the generEHlist
105 CCFP Topics Podcast

Topic: Trauma

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According to the World Health Organization (WHO) and the Centers for Disease Control (CDC), more than nine people die every minute from injuries or violence. A total of 5.8 million people of all ages and economic groups die every year from unintentional injuries and violence. The burden of injury accounts for 18% of the world's total diseases. Motor vehicle crashes alone cause more than 1 million deaths annually and an estimated 20 million to 50 million significant injuries; they are the leading cause of death due to injury worldwide.

Traumatic presentations are unfortunately quite common, so it's important we get comfortable with a strong approach. Our goal today is in no way to complete an exhaustive review. That being said, we did our best to prepare a brief overview that allows us to cover the CCFP objectives. Get ready. This is a pretty robust topic to cover, so buckle up!!

Before we dive into our approach to the trauma patient, let's quickly touch on our approach to trauma situations and chat a little about triage systems.

Objective 3. When faced with several trauma patients, triage according to resources and treatment priorities.

Regardless of whether this is prehospital field triage or ED triage, the goal is to treat critical patients who have the greatest chance of survival with the least expenditure of time and resources. There are multiple different triage systems that exist out there, none of them perfect. Practically, if you anticipate incorporating some EM work in your career, I would encourage you to connect with your local groups to see which they frequently use.

A commonly used system is the SALT triage system. It stands for Sort, Assess, Lifesaving Interventions, Treatment/Transport. Simply put, patients are placed into 5 different categories to help decide who to treat and in which order.

- **Category 1 (RED)** is *Immediate*, these injuries are immediately life-threatening
- **Category 2 (YELLOW)** is *Delayed*, these injuries require treatment within 6 hours but are not immediately life threatening
- **Category 3 (GREEN)** is *Minimal*, these injuries are the "walking wounded" or can be psychiatric in nature
- **Category 4 (BLUE)** is *Expectant*, patients in this category have severe injuries and are unlikely to survive in the context of available resources
- **Category 5 (BLACK)** is *Dead*

Check to show notes for a good visual of this triage system.

It's good to keep in mind there are several factors that affect any triaging system. The big ones to consider are the amount of medical personnel available, their expertise, medical resources, and, especially important in large trauma injuries, access to a surgeon and an OR.

Now we are ready to start reviewing our general approach to a trauma patient.

The old reliable ABCDE!

Objective 1. Assess and stabilize trauma patients with an organized approach, anticipating complications in a timely fashion, using the primary and secondary surveys.

Our systematic approach to a trauma patient starts with the primary survey, also known as the ABCDE approach. The purpose of the primary survey is to identify immediately life-threatening injuries and address them appropriately.

Clinical conditions in trauma can shift rapidly. Any decline in a patient's status warrants repeating the primary survey (from the top!) to identify any change in the patient's status that requires immediate intervention. A useful approach to consider is the ABCDE mnemonic, which allows a systematic approach. That being said, as we review it, keep in mind that things can happen simultaneously and out of sequence if the situation demands it.

Using our simple mnemonic, ABCDE guides us through the steps of the primary survey.

So let's review!

A! A stands for airway maintenance and cervical spine protection.

Now I know we start with A and the airway is important, but in the trauma context, always think of cervical spine protection within the airway category.

Consider if your patient requires spinal motion restriction (SMR), in other words, if they should be placed in a cervical collar. This is commonly done by pre-hospital colleagues, but not always. If a patient arrives already in SMR, ensure the collar is appropriately placed (it is good to know which collar is used in your area or ED). If there is no collar, quickly assess if one is indicated.

Indications for SMR following **blunt** trauma include:

- Dangerous mechanism of injury (which is by far the most common indication)
- Acutely altered level of consciousness (e.g., GCS <15, evidence of intoxication)
- Midline neck pain
- Focal neurologic signs and/or symptoms (e.g., numbness or motor weakness)
- Anatomic deformity of the spine

- Distracting injury

A quick reminder, a cervical collar is not itself a benign procedure. It does have risks including:

- Risk of aspiration (vomiting is not uncommon in head injuries)
- Impeded airway management (it can restrict mouth opening by at least 25%)
- Directly compromises respiration (↓ FEV1 by 15%)
- Increase ICP → complicating global brain injury
- Pressure ulceration or rashes → Pain + increases chances of secondary infection
- Concealments of important physical findings (soft tissue injuries, tracheal deviation, or subcutaneous air)

It is an important tool, but ensure it is indicated. There are contra-indications to SMR. These include penetrating trauma and ankylosing spondylitis. Documented neurologic deterioration, and even death, have been reported with the use of a cervical collar in patients with ankylosing spondylitis.

