neuromuscular blockade without prolonged weakness or worsened rigidity. She did not require prolonged ventilator support, and she had no difficulty with extubation. Additionally, she did not experience prolonged or excessive weakness throughout her recovery.

Discussion:
Because of conflicting results in the few reports published, it has been difficult to establish the most safe and beneficial anesthesia plan for a patient with Stiff-Person Syndrome. This report describes the clinical course for a single patient with Stiff-Person Syndrome who received general anesthesia on three separate occasions. Her anesthetics included various combinations of neuromuscular blockade, volatile agents and total intravenous anesthesia. Unlike several previous reports regarding anesthesia and Stiff-Person Syndrome, the post-operative period for this patient did not require prolonged intubation or result in any residual weakness. While more comprehensive studies are required to definitively define the safety of neuromuscular blockade in this patients with this disease, this report clearly demonstrates no complications with use of muscle relaxants in a patient with Stiff-Person Syndrome.

References
Abstract 49
Cooled Radiofrequency Ablation for Advanced Treatment of Intractable Knee Pain from Diffuse Osteoarthritis
Mansoor M. Aman M.D., Anita Gupta D.O., PharmD. Division of Pain Medicine, Department of Anesthesiology and Perioperative Medicine, Drexel University College of Medicine

INTRODUCTION: Osteoarthritis of the knee is recognized as one of the leading causes of chronic non-cancer pain having deleterious effects on quality of life. Having failed conservative and pharmacologic therapy, patients seek interventional and surgical techniques for alleviation of pain. Cooled Radiofrequency (C-RFA) may be employed as adjunct to total knee or partial knee arthroplasty, or used in patients who are not good candidates for surgery. An overview of disease process, available treatment options, candidate selection, and anatomic considerations will be discussed in this report.

CASE REPORT: 56-year-old female presented for outpatient evaluation of her bilateral knee pain from chronic osteoarthritis after having failed conservative, pharmacological, and various procedural therapy. She was not a surgical candidate for total knee arthroplasty secondary to her elevated body mass index and co-morbidities. Her unremitting pain affected both her functional, and mental status. We employed C-RFA targeting the superior medial and lateral, inferior medial and lateral, and recurrent tibial genicular nerve branches. Follow up at 14 days, 30 days and six months showed marked improvement in her Visual Analog Scale scores and reduction in opioid consumption.

ANATOMY

SG- superior genicular, SMG- superiomedial genicular, IMG- inferomedial genicular, SLG- superiolateral genicular, ILG- inferolateral genicular

DISCUSSION: Patients that have failed the spectrum of conservative therapies seldom get relief from the more aggressive treatments such as intra-articular injections and arthroscopy. C-RFA is a useful technique in the management of uncontrolled chronic pain secondary to diffuse OA of the knee. C-RFA also has a role in the management of unremitting pain after an adequate surgical repair. Further study is needed to assess the impact on C-RFA on opioid consumption and long-term pain control.

REFERENCES
Abstract 50

Title: You Put the Tube Where?: A Case of Innovative Airway Management

Authors: Andrew R Hulme MD, Mark Lischner DO

Department/Institution: University of Pittsburgh (UPMC) Department of Anesthesiology

Introduction: This case report is an exciting and innovative example of urgent airway management utilizing cross field ventilation in a thoracic surgery.

Case Presentation: A 71 year old male with pertinent past medical history of lung cancer status post right upper lobectomy two months prior presented with acute onset hemoptysis to an outside hospital, where he was intubated and transferred for further surgical evaluation. Upon arrival, the patient went directly to the operating room where bronchoscopy revealed pulsatile bleeding from a small defect in the right main bronchus creating a fistula with the right pulmonary artery. The preexisting 7.5 single lumen endotracheal tube (ETT) was advanced into the left main bronchus for single lung ventilation, and the patient was placed in the left lateral decubitus position. Partway through the surgery, a somewhat sudden increase in peak airway pressures and rising end tidal carbon dioxide prompted repeat bronchoscopy which showed that the ETT had migrated cephalad and was blocked by blood and a surgical sponge. A 6.0 ETT was then passed to the surgical team and placed into the thoracotomy site, into the opening in the right main bronchus and across the carina into the left main bronchus for cross field, single lung ventilation. It was determined that the original ETT did not have adequate length for a secure left main bronchus oral intubation in the tall patient. A custom extra-long tube-within-tube was constructed by suturing a 6.5 ETT into the back of a 7.0 ETT (see image below). Towards the end of the surgery, a secure oral airway was reestablished by retrograde intubation. The surgical team passed a tube exchanger through the right main bronchus defect up through the mouth, where it was attached to the custom ETT and guided into the left main bronchus by both the surgical and anesthesia team. The patient went to the intensive care unit post operatively and was discharged home roughly three months later.

Discussion: Tracheal or bronchial injuries pose many challenges to the anesthesia provider, notably intubation and single lung ventilation. Options for oxygenation and ventilation include double lumen endotracheal tubes, bronchial blockers, jet ventilation and cardiopulmonary bypass. Cross field ventilation is a rare, yet potentially lifesaving alternative airway technique. It could be argued that all operating room facilities for thoracic surgery should include a sterile airway circuit as well as specialty endotracheal tubes in the event of an unusual airway emergency.

Abstract 54

Title: Acute Compartment Syndrome: Regional Analgesia did not delay early diagnosis

Authors: Jessica Boden DO, Hilellen Cruz Eng MD

Department and Institution: Department of Anesthesiology and Perioperative Medicine, Penn State Hershey Medical Center, Hershey, PA

Introduction:
Acute Compartment Syndrome (ACS) of the thigh is a rare but disastrous complication that can occur after total knee arthroplasty. Once diagnosed, it is a surgical emergency. There is a critical 12-hour window between symptom onset, diagnosis, and treatment of compartment syndrome. Delayed diagnosis is associated with significant morbidity secondary to irreversible ischemic necrosis to the muscles and nerves within the muscle compartment. There has been concern raised that epidural analgesia or peripheral nerve blockade may "mask" the symptoms of acute compartment syndrome. However, little is known about the effect of adductor canal catheters in respect to masking ACS associated pain.

Case Presentation:
We present the case of a 56-year-old male, with history of chronic opioid use for degenerative osteoarthritis, who developed acute anterior compartment syndrome after an elective right total knee arthroplasty. Spinal anesthesia was performed for the procedure and local infiltration analgesia (LIA) was administered by the surgeon. In the post-anesthesia care unit, an adductor canal continuous peripheral nerve catheter (CPNC) was placed atraumatically using ultrasound guidance. It was not bolused due to the recent LIA injection by the surgeon. A continuous infusion of 0.2% Ropivacaine, at 8 cc/hr, was started ten hours after LIA injection and no boluses were administered. Within 6 hours post-operatively, the patient was complaining of tightness in his right thigh. Pain intensity was initially described to be 8/10, with moderate relief obtained with scheduled PO 8 mg dihydromorphone, 4 mg IV morphine q1hr, and 100 mg Morphine SR. During the next four hours, the patient was reevaluated due to ongoing complaints of unrelenting 10/10 right thigh pain despite the local anesthetic infusion via the CPNC and PRN IV boluses of additional opioids. Bedside evaluation demonstrated the patient's right thigh to be extremely tense, edematous, and tender to palpation. By 10 hours after symptom onset, the patient was taken emergently to the operating room, where an anterior compartment fasciotomy was performed. The patient made a full recovery without complication.

Discussion:
The diagnosis of compartment syndrome was made within less than 12 hours of symptom onset and the patient underwent emergent fasciotomy. It is critical to be vigilant during the early post-operative period for the development of ACS. In this case, the postoperative adductor canal catheter did not mask the developing compartment syndrome. The diagnosis was promptly made, resulting in definitive treatment occurring within 12 hours of symptom onset. Based on the presenting case, in the appropriate setting, adductor canal block did not delay the diagnosis of acute compartment syndrome.

References:
Abstract 56

Title: Dystonic Reaction Likely Induced by Ondansetron

Authors: Elizabeth A. Ungerman M.D. M.S., John J. Hache M.D., and Patrick J. Forte M.D.

Department: Anesthesiology

Introduction: Patients are at risk for numerous perioperative adverse drug reactions. Acute dystonic reactions following general anesthesia are infrequently encountered and associated with a number of medications routinely administered during anesthetic care. It is important to accurately diagnose and treat dystonic reactions to prevent further discomfort and distress to the patient and their families.

Case Presentation: A 42 year-old man with ulcerative colitis was scheduled for proctectomy under general anesthesia. As part of the ERAS (Enhanced Recovery After Surgery) pathway, the patient received spinal analgesia with intrathecal morphine. Ketamine and lidocaine were infused intraoperatively along with a bolus of intravenous magnesium. General anesthesia was maintained with sevoflurane. Ondansetron and dexamethasone were administered for post-operative nausea and vomiting (PONV) prophylaxis. There were no complications during the preoperative and intraoperative phases of anesthetic care. In the post-anesthesia care unit (PACU) the patient was extubated and subsequently began shaking his head involuntarily. Physical exam showed weakness to voluntary movement in the lower and upper extremities with simultaneous uncoordinated muscle contractions. Vital signs were stable. An acute dystonic reaction was diagnosed and diphenhydramine was administered with rapid resolution of these symptoms. At the time, ketamine was suspected as the cause. The patient improved and was discharged. Three months later, the patient presented for incision and drainage of an abscess near the original surgical site. Due to the previous dystonic reaction, ketamine was avoided and the patient underwent general anesthesia with sevoflurane. Ondansetron and dexamethasone were again administered for PONV prophylaxis. After successful extubation, he was taken to PACU where he began to have muscle twitching, torticollis and muscle weakness. Following initial unsuccessful treatment with meperidine, he was given diphenhydramine and his symptoms resolved.

