Case-Based Learning Discussion (CBLD) for Anesthesia

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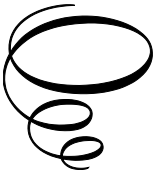
Edited by

Stacey Watt

Cambridge Scholars Publishing



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CHAPTER ONE

INTRODUCTION TO CASE-BASED LEARNING

TOPIC: THE IMPORTANCE OF CASE-BASED LEARNING: HOW WE CAN LEARN TOGETHER!

STACEY WATT, MD, MBA, MHPE, FASA

The use of case-based learning began as a method of teaching in the mid-1960s at McMaster University. This method of instruction spread quickly throughout the medical community and soon became a staple within medical education. In contrast to traditional instruction, case-based discussions are learner-centered in the context of a case or problem that requires resolution. In challenging the learners to solve open-ended and sometimes difficult questions, the participants must engage in active learning together with other participants to find a solution. Discussions are facilitated by a faculty member (or more advanced learner) who guides the discussion while ensuring all voices are heard.

The essential elements of a case-based learning activities are small groups and guidance by a faculty member or advanced learner skilled at facilitating active learning discussions. Groups of between five and ten often provide a manageable number of learners to ensure active communication, but not so many as to inhibit some participants from engaging in the discussion. The faculty member facilitating the case-based learning activity should have experience in moderating active learning sessions. Since case-based learning is not a teacher-centered platform of learning, in which the faculty member lectures on a topic and the learners are often passive recipients, the faculty member must learn to guide discussions through listening and questioning.

To set up a successful case-based learning discussion (CBLD) session, the writer must pay close attention to the objectives of the CBLD activity in addition to the scenario that will be described to the learners. What key

objectives do you want your learners to take away from the session? This step should be the first of writing a CBLD and should take the most time. Objectives that start with active words such as "list, compare, differentiate, demonstrate, explain, identify, or locate" are great examples of successful objectives. Objectives that convey a vague knowledge of the topic, such as "know" or "understand," should be avoided.

The next step, after writing objectives, is to design the scenario of the CBLD. How will the problem the learners need to solve emerge through the scene you describe? The scenario should be interesting and provide multiple avenues for conversation. Try to avoid obvious or easy scenarios. The goal is to challenge your learners to think through the case with which they are presented. Remember to include some guiding questions within your case discussion. Choose questions that will stimulate your learners to ask more questions or clarify the ideas and plans they discuss during the CBLD. Guiding questions can be included or withheld from the CBLD scenario that is shared with the learners prior to the activity. Some moderators like to have the learners think about questions before the session, while others choose to leave the guiding questions for the discussion itself to help move the discussion forward. After you have written the objectives and case scenario, do some further research regarding the topic to ensure you are able to successfully guide a discussion through the stages of discovery as the case evolves. Once you and the learners are prepared for an active discussion, the CBLD activity can commence.

As you sit your group down for the discussion, it is important to revisit the learning objectives and unofficial rules of the CBLD. The unofficial rules are to be respectful to all learners involved within the activity; to allow everyone to join in the conversation; and to encourage the sharing of ideas and asking of questions. Once you have set forth the ground rules you can introduce the case. The best way to warm up the CBLD group is to start with a simple question. From that point on, the moderator's job is to keep the conversation moving and not to lecture the learners about the topic material. It is important for the moderator to not monopolize the conversation but serve as a catalyst for conversations between the learners.

CBLD activities should take approximately forty-five minutes to one hour to complete. After the activity concludes, take a minute to debrief and ask how the learners responded to the activity. You can also ask them to provide feedback on how to improve the CBLD or ask what questions they would include in the discussion the next time the session is given. Feedback is valuable for not only the other learners but also to the moderator.

We hope that by reading this book you will be inspired to include case-based learning in your educational tool belt. Use these cases as an introduction to case-based learning but be encouraged to go forth and create your own CBLDs and even join the ranks of CBLD moderators!