Once that's settled, we quickly move onto our true A - airway.

The airway must be rapidly assessed for **patency and protection** in all trauma patients. This can be done simply in awake patients by asking them to state their name and what occurred during the incident. It is also important to identify any significant facial trauma or burn injury which puts the airway at risk for compromise, This includes assessing the risk of inhalation injury. You can also search and remove any foreign bodies.

That being said, it is no longer recommended to perform a blind sweep as you might push the tongue back and further obstruct the airway. So if you don't see anything, keep those fingers out of the mouth!

An altered level of consciousness can also render a patient unable to protect their own airway. You may have heard of the trauma rule of thumb GCS < 8, intubate. An obtunded patient is at risk of airway compromise.

If we identify that the airway is at risk, then what?

Objective 4. In trauma patients, secure the airway appropriately.

When required, airway management can be broken down into 3 categories. Basic, temporizing, and definitive.

Basic manoeuvers help support the airway and improve oxygenation and ventilation. They include:

- A jaw-thrust. This might be the most important initial procedure for an obtunded patient.
    - As a quick note, chin-lifts are not commonly used in blunt trauma patients given the need to protect the cervical spine.
- Supplemental oxygen is often administered to all trauma patients.

If not sufficient, **temporizing measures** can be considered. These are often used until a definitive airway can be established and include NPAs, OPAs, and LMAs.

An NPA, or nasopharyngeal airway, is generally used for patients with an intact cough and gag reflex. They are however contraindicated if there is significant facial trauma or suspicion of basilar skull fractures as there is a risk of displacement (it ending up where you definitely don't want it).

An OPA, or oropharyngeal airway, is also a great adjunct. They are reserved for unresponsive individuals with NO cough or gag reflex. Otherwise, an OPA may stimulate vomiting, laryngeal spasm, or aspiration.

Finally we have LMAs, or laryngeal mask airways. These are supraglottic airway devices which can be used as a temporary method to maintain an open airway. It is important to note that they are not considered "definite" airways and patients remain at risk for aspiration of gastric content or blood.

Which brings us to our **definitive airways**.

A definitive airway is defined as the placement of an endotracheal tube with a cuff inflated below the vocal cords. Generally, in obtunded or severely injured patients, it is the preferable way to secure the airway. Definitive airways allow for oxygenation and ventilation in addition to preventing aspiration.

ETT placement or intubation is typically done via a Rapid Sequence Induction or RSI. We won't go into details here but briefly, it is a method that allows for quick sedation and temporary paralysis of patients at high risk of aspiration (all trauma patients) so they can be intubated.

What if we are unable to place an ETT?

Well, we've already mentioned one option.. An LMA is a great back-up to have on hand, remembering that it is not considered a definitive airway. There are also a few adjuncts that can help with difficult intubations including using a bougie. In circumstances where oral intubation is not a reasonable clinical option (for example significant anatomical disruption of face and neck) or after failed intubation, a **surgical airway** or emergency front of neck access (eFONA) is performed.

In an emergency situation, the more appropriate term is a cricothyroidotomy. This consists of making an incision on the front of the neck to create an opening in the cricothyroid membrane. A smaller ETT (5–6) or (if you happen to have one around) a tracheostomy tube is then inserted and secured.

T rauma surgeons have told me that the most difficult part is the decision of doing an eFONA. The procedure itself is pretty simple.

Is there any way of estimating which patients are more likely to have a difficult airway?

There is! A common mnemonic is LEMON.

- **L** stands for **Look**: we are assessing for obesity, beards, dental or facial abnormalities, trauma to the neck or face.
- **E** stands for **evaluate using 3-2-2 rule**. If the distance between the incisors with their mouth open is less than 3 fingers wide, or if the distance from chin to the hyoid bone is less than 2 fingers or the distance between the hyoid and the thyroid is less than 2 fingers, it may be a difficult intubation.
- **M** stands for **Mallampati score**, **check out the show notes for a visual** but basically the harder it is to see the patients tonsils and uvula with their mouth wide open, the harder it will be to intubate.
- **O** stands for **obstruction**. If there are signs of stridor, a foreign body or masses compressing the airway it can also increase difficulty of intubation.
- And finally **N** stands for **neck mobility**, the less extension of the upper cervical spine and flexion of the lower cervical spine the harder it will be to place the patient into the optimal position we call the "sniffing position". This is a significant restriction in trauma patients as most of them will be on cervical precautions.