Discussion: Acute dystonic reactions can be elicited by a multitude of medications used in routine anesthetic care. Ondansetron, a competitive and selective 5-HT3 receptor antagonist, has been established as an effective antiemetic with a side effect profile that includes a low incidence of severe adverse effects. The 5-HT3 serotonin receptor is present in the central, peripheral and enteric nervous systems and is located on the enterochromaffin receptors on the gastrointestinal mucosa. The first case report suggesting ondansetron induced extrapyramidal effects was published in 1991 by Dobrow et al. Since then, a significant number of case reports have surfaced further implicating the role of ondansetron in eliciting extrapyramidal activity. The blockade of 5-HT3 receptors at central sites along with ondansetron mediated inhibition and reduction of mesolimbic dopaminergic activity have been postulated. Additionally, it has been proposed that ondansetron plays a role in antagonism of the locomotor activity produced by mesolimbic dopamine.

Risk factors for acute dystonic reactions include young age, a positive history of previous reactions, a history of substance abuse, and prior administration of antipsychotic or antiemetic medications.

Presentation is usually not life threatening but often painful and distressful to the patient and frightening for observers.

References:
Abstract 57

DELAYED AWAKENING FOLLOWING A CESAREAN SECTION SECONDARY TO HYPOCALCEMIA/HYPERMAGNESEMA

JAHZREEL ALLARDICE THOMPSON MD, PRAMOOD KALIKIRI MD

DEPARTMENT OF ANESTHESIOLOGY, DREXEL UNIVERSITY COLLEGE OF MEDICINE, HAHNEMANN UNIVERSITY HOSPITAL, PHILADELPHIA, PA 19102

Introduction

Delayed emergence is defined as the failure of the patient to regain the expected level of consciousness within 30 minutes after the end of an anesthetic administration. Causes range from non-severe and acutely reversible such as electrolyte abnormalities, or hyperthermia to severe and potentially life-threatening such as cerebrovascular accidents. Early identification of the cause as well as preventative measures is necessary if the delivery of safe anesthesia is desired.

Case Presentation

23- year-old female gravida 1 para 0 presented to the labor and delivery ward at 26 weeks 6 days with complaints of lower abdominal pain and complaints of a clear discharge. She also reported having a fever on and off for the past week. She denied vaginal bleeding and contractions and reported positive fetal movement. The patient was noted to be diffusely tender to palpation of the uterus with active HSV lesions of the labia bilaterally. Fetal monitoring at the time was noted for fetal tachycardia. The patient’s vitals at this time showed tachycardia in the 120s and a temperature of 102 F. Her weight was 50kg; height 5’2” with a BMI of 18.She was diagnosed with Preterm premature rupture of membranes (PPROM), chorioamnionitis and acute Herpes Simplex Virus (HSV) outbreak. The decision was made to deliver the baby and due to the primary HSV outbreak the decision was made to undergo General Anesthesia. Peri-operatively the patient received Betamethasone 1gm as well as 6g of Magnesium sulfate for fetal neuroprotection. She also received Ampicillin 2gm, Gentamicin 225mg and Clindamycin 900mg. She was taken to the operating room and a rapid sequence induction was performed with Propofol 150mg and Succinylcholine 100mg. She was intubated with a 6.5 ETT tube without any difficulty. Maintenance of anesthesia was with Sevoflurane and Nitrous Oxide. Skin incision was made at 2326 hrs, uterine incision was 2329 hrs and the baby was delivered at 2330 hrs. After the baby was delivered, she received Fentanyl 200mcg IV and Morphine 5mg IV for analgesia. The procedure ended at 0120 hrs, the patient’s vital signs were stable, she was breathing spontaneously, tidal volumes were greater than 300ml, her respiratory rate was 24 breaths per minute and there was no inhalational agent on board, yet the patient was not able to be aroused. The patient’s preop labarotary results were reviewed; the only abnormality noted was a total calcium of 7.2. Physical exam at the time showed sluggish deep tendon reflexes. The decision was made to give 1gm Calcium chloride IV, due to the low preop calcium and the possibility of magnesium toxicity. Arterial blood gas, basic metabolic panel and magnesium levels were sent after the patient was given the calcium chloride IV. These results showed normal serum glucose, Ionized Calcium 1.02, Total calcium 5.7 and Magnesium level of 3.3. Shortly after the patient became responsive, was extubated and transported to the recovery room.

Discussion:

Residual sedation from drugs is the most common cause of delayed emergence. Other causes to consider include, hypoxia, hypercarbia, electrolyte abnormalities, hypothermia, seizures, strokes and central anticholinergic syndrome. We attributed the delayed awakening in our patient to hypocalcemia secondary to magnesium toxicity. Hypermagnesiumemia is a known cause of delayed awakening following general anesthesia. It potentiates the action of neuromuscular blocking agents, which may appear as unconsciousness, cause muscle weakness as well as respiratory insufficiency. Magnesium sulfate inhibits calcium release from the neuromuscular junction which is the second messenger involved in acetylcholine release. Treatment with Calcium chloride reverses this effect of magnesium sulfate.

References

Airway Management in Patient with Thyromegaly Undergoing Thyroidectomy and CABG

Authors: Garrett Russell, MD, Nicole Imbriale-Townsend, DO, Matthew McConnell, MD

Department of Anesthesiology, Allegheny Health Network Medical Education Consortium

Introduction: Thyromegaly is a relatively common condition characterized by an enlarged thyroid gland due to hyperplasia, nodule formation or thyroiditis. Patients may have symptoms of hypothyroidism or hyperthyroidism, obstructive symptoms such as dyspnea on exertion or dysphagia, nerve issues presenting as vocal cord palsy, or more commonly they will be asymptomatic. Although thyromegaly does not commonly cause tracheal deviation and/or compression, this structural anomaly can lead to challenging issues seen in the operating room. Our case is an example of severe thyromegaly which illustrates the difficulty encountered when securing the airway and trying to place echocardiography and other monitoring devices.

Case Presentation: A 66-year-old female presented to the hospital after experiencing chest pain. She was diagnosed with a non-ST-segment elevation myocardial infarction and underwent subsequent cardiac catheterization, which revealed significant 3-vessel disease. A substernal goiter was noted during her admission and general surgery was consulted for surgical management. Her CT scan showed a large substernal goiter with tracheal compression and rightward deviation. She was scheduled for a combined thyroidectomy and coronary artery bypass grafting (CABG). Her pre-anesthetic evaluation was notable for thyromegaly and rightward tracheal deviation. Despite a Mallampati III score, she had normal cervical range of motion, intact dentition, and a thyromental distance greater than three fingerbreadths. After induction of general anesthesia, the patient was easily mask ventilated with the use of an oral airway. Because there was a Cormack-Lehane grade 3-4 view with direct laryngoscopy, the decision was made to proceed to video laryngoscope. She had a grade 3 view with video laryngoscopy and an endotracheal tube was placed on the second attempt. Prior to surgical incision, placement of a transesophageal echocardiography (TEE) probe was attempted but met with resistance. TEE probe insertion was attempted three times unsuccessfully. An orogastric tube was also attempted unsuccessfully and insertion was aborted. She underwent successful thyroidectomy and subsequent CABG. She was admitted to the surgical ICU and was extubated without complications on post-operative day 1.

Discussion: This case illustrates the potential for complications with airway management in a patient with thyromegaly, as well as complications with the passage of esophageal devices used for intraoperative monitoring. It is important to recognize the potential complications in order to safely secure the airway and provide monitoring during certain procedures. The main issues include the inability to intubate or ventilate due to tracheal compression and obstruction, perforation of the esophagus or trachea, nerve damage, and unexpected post-operative ventilatory requirements. There are several catastrophic events that could ensue if the thyroid prohibits the ability to intubate or ventilate. Symptoms become more manifest when the patient is supine and the enlarged thyroid constricts the larynx. It may benefit these patients to maintain spontaneous ventilation during induction and one should consider performing an inhalational induction in the seated position or an awake fiberoptic intubation for these extrathoracic lesions. Even an emergency cricothyrotomy would be more difficult due to the enlarged gland displacing and obscuring other anatomical structures. A large thyroid could lead to case cancellations if necessary monitoring devices such as a TEE probe cannot be passed. It is important to remember that we were unable to even place an orogastric tube and that there was significant tracheal deviation. Although thyromegaly is usually not as severe as in this case, we recommend better preoperative evaluation and consultation with an anesthesiologist at a perioperative clinic to assess the airway and determine if imaging may be necessary before surgery. A better knowledge of the thyroid size and degree of compression would facilitate safer general anesthetic inductions and fewer unexpected complications.

References:
Stepwise Intraoperative Management of Renal Cell Carcinoma with IVC Thrombosis.

Matthew Troum DO, Andreas Karachristos MD, Marc Smaldone MD, Gordon Morewood MD

Introduction. Renal cell carcinoma (RCC) is a malignancy which originates from the proximal convoluted tubule and comprises approximately 90-95% of kidney related cancer. The tumor commonly extends to the renal vein and a tumor thrombus may extend to the inferior vena cava (IVC). The mainstay of treatment is nephrectomy with IVC thrombectomy or resection and reconstruction. Tumor debulking may improve survival in these patients and furthermore minimizes morbidity and mortality from tumor emboli. We present a complex case in which complete IVC thrombectomy required coordinated perioperative decision making and adaptation of the surgical course.

Case Report. A 75 year old male presented with a past medical history of RCC and robotic assisted left nephrectomy one year prior. Repeat CT scanning demonstrated an IVC thrombus extending from the left renal vein remnant to the junction of the IVC and right atrium (level III-d) in addition to an enhancing mass in the upper pole of the contralateral kidney. The patient was scheduled for an exploratory laparotomy with IVC thrombectomy and wedge resection of the right kidney. General anesthesia was used with a balanced isoflurane / fentanyl technique. Monitoring consisted of a radial arterial line, oximetric pulmonary artery catheter, and continuous TEE. The right internal jugular vein was double cannulated with the pulmonary artery catheter and an 18 French straight aortic cannula do allow for volume administration and the possibility of veno-veno bypass. Surgical exposure was achieved via a subcostal chevron incision. After exposure of the major vessels a test cross clamping of the IVC was attempted. Immediate hypotension resulted despite volume loading and vasopressor support with epinephrine and norepinephrine infusions. After discussion between the surgical and anesthesia teams it was decided that veno-veno bypass would be required for adequate right heart filling during the thrombectomy. The right groin was cannulated with a 19F cannula and veno-veno bypass was achieved with a centrifugal head pump but without the use of an oxygenator or anticoagulation. After the establishment of veno-veno bypass the IVC was clamped at the right atrial junction and infra-renal IVC and an open thrombectomy was completed under direct vision. A part of the vena cava was also resected and reconstructed by using a bovine pericardium patch. Following repair of the IVC the use of veno-veno bypass was discontinued and attention was turned to resecting the tumor from the right kidney, by partial nephrectomy. During this surgical procedure a complete TEE examination was repeated which revealed residual clot in the suprahepatic portion of the IVC. Of particular importance was the limited extent but near occlusive nature of the residual thrombus with flow acceleration around its periphery on color Doppler. Veno-veno bypass was re-initiated and the suprahepatic IVC was re-explored via a transverse incision. The hepatic veins were protected. The residual clot was identified and excised without difficulty. A final intraoperative TEE examination demonstrated a widely patent IVC in confluence with the right atrium. Post-operatively the patient was transported to the surgical intensive care unit and was extubated the following day.

