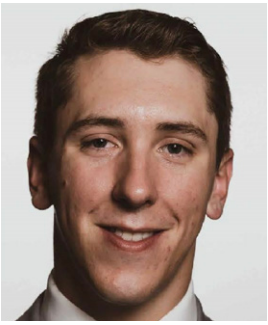
SCIENCE AND TECHNOLOGY

Trauma Surgery: Exploratory Laparotomy/ Hemicraniectomy/ Thoracotomy



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OVERVIEW OF TRAUMA

Trauma

Trauma occurs unexpectedly and is a significant contributor to morbidity and mortality across all age groups, ranking as a leading cause of death among both the young and elderly (Butterworth, Mackey, & Wasnick, 2018, p. 820). Trauma management involves complex procedures, as illustrated in the case discussed below.

Recovery from trauma entails a comprehensive process for the patient. Trauma patients' care begins upon the arrival of Emergency Medical Services (EMS) at the scene, followed by transportation to the hospital. Upon hospital arrival, resuscitation begins promptly, leading to surgical intervention. Post-surgery, the patient often recovers in the intensive care unit and then proceeds to months of rehabilitation (Butterworth, et al., 2018, p. 820).

Trauma: Exploratory Laparotomy

One of the most common surgeries performed for trauma patients is exploratory laparotomy (ex-lap). This surgery addresses abdominal trauma or any acute conditions within the abdominal cavity (Jaffe, Schmiesing, & Golianu, 2020, p. 709). The ex-lap surgery begins with a large midline abdominal incision, followed by the surgeon exploring the four abdominal quadrants. During this process, biopsies may be taken from the liver (Jaffe, et al., 2018, p. 709). The primary goal of the ex-lap procedure is to identify, localize, and cease bleeding to restore hemodynamic stability. It is essential to note that before further assessment of patient stability, the surgical team addresses vascular trauma while

the anesthesia care team manages hypovolemia, aiming to restore the patient to normovolemia.

In the anesthetic management of trauma ex-lap, the provider must handle numerous tasks, requiring a team-based approach to ensure patient safety during surgery. One key task for the anesthesia provider is to secure and manage the airway. However, it is important to note that patients with significant trauma often require intubation in the field or emergency department before arriving in the operating room (Butterworth, et al., 2018, p. 820). If the patient is not intubated in the field, the anesthesia provider meets the patient in the trauma bay, working with the surgeon and emergency department to assess the current status and develop an action plan for the operating room. The physician addresses three critical aspects of airway management: evaluating the trauma patient with basic life support intervention, presuming the presence of a cervical spine cord injury, and addressing potential failed endotracheal tube placement (Butterworth, et al., 2018, p. 821).

For the anesthesia technologists, it is pivotal to be familiar with common airway assessment tests and results, as this knowledge helps determine the types of equipment to prepare in the operating room. For example, limited neck mobility and a thyromental distance of less than 7 cm indicate the need for a video laryngoscope. However, it is always best practice to assume a trauma patient will have a difficult airway and have a video laryngoscope readily available.

Trauma: Hemicraniectomy

Trauma occurring to the cranium often requires emergent surgical procedure, typically utilized to reduce swelling, decrease intracranial pressure, and ensure cerebral perfusion pressure remains adequate. When trauma to the head happens typically, it requires an emergent surgical procedure. Most of the surgeries can be addressed through a wide frontotemporoparietal craniotomy (Jaffe, et al., 2018, p. 711). One of the most significant factors for craniotomy procedures ins time and precision. In the surgical procedure of a hemicraniectomy, the surgeon makes an incision resembling a question mark, starting from the tragus and extending superiorly to the frontal area of the patient. This flap is then retracted back to expose the skull for the cranial drill (Jaffe, et al., 2018, p. 711). Once the skull is removed the surgeon is going to assess the state of the hematoma, and gently remove the hematoma relying on warm irrigation. To ensure proper recovery, management of ICP and CPP the surgeon may end up placing an external drain at the surgical site as well as leaving the skull off as to prevent brain swelling from impacting the cranial pressures and perfusion of the brain (Jaffe, et al., 2018, p. 711).

The anesthesia side of any neurosurgery type of case can be unique. In the event of a traumatic brain injury (TBI), there is typically an increase of intercranial pressure due to the hematoma. Hyperventilation, mannitol, hypertonic saline, and diuresis is used to help maintain the ICP until fixed (Jaffe, et al., 2018, p. 711). With most TBI patients tongues typically fall back into the mouth which can cause an airway obstruction so careful attention to airway management, specifically during induction is needed. TBI patients tend to develop the Cushing's Triad which is a critical event where a patient develops severe hypertension, bradycardia, and irregular respirations. These are hallmark signs of a herniation of the brain, with the treatment being a decompression, via craniotomy (Jaffe, et al., 2018, p. 711).