As a recap, in terms of airway management, quickly secure the cervical spine if appropriate and assess the patient's airway patency and protection. This can be easily done by asking the patient some simple questions. Consider facial trauma, burn injuries, potential obstructions and level of consciousness in your assessment. Rely on your basic (jaw thrust and O2), temporizing (NPA, OPA or LMA) and definitive (ET intubation or eFONA) airway measures.

Continuing with our ABCDE approach we are going to move onto B.

B stands for **Breathing**.

Just because the patient has a patent airway, it doesn't ensure that they are adequately ventilating. For adequate ventilation and gas exchange to occur, the lungs, chest wall, and diaphragm all have to be functioning appropriately. Therefore each of those components need to be assessed. To do this, we look, listen, and feel.

Look at the patient, their respiratory rate and their SpO2. Look for signs of increased work of breathing including intercostal indrawing, scalene retractions and nasal flaring. Are breaths shallow or deep, fast or slow? Look at the chest for any obvious chest wall deformities, segments moving abnormally, or the presence of sucking chest wounds.

Next, listen to the lungs. In the context of the primary survey, you are exclusively auscultating to assess bilateral air entry, paying specific attention to the presence or absence of lung sounds.

Finally, feel. Feel for a potential tracheal shift, then quickly move to the chest to feel for crepitus indicating subcutaneous air, any flail segments, broken ribs or tenderness. This is so, so important in trauma.

So what do we do if breathing is not adequate?

If it is life-threatening, then move to treating the underlying cause. Remember, during the primary survey, we are looking for life-threatening injuries. Don't get distracted by some minor wheezing. In the traumatic context, this usually involves treating tension pneumothoraces, massive hemothoraces, significant flail chests, or open pneumothoraces.

Those are those sucking chest wounds we mentioned.

Provide the patient with oxygen to maintain their SpO2. Generally, all patients get placed on nasal prongs which can only deliver up to 4-6 L of O2 per minute. That may not be sufficient, so you may need to throw on a non-rebreather mask which can deliver up to 15 L per minute.

If you have absent breath sounds on one side and the patient is unwell, consider rapidly performing a needle decompression or placing a chest tube. A significant flail chest might require intubation to take over the patient's breathing as they are at risk of tiring, their lung injury evolving, and going into respiratory failure. We will discuss these diagnoses and their management in further detail in a little bit.

So for breathing, look at the patient, their RR and SpO2, listen for air entry, feel the chest and address any life-threatening findings. Alright what's next?

Now we move on to **C! C** stands for **Circulation**, in other words shock.

Let's pivot from our primary survey here a little, and talk a little bit more about shock so we can check off objective 5.

Objective 5. In a patient with signs and symptoms of shock, recognize the shock, define the severity and type. and treat the shock.

Let's refresh our memories on the definition of shock. Shock is defined as inadequate organ and tissue perfusion and oxygenation. In other words, the metabolic demands outweigh its supply.

Patients in early shock will be tachypneic and tachycardic. They may have a narrow pulse pressure (difference between systolic and diastolic blood pressure), reduced capillary refill and cool extremities. As the shock progresses, patients become hypotensive, altered and oliguric (eventually anuric).

Shock generally fits into 4 major types or categories:

1. **Hypovolemic**- these patients are intravascularly depleted due to hemorrhage (over 90% of the shock we see in trauma!), severe burns, or severe dehydration due to conditions such as diarrhea or DKA.
    a. These patients require volume repletion!
2. **Obstructive**- With obstructive shock, something is obstructing or getting in the way of blood going into and out of the heart or the great vessels. Consider diagnoses such as cardiac tamponade, tension pneumothorax, or PE and treat accordingly.
    a. This can mean an emergent pericardiocentesis in a tamponade, a needle decompression or chest tube in a tension pneumothorax, or anticoagulation and/or thrombolysis in a PE.
3. **Cardiogenic**- these are cases where the heart is unable to pump the blood forward. In trauma, cardiac blunt injury tends to be the main culprit. However, this category also includes myocardial ischemia, dysrhythmias, congestive heart failure, cardiomyopathies or cardiac value problems. This may be incidental in trauma cases (meaning having caused the trauma).
    a. If there's a problem with the heart pumping adequately, the treatment lies in fixing or supporting the pump.
4. **Distributive**- this refers to systemic vasodilation leading to inadequate perfusion. This category can be further divided in septic, anaphylactic and neurogenic shock.
    a. The circulatory system has expanded so we want to contract the circulation or expand the volume flowing through the system! This typically includes fluids, vasopressors, antibiotics (if sepsis is suspected) or epinephrine (if anaphylaxis is suspected).