Discussion. It has been reported that tumor thrombus occurs in 4-10% of patients with RCC. Despite recent improvements in preoperative imaging, surgical planning and perioperative care, the mortality for IVC thrombectomy ranges from 2.7% to 13% arising primarily from massive pulmonary embolism, myocardial infarction and hemorrhage. Careful stepwise planning and preparation is essential to safe and successful thrombectomy. Veno-veno bypass may be accomplished with minimal additional risk and may allow for significantly improved operating conditions and hemodynamic stability. Intraoperative TEE is useful in the preoperative evaluation of the extent of thrombus, in detecting tumor or gas emboli, and in intraoperative confirmation of complete thrombus removal in addition to monitoring heart function.

CO₂ Narcosis After Retroperitoneal Robotic Surgery: A Case Series

Christian S. Balabanoff MD; Robin Schiller DMD; Ellen Hauck DO PhD; John Ferrari MD and Eric Gewirtz MD

Causes of postoperative respiratory failure are many. Common causes include narcotic overdose, insufficient muscle relaxant reversal and patient disease state. Acute respiratory failure after surgery due to CO₂ retro-pneumoperitoneum induced hypercarbic narcosis is a serious potential concern but is a rare clinical consequence.¹ ² ³ We present three patients in whom post op respiratory failure may be the result of such CO₂ narcosis and respiratory depression. The patients were two male and one female, ages 45-62, ASA physical status where 2, 3 and 2. Their body mass index ranged between 18 and 27. The patients had right-sided robotic surgeries involving the kidney or ureter, and insufflation of the retroperitoneum was performed with CO₂. All patients received fentanyl and rocuronium. They were reversed with neostigmine and glycopyrrolate at the end of surgery and extubated once appropriate criteria were met (sustained head lift, awake and cooperative). All three patients subsequently presented with respiratory failure, one on transport to the postanesthesia care unit (PACU) and two within 40 minutes of arrival to PACU. No medications were given to any of the patients outside of the operating room before respiratory failure. Each patient required assisted ventilation, and one required reintubation. All three patients recovered respiratory drive while in the PACU without additional treatment. None of these patients exhibited signs of narcotic induced loss of respiratory drive or incomplete reversal of paralytic, but all three were subject to over two hours of CO₂ insufflation. Streich et al have shown that during laparoscopic retroperitoneal surgery, CO₂ absorption increases over time and persists after exsufflation.⁴ Having robotic retroperitoneal surgery in common suggests the etiology of respiratory failure could be due to CO₂ retro-pneumoperitoneum narcosis. The increased bodily CO₂ could possibly result from duration of insufflation, the extraperitoneal approach, the development of subcutaneous emphysema or a combination of the above⁵, ⁶. Further study is underway to elucidate the mechanism of these cases of postoperative respiratory failure.

References
Anesthetic Management of a Patient with Low-Flow Critical Aortic Stenosis, s/p AVR, Pulmonary Hypertension, and Atrial Fibrillation with Supra-Therapeutic INR for the Treatment of Strangulated Inguinal Hernia

Angeline M Nguyen MD, Michael Tran DO, David Kim MD, Gordon Morewood MD MBA FASE
Anesthesiology Department, Temple University Hospital

Introduction
Aortic valve stenosis (AS) is the most common cause of left ventricular outflow obstruction. Atrial fibrillation is the most common sustained cardiac arrhythmia and occurs in more than 9% of patients with AS. When atrial fibrillation occurs in the presence of severe AS there are important implications for the patient's perioperative management during emergent non-cardiac surgery.

Case Presentation
A 75 year old female presented with a history of recurrent severe AS after having undergone an aortic valve replacement 6 years previously. The patient’s medical history also included chronic left ventricular failure (EF 20-25%), moderate to severe pulmonary hypertension, COPD/emphysema and atrial fibrillation being treated with Coumadin. During outpatient preparation for a transcatheter aortic valve replacement (TAVR) she presented to the emergency department with an acute onset right inguinal pain. Shortly after hospitalization she was found to be in rapid atrial fibrillation with a heart rate ranging from 130 to 150 bpm and to have a supra-therapeutic INR (7.7). Two days post admission a CT scan demonstrated findings suggestive of a strangulated right inguinal hernia.

Due to the patient’s comorbidities, a cardiac anesthesiologist was consulted by the patient’s general surgeon regarding her ability to tolerate surgery. The decision was made to proceed with a hernia repair under MAC with local anesthesia. If conversion to laparotomy was required intraoperatively, the anesthetic technique would then be converted to general anesthesia.

Preoperatively the patient received one unit of fresh frozen plasma, 10 mg of intravenous Vitamin K and 2300 Units of prothrombin complex concentrate (PCC). Subsequently, a stat intraoperative INR was found to be normal (1.0). Intraoperatively fentanyl and precedex infusions were used for sedation. The surgeon administered a mixture of 0.25% bupivacaine plain and 1% lidocaine with 1:200,000 epinephrine for a total of 20cc in the surgical field. Hemodynamically the patient remained stable throughout the five hour procedure and was comfortable with the provided sedatives. Postoperatively she was transferred to the intensive care unit for close monitoring overnight.

Discussion
Aortic stenosis and atrial fibrillation are both conditions associated with increased cardiovascular morbidity and mortality. The emergent nature of this patient’s surgical disease compounded her risk of suffering an adverse event in the perioperative period. Various and competing risks included bleeding, thromboembolism, acute congestive heart failure, and sudden cardiac death. For her anesthetic care a minimalist approach was adopted with careful titration of sedative agents supplementing the maximum allowable doses of local anesthetic. Reversal of an excessive anticoagulation state was rapidly achieved using prothrombin complex concentrate (PCC) and resumption of anticoagulation was initiated once surgical hemostasis was confirmed.

Conclusion
In this patient with multiple co-morbidities, effective and timely communication between disciplines and specific team members was essential in formulating an appropriate plan of action and assuring the best possible outcome.

References
Abstract 62

Pneumothorax and Systemic Air Embolism During Endobronchial Cryospray Ablation and Balloon Dilation

Bradley M Hammond, DO, Bilal Ahmad, MD, Christopher Witkowski, CRNA

INTRODUCTION:
The authors present an unusual case of tension pneumothorax and systemic air embolism, presumably caused by pulmonary barotrauma and entrainment of nitrogen (N₂) gas into the systemic circulation following spray cryotherapy for an endobronchial mass.

CASE PRESENTATION:
A 59 year-old female with an obstructing metastatic bronchus intermedius lesion (Figure 1) presented to the operating room for palliative bronchoscopy, cryoablation and balloon dilation. Flexible bronchoscopy revealed marked narrowing of the bronchus intermedius to a diameter of 2 mm. Cryospray ablation was performed, observing standard passive venting precautions. The bronchus intermedius was then dilated with an endobronchial balloon. At this point, the patient developed sudden and refractory hypotension, as well as elevated peak airway pressure, bradycardia, and precipitous decline in end-tidal CO₂. ACLS measures were instituted and bilateral tube thoracostomy performed. Intra-operative chest radiograph revealed right pneumothorax, pneumomediastinum, and subcutaneous emphysema in the right neck. The patient’s rhythm deteriorated into ventricular fibrillation. Return of spontaneous circulation was achieved after defibrillation. Rescue transesophageal echocardiography (TEE) revealed normal left ventricular function and a dilated/hypokinetic right ventricle. There was air noted in the left ventricle. There was no air in the right heart, nor was there evidence for atrial or ventricular septal defect (Figure 2).

DISCUSSION:
Spray cryotherapy requires adequate passive venting of N₂ gas to protect against barotrauma of the airway. Passive venting is typically accomplished by deflating the endotracheal tube (ETT) cuff and disconnecting the circuit from the ventilator. In addition, monitoring for vented mist expelled from the ETT, as well as observation of chest rise, should be performed. Barotrauma is a known complication of cryospray ablation. Over-distention and rupture of the alveolus creates a pressure gradient for the diffusion of air into the perivascular adventitia, leading to pulmonary interstitial emphysema, as well as potential for pneumothorax, pneumomediastinum, or subcutaneous emphysema. The authors conclude that the severity of endobronchial obstruction hindered adequate venting of N₂ gas from the distal tip of the cryocatheter, which was positioned distal to the obstruction, resulting in barotrauma and tension pneumothorax. Additionally, the development of high instantaneous pressure within the distal airways may have promoted dissection of N₂ gas through the lung parenchyma, facilitating the entry of gas bubbles into the pulmonary venous circulation via a bronchopulmonary venous connection. Given the dysrythmia following tube thoracostomy and the hypokinetic right ventricle visualized on rescue TEE, it was hypothesized that N₂ gas embolization to the right coronary artery may have occurred.