Trauma: Thoracotomy

Another common trauma procedure is a thoracotomy, colloquially known as a "clamshell." Common indications for a thoracotomy include penetrating chest wounds, blunt force trauma, hemothorax, aortic injury, and cardiac tamponade. Hemothorax is typically due to massive exsanguination in the chest, often resulting from cardiac, vascular, or pulmonary injuries. Another cause is pericardial tamponade (Jaffe, et al., 2018, p. 814). When a patient requires this procedure in the emergency department, the odds of survival are less than 15% (Jaffe, et al., 2018, p. 814).

A thoracotomy involves an incision that extends from the sternum to the side of the chest at the 5th intercostal space. Heavy scissors are used to divide the muscles and cut across the sternum. This method is typically used as a last resort because it often leads to cardiac massage. For anesthesia in an emergency thoracotomy (clamshell), an endotracheal tube along with an orogastric (OG) or nasogastric (NG) tube should be secured. Typically, patients are not anesthetized for this procedure (Jaffe, et al., 2018, p. 815).

CASE OVERVIEW

Patient Demographics

During trauma procedures, obtaining demographic information to guide care in the operating room is not always straightforward. Therefore, trauma room setups need to be comprehensive and adaptable to a wide array of patient

types and surgical specialties. In most cases, a complete picture of the patient may not be available until well after the surgeries are completed, and demographic information often comes hours later.

In this review, the only information provided by the EMS team was the patient's age, 26, and sex, which was male. Additionally, we were informed that the patient was ejected from a motor vehicle and that the team was en-route to the hospital. EMS reported that the patient was unconscious upon their arrival and that CPR was performed for five minutes, after which return of spontaneous circulation (ROSC) was achieved. Further information included current airway management techniques, noting that the patient was intubated with an 8.0mm endotracheal tube (ETT) at a depth of 24 cm. Vital signs during transport indicated tachycardia, hypotension, and tachypnea, though oxygen saturations were reported as normal.

For the anesthesia technologist, it is crucial to be prepared for several contingencies. First, while the airway was initially managed, the depth of the tube and the unknown extent of trauma might necessitate reintubation. Additionally, the reported vitals from EMS indicated likely heavy internal bleeding, suggesting the need to coordinate with the blood bank to prepare for an emergent transfusion.

Upon the patient's arrival at the emergency department, the trauma surgeon initiated a Focused Assessment with Sonography for Trauma (FAST) protocol. This is an emergent ultrasound procedure used to diagnose internal bleeding. The test is a four-stage exam that assesses the upper right quadrant for signs of fluid in and around the liver and kidney. The exam continues to the left upper quadrant, pelvis, and pericardial view below the xiphoid process. Similar to the assessment of the upper right quadrant, the surgeon looks for signs of internal bleeding, as this will determine the types of surgery required to save the patient (Quinn & Sinert, 2011). In this review, the patient had a positive FAST exam and was rushed to the operating room within 10 minutes of exam completion. It was determined that the patient had significant upper right quadrant bleeding and needed an emergent exploratory laparotomy.

The anesthesia team determined that the patient's ASA status was ASA 5 E and activated the massive transfusion protocol (MTP). As the ex-lap proceeded, neurosurgery needed to perform a hemicraniectomy on the patient urgently due to increasing ICP and diminished CPP. The trauma team temporarily packed the patient to control the bleeding and allowed neurosurgery to perform their procedure. Anesthesia conducted arterial blood gases (ABGs) every 10-15 minutes, but saw no improvements initially, and the MTP continued. After neurosurgery finished, the trauma team resumed the exploratory laparotomy. Although the trauma surgeon could not initially locate the source of the bleeding, they identified significant bleeding in the upper quadrants. The trauma surgeon decided to proceed with a thoracotomy.

Anesthesia continued to monitor ABGs and noted no improvements until the trauma surgeon identified a bleed under the chest cavity and temporarily repaired it. At this point, a small improvement was observed. The MTP remained active, with the patient receiving 53 units of PRBC, 53 units of FFP, 12 units of platelets, 12 units of cryoprecipitate, and 13 liters of Plasmalyte. The patient survived and was transported to the ICU.

RISKS AND COMPLICATIONS ASSOCIATED WITH TRAUMA SURGERY

Anesthesia should be aware of the risks associated with any trauma patient. There are numerous risks involved in trauma anesthesia, and anesthesia providers should always utilize the ABC mnemonic for a quick patient assessment. Additionally, anesthesia should consider all trauma patients to have a full stomach, necessitating a rapid sequence intubation (RSI) procedure (Pardo & Miller, 2018, p. 727). When intubating a patient, providers should always use a video-guided system to ensure the safe and timely placement of the tube, minimizing risks to the patient's safety.