It is important to consider all four types of shock in our trauma patients. That being said, for the most part, trauma patients will typically fall into hypovolemic category, more specifically into hemorrhagic shock. If they are hemodynamically unstable and shocky, you should immediately think of a source of bleeding.

Hemorrhagic shock can be divided into 4 severity classes, from 1 to 4. To estimate and determine a class we look at estimated blood loss, vital signs, capillary refill, urinary output and GCS. We won't go into the nitty gritty of this classification but for more details check out the ATLS classification of hypovolemic shock. **We've attached a handy table in the show notes**. A key

thing to remember is if your patient is hypotensive, they have probably already lost >1.5 L of blood.

Let's circle back to our primary survey! As the most common cause of shock is by far hemorrhagic shock, when assessing our C, we are mostly concerned with determining a source for bleeding, controlling hemorrhage, and resuscitating with blood. Definitive bleeding control is essential, along with appropriate replacement of intravascular volume.

Check the patient's heart rate and blood pressure, their mentation, skin color and temperature, capillary refill, and feel for a pulse in all four limbs. Next, assess for any potential bleeding and source control. Think of the 5 spots blood can pool in sufficient quantity to kill someone: the chest, the abdomen, the pelvis, the long bones and the floor. You would have already auscultated the chest. Feel the abdomen. Any rigidity or guarding should raise suspicion for an intra-abdominal bleed. Assess the stability of the pelvis. If it is unstable, meaning an open book pelvic fracture is suspected, maintain pressure until a pelvic binder is placed. This can be done via commercial pelvic binders or by using a sheet wrapped tightly around the greater trochanters (not the hips!). If using a sheet, it is a good idea to also tie the ankles together in internal rotation to prevent external rotation of the hips and further bleed. Palpate the long bones assessing for any displaced fracture that could be a source of bleeding. Reduce if thought to be contributing to the patient's hemodynamic instability, but don't anchor on distracting injuries. Remember, the primary is designed to find and address life-threatening injuries. And finally, assess for any external bleeding. Don't forget to check the armpits, groins and scalp. Apply direct pressure to any site that is actively bleeding. A penetrating injury may require placing your finger directly in the injury or significant packing. If unable to control the bleeding with direct pressure, consider placing a tourniquet, remembering that a commercial tourniquet is what is truly required as improvised tourniquets won't provide adequate arterial occlusion. Staples or sutures may also be required, but again, only for life-threatening bleeds.

As a quick side note, our physical exam is helpful, but not great at determining where the blood is. Chest, abdomen, pelvis especially require adjuncts (CXR, FAST, pelvis XR) to really know. So doing the physical exam is useful and may contribute to your Dx, but don't, for example, rule out a pelvic fracture just because the pelvis feels stable.

On the flip side of hemorrhage control, is resuscitation. This is the time to get two large-bore IVs in place, anticipating intravascular resuscitation no matter your findings. If IV access cannot be secured, move towards intraosseous access. The proximal tibia and humeral head are the preferred sites in adults. The distal femur, proximal tibia, and distal tibia are preferred sites for infants and neonates. Always consider traumatic injuries when placing an IO. Ensure your fluids will be able to reach the heart. Don't go placing a right proximal tibia IO if a right femoral fracture is suspected.

Depending on their clinical context, trauma patients may require fluid resuscitation. As most shock in trauma cases is hemorrhagic in nature, they specifically require blood. Treating hypotension with crystalloid fluids will not help treat their shock, and has been shown to cause harm, partly through dilutional coagulopathies. 1 L of crystalloids is fine, but if you're requiring more than that, call the blood bank.

As most shock in trauma cases is hemorrhagic in nature, they specifically require blood. Treating hypotension with crystalloid fluids will not help treat their shock, and may cause further harm through dilutional coagulopathies. 1 L of crystalloids is fine, but if you're requiring more than that, call the blood bank. Type O pRBCs are indicated for patients with exsanguinating hemorrhage (without a type and screen). To avoid sensitization and future complications, Rh-negative pRBCs are preferred for females of childbearing age.

In patients with ongoing or suspected ongoing bleeding, give tranexamic acid (TXA).

Ultimately, if the patient remains hemodynamically unstable despite resuscitation, they may require an emergent OR or IR procedure to achieve hemostasis.