REFERENCES:

Figure 1: Preoperative CT chest
Figure 2: Rescue TEE (ME AV LAX view).
Abstract 64

Prone Positioning of a Hypoxemic Patient on VV-ECMO during Acute Cell Mediated Rejection after Lung Transplantation

Mikaela S. Jayashekaramurthy, Jessica M. Reardon, Department of Anesthesiology, Temple University School of Medicine

Introduction: Lung transplant recipients are most susceptible to acute cellular rejection (ACR) within the first year, as up to 36% will experience at least a single episode. Understanding who may be at heightened risk for ACR has not been well defined. Clinical signs and symptoms are non-specific and can be indistinguishable from humoral mediated rejection. The standard treatment for ACR consists of a three-day course of intravenous pulse dose steroids followed by a prednisone taper. The majority of these patients has a rapid improvement. In cases of refractory hypoxemia while on veno-venous extra-corporeal membrane oxygenation (VV-ECMO), a few studies indicate that prone ventilation improves oxygenation and lung compliance.

Case Presentation: A fifty-seven year old man with a past medical history of idiopathic pulmonary fibrosis and severe pulmonary hypertension underwent bilateral lung transplantation with basiliximab induction. The day after his transplantation, he was extubated but needed intermittent non-invasive positive pressure due to significant desaturation with movement. The patient was initiated on vancomycin after discovery of donor positive methicillin resistant staphylococcus aureus culture, but never exhibited any resulting infection. On post-operative day seven, the patient presented with acute hypoxic respiratory failure requiring intubation. Empiric broad-spectrum antibiotics including antifungal treatment were begun. Bronchoscopy revealed normal anastomoses and negative cultures. Immune cell function was 53 ng/mL ATP. The following day emergent VV-ECMO was performed due to continued hypoxemia despite maximal ventilator support. Given the patient’s critical status and negative cultures, high dose methylprednisolone was empirically started based on a presumed diagnosis of acute cell mediated lung rejection. He continued on VV-ECMO while on the ventilator and was still profoundly hypoxemic without any ability to wean ECMO support. He underwent tracheostomy and was then placed in the prone position while on VV-ECMO. By the fourth day in prone position, the patient’s oxygenation markedly improved. VV-ECMO was discontinued nine days after placement. He was transitioned to the ventilator rehabilitation unit a month post-surgery. The tracheostomy was removed roughly four weeks later. Immune cell function improved to 390 ng/mL ATP at the end of two months. At his first post-transplant office visit, the patient was breathing with ease and without supplement oxygen.

Discussion: Predicting the development of ACR requires more focused study of both genetic and environmental factors that contribute to the complex host response to lung allotransplantation. Clinical indications for prone ventilation while on ECMO are poorly defined; however, a limited number of studies have found prone positioning effective in the setting of hypoxemic respiratory failure while on ECMO. Prone ventilation can effectively improve ventilation/perfusion mismatch by decreasing shunt and aerating the dependent lung zones, permitting larger tidal volumes. Additional studies as to the best timing and duration for prone positioning on VV-ECMO in patients with acute cellular rejection in lung transplantation are needed to evaluate effectiveness in recovery.

References

Abstract 67

Title: “What is this White Stuff between the Cords?”

Authors: Maimouna Bah MD, Hawa Abubakar MD, Ashish Sinha MD, PhD. MBA.

Department: Anesthesiology and Perioperative Medicine Drexel College of Medicine/Hahnemann University Hospital.

Introduction: Airway assessment is an essential skill in the anesthesiologist's armamentarium. As part of this a thorough assessment of fasting status is paramount. Asphyxia as a result of chewing gum is a rare entity; however, it is an avoidable cause of morbidity and mortality. In recent years with the advent of fast track surgery, the nil per os rules have been relaxed for chewing gum with evidence showing that it may enhance bowel recovery following colectomy and reduce hospital length of stay. As a result of this relaxation, as anesthesiologists we should be particularly weary of patient's chewing gum in all settings. Of particular concern is provision of anesthesia during emergency situations when information on airway assessment may be limited. We report a case of partial airway obstruction as a result of chewing gum aspiration.

Case Presentation: A 68 year old female with a past medical history of coronary artery disease, atrial fibrillation, mitral valve replacement, chronic obstructive pulmonary disease on 2-3.5L of home oxygen, pulmonary hypertension, heart failure with an ejection fraction of 45%, hypertension, sick sinus syndrome, hyperlipidemia, transient ischemic attack, gastrointestinal bleed, diverticulitis, chronic kidney disease stage 3 and blindness in the left eye presented to the emergency department with generalized weakness and shortness of breath. Her history was positive for fever, chills, nausea, decreased appetite and an episode of loose bowel motions. Physical examination revealed decreased breath sounds at the bases bilaterally, a murmur of mitral insufficiency and tenderness in the right upper quadrant. For further investigation she required a CT Abdomen Pelvis with contrast. She had a known allergy to contrast but following discussion with her family, they accepted the attendant risk and elected to have the study done. She was pre-treated with methylprednisolone 40mg IV, diphenhydramine 50mg IV prior to receiving contrast for the CT scan. She was also given 0.5mg of Lorazepam IV prior to the contrast. Midway through the scan she began complaining of difficulty breathing. The scan was interrupted to attend to her and it was during this period that she went into a PEA arrest. Prompt CPR was started. Attempts to bag mask ventilate were difficult; there was inadequate chest rise following each breath with paradoxical movement of the chest. On direct laryngoscopy, the patient was found to have a wad of gum between her cords. This was carefully retrieved using Yankauer suction. She was successfully intubated, ventilated, regained spontaneous circulation prior to being transferred to the ICU for further management.

Discussion: This case highlights the importance of vigilance in managing the airway. Prior to the post arrest laryngoscopy, no one was aware that the patient had chewing gum in her mouth. Additionally, she had received Lorazepam. We postulate that bag mask ventilation led to migration of the chewing gum into the tracheal opening where it lodged itself between the cords. The paradoxical chest movement observed was as a result of partial obstruction of the airway. Recognizing this clinical sign was important in ensuring a positive outcome for this patient. This case has implications that far outreach the emergency setting. Patients coming for fast track bowel surgery in some settings are allowed to chew gum up until 2 hours prior to their surgery. Due to a variety of factors including patient anxiety and not being asked specifically, they may forget to spit out the gum which could lead to airway obstruction at the time of induction. As anesthesiologists, we should have a heightened sense of awareness of this potential complication and ask all our patients specifically about chewing gum use and disposal prior to administering sedatives or anesthetic agents.

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Abstract 70

**Title:** Presentation of Patient Undergoing Emergent Exploratory Laparotomy for Bowel Perforation Complicated by Pulmonary Embolus and Intraoperative Cardiac Arrest

**Authors:** Ksenia Guvakova M.D., Darsi Pitchon M.D., Michael Tran, M.D., Clint Fleckenstein D.O., Abiona V. Berkeley, M.D., J.D.

**Department/Institution:** Department of Anesthesiology at Temple University Hospital

**Introduction:** Though cases complicated by life-threatening comorbidities may not be the norm, during emergent procedures when little can be done to optimize a patient’s status it is of utmost importance that we maintain a high index of suspicion should complications occur. Since patients undergoing surgery are at increased risk for venous emboli and hence, pulmonary emboli, compared to the general population, it is important to understand the pathophysiology of the disease as well as how to manage the patient should outcomes such as cardiac arrest occur in the operating room.

**Case report:** This is the presentation of a fifty-eight year old male who was admitted to the hospital with a saddle pulmonary embolus and clostridium difficile pan-colitis causing perforation of the sigmoid colon. During emergent total abdominal colectomy and ileostomy, the patient developed ventricular fibrillation and ACLS was initiated. Emergent TEE showed severe right ventricular failure due to suspected intraoperative migration of the embolus. The patient was placed on cardiopulmonary bypass and emergent thrombo-endarterectomy was performed. The patient’s hospital course was complicated by multiple thrombi, heart failure, and shock.

**Discussion:** Studies from 2008-2009 suggest an average incidence of pulmonary embolus (PE) to be 1.6% in a population undergoing general surgery, and 0.32%-1.0% in abdominal surgeries of which 0.9% and up to 0.4% are respectively fatal. The risks are increased in orthopedic surgeries, trauma and acute spinal cord injuries up to 6.2% and 9% respectively. Pulmonary emboli can have devastating effects on the cardiovascular system and it is important to identify the disease process early and to be able to generate a multistep action plan for treatment. Intraoperative cardiac arrest during anesthesia differs from cardiac arrest in any other hospital or community setting, primarily because it is witnessed and commonly anticipated. The response is hence more immediate and focused. One of the many etiologies for intraoperative cardiopulmonary arrest is RV failure. It should be managed with a combination of pulmonary vasodilators and positive inotropic agents. In contrast to LV failure, the use of vasoconstrictive agents for RV dysfunction may improve CO and distal perfusion, whereas LV failure requires afterload reduction. Overall, acute PE is associated 15.3- 25.3% three month mortality and up to 25-32% mortality in patients with RV failure. In this patient’s case the timely identification of bilateral pulmonary artery embolism and the quick response of the multidisciplinary team intraoperatively along with effective ACLS and short CPB time resulted in successful recovery of cardiac and neurologic function.

**References:**

Abstract 73

A Case of Arterial and Venous Tear During Single Lead Extraction

Authors: Michael S. Green, Rayhan A. Tariq, Vishal Patel, Daniel WU

Department of Anesthesiology and Perioperative Medicine, Drexel University College of Medicine

Introduction: The use of Implantable cardioverter-defibrillator (ICD) or pacemakers has increased significantly over the past 2 decades. The use of ICD involves placing the left ventricular (LV) lead via the coronary sinus (CS), by using a transvenous approach. LV leads are very likely to fail over time. Transcutaneous lead extraction (TLE) can be associated with significant morbidity and mortality. Reported major complication and mortality rates with TLE vary widely across studies. In one large study the rate of major complications in TLE was found to be 1.4%. In particular, Active fixation CS leads present significant challenges to extraction. In the presence of hemodynamic changes during the procedure the occurrence of both an arterial and venous injury must be considered during the extraction of a single lead. True multidisciplinary team work is needed to obtain the highest quality outcomes.