In trauma cases, managing massive transfusion protocol (MTP) and fluid resuscitation is often crucial. Delaying blood transfusions to a patient can hinder trauma resuscitation and exacerbate the patient's condition (Butterworth et al., 2018, p. 827). In cases where a large amount of blood is used, providers may encounter the lethal triad, comprising hypothermia, acidosis, and coagulopathy. The "50/50 rule," introduced recently, has garnered considerable attention (Pardo & Miller, 2018, p. 402). This rule indicates that with every 10 units of blood given to the patient, there is a 10% increase in mortality (Pardo & Miller, 2018, p. 402).

ANESTHESIA TECHNOLOGIST ROLE

When it comes to trauma surgery, it's essential to have a designated OR suite prepared. The anesthesia technologist should ensure that the suite is equipped with all necessary

anesthetic equipment, including MTP rapid transfusers, endotracheal tubes, basic ASA monitors, and machine setups. They should also receive a report from their provider to understand what's happening. Once there's knowledge of a trauma patient, a game plan is established upon the patient's arrival.

Once the trauma patient arrives, the priority is to transfer them to the operating table and induce anesthesia. It would be beneficial to have a secondary technologist to assist in starting procedures like MTP, Cell Saver, or central line insertion. Additional IV access is crucial once the patient is anesthetized, followed by assistance with arterial line placement using ultrasound guidance. The patient is typically connected to a Belmont for their MTP through a 16g IV. ABGs are run every ten to fifteen minutes to monitor the patient's condition, focusing on hemoglobin and calcium levels due to the significant blood loss.

The surgery itself is often long and stressful. The patient may receive large amounts of fluid and blood, leading to alkalosis and systemic swelling. After surgery, the patient is transferred to the trauma intensive care unit, where they may continue to receive blood and be placed on warming devices due to hypothermia. Anesthesia may administer epinephrine drips to maintain blood pressure and heart rate stability.

Conclusion

Trauma surgery is inherently stressful, requiring quick thinking and planning in all aspects, not just the surgical procedures themselves. On the anesthesia side, there are numerous considerations that providers must be mindful of. Effective communication is crucial within the anesthesia team and between the surgical and anesthesia teams. Collaboration is key in trauma surgery, with optimal outcomes achieved when everyone works together seamlessly. Each member involved in trauma surgery should be highly experienced, capable of working independently, and trusting others to fulfill their roles, ensuring a smooth process aimed at saving the patient's life.

References

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Take the QUIZ on the next page!

Continuing Education Quiz

To test your knowledge on this issue's article, provide correct answers to the following questions on the form below. Follow the instructions carefully.

1. **What is the primary goal of an exploratory laparotomy (ex-lap) procedure in trauma surgery?**
   A) To assess neurological function
   B) To identify and cease bleeding in the abdominal cavity
   C) To manage bone fractures
   D) To stabilize blood pressure

2. **What is the primary purpose of a hemicraniectomy in trauma surgery?**
   A) To assess internal bleeding
   B) To reduce swelling and intracranial pressure
   C) To manage abdominal trauma
   D) To stabilize blood pressure

3. **What is the primary indication for a thoracotomy in trauma surgery?**
   A) To address abdominal trauma
   B) To manage hemothorax and cardiac tamponade
   C) To assess neurological function
   D) To stabilize blood pressure

4. **What is the primary goal of a hemicraniectomy in trauma surgery?**
   A) To assess internal bleeding
   B) To reduce swelling and intracranial pressure
   C) To manage abdominal trauma
   D) To stabilize blood pressure

5. **What is the primary goal of the Focused Assessment with Sonography for Trauma (FAST) protocol in trauma surgery?**
   A) To diagnose internal bleeding
   B) To assess neurological function
   C) To evaluate bone fractures
   D) To measure blood pressure

6. **What is the "50/50 rule" in trauma resuscitation?**
   A) For every 10 units of blood given, there is a 10% increase in mortality
   B) For every 50 minutes of surgery, there is a 50% chance of complications
   C) For every 50 units of blood given, there is a 50% increase in mortality
   D) For every 50% decrease in blood pressure, there is a 50% increase in mortality

7. **Ex-lap procedures have what type of incision?**
   A) Midline
   B) Transverse
   C) Paramedian
   D) Angular

8. **What is the other name of the thoracotomy?**
   A) Clamshell
   B) Clamhollow
   C) Superficial
   D) Inverse

9. **What size tube was used on this patient?**
   A) 6.0
   B) 7.0
   C) 7.5
   D) 8.0

10. **What is the name of the clinical sign that indicated brain herniation?**
    A) Cushing's triad
    B) Dealings Triad
    C) Fuller's sign
    D) Westinghouse mark

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1.	A B C D	6.	A B C D
2.	A B C D	7.	A B C D
3.	A B C D	8.	A B C D
4.	A B C D	9.	A B C D
5.	A B C D	10.	A B C D

Quiz 2

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