CHAPTER TWO

TRAUMA

TOPIC: TRAUMA: AN ANESTHESIOLOGIST'S APPROACH TO PATIENTS WITH TRAUMATIC INJURIES

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ANU MAHAT, MD,
PRABHDEEP SINGH, MD,
SANGEETHA KAMATH, MD

Objectives

1. How to perform an initial trauma assessment. Learners will be able to list and understand the components of the primary and secondary surveys.
2. Demonstrate an understanding of application and interpretation of the Glasgow Coma Scale
3. Demonstrate the role of POCUS in preoperative assessment in polytrauma patient.
4. Understand the management of hemorrhagic shock and its pre-, intra, and perioperative implications – brief overview of massive transfusion protocols and TEG
5. trauma
6. Understanding the sequelae and intraoperative interventions of acute hemorrhagic shock

Background

A 56-year-old, 70 kg unknown male was brought into the emergency department by ambulance after being found near a subway train. (Aside: Was he on the tracks?) On initial report, he had an obviously deformed right lower extremity with a tourniquet applied above a severed right foot. His right hip was shortened and externally rotated. His pelvis was unstable with notable bruising. He was minimally responsive with one pupil dilated more

than the other. On auscultation he had decreased breath sounds on the right lung, with bruising noted on the right chest wall.

Vital signs: HR 146

BP 72/46

RR 30

Oxygen saturation 84% on face mask with 8L/min supplemental O2

Past Medical History: (Aside: How did you get this history?) Hypertension, alcohol use

Allergies: None

Past Surgical History: (Aside: How did you get this history?) appendectomy at the age of 26

Physical Exam:

General: ill-appearing middle aged male

CVS: tachycardic, thready pulse, capillary refill > 3s; otherwise, unremarkable

Respiratory: decreased breath sounds on right side

Abdominal: suprapubic tenderness to palpation, positive rebound tenderness

Extremities and Pulses: tourniquet applied to right lower extremity

Laboratory Findings

Hemoglobin: 16 g/dLSodium: 146

Hematocrit: 45 Potassium: 4.7

Platelets: 152BUN: 38

Complete blood count: 13.8

Creatinine: 0.9

Guiding Questions

1. What is your initial approach as you arrive in the emergency room?
2. What POCUS adjuncts could you use in the emergency room for quick assessment of potentially other life-threatening injuries?
3. How would you approach this patient's Glasgow Coma Scale?
4. Based on his seemingly large volume blood loss, tachycardia and hypotension, how do you plan to manage his hemorrhagic shock?
5. How would you prepare the operating room and what are your intraoperative concerns?

Discussion

In 2021, trauma was the leading cause of death of individuals under the age of 45 years old, accounting for more than 220,000 deaths. Trauma remains an important public health concern due to the associated morbidity, mortality and economic burden. Management of polytrauma patients has advanced and improved over the last few decades with a better understanding of the pathophysiology of shock, resuscitation, and hemodynamic changes. Anesthesia and application of anesthetic principles have consequently evolved and can be applied in polytrauma patients throughout their journey of treatment although the anesthetic management of a trauma patient is an art rather than a science.

1. What is your initial approach as you arrive in the emergency room?

Trauma assessments begin long before arrival to the hospital. The first responder carries invaluable insight for future management decisions. Emergency medical personnel gather information including mechanism of injury, initial and ongoing vital signs, any treatment started in the field and past medical history that they may have retrieved from others at the scene.

In preparation for receiving a trauma patient, health care providers should prepare all essential equipment. This includes airway management devices, intravenous and/or arterial access devices, monitoring devices, and medications. More sophisticated equipment such as ultrasound devices and portable X-ray equipment should also be available. A simple stethoscope is an oft forgotten critical piece of equipment.

Upon arrival to the emergency room

The emergency medical personnel will endorse all pertinent information about the patient and the events surrounding the trauma. The American

College of Surgeons developed the Advanced Trauma Life Support which is globally implemented and identifies the most life-threatening injuries and allows the assessing trauma team to treat the trauma patient in a systematic way.