Case Presentation: A 71-year-old male was admitted by electrophysiology for extraction of a 6-year-old implantable cardioverter-defibrillator lead due to fracture from insulation break. During the lead extraction process, the patient’s blood pressure fell precipitously and echocardiographic findings were consistent with a pericardial effusion. After an unsuccessful pericardiocentesis, anesthesiology and cardiothoracic surgery were called to the electrophysiology suite. Open chest sternotomy and evacuation of hematoma from within the pericardium was performed. Subsequent surgical repair of several injuries were completed including the distal coronary sinus, a large degloving injury of posterior portion of the heart, and a large first obtuse marginal branch bleed. This case demonstrated that when performing a Transcutaneous lead extraction (TLE), a traction related injury can cause arterial rupture with concomitant coronary sinus injury.

Discussion: Most pacemaker leads implanted within a year can be removed without the use of any specialized equipment, termed “lead explant”. But as the duration of the leads increase, fibrosis will form around the leads and adhere them to the vessel walls; thus requiring specialized equipment in a procedure named “lead extraction”. Lead extraction can be associated with significant morbidity and mortality. The risk of causing concomitant arterial and venous injury is rare. Active fixations CS leads were introduced to reduce the rate of lead dislodgment, but the active fixation mechanism can present with added complications should these leads necessitate extraction. We report a case of marginal artery rupture along with coronary sinus rupture after an active fixation CS lead extraction. A multidisciplinary team-based approach can ensure patient safety when faced with complications such as a coronary sinus and arterial rupture.

References:
Abstract 74

Title: Anesthesia for Idiopathic Benign Hyper-CK-Emia

Authors: Marcus Walton MD, Hawa Abubakar MD, Marcus Zebrower MD,

Department: Anesthesiology and Perioperative Medicine Drexel College of Medicine/ Hahnemann University Hospital

Introduction: Elevations in CK are expected with muscular injury or myopathy. Idiopathic benign hyperCKemia (IHCK) is the finding of an elevated creatinine kinase (CK) in the absence of neuromuscular disease or muscle injury. Clinically this is defined as an elevation in CK of at least 1.5 the upper limit of normal. It is important to note that CK values vary depending on race and sex; therefore, when making clinical decisions this must be factored in. An elevated CK can be caused by a variety of reasons including connective tissue disease, electrolyte imbalance, endocrinopathy, renal disease, cardiac disease and malignancy. In anesthesia with a CK excursion it is important to consider malignant hyperthermia (MH). MH is a rare anesthetic emergency that is life-threatening and must be promptly recognized and treated. Patients with hyperCKemia are thought to be at an increased risk for MH. An in-vitro study examining muscle contracture of 49 muscle biopsy samples taken from patients with asymptomatic elevations of CK showed abnormal muscle contracture following exposure to 3% halothane or 2% halothane or caffeine alone. We describe the case of a gentleman who was found to have an asymptomatic elevation in CK. Given the implications of developing MH we elected to manage this patient with MH precautions as outlined below.

Case Presentation: The patient is a 54 year old male with the past medical history significant for diabetes complicated by organic impotence who presented for pre-operative evaluation for insertion of an inflatable penile implant. While gathering history, it was noted that the patient also had a history of benign elevated creatine kinase. The patient had no personal or family history of a myopathy or malignant hyperthermia. In order to undergo general anesthesia for this procedure the plan included use of TIVA. On induction the patient was treated with versed, fentanyl, propofol, and rocuronium. And for maintenance of anesthesia the patient was treated with remifentanil and propofol infusions. Throughout the case the patient was monitored with standard ASA monitors and remained stable.

Discussion: This case underlines a group of patients who are potentially at risk for malignant hyperthermia and demonstrates preventative measures. The relationship between malignant hyperthermia and myopathies are well known with volatile anesthetics and succinylcholine, which are very commonly used in anesthesiology. There is evidence in the literature of the relationship with IHCK and and malignant hyperthermia. Due to the morbidity and mortality associated with malignant hyperthermia; anesthesiologist should use cautious measures when selecting and providing anesthetics for these patients.

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Abstract 76

Pulmonary Arteritis, Talc Granulomatosis and Right Heart Failure Secondary to Oral Opioid Injection via Hickman Catheter

Joshua Knight MD, Trent Emerick MD, Haibin Wang MD

Department of Anesthesiology, University of Pittsburgh School of Medicine, University of Pittsburgh Medical Center, Pittsburgh, PA

Introduction: Talc granulomatosis is an inflammatory process of the pulmonary vasculature found in IV drug abusers, often from peripheral use of crushed oral medication. It can mimic septic emboli, miliary tuberculosis, and can cause irreversible fibrosis, right heart failure. Described here is a case of central injection via indwelling catheter in a patient with no prior reported IV drug abuse.

Case Presentation: 38yo female with history of Crohn’s disease, chronic abdominal pain followed by chronic pain service, and no prior cardiac history presented with dyspnea. For several weeks prior she had vomiting with concern of not absorbing oral opioids, several emergency department visits requesting more opioids, and a recent admission for pulmonary septic emboli from a Hickman catheter. Repeat chest CT showed scattered nodular opacities, mediastinal lymphadenopathy, and no embolism. Transthoracic echocardiogram revealed RV dysfunction and estimated PA pressure of 82. Later she admitted to crushing oxycodone and injecting via the Hickman catheter. She was admitted for management of right heart failure.

Discussion: Determining etiology of inflammatory lung processes can be difficult in patients with multiple comorbidities coupled with opioid dependence. Careful monitoring and a strong history and physical can be helpful in preventing opioid misuse and abuse. Indwelling lines provide an easy-to-access route of intravenous injection. Talc granulomas are nearly pathognomonic for intravenously-injected oral medication, and prompt treatment of associated end-organ damage is paramount.

References:

Abstract 77

TITLE: TandemHeart as a bridge to coronary artery bypass grafting after out-of-hospital cardiac arrest and failed percutaneous coronary intervention

AUTHORS: Chantel A Gray, Kathleen Tyson

DEPARTMENT AND INSTITUTION: Department of Anesthesiology, Temple University Hospital, Philadelphia, PA

INTRODUCTION: Cardiac shock is the leading cause of death in cases of acute myocardial infarction (MI), with a 30-day mortality between 40-50%. Over the last few years, the management of cardiogenic shock has been altered by the availability of percutaneous circulatory support devices. There are few randomized trials evaluating the efficacy of these devices for patients not responding to standard cardiogenic shock treatment, and conflicting evidence exists regarding the role of percutaneous circulatory support for patients with out-of-hospital cardiac arrest (OHCA). In our case, the TandemHeart was used successfully as treatment in refractory cardiogenic shock after OHCA.

CASE PRESENTATION: A 64 year old male with past medical history of hypertension, diabetes, and stroke experienced cardiac arrest while driving at work. Colleagues witnessed the patient's motor vehicle accident and activated the emergency contact system. Emergency responders performed resuscitation, including defibrillation, after which the patient was transported to the nearest hospital. He underwent emergent percutaneous coronary intervention (PCI), and was found to have 99% occlusion of the mid-LAD and collateralized RCA occlusion. After unsuccessful attempts at revascularization, an intra-aortic balloon pump (IABP) was placed for cardiogenic shock (CI = 1.3 L/min/m² with improvement to 1.6 L/min/m² with IABP), and the patient was transferred to our institution for advanced management. On arrival, the patient was on inotropic support including epinephrine, norepinephrine, and dopamine without hemodynamic improvement. The decision was made to utilize a TandemHeart as a bridge to definitive treatment. Placement of the TandemHeart increased the cardiac index to 3.7 L/min/m², with weaning and eventual removal 3 days later. The patient underwent successful two vessel coronary artery bypass grafting (CABG) the following week.

DISCUSSION: Conventionally, the TandemHeart offers an option for short-term left ventricular support as a bridge to recovery, implantation of a long-term left ventricular assist device, or cardiac transplant. In our case, the TandemHeart was used as a bridge to CABG after OHCA, failed PCI, and inadequate left ventricular support from an IABP. Current guidelines recommend the use of IABP in the treatment of cardiogenic shock; however, recent study has shown that IABP use does not improve 30-day survival after an acute MI with early revascularization. When compared to the IABP, the TandemHeart achieves a greater increase in cardiac output, cardiac index, and mean arterial blood pressure; as such, the TandemHeart should be considered as a reasonable option in the treatment of refractory cardiogenic shock.

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Abstract 79

Hypoxic Respiratory Failure Secondary to Gastrografin Aspiration

Jessica Lumsden, D.O., Meera Gonzalez, M.D., Mala Gurbani, D.O.
Department of Anesthesia, Temple University Hospital

Intro
Pulmonary aspiration of gastric contents (Mendelson’s Syndrome) during the induction of general anesthesia is a rare complication. Though exceedingly rare, pulmonary aspiration is closely linked with high rates of postoperative mortality and major pulmonary complications [2]. Thus, it is crucial that anesthesiologists are aware of the risk factors for aspiration. For example, oral contrast medium is frequently administered for CT examinations, and the sequelae of aspiration of such material may be deleterious. In particular, the water-soluble non-absorbable agent Gastrografin can cause profound pulmonary edema and respiratory collapse with an extremely high mortality [1]. Here we describe a case in which the patient survived pulmonary insult secondary to Gastrografin aspiration with resuscitative measures ultimately requiring veno-venous extracorporeal membrane oxygenation (VV-ECMO).

Case Presentation
A 49-year-old morbidly obese man (BMI 47) with a past medical history of insulin-dependent diabetes mellitus, hypertension, congestive heart failure, hyperlipidemia, sleep apnea, and chronic renal insufficiency underwent an uneventful laparoscopic Roux-en-Y gastric bypass. The next day the patient complained of abdominal pain and belching. An upper GI series revealed an obstruction at the gastro-jejunal anastomosis. The patient was brought to the operating room emergently for evacuation of a suspected clot via upper endoscopy. The patient’s room air oxygen saturation was 84% but increased to 99% with pre-oxygenation. Anesthesia was induced with a modified rapid sequence induction with propofol, rocuronium, and cricoid pressure with the patient's head elevated. The endotracheal tube was placed easily, yet when the pilot balloon was inflated, copious amounts of bloody secretions came out of the esophagus and were suctioned immediately. The case proceeded uneventfully. However, towards the end of the case, the patient acutely desaturated to 84%. FiO₂ was increased to 100%, recruitment maneuvers were unsuccessful, and breath sounds were faint. An ABG showed a PaO₂ of 52mmHg. Copious pink frothy secretions were repeatedly suctioned from the endotracheal tube with SpO₂ in the 70s. A multidisciplinary team agreed that the patient should be placed on veno-venous ECMO secondary to acute refractory hypoxic respiratory failure. The patient’s hypoxia resolved within several minutes after ECMO placement. ECMO was decannulated on POD 8 and the patient was extubated on POD 23 and discharged home approximately 5 weeks later.