Some trauma patients may need large amounts of blood products requiring the activation of a Massive Hemorrhage Protocol. A massive blood transfusion is typically defined as the transfusion of 10 units of packed red blood cells within a 24 hour period or more than 4 units in 1 hour. It's a good idea to get comfortable with your local MTP to know how much blood product you have access to and how to obtain it. That being said, to help estimate which patients will require massive transfusion, you can use the ABC Score, a handy calculation that can be found on MDCalc **and in the show notes.** The gist of it is as follows. In the ABC Score studies, scores <2 in trauma patients were unlikely to require massive transfusion. Each criteria is worth 1 point and they include:

- HR ≥ 120
- sBP ≤ 90
- Penetrating injury
- Positive Fast scan

If two or more criteria are met, your patient may likely require a massive transfusion, so consider ordering the blood to have on hand!

Would you consider using the point of care ultrasound at this point in your primary care survey?

This is a great question. POCUS is a great tool, especially in trauma cases. The eFAST scan which can assess for pneumothoraces, hemothoraces, pericardial hemorrhage and intraperitoneal hemorrhage can be particularly helpful in our assessment. It is considered an adjunct usually performed following your primary survey as to not distract or delay the identification of life-threatening concerns. It's generally a question of how useful it is. For example, if a patient is totally stable and you have a CT scanner, it won't do anything so, well, don't do it. If a patient

has a GSW to the abdomen and is unstable, it also won't change anything. The major pitfall of doing it during the C stage is that it takes a few minutes at best and distracts everyone from more valuable parts of the primary survey.

a quick review,

while assessing circulation, consider all forms of shock, but in trauma patients, think bleed, bleed, bleed. Assess for sources of bleeding (chest, abdomen, pelvis, long bones and external sources) and control accordingly (pressure, tourniquet, staples, pelvic binder, or, if needed an OR). Get some large-bore IV or IO access and resuscitate with blood. Use the ABC score for potential massive hemorrhage protocol.

Moving on to our D. **D stands for disability**.

At this step we are assessing the patient's level of consciousness and gross neurological function. Check pupils to assess size and responsiveness. Assess their overall level of consciousness and response to commands. This can quickly be assessed through the mnemonic AVPU: Alert, Verbal (responds only to verbal stimuli), Pain (responds only to pain), Unresponsive. Check pupils and see if they grossly move all four limbs spontaneously. It can be helpful to use the Glasgow Coma Scale. On the primary, you're looking for bad TBIs and spinal cord injuries that could lead to respiratory/circulatory collapse.

Until proven otherwise, always presume that changes in level of consciousness are a result of central nervous system injury (eg. brain bleed). Remember that drug or alcohol intoxication can accompany traumatic brain injury.

Another aspect of our disability assessment is a quick POC glucose measurement.

ABC **DEFG** - **d**on't **e**ver **f**orget **g**lucose. Hypoglycemia may be contributing to an altered level of consciousness or cause of a traumatic event and can be an easy thing to address.

Finally in our primary survey we have reached **E! E for Exposure and Environment.**

Completely expose the patient to assess them from head to toe for any bodily injury. Again, armpits, groins and scalps tend to be areas where injuries are be commonly missed. Check everywhere! Importantly, this includes doing a **log roll** to examine the back for any injuries and palpate the spine for any tenderness or obvious step off deformities. Ensure to maintain adequate spinal motion restriction throughout. The log roll may be an opportune time to perform a DRE to assess for bleeds and anal tone, if appropriate. DREs are certainly not necessary in every trauma patient but if you think they may have a **rectal or distal bowel injury** or **spinal cord injury**, do it. Remember that they're already going through a pretty stressful situation so make sure the information you gather from the DRE is "worth it". If the patient can follow commands, you may also opt to simply ask them to squeeze their gluts together.

This is also time to check on the patient's core temperature and take appropriate measures to prevent hypothermia. This brings us to objective 6.

Objective 6. In trauma patients, rule out hypothermia on arrival and subsequently.

Hypothermia, typically defined as a core temperature below 35 °C, can be caused by increased heat loss due to exposure to a cold environment or impaired regulation due to brain injury. In trauma, always consider shock as a potential cause. When you're systematically shut down, you don't make much heat

Although less common in trauma cases, hypothermia can also be caused by decreased heat production because of an underlying medical condition such as hypopituitarism, hypoadrenalism, and hypothyroidism.

So how do we recognize hypothermia?

Well, all trauma patients should have a core temperature taken. That being said, clinically, in cases of mild hypothermia (32-34.9 °C), the patient can be tachypneic, tachycardic, shiver and experience ataxia and dysarthria.

When hypothermia becomes moderate (28-31.9 °C), patients can lose their ability to shiver, have a decreased LOC, become combative, have muscle rigidity, and dilated pupils.