The components include ABCDE: Airway, Breathing, Circulation, Disability and Exposure.

A: Airway with cervical spine protection
B: Breathing and Ventilation
C: Circulation and Control of Bleeding
D: Disability / Assessment of Neurological Status
E: Exposure

Some injuries that may be identified during a primary survey include tension pneumothorax, airway obstruction, open pneumothorax, flail chest, cardiac tamponade, massive hemothorax and flail chest.

Adjuncts to the Primary Survey

- ECG is used to evaluate arrhythmias, ST elevation, pulseless electrical activity and cardiac tamponade
- Chest Xray can determine presence of a pneumothorax, hemothorax or suspected aortic injury
- FAST exam identifies free fluid in the abdomen, or pericardial fluid indicative of effusion and/or cardiac tamponade
- Urinary catheters can provide information as well as guide fluid resuscitation
- Gastric catheters can decompress the stomach, thereby reducing the risk of aspiration
- Pelvic Xray identifies pelvic fractures; Pelvic binders are placed in attempt to tamponade massive bleeding from a significant pelvic fracture.

2. How can Point-of-Care Ultrasound enhance the trauma assessment?

POCUS in the Trauma Bay

Point-of-care ultrasonography (POCUS) is an invaluable assessment tool used to quickly determine preliminary diagnostic information as early as upon arrival to the emergency room and can also be used in the operating room. It is now a standard of care in the evaluation in the trauma patient.

Historically, ultrasound was first used in Europe to detect intraperitoneal fluid. Fast forward to present day trauma evaluations and management, POCUS allows advanced vascular access, peripheral nerve blockade, cardiac and neurologic assessments, airway, lung and gastric evaluations. For an anesthesiologist, this gives an immense insight into planning and execution of airway and intraoperative management of the trauma patient.

The FAST exam looks for free fluid in the intraperitoneal and thoracic cavities, using ultrasound to image 4 standard views:

- Right upper quadrant
- Subxiphoid
- Left upper quadrant
- Left paracolic gutter

The use of the FAST exam has improved the ability to predict definitive operative intervention and reduced time for disposition. A Meta-analysis of 11 studies demonstrated that the sensitivity for detection of any amount of free fluid by ultrasound was 90%, and the specificity was 98%. This is especially useful in young patients who can maintain hemodynamic stability on initial presentation but will likely require operative intervention due to significant injuries.

Assessing cardiac function is also an invaluable asset to an anesthesiologist in the management of the trauma patient, and a bedside cardiac POCUS has been shown to be comparable to a formal echocardiogram. It can diagnose and ascertain shock, distinguishing between cardiac and obstructive shock, assessing dynamic volume status by looking at the diameter of the inferior vena cava and evaluate the function of the left ventricle.

The gastric ultrasound proves its worth in the trauma assessment as aspiration risk in these patients can be high due to an unknown fasting status and in a patient with a depressed level of consciousness that cannot provide last NPO time. It has the benefit of distinguishing between solid and liquid contents and can provide estimation of gastric volumes. If fluid is noted within the gastric antrum in either the supine or right lateral decubitus positions, these patients can be considered a “full stomach” and considerations for anesthetic techniques such as RSI, possible regional anesthesia if appropriate and addition of chemical aspiration prophylaxis is warranted.

3. How is the Glasgow Coma Scale used?

Glasgow Coma Scale is a well-known trauma score and has been studied as a predictor of outcomes in traumatic brain injury patients. Use is limited in patients under the influence of alcohol and illicit drugs, eye injuries and already ventilated patients. There is also wide inter-observer variability, nonetheless it is a commonly relied upon assessment for decision making of further imaging, providing definitive airway intervention and possible neurosurgical intervention.