Discussion
The administration of oral contrast media in diagnostic CT allows for visualization of the bowel wall and differentiation from surrounding structures. Gastrografin is a flavored mixture of sodium and meglumine diatrizoate. Gastrografin’s high osmolality allows for its therapeutic role in adhesive small bowel obstruction, yet this patient had profound pulmonary edema secondary to this property. Presumably, the aspiration event occurred prior to the patient’s operating room arrival when the patient was belching. Aspiration is one of the leading risk factors for acute lung injury and acute respiratory distress syndromes. ARDS typically involves sudden, severe pulmonary inflammation and alveolar-capillary permeability injury that results in edema, hypoxemia, loss of lung compliance, and is frequently associated with multi-organ failure. VV-ECMO provides oxygenation and rests the lungs, decreasing the insult caused by mechanical ventilation and should be considered as an alternative to conventional therapy for adults with ARDS. Per the Extracorporeal Life Support Organization, ECMO should be considered when the risk of mortality is greater than 50% (PaO₂/FiO₂ < 150 on FiO₂ > 90%), and is indicated when the risk of mortality is greater than 80% (PaO₂/FiO₂ < 100 on FiO₂ > 90%). [3]. This case suggests that the damage of life-threatening ARDS and acute lung injury can be ameliorated with the rapid initiation of VV-ECMO by experienced providers.

References
Abstract 80

Management of Hypertrophic Cardiomyopathy In Pregnancy
Department of Anesthesia, Temple University Health System

Introduction
Hypertrophic obstructive cardiomyopathy (HCM) is a genetic disorder causing asymmetric hypertrophy of the left ventricular septum. Patients are extremely sensitive to fluctuations in ventricular volume, blood pressure, heart rate and rhythm. Many patients remain asymptomatic and are typically diagnosed with echocardiography. Patients may experience palpitations, dyspnea (particularly on exertion), chest pain, fatigue, and even syncope. Patients who are symptomatic during pregnancy have often displayed symptoms prior to pregnancy as well. Given the myriad of physiologic changes that occur during pregnancy, patients with HCM are often counseled to avoid pregnancy. However, patients with HCM presents unique physiologic challenges for anesthesiologists, particularly the parturient patient.

Case Presentation
A 38 yo G1,P0 woman with a past medical history of apical variant hypertrophic cardiomyopathy, liver hemangiomia, and pseudolymphoma secondary to beta-blocker usage presented to the OB triage area at 36 weeks and five days with decreased fetal motion. The patient had been closely followed by cardiology throughout her pregnancy and was to have a scheduled c-section for delivery. The patient had a recent ECHO, showing hyperdynamic left ventricular function, a midcavitary gradient of 36mmHg, with no systolic anterior motion of the mitral valve. After a multidisciplinary meeting involving Obstetrics, Maternal Fetal Medicine, Cardiology, Heart Failure, and Anesthesiology, the decision was made to proceed with an elective c-section with regional anesthesia. Epidural analgesia was chosen in addition to arterial line and two large bore IVs. Prior to the placement of the epidural, the patient was bolused with 1L normal saline. The patient had a lumbar epidural placed at L4-5. Prior to the start of the c-section, the patient was given 250mL albumin and her epidural was bolused with a total of 20mL of 2% lidocaine with epinephrine 1:200,000 in 2mL aliquots. The patient was maintained on a phenylephrine infusion during delivery, which had an EBL of 1600mL. The patient had stable VS postoperatively and was discharged home on postpartum day 4.

Discussion
Women with hypertrophic cardiomyopathy are often counseled to avoid pregnancy, due to the myriad of physiologic changes involving increased intravascular fluid volume. Increased intravascular volume combined with decreased po intake and the valsalva performed by laboring patients can cause decreased venous return which can acutely worsen the left ventricular obstruction. An acute worsening of the obstruction can lead to coronary ischemia. Furthermore, given the large volume shifts that occur with delivery, there is also a real concern of dyspnea secondary to pulmonary edema. One of the most feared complications resulting from HCM is sudden cardiac death (SCD). Women who are asymptomatic prior to pregnancy have been found to tolerate pregnancy well.

Delivery of parturients with hypertrophic cardiomyopathy is typically via elective c-section. However, there are far more documented cesarean sections, of which the most common method of anesthesia was general. Regarding the use of anesthetic for cesarean section, there are no clear cut guidelines, merely case reports. A literature review revealed that general anesthesia the most common method of anesthesia for cesarean for patients with HCM. There are several reports of patients who delivered uneventfully with regional (LEA or CSE) anesthesia for cesarean section. Epidural infusion with concomitant vasopressor use with an alpha agonist (such as phenylephrine) has been well tolerated in the case reports as well as in our patient. It is important for anesthesiologists to recognize the physiologic considerations of HCM and how it impacts the parturient.

References
Abstract 81

A CASE OF INTRAOPERATIVE HYPERCARBIA

Cecilia K Leatham M.D., Mian Ahmad M.D.

Department of Anesthesiology and Perioperative Medicine, Drexel University College of Medicine, Philadelphia, PA

Introduction: Intraoperative hypercarbia may have a benign etiology or may be the result of a life-threatening process. While the most common cause is decreased minute ventilation, other concerning causes include anesthesia machine malfunction and hypermetabolic states. Hypercarbia can have dire consequences ranging from respiratory acidosis and sympathetic stimulation to increased pulmonary artery pressure and right ventricular failure.

Case Presentation: A 49-year-old female patient with a past medical history significant for anemia and laryngeal polyps was scheduled for a robotic hysterectomy and bilateral salpingectomy under general anesthesia. The patient had a smooth IV induction with an easy intubation. Anesthesia was maintained using sevoflurane, opioids and rocuronium. Approximately forty-five (45) minutes post incision, the patient’s ETCO₂ and FiCO₂ slowly increased. Despite progressively increasing the minute ventilation to more than double the normal value, ETCO₂ steadily increased and reached a maximum of 70 mmHg. The patient’s FiCO₂ also steadily increased and reached a maximum of 7 mmHg. The CO₂ absorbent seemed to be exhausted and was replaced. Anesthesia machine display indicated need for change of flowmeter sensor and so that was also replaced. On visual inspection, the unidirectional valves operated fine. Within 30 minutes the CO₂ absorbent changed color again and was replaced again. The situation was discussed with the surgical team and insufflation pressure was checked. It was found to be less than 15 mmHg. The decision was made to complete the surgery since the patient remained hemodynamically stable. As it seemed that the problem lay with the anesthesia machine, once the incision was closed, the machine was removed, the patient was attached to Mapleson D circuit and allowed to breathe spontaneously. Pre-extubation ABG showed a respiratory acidosis with pH of 7.24, and pCO₂ of 60.3. Once the patient met extubation criteria, she was extubated in the operating room. She remained stable throughout her postoperative stay. The anesthesia machine was checked by the manufacturer’s technician and declared to be normal. He mentioned in passing that he had found the exhaust valve of the scavenging system closed and did not feel that that could have caused the problem. In fact, that was exactly what seemed to have caused the problem. The valve was opened and the machine was used subsequently many times without any further incident of hypercarbia.

Discussion: This case illustrates an anesthesia machine related cause of intraoperative hypercarbia. We postulate that a problem in the scavenging system was responsible for rising carbon dioxide levels in this patient. Increased minute ventilation and CO₂ absorbent could not keep up with unlimited supply of CO₂ coming from CO₂ tank used for insufflation of the abdomen as the closed exhaust valve did not allow any CO₂ to be vented out of the system. The system can handle the normal amount of CO₂ produced by the patient but cannot keep pace with the excessive quantity of CO₂ coming from an outside source.

References:
Abstract 83

Acute-onset Quadriplegia in a Complicated Intubated Patient with a Thoracic Epidural

Anish Sethi, D.O.1, Meera Gonzalez, M.D.1, Gaurav Trehan, M.D.1, Christopher Haydel, M.D.2
1Department of Anesthesiology, Temple University Hospital, Philadelphia, PA, USA; 2Department of Orthopaedic Surgery and Sports Medicine, Temple University Hospital, Philadelphia, PA, USA.

Introduction:
Epidural analgesia can significantly benefit respiratory function in patients with blunt chest trauma. The associated severe pain and agitation can lead to a multitude of complications including pneumonia, hypoxia, atelectasis, and prolonged need for invasive mechanical ventilation. While there are multiple benefits of epidural analgesia, there exist various rare, but severe complications associated with catheter placement. These complications include direct spinal cord trauma, cord compression from epidural hematoma/abscess, chemically-induced subarachnoiditis, cord ischemia, or vascular injury. It is important for the anesthesiologist to immediately recognize and manage these complications, especially in critically-ill patients presenting with comorbid risk factors. However, just as important, the presence of an epidural catheter should not distract the clinician from considering other etiologies of abrupt neurological changes encountered in the patient. A comprehensive history and physical, combined with diagnostic tools can shed light onto the causes for acute-onset paralysis in most patients.

Case Presentation:
An 80-year-old male presented to the ED after sustaining multiple traumatic injuries from a high velocity mechanism, including T1-T9 rib fractures, right-sided flail chest, and multiple thoracic vertebral fractures. He was intubated in the trauma bay and a right-sided chest tube was placed. Once his thrombocytopenia was corrected, a thoracic epidural was placed for adequate analgesia for ventilator weaning with a paramedian approach in the lateral position. Twelve hours later the catheter had migrated out and several attempts at replacing the epidural were unsuccessful. Twelve hours later the patient developed acute-onset quadriplegia, with the upper extremities affected most. The next day, symptoms had slightly improved, but still significantly changed from baseline. A subsequent MRI showed cord edema but no hematoma (see figure 1). Central cord syndrome secondary to the original traumatic injury was suspected.