Finally if hypothermia is severe (<28 °C), patients can suffer complications such as hypotension, acidemia, VFib, asystole, flaccidity, apnea, and even coma.

Especially following full exposure, trauma patients are at increased risk of developing hypothermia. It is important to frequently check on the patient's temperature and take appropriate measures to prevent hypothermia. These include keeping the patient warm with blankets, using warm fluids during resuscitation and considering heaters (like a bair hugger) if necessary. Remember, hypothermia is part of the trauma triad of death along with acidosis and coagulopathy, a combination that results in a significant rise in mortality rate.

And that is your primary survey!

That's it?

I know, that was a lot of information. The primary survey can seem complex and quite daunting but remember, the goal is to identify life-threatening injuries and act on them. If there is a sudden deterioration in your trauma patient despite a previous primary survey, you start again from the top.

Let's quickly recap our primary.

A - for airway and c-spine protection. Secure a patent and protected airway and ensure SMR if required.

B - for breathing. Look at the RR, SpO2 and for respiratory distress, listen for bilateral air entry, feel for any chest wall injuries and address any life-threatening findings (oxygen, needle decompression/chest tubes).

C- for circulation. Looking for shock, in trauma think bleed, bleed, bleed. Assess for shock, find and control sources of bleeding and resuscitate with blood.

D- for disability. Assess pupils and gross neurological function with AVPU. Can consider a GCS as well. In any altered LoC, suspect TBI. Don't Ever Forget the Glucose.

E- for exposure and environment. Fully expose and log roll to assess for further injury and spinal involvement. Check temperature and treat/prevent hypothermia.

Important note. You can and should do a good primary survey in less than a minute. It's an important skill to quickly rule out things that are trying to kill your patient!

Let's dive into "addressing these life-threatening injuries" a little more. Let's tackle objective 2.

Objective 2. Suspect, identify, and immediately begin treating life-threatening complications.

In trauma, these life-threatening complications are sometimes referred to as the "lethal 6", six diagnoses that have been identified as conditions that can be quickly life-threatening and should be treated as soon as possible. Let's go over each one by one.

1. Airway Obstruction

- Suspect when patient has neck swelling and/or expanding hematoma, major trauma to the face, vitals may show decrease HR, increase or decrease RR, decreased O2 sats
- Often identified during primary survey, can present with decrease in breath sounds, stridor and decreased chest rise
- Treated with supplemental O2 and airway management (our basic, temporizing and definitive airway measures)

2. Tension Pneumothorax

- Suspect when patient is in respiratory distress, vitals may show increase HR, RR (decrease BP and O2 is a late finding)

- Identify by looking for unilateral decreased breath sounds, tracheal deviation (away from affected side), unilateral percussion dullness and increased JVP.
- Treated with needle decompression and/or chest tube at the 5th intercostal space (nipple line) at the mid-axillary line of the affected side.

3. Open Pneumothorax

- Suspect when a patient has a visible chest wound and/or the intrathoracic viscera is visible and dyspnea, vitals may show increase HR/RR and decreased O2 sat
- Can initially be treated with a three-sided occlusive dressing for the open wound, but generally will need to close the hole and get a chest tube in.

4. Massive Hemothorax

- Suspect when patient has sustained rib fractures from the trauma and is presenting with chest pain and worsening dyspnea. Also suspect in penetrating chest trauma with hemodynamic instability.
- Identify by looking for unilateral decreased breath sounds and dullness to percussion
- Treated with chest tube insertion at the 5 intercostal space (nipple line) at the mid-axillary line of the affected side and volume resuscitation (WITH BLOOD)!

5. Cardiac Tamponade

- Suspect when a patient has penetrating trauma to the cardiac box or, rarely, significant blunt force to the chest, vitals may show increased HR/RR rate, decreased BP and decreased SpO2
- Classic textbook finding to identify cardiac tamponade is Beck's Triad: hypotension, JVD, and muffled heart sounds. This is true, but essentially never the way we diagnose it in the trauma bay: we have POCUS, which is soooo much better.
- This is AN EMERGENCY. Typically treated with pericardiocentesis (if patient about to die or you have no surgery at your site) or thoracotomy and opening pericardial sac.

6. Flail Chest

- Suspect in patients with blunt trauma, paradoxical chest wall motion, pain and difficulty inspiring, vitals may show increase HR/RR and decreased O2 sats
- Often identified when flail segment is found, requires at least 3 consecutive ribs broken in 2 or more places for diagnosis. Patients may also have decreased breath sounds, crepitus and palpable chest wall instability
- Treated with supplemental O2 and pain control (systemic and local). Severe flail chest causing respiratory failure may require intubation.