Disability in the primary survey is assessed by The Glasgow Coma scale. It is a measure of the patient's level of consciousness and has developed over the years as a predictor of patient outcomes. It is a tool that should be continually reassessed, especially in the setting of trauma. There is a triple scoring system:

- Best eye opening (maximum 4 points)
- Best verbal response (maximum 5 points)
- Best motor response (maximum 6 points)

Glasgow Coma Scale

Best eye response (E)	Spontaneous – open with blinking at baseline	4
	Opens to verbal command, speech, or shout	3
	Opens to pain, not applied to face	2
	None	1
Best verbal response (V)	Oriented	5
	Confused conversation, but able to answer questions	4
	Inappropriate responses, words discernible	3
	Incomprehensible speech	2
	None	1
Best motor response (M)	Obeys commands for movement	6
	Purposeful movement to painful stimulus	5
	Withdraws from pain	4
	Abnormal (spastic) flexion, decorticate posture	3
	Extensor (rigid) response, decerebrate posture	2
	None	1

Adapted from Nurse's knowledge and practice in the application of the Glasgow Coma Scale in the Intensive Care units and Emergency Department at Muhimbili at National Hospitaland Muhimbili Orthopedic Institute.

There is a maximum score of 15. If GCS is deemed to be < 8, this may be indicative of a patient's inability to protect their own airway, increase

chances of aspiration and hypoxia, therefore a definitive airway is warranted.

Pupillary size and lateralizing signs are assessed on a continuous basis, especially when there is evidence of head injury and possibility of worsening neurological status.

4. Based on his seemingly large volume blood loss, tachycardia and hypotension, how do you plan to manage his hemorrhagic shock? How do you Navigate Coagulopathy in the setting of Trauma?

Coagulopathy induced by trauma, affects approximately one-third of patients after trauma. Acute traumatic coagulopathy can increase morbidity and mortality and deserves special consideration by the anesthesiologist to improve patient outcomes. It is an endogenous hyper coagulopathy seen within 1hr of the trauma. Understanding the pathophysiology of normal coagulation is useful in combating a coagulopathic patient.

In brevity, normal hemostasis involves four steps:

- Initiation
- Amplification
- Propagation
- Inactivation

Hemostasis is a dynamic process that balances pro- and anticoagulation and fibrinolytic (favoring clot formation) and fibrinolysis (clot breakdown) pathways. Interactions occur between clotting factors, platelets, endothelial cell walls and other important mediators of coagulation including endothelial receptors, tissue factor pathway inhibitors, nitric oxide and tissue plasminogen activator.

The classical factors, otherwise known as “The Lethal Triad”, hypothermia, hemodilution coagulopathy and acidosis were triggers of the trauma induced coagulopathy, however it has been found that the coagulopathy associated with trauma begins in the early stages of trauma even before any medical intervention.

With major blood loss, hemorrhagic shock ensues, inadequate tissue oxygenation activates anerobic metabolism and creates metabolic acidosis. Plasma proteins such as fibrinogen, and all the clotting factors are compromised as pH levels decrease. Trauma can also cause heat loss via reduced heat production and aggressive resuscitation efforts. Platelet

function and clotting factor activity will start to decline at temperatures less than 36 degrees C and worsens dramatically at temperatures less than 33 degrees C.

Early identification of coagulopathy is important and can lead to an overall improved outcome. Traditional clotting tests, the prothrombin time (PT) and activated prothrombin time (aPTT), INR, platelet count, fibrinogen levels are the most used in the evaluation of coagulation. In more recent developments, thromboelastography has been introduced to better identify coagulopathy, with additional benefit of identifying the stage, type and which coagulation factor level has been affected most. Additionally, the thromboelastogram can prevent inappropriate transfusion of blood products, as you can tailor your approach to transfusion according to the reduced actors that are identified.

Massive transfusion protocol entails replacing the patient's total blood volume (>10 units of packed red blood cells) in 24 hours. It is typically activated in any 1) penetrating trauma, 2) positive FAST Exam 3) arrival systolic blood pressure of < 90 mmHg and 4) tachycardia on admission.