Discussion:
Acute-onset paralysis following epidural catheter placement can result from spinal cord compression, trauma, neurotoxicity, or trauma. The cornerstone to managing acute neurological injury following epidural placement is early diagnosis via physical examination and MRI, followed by early neurosurgical intervention if necessary. This patient presented many unique challenges, including multiple distracting injuries, delays in obtaining emergent MRI secondary to an implanted pacemaker, and placement of the epidural in a sedated/intubated patient. Central cord syndrome (CCS) is caused by traumatic injury causing hyperextension of the cervical spinal cord, usually in patients with pre-existing spondylosis. It is characterized by symmetrical motor weakness, greater in the upper versus lower extremities, and a variable degree of sensory loss below the level of injury.

References:

Figure 1: T2 weighted sagittal MRI of the cervical spine demonstrating localized cord edema and spinal stenosis at C5-6 and C6-7.
Abstract 84

Pulmonary Edema in Heart Failure with Preserved Ejection Fraction

Authors: Galen A. Royce-Nagel, MD, Kunal Karamchandani, MD

Department of Anesthesiology and Perioperative Medicine, Milton S. Hershey Medical Center, Hershey, PA

Introduction: Heart failure with preserved ejection fraction (HFPEF) refers to the clinical syndrome of HF coupled with evidence of diastolic dysfunction and is associated with significant mortality and morbidity. The incidence of HFPEF has been variably described between 30-50% among patients with heart failure.\(^1\) We describe the case of acute HFPEF presenting as a harbinger of myocardial infarction in the perioperative period.

Case Presentation: A 63-year-old male underwent abdomino-perineal resection and right partial hepatectomy for metastatic colon cancer. His past medical history was significant for hypertension, recently diagnosed non-insulin dependent diabetes, a cerebral vascular accident 9 years prior, and an episode of acute congestive heart failure approximately one year before surgery.

At the pre-operative evaluation the patient described his functional capacity as excellent (>6 metabolic equivalents) and he denied any symptoms of HF. A recent transthoracic echocardiogram (TTE) showed normal left ventricular (LV) function without LV hypertrophy or significant valvular pathology. Due to this, the decision was made to proceed with surgery without further work-up.

The surgery lasted approximately eight hours. His intra-operative fluid management was guided by measurement of stroke volume variation (SVV) via Vigileo\(^\text{TM}\) (goal <13), serum lactate levels (goal <2 mg dl\(^{-1}\)), and urine output (goal > 0.5 ml kg\(^{-1}\) per hour). He remained hemodynamically stable throughout.

Immediately after extubation, he became acutely hypertensive and his oxygen saturation began to decline. Pink frothy sputum was noted and the patient’s trachea was promptly re-intubated. The immediate post-operative chest x-ray revealed bilateral vascular congestion. The electrocardiograph (ECG) was negative for ST changes and the serial troponin I levels peaked at 0.5 ng ml\(^{-1}\) (normal <0.12).

Within 12 hours, his respiratory status improved and he was extubated. A repeat TTE done on post-operative day 1 (POD 1) showed an ejection fraction of 60% without any wall motion abnormalities. Despite this, he had another episode of acute pulmonary edema on POD 1 followed by a third episode on POD 4. His ECG on POD 4 now showed ST elevations. He underwent emergent cardiac catheterization with placement of two bare metal stents. The remainder of his hospital course was uneventful.

Discussion: Perioperative HFPEF, although associated with significant mortality and morbidity, has been underestimated and not well described in literature. A chief reason is likely the poor sensitivity and specificity of echocardiography to recognize HFPEF.\(^2\) Coronary artery disease is present in 40-55% of patients with HFPEF.\(^3\) The first abnormality induced by epicardial ischemia is reduced ventricular compliance, not wall motion abnormality, ECG changes, or chest pain.\(^4\) Therefore, patients presenting with acute HFPEF without clinical or ECG evidence of myocardial ischemia may still have significant angiographic ischemic heart disease.\(^5\) Our patient highlights this correlation, as well as the difficulty in identifying patients with HFPEF due to the lack of sensitivity and specificity of TTE.

References
Abstract 85

Unexpectedly Interesting Airway: Cuffed ETT Defect at Site of Pilot Tube

Authors: Galen A. Royce-Nagel, MD, Gregory E. R. Weller, MD

Department of Anesthesiology and Perioperative Medicine, Milton S. Hershey Medical Center, Hershey, PA

Introduction: Cuffed endotracheal tubes (ETTs) allow for a better tracheal seal around the ETT, leading to improved tracheal fit, reduced need for re-intubation due to re-sizing, and improved ventilation mechanics due to lower air leak. The seal provided by the ETT cuff also reduces volatile agent pollution, and provides lung protection from gastric contents. The intra-operative loss of cuff pressure is thus a potentially dangerous event, however, cuff leak is not the only potential pitfall of a cuffed ETT. This case presentation identifies an unusual site for ETT leak associated with the structure of a cuffed ETT.

Case Presentation: A four-year-old, 14kg male presented for gastrocutaneous fistula closure after he no longer needed his gastric tube (initially placed for feeding difficulties). Co-morbidities included prematurity and medication-controlled gastro-esophageal reflux disease (GERD). Prior to induction, the cuff of a new 4.5mm standard PVC ETT was briefly checked for patency, leaks, and pilot balloon and valve function. Following inhalational induction of general anesthesia with nitrous oxide and sevoflurane, a peripheral intravenous catheter was placed in the hand, and propofol and fentanyl were administered. Direct laryngoscopy with a Wisconsin blade size 1.5 revealed a grade 1 view, and the ETT was advanced into the trachea uneventfully and secured at 14.5 cm. The cuff was inflated with air, bilateral breath sounds and etCO₂ were confirmed, and mechanical ventilation was initiated in volume mode.

Approximately two minutes later, decreasing tidal volumes and increased flow requirements indicative of a moderate circuit leak were noted. Suspecting cuff underinflation, an additional 1 mL of air was added via the pilot valve, resulting in an even larger circuit leak. Conversely, removal of some air from the cuff resulted in a smaller leak. Due to suspicion of an ETT defect, the entire ETT was replaced, with improved circuit leak and ventilation parameters. The remainder of the anesthetic and surgery proceeded uneventfully.

Ex vivo, integrity of the cuff, pilot line, and pilot balloon of the original ETT was re-verified. Still suspecting an unidentified ETT defect, oxygen was then insufflated through the lumen of the ETT, while the ETT was suspended underwater. Copious bubbling revealed a large leak through the wall of the ETT at the location where the pilot inflation line joins the ETT.

Discussion: This unusual type of leak explains the counter-intuitive finding that increased cuff pressure resulted in increased measured leak in vivo; the improved tracheal seal led to increased pulmonary pressures, which then increased the air leak through the ETT defect.

Common causes of ETT leaks include: insufficient cuff inflation, undersized ETT, excessive peak airway pressures, and incompetent cuffs, pilot balloons, or inflation lines. Solutions to be considered include ETT replacement, oropharyngeal packing, and attempts to repair or compensate for the leak (e.g. jerry-rigging the pilot balloon with 3-way stop-cock, or continuous insufflation of the cuff to maintain pressure). Prevention requires careful pre-operative ETT inspection, and vigilant intra-operative leak and pressure monitoring.

This case illustrates the challenge presented by an unexpected failure of ETT integrity after tracheal intubation. Learning points include understanding the reasons for choosing cuffed ETTs, recognizing the common and uncommon causes of leaks, and developing strategies for diagnosing, solving, and preventing such device failures.

References:
Paravalvular Leak with Unusual Eccentric Jet Post Aortic Valve Replacement

Bradford Cardonell, MD, Xiaren Wu, MD, Joseph Stemm, MD, Barry Marks, DO
Department of Anesthesiology
Geisinger Medical Center, Danville PA

Introduction:
Paravalvular leak (PVL) has been shown to be present in up to 15% of elective valve replacements. It appears to be much less common with aortic valve replacement (AVR) occurring in only 1-3.5%.

Case Presentation
A 67-year-old male had new onset of dyspnea with exertion. A transthoracic echocardiography (TTE) revealed severe aortic stenosis with an area of 0.68 cm², peak velocity of 437 cm/sec, and a peak pressure gradient of 76.2 mmHg. A cardiac catheterization showed non-occlusive coronary artery disease and a highly calcified aorta, femoral arteries, and coronary arteries. He was subsequently scheduled for an AVR.

The procedure was performed with a tissue valve. An intraoperative transesophageal echocardiogram (TEE) on mid esophageal aortic long axis view revealed a brief and wide turbulence just proximal to the aortic prosthesis, extending from the anterior to posterior left ventricular outflow tract (LVOT). The rectangular turbulence band was limited to 2-3 cm under the aortic valve. The origin of this turbulence was not clear, and it was difficult to determine the jet’s speed and direction. However, on deep transgastric view there was a large diastolic jet that originated from the anterior aspect of the aortic root and traveled straight across the LVOT. The jet was then redirected by the posterior wall of the LVOT and anterior mitral leaflet towards the left ventricular apex. The PVL was assessed as severe, and surgical re-exploration and repair was performed. After resuming cardiopulmonary bypass (CPB), a small gap between the aortic valve ring and the aortic wall was found. An additional suture was placed. Surprisingly, the PVL on TEE remained similar, only slightly reduced in severity. The valve was again re-exposed and now replaced with a new valve of the same size sutured in the same fashion. Mild PVL was still noted with TEE, but with a different pattern, and clinically acceptable considering the risks of resuming CPB for a third time. Ten days after surgery, a follow-up TTE revealed that there was no significant aortic valve leak.

Discussion:
Significant regurgitation has been shown to be an independent risk factor for mortality. In most cases the PVL improves with time. If missed, a large PVL may result in heart failure, hemolytic anemia and increased risk of infective endocarditis. PVL is more common after a transcatheter aortic valve implantation. This type of PVL following AVR is rare, and its severity can be missed unless a thorough TEE is performed.