And those are the lethal six. Keep them on your differential as you are completing your primary and be ready to act accordingly.

Ok, now can we move on to Secondary survey?

Yep, let's do it!

The purpose of a secondary survey is to identify other major but non-life threatening injuries or areas of concern. This includes doing a history and full physical exam along with appropriate initial investigations. This is done once the primary survey is complete and the patient is stabilized.

Let's start with the history. The acronym **AMPLE** is often used to guide a succinct and trauma-focused history.

This involves asking about **A**llergies, **M**edications, **P**MHx, **L**ast meal or oral intake and the **E**vents leading up to injury.

Next we would move on to a full head-to-toe physical exam. We won't go in depth here but the key is to have a systematic approach that allows you to "lay eyes" and feel every part of the body to assess for less obvious injuries that weren't picked up on the primary survey.

And finally, order your appropriate initial investigations. These will depend on the trauma mechanism and the patient's clinical presentation. They can include blood work (type and screen, CBC, lytes, creatinine, lactate at minimum. Trops, CK, liver enzymes are other things to consider. VBG often a good way to get info quickly!) and imaging (CXR, XR of suspected fractures, CT head, chest and abdomen, PoCUS). You may even want to insert some adjuncts such as gastric and urinary catheters.

As mentioned, the secondary survey is done once the patient is stable, which brings us to objective 8. Let's power through these last few objectives!

Objective 8. Do not move potentially unstable patients from treatment areas for investigations (e.g., computed tomography, X-ray examination).

Trauma patients need a high level of observation and reassessment as they are at risk of decompensation, especially early after injury. It may be tempting to move a patient to diagnostic imaging to get some answers but it is always best to make sure the patient is stable and will likely remain that way throughout the entirety of the investigation. No one wants to be dealing with a code blue in the CT scanner!

Another important note, investigations should never delay transport. If the patient ultimately requires a transfer to a different institution for definitive care, something we will discuss shortly, investigations should never delay the transfer.

Coming back to our trauma assessment. We've done a primary survey. The patient is stable. The secondary survey is complete and investigations are pending. Once you have a second to take

a breath, consider potential medical problems that could have contributed or precipitated the traumatic incident.

Objective 7. Suspect certain medical problems as the precipitant of the trauma.

After a thorough secondary survey, depending on the history and findings, consider certain medical problems that may be contributing and treat accordingly. These might include seizures (collateral history, history of seizure, post-ictal state), drug intoxication (consider naloxone, watch for specific toxidrome), hypoglycemia (POCT glucose, dextrose), or attempted suicide (involuntary stay for a psychiatry assessment). The mechanism of injury can often be a good clue to this. For example: single vehicle against telephone pole when driving conditions are okay → often will be a medical cause. Investigate, treat and follow as appropriate.

Objective 9. Determine when a patient transfer is necessary.

Depending on which site you are working at, you may or may not be equipped to manage some of the patient injuries. It's always a good idea to consult early and update as needed. It may turn out your site has the capabilities but not the knowledge for certain managements so a phone call to a specialist may be all that is needed. However, sometimes, especially in rural areas, there is no capability to provide the indicated interventions. In this case, the goal is to stabilize the patient to allow a transfer to the appropriate site.

The main things are really:

- need for higher intensity of care
- need for equipment that's not available locally (e.g. CT, US)
- need for expertise (e.g. obstetrics)
- risk of decompensation (e.g. stable high grade spleen injury)
- There is evidence that geriatric patients do better in specialized centres.
- There is also evidence that patients with high injury burden have better outcomes in trauma centres.

So, stuff to consider and work in.

This leads us nicely into our next objective.

Objective 10. Transfer patients in an appropriate manner (i.e., stabilize them before transfer and choose the method, such as ambulance or flight).

This one is pretty self explanatory. You are going to stabilize the patient to the best of your ability and then transfer using an appropriate method.

As previously stated, when faced with a patient you know is going to need a transfer, do not perform diagnostic procedures that will not change the immediate management and will delay the transfer.

Do not delay transfer to provide extensive wound care. Closing lacerations, dressing wounds, etc is fine, especially if not hemostatic. The key is not to hold things up for low value interventions.

A quick note, splinting limbs is another example we see missed a lot: you should immobilize and reduce fractures whenever possible as it will reduce pain, decrease chance of fat embolism, and decrease bleeding.

Complete your primary survey. Complete a secondary if time permits (which it usually does). Consider tetanus and antibiotics. Splint and traction fractures if indicated. And transfer the patient.