Quick tips for management of the trauma patient in hemorrhagic shock:

- Premedication is generally not indicated, as narcotics and sedatives could worsen an already hemodynamically unstable patient
- Patients with ongoing hemorrhage, should have definitive management of control of bleeding as soon as possible
- Initial resuscitation should aim to restore intravascular volume with crystalloids and blood products to maintain oxygen delivery and tissue perfusion
- Tranexamic acid can be administered at a loading dose of 1g infused over 10 minutes, followed by intravenous infusion 1g over 8 hours
- Massive transfusion protocol can be implemented in the event of major blood loss and ensuing hemorrhagic shock
- FFP/Platelets/Red Blood Cells should be replaced in a 1:1:1 or 1:1:2 ratio
- Permissive hypotension is recommended to limit further blood loss
- Isotonic crystalloids as well as vasopressor support is warranted to maintain perfusion goals
- Try to maintain normothermia
- Acid-base balance should be closely monitored; supplemental sodium bicarbonate should not be arbitrarily administered based on

a number, however persistent metabolic acidosis should ne treated, especially in the setting of renal failure or severe muscle injury
- Calcium levels should be checked and maintained within normal reference ranges
- If, thromboelastogram is not available, the threshold for fibrinogen replacement is evidence of disseminated intravascular coagulopathy, fibrinogen < 150 mg/dL; initial dose is 3 – 4 g or 50 mg/kg.
- Platelet transfusion is recommended in the case of history or documentation of platelet dysfunction, and in patients with continuous bleeding, who were previously on platelet inhibitors.

5. How would you prepare the operating room and what are your intraoperative concerns?

Postoperative Care

Most trauma patients who have required management of hemorrhagic shock, major intrabdominal or intrathoracic repairs, acid-base disorders and coagulopathy correction, will need to be monitored postoperatively in an intensive care setting. Hemodynamic monitoring and mechanical ventilation, close urine output monitoring and in undoubtedly more fluid resuscitation may be necessary in the immediate postoperative period.

This should be carried out in a setting where the invasive lines, monitoring and one-to-one nursing can be achieved. The postoperative course can be as equally challenging as the intraoperative course and, using all resources and personnel necessary to maintain continuity of care is as equally important.

Take Home Points

- Anesthetic management of the trauma patient, although urgent and emergent should be carefully thought out and comprehensively approached from all aspects.
- Consideration for the pre-arrival events will assist in planning for execution of a well thought out anesthetic intraoperative and postoperative plan.
- Glasgow Coma Scale should always be closely monitored and documented on a continuous basis in order to implement appropriate management.
- Point of Care Ultrasound has become a vital part of trauma assessment and can improve time to definitive intervention of traumatic injuries.

- Hemorrhagic shock, coagulopathy, acidosis and hypothermia should be treated in a timely manner to avoid irrevocable injury and complications. Intraoperative strategies as well as a continued postoperative resuscitation are equally important.

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CHAPTER THREE

ACUTE AND CHRONIC PAIN

TOPIC: MEDICATIONS FOR OPIOID USE DISORDER AND THE PERIOPERATIVE PATIENT: MANAGEMENT OF BUPRENORPHINE, NALTREXONE AND METHADONE

ALOPI PATEL, M.D.

Objectives

- Identify the characteristics of buprenorphine that can affect perioperative pain management
- Develop an anesthetic plan for patients on medications for opioid use disorder
- Develop a pre-procedure screening and medication management plan for patients taking buprenorphine, methadone or naltrexone

Background

A 35-year-old, 70 kg male presents for an urgent tibia and fibula open reduction internal fixation after falling while ice skating. His medical history is significant for a history of prescription pill abuse. He states he was initially prescribed oxycodone for post-operative pain control after a lumbar discectomy at the L3-L4 level in 2017. He states he became addicted and sought out street oxycodone to get his 'fix'. He states he eventually went to an addiction specialist after his opioid addiction started interfering with his professional and personal life. He is now on a medication assisted treatment program that utilizes buprenorphine 12mg-naloxone 3mg in a sublingual form. He takes it regularly and his last dose was yesterday.