References:
Abstract 87

Case Report
Title: Targeting Opioid Induced Constipation with Peripherally Acting Mu-Receptor Antagonist Naloxegol

Authors: Christopher J Snell M.D. M.P.H., Anita Gupta D.O., PharmD, Mansoor Aman M.D.

Department and Institution: Division of Pain Medicine, Department of Anesthesiology and Perioperative Medicine, Drexel University College of Medicine

Introduction: Pain is the most common reason for people to seek medical care in the United States and affects approximately 100 million Americans, with associated costs of about $500 billion. Opioids have become an integral part of targeting pain, however with the high dosing often required to achieve goals of care many patients experience opioid induced constipation (OIC). Naloxegol pharmacologically is naloxone that is modified as a pegylated moiety, limiting its ability to penetrate the blood brain barrier.

Case Presentation: 62-year-old female with a history significant for lumbar spinal stenosis with degenerative spondylolisthesis was being managed on long-term opioid therapy. Her narcotic medications included a 75mcg Fentanyl patch, oxycodone IR 20mg Q4-6hrs PRN. Although her regimen adequately controlled her pain and improved functionality, she developed severe intractable opioid induced constipation (OIC) limiting her bowel movements to once a week despite her bowel regimen. The patient was resistant to initiating SCQ therapy and was started Lubiprostone 24mcg BID. Although she had moderate improvement in her OIC, she complained of severe nausea and was subsequently placed on Naloxegol 12.5 mg once daily. In follow up she reported improvement in frequency, straining, and consistency of her bowel movement without GI side effects.

Discussion: Naloxegol shows promise as being both convenient given its oral route, and rapidly effective alternative to current treatment options for OIC in chronic non-cancer pain patients.

References:
Abstract 89

Central ECMO Cannulation after Ischemic Muscular Ventricular Septal Rupture

Matthew Bell, MD, Theodore Cios, MD MPH, Srikantha Rao, MD MS
Department of Anesthesiology and Perioperative Medicine, Penn State Health, Hershey, PA

Introduction:
Post infarction muscular ventricular septal rupture (PI-VSD) is a rare complication of acute myocardial infarction (AMI) with an incidence as high as 2%. Up to 5% of mortality from AMI is attributable to PI-VSD and mortality is up to 90% within the first year if it remains untreated. Early surgical intervention between 9 and 18 days post VSD formation is preferred over delayed intervention. Aggressive supportive care is often required until surgery can be performed.

Case Description:
A 63 year old male suffered an anterior ST-elevation myocardial infarction, underwent PCI and echocardiography revealing a muscular ventricular septal(VS) rupture. He required vasopressors and an intra-aortic balloon pump. He was taken to the operating room for emergent placement of central veno-arterial extracorporeal membrane oxygenation (VA-ECMO). ECMO was successfully initiated, and the patient was returned to the ICU. Later that evening a massive thrombus formed in the ECMO circuit, which was emergently changed. The patient than became bradycardic, ACLS was initiated, echocardiography revealed possible right ventricular free wall rupture and the patient died.

Discussion:
PI-VSD occurs in 0.2% of AMI and results in left to right shunt with right ventricular volume and pressure overload. RV overload and decreased cardiac output will lead to impaired end organ perfusion and organ dysfunction. The role of mechanical circulatory support is controversial, but it has been reported as a bridge to definitive management. VA-ECMO can improve end organ perfusion, relieve the RV overload and allow time for definitive management. Anesthetic management of these patients occurs when they acutely decompensate, requiring mechanical circulatory support, or for definitive surgical management. The primary goals of anesthetic management are to decrease RV overload and to promote forward flow. Early intervention, including surgical or percutaneous procedures reduces mortality but it remains as high as 37% after treatment.

References:
Bleeding vs. Clotting: An Anticoagulation Challenge for Emergent Implantation of a Total Artificial Heart in a Patient with Heparin-Induced Thrombocytopenia

Natalia Martinez Acero MD, Y. Yuliana Salamanca-Padilla MD, Theodore J Cios MD, Behzad Soleimani MD, Dmitri Guvakov MD.

Department of Anesthesiology & Perioperative Medicine, Penn State Hershey Medical Center, Hershey, PA

Introduction: Heparin-induced thrombocytopenia (HIT) is a rare but life-threatening side effect of heparin, which presents a therapeutic challenge for patients requiring cardiac surgery. HIT is an immune-mediated disorder that occurs when IgG antibodies are produced against platelet factor 4-heparin complexes. There is no published literature that recommends anticoagulation for total artificial heart (TAH) implantation in the setting of HIT and renal failure, a surgery that by itself already carries a significant blood loss. We present a case report of a HIT patient in acute renal failure that successfully underwent urgent TAH implantation using tirofiban and unfractionated heparin for cardiopulmonary bypass (CPB).

Case Presentation: A 44-year old male with recently diagnosed non-ischemic cardiomyopathy (ejection fraction 15%) was admitted with a congestive heart failure exacerbation, unresponsive to medical management. The patient underwent insertion of a HeartWare left ventricular assist device (LVAD) with a post-operative course complicated by right ventricular failure, ischemic hepatitis, renal failure requiring continuous renal replacement therapy (CRRT), HIT, and thrombosis of the left ventricular inflow cannula. The surgery team decided to proceed with urgent implantation of a TAH. The patient was being anticoagulated with argatroban for HIT type II.

Intra-operatively the argatroban infusion was discontinued and a bolus of 10 mcg/kg of tirofiban was administered 10 minutes before cannulation for CPB. A tirofiban infusion was then started at 15 mcg/kg/min. Eight minutes later, a bolus of unfractionated heparin (300-400 U/kg) was administered for a target activated clotting time (ACT) goal >480 seconds for institution of CPB. Thromboelastography (TEG) and ACT were used intra-operatively to monitor anticoagulation. Total CPB time was 187 minutes. The tirofiban infusion was stopped 1 hour before separation from CPB.

After discontinuation of CPB, heparin was reversed with protamine and followed by transfusion of fresh frozen plasma, cryoprecipitate, platelets and a dose of prothrombin complex due to prolonged R time and reduced maximal amplitude in the TEG. Despite this, there was persistent bleeding requiring additional transfusion of blood products and administration of 4-factor PCC. Three hours after CPB, thrombus was finally seen in the operative field. Our patient further complicated with severe pulmonary edema, requiring veno-veno extracorporeal membrane oxygenation (ECMO). The patient was transferred post-operatively to the ICU on high-dose pressor support and with an open chest. The patient had complete recovery of neurological function and was decannulated from ECMO a few days later, but required a prolonged ICU stay with persistent need for CRRT and with ventilator-dependent respiratory failure (VDRF).

Discussion: No single agent fulfills all of the criteria for an ideal anticoagulant for CPB, except for heparin. Argatroban and bivalirudin can increase the risk of thrombosis of the CPB machine, while lepirudin and danaparoid can lead to massive bleeding. Tirofiban, a GPIIb-IIIa platelet inhibitor (4-8 hour effect) with biliary elimination (70%) offered the best pharmacologic profile for our patient (adequate platelet inhibition prior to heparin use in HIT without a prolonged half life secondary to renal failure). Despite using the agent we considered would have the least side effects, we encountered major complications such as severe bleeding, massive transfusion leading to severe pulmonary edema requiring V-V ECMO, and VDRF.

References:
Abstract 100

Misadventures of a Retrograde Cardioplegia Catheter
Corey R Herman, Baskaran Sundaram, Jordan E Goldhammer
Sidney Kimmel Medical College at Thomas Jefferson University Hospital

Introduction:
There are many potential complications of insertion of a retrograde cardioplegia catheter. We report a previously not described inadvertent placement of a retrograde coronary sinus (CS) catheter from the right atrium into the left atrium through a small inferior sinus venosus defect (SVD).

Case Report:
A 47 year old male was transferred to our institution with symptoms concerning for a CVA. Preoperative TEE revealed a trileaflet AV with a mobile, linear echodensity prolapsing into the LVOT and moderate AI. Cardiac catheterization revealed 100% occlusion of the LAD and 40% occlusion of the Cx. AV mass excision and two-vessel CABG was planned. Intra-operative TEE confirmed no ASD or PFO by 2D exam or with color Doppler flow. Median sternotomy, dissection of the LIMA and placement of arterial and venous cannulas were completed without complication. Continuous TEE monitoring was used to visualize a 12Fr CS catheter enter the coronary sinus and disappear from the 4CME view. When catheter position was interrogated using a 2CME, it was noted that the CS catheter had entered the LA and was directly abutting the MV hindering trans-mitral flow. (Image 1) The catheter was immediately removed and subsequent color flow Doppler across the inter-atrial septum and bubble study failed to identify a defect in the septum. No CS injury was detected by manual inspection of the surgical field or TEE and a second attempt at cannulating the CS was successful. CPB was initiated and an AV replacement and two-vessel CABG was completed uneventfully. A subsequent review of preoperative imaging revealed no pre-existing CS variation; however, a contrast enhanced CT from five years prior revealed a small inferior SVD. The patient was discharged on post-operative day#12 and remained free of vascular embolic events at 6 month follow-up.

Discussion:
Retrograde cardioplegia administration through the CS may be necessary to obtain sufficient myocardial protection in cases of high-grade coronary artery stenosis in the absence of adequate collateralization or significant AI. The decision for cannulation is not without risk as there is potential for trauma to the CS. Certain anatomical variations may make CS cannulation difficult and the presence of an ASD or unroofed CS can also facilitate an incorrect passage for a CS catheter. SVDs are types of ASDs located in the wall that separates the LA from the SVC or IVC. An inferior type SVD is located 1-2cm posterior to the CS ostium and could easily be the site of entry for a misplaced CS catheter. A previously undiagnosed inferior SVD was the likely conduit for a CS catheter to cross into the LA. In the absence of thorough CS interrogation with TEE, the likelihood of injury to the LA and mitral apparatus along with ineffective myocardial protection would have been inevitable. All retrograde CS cannulation should be under direct TEE guidance followed by mandatory confirmation of proper placement in additional views.

References:

Figure 1: 2CME View. Coronary sinus catheter in the left atrium with balloon at the level of the mitral annulus. LA=left atrium, LV=left ventricle, MV=mitral valve, CSC=coronary sinus catheter