Vital signs: HR 90

BP 105/64

RR 22

T 36.8°C

Past Medical History: Opioid Use Disorder, Anxiety, Depression

Past Surgical History: None

Physical Examination: Weight 74 kg

Guiding Questions

1. What are the characteristics of the buprenorphine-naloxone sublingual film vs. buprenorphine tablet vs Buprenorphine patch?
2. How will the use of this medication change your anesthetic management?
3. What opioid requirements do you expect for this patient?
4. Where should this patient go post-operatively? PACU? Floor bed? Step-down? ICU?
5. When should the buprenorphine be re-started?
6. How can you maximize pain control in this patient?
7. If this patient had been on naltrexone, what concerns would you have with a recent naltrexone injection versus after one that was administered over two weeks ago?
8. What would be your concerns if this patient had a pre-existing subcutaneous naltrexone implant that was placed one month ago?

Discussion

Buprenorphine

1. What are the characteristics of the buprenorphine-naloxone sublingual film vs. buprenorphine tablet vs Buprenorphine patch?

Most medication-assisted treatment (MAT) programs for patients with opioid use disorder (OUD) consist of either buprenorphine, naltrexone or methadone. Buprenorphine has been available since the 1970's but since the Drug Addiction Treatment Act of 2000 was passed, buprenorphine is now available in the sublingual form for outpatient opioid detoxification, addiction management and chronic pain management.

Buprenorphine is a mu opioid receptor partial agonist that binds with high affinity to the mu receptor. It is also a weak kappa and delta receptor antagonist. As a partial mu agonist, buprenorphine binds tightly to the mu receptor but cannot impart the complete effect of a full mu agonist. Even at

maximal receptor occupancy, it will only impart a partial mu agonism effect. Due to this partial agonism, as the dose of buprenorphine increases, the respiratory effects reach a plateau, making it an ideal medication for those with opioid abuse.

Buprenorphine is available in several different formulations with and without naloxone. Suboxone® is a buprenorphine-naloxone formulation that is combined in a 4:1 ratio, respectively. Naloxone is added to this specific formulation due to its pure opioid antagonism effects at the mu receptor. Naloxone has a high affinity for the mu receptor but has poor bioavailability when taken orally. However when injected, naloxone exhibits its full mu antagonism effects negating any mu receptor agonism. Buprenorphine can also be used for MAT without naloxone. Other formulations of buprenorphine include a tablet form (Subutex®) and a patch form (Butrans®).

Adverse effects of buprenorphine are similar to those of full mu agonists such as nausea, vomiting, drowsiness, cognitive changes, urinary retention and more. Buprenorphine alone can cause respiratory depression especially in patients concomitantly utilizing benzodiazepines, alcohol or other sedatives. Respiratory depression is less common with the buprenorphine-naloxone combination due to a ceiling effect. Naloxone in the buprenorphine-naloxone formulation can induce withdrawal symptoms in patients who are addicted to opioids.

It is important to consider interactions of medications with buprenorphine whether it is with naloxone or not. The sedating effect of buprenorphine is synergistic with other sedating medications such as opioids, benzodiazepines, antihistamines and antipsychotics increasing the risk of respiratory depression. CYP3A4 inhibitors such as ketoconazole may increase buprenorphine concentration. CYP3A4 inducers can decrease the concentration of buprenorphine. Use of buprenorphine with serotonergic medications may cause serotonin syndrome. Chronic use of opioids may influence the hypothalamic-pituitary-gonadal axis, leading to androgen deficiency that may manifest as low libido, impotence, erectile dysfunction, amenorrhea, or infertility.

Buprenorphine, when administered sublingually or via the buccal route, has higher bioavailability than naloxone. Naloxone essentially has no bioavailability in the sublingual formulation unless it is abused and injected intravenously. Buprenorphine is metabolized and eliminated in urine and feces. Naloxone undergoes metabolism as well in a similar manner.

Buprenorphine has a mean elimination half-life ranging from 24-42 hours. Naloxone has a mean elimination life of 2 to 12 hours. The high receptor binding affinity, long half-life, and partial agonism of mu receptors may inhibit the analgesic potency of opioids causing potentially uncontrolled postoperative pain.

2. How will the use of this medication change your anesthetic management?

There is no consensus or high-level evidence on optimal acute pain management strategies for patients taking buprenorphine formulations. However, it is important to note that abrupt discontinuation of buprenorphine can precipitate relapse in a patient with OUD. Other intraoperative concerns include opioid withdrawal with abrupt discontinuation of buprenorphine.

3. What opioid requirements do you expect for this patient?

Traditionally, most institutional protocols previously suggested discontinuing buprenorphine anywhere from 3-5 days prior to elective surgery with severe pain anticipated post operatively. There is increasing concern that the OUD patient has considerable risk of cravings and potential relapse in the perioperative setting due to cessation of buprenorphine. To address this growing concern, multidisciplinary teams with psychiatrists and addiction medicine specialists have proposed new recommendations for patients using buprenorphine for the diagnosis of OUD. There is growing evidence that low dose buprenorphine could be continued in the perioperative period with concomitant full mu agonists without a detrimental effect on pain control. Furthermore, there may be a benefit of low dose buprenorphine providing synergistic analgesia in the perioperative setting.

With increasing evidence, the decision to continue, decrease or stop buprenorphine seems to be multifactorial and a decision that needs to be made in conjunction with the patient, surgeon, anesthesiologist and primary prescriber. There is a significant increase in mortality within the first 4 weeks after cessation in buprenorphine due to relapse regardless for what reason the buprenorphine was stopped. Patients with concomitant history of depression, anxiety, or substance abuse are at the highest risk. Discontinuing buprenorphine, regardless of whether in the perioperative period, can lead to relapse in 50% of patients.

Suggested recommendations can be stratified based on buprenorphine dose as well as severity of postoperative pain. The Mass General Department of Anesthesia recently published their institutional guidelines for perioperative buprenorphine management in which they recommend continuing

buprenorphine in the perioperative setting for all mild pain surgeries as well as for moderate to severe pain surgeries if buprenorphine dose is less than 16 mg daily. If the buprenorphine dose is greater than 16mg then they recommend titrating down to 16mg daily on the day before surgery and subsequently to 8mg on day of surgery as well as in the acute postoperative period. Once surgical pain has subsided, all full mu agonists can be tapered off and the patient can resume the home buprenorphine dose.

Furthermore, it is recommended for the perioperative team to be in close communication with the buprenorphine provider to reach a consensus on management. If addiction consult service is available then they should be available to support patients post-operatively. Upon discharge, the patient should have an appointment with a buprenorphine provider along with a handoff of the postdischarge plan. All non-opioid multimodal medications should be continued as necessary in the postoperative and postdischarge period.

Intraoperative anesthetic management for patients on buprenorphine formulations that have not been decreased or stopped for an adequate period of time should implement maximal multimodal strategies for pain control. It is prudent for the team to consult the acute pain service even prior to entering the OR if it is feasible. The use of non-opioid analgesics such as ketamine, gabapentinoids, NSAIDs, COX-2 inhibitors, alpha-2 agonists and acetaminophen should be maximized pre- and post-operatively depending on patient comorbidities. Continuous regional anesthetic techniques should also be considered if compatible with surgical interventions such as epidural catheters or peripheral nerve catheters. Ketamine and/or lidocaine infusions can also be considered for intraoperative pain control. If delaying surgery is an option, the benefits of delaying surgery for patient optimization should be discussed with the surgery team.

4. Where should this patient go post-operatively? PACU? Floor bed? Step-down? ICU?

Post-operatively, the acute pain service should follow these patients closely. It is also recommended for the patient to be monitored in the ICU or stepdown unit if there is a need for ongoing fentanyl or other short-acting opioid infusion to maintain pain control and to avoid opioid withdrawal. If buprenorphine has been suddenly stopped, this period of time is critical as patients have a precarious balance of ongoing opioids (i.e. fentanyl infusion) and declining buprenorphine levels which place the patient at risk of opioid overdose if the opioids are not tapered sufficiently to keep up with declining

buprenorphine levels. It is also recommended to avoid use of long-acting opioids due to unpredictable response to declining buprenorphine levels. It is prudent to continue pain control with multimodal medications and short acting full mu agonist opioids with high binding affinity such as hydromorphone via PCA or fentanyl IV infusion or PCA. There are no consensus guidelines or high level of evidence research studies that advocate the use of IV PCA vs IV infusion. These decisions should be made by the acute pain service in conjunction with the primary team as deemed appropriate for the patient.

Pain management in the chronic buprenorphine user can be further complicated by the phenomenon of opioid-induced hyperalgesia (OIH). OIH is a phenomenon in which a patient on chronic opioid therapy has increased sensitivity to painful and non-painful stimuli as a consequence of chronic opioid exposure. Opioid tolerance in patients can often be overcome by higher doses of opioids, however escalating opioids in the patient with OIH can often worsen pain. It is difficult to diagnose opioid tolerance versus OIH in the acute clinical setting, especially in patients on buprenorphine therapy.

1. When should the buprenorphine be re-started?
2. How can you maximize pain control in this patient?

In addition to difficulty with pain management in patients on MAT, it is also important to consider that they are at high risk of relapse. When possible, for elective surgeries with low to even moderate levels of expected pain, it is prudent to continue chronic buprenorphine therapy to avoid risk of relapse. However, if buprenorphine is stopped for any period of time there must be a multi-disciplinary effort to provide adequate pain relief and resume buprenorphine therapy as soon as possible.

Naltrexone

5. If this patient had been on naltrexone, what concerns would you have with a recent naltrexone injection versus after one that was administered over two weeks ago?

In addition to buprenorphine, naltrexone is used for management of several types of addictions including opioid and alcohol addiction. Its mechanism of action is by reversibly blocking opioid receptors and weakening effects of opioids. Although the mechanism of action for the treatment of other types of addictions is not fully understood, it is likely due to modulation of the dopaminergic reward pathways. It is used to decrease cravings and use

of opioids and therefore decrease the risk of overdose even if patients were to use opioids. It is often given once per month intramuscularly (IM) resulting in much better compliance of MAT than many other oral regimens. Other routes of administration include oral tablet form and a subcutaneous implant.

6. What would be your concerns if this patient had a pre-existing subcutaneous naltrexone implant that was placed one month ago?

Oral naltrexone can be stopped approximately 3-5 days prior to anticipated surgery. Perioperative pain management may be challenging depending on when the last dose of naltrexone IM was administered. If naltrexone is at peak levels shortly after the IM dose, then a degree of resistance to opioid analgesics should be expected and treated with higher doses of opioids as well as maximal multimodal medications. If the patient presents in the second half of the month after the last IM dose, it is possible that the naltrexone levels are declining and therefore patients may be at risk of sensitivity to opioids. If a pre-existing implant is already in place, it is best to not remove it and proceed with maximal multimodal medication management for pain control. Higher doses of opioids may be required for pain control in patients with naltrexone implant however removal is not advised due to variable levels of naltrexone levels after removal.

Methadone

Methadone is a full mu receptor agonist with significant analgesic properties and should be continued in the perioperative setting. Abrupt discontinuation of methadone can cause opioid withdrawal and place the patient at risk for relapse. Optimal perioperative pain control for patients on methadone includes use of short-acting opioid agonists, multimodal analgesic adjuncts, regional anesthesia, neuraxial anesthesia and other non-opioid interventions including complementary therapies if available.

Take Home Points

- Pain management in the perioperative setting is challenging in the patient on medication assisted treatments therefore multimodal medications and regional anesthesia should be optimized for all patients.
- The Substance Abuse and Mental Health Services Administration (SAMHSA) recommends that each provider individually assess each patient when considering to continue or discontinue buprenorphine in situations where moderate to severe pain is anticipated.