So how do we decide how to transfer the patient?

Generally ambulances will be used if the distance is short, or if the patient is stable enough for a longer transfer time. If the patient needs to be transferred as quickly as possible to a site far away, flight is going to be the best option. The mode of transfer is also dependent on weather conditions and availability.

We are almost to the end, just a few more objectives to cover!

Objective 11. Find opportunities to offer advice to prevent or minimize trauma (e.g., do not drive drunk, use seatbelts and helmets)

This kind of teaching can be done both in your clinic before a trauma has occurred and after a patient has landed in your ED (once they're stabilized and treated of course).

An important part of a family physician's job is preventative health and patient education. After building a rapport with your patients it is often easier to support them in their alcohol or substance use disorder if appropriate as it can increase their risk of accidents. You can also remind patients of seatbelt and helmet use during clinic visits. Encouraging patients to take a basic first aid course and have an appropriate first aid kit in their car can be lifesaving.

Obviously not all traumas can be prevented ahead of time so it is important to offer advice post-trauma as appropriate to minimize the risk of recurrence. We don't want to be doing this at times when the patient is acutely unstable, but an opportune time may be at discharge or in your clinic at a follow-up appointment. More and more hospitals have HVIP (Hospital-based violence intervention programs) to break the cycle of violence. Check if there is a similar program at your hospital and get their team involved.

Objective 12. In children with traumatic injury, rule out abuse. (Carefully assess the reported mechanism of injury to ensure it corresponds with the actual injury.

It is an important consideration in all pediatric traumas. Assess if the mechanism of injury coincides with the child's development milestones and injury pattern. Any suspicion of abuse merits involving the appropriate authorities and a social worker consult. There are some injury patterns that make you more suspicious for child abuse and maltreatment.

- Head/CNS
    - Torn frenulum, dental injuries, black eyes (bilaterally), hair loss (traumatic), retinal hemorrhage, CNS injury (diffuse, severe)
- Abusive Head Trauma (previously known as shaken baby syndrome)
    - Severe head injury caused by the brain rebounding inside the skull during vigorous shaking, resulting in brain swelling/bruising, increased ICP, subdural/subarachnoid hemorrhage.
- Skin injuries
    - Object shaped bruises or burns, bite marks, glove/stocking burn distributions, bruises of multiple stages of healing or in easily concealed areas
- Bone injuries
    - Femur # when <1yo, spiral # of long bones in non-ambulatory children, infants w/metaphyseal #s, multiple #s of various ages, rib # w/minor trauma, complex and/or multiple skull #

Overall, if the story doesn't match the child's ability (based on their developmental milestones) or their pattern of injury, ensure you have considered the possibility of child abuse.

And those are our objectives covered.

A lot of important information in this episode. Might require a few listens to catch all the good learning points. But let's review a few of the big take home points, shall we?

Let's do it.

Well, first we reviewed the SALT triage system and the importance of considering resources, personnel, and treatment priorities when faced with several trauma patients.

We then spent the bulk of the episode discussing an organized approach to assessment and stabilization of a trauma patient.

This included our primary survey, our ABCDE approach, in which we discussed securing a protected and patent airway through basic, temporizing and definitive maneuvers as well as c-spine protection with spinal motion restriction if appropriate.

We reviewed our breathing assessments and potential interventions (primarily oxygen and chest tubes).

While discussing circulation, we reviewed shock as a concept and its types, but understood that traumas typically are victim of hemorrhagic shock so definitive bleeding control along with resuscitation via appropriate access is essential. This may require an OR if unable to control in the ED. That's right! Quick review of the spots where patients can bleed out into: chest, abdomen, pelvis, long bones and externally.

We also explored the ABC Score for consideration of massive transfusion needs.

With disability, we are assessing pupils and gross neurological function through the AVPU or GCS. And DON'T FORGET the GLUCOSE.

And to finalize our primary survey, we reviewed the exposure section. Full exposure to assess for other injuries, not forgetting the armpits and groins, log roll to assess the spine and finally treat and prevent hypothermia.

We then reviewed the lethal six and how to treat them. Those included

1. Airway Obstruction
2. Tension Pneumothorax
3. Open Pneumothorax
4. Massive Hemothorax
5. Cardiac Tamponade
6. Flail Chest

We moved onto the secondary survey and reviewed the SAMPLE history (signs and symptoms, allergies, medications, PMHx, last oral intake and events prior to injury), a full head-to-toe systematic physical exam and initial investigations.

Which we will only do if appropriate and the patient is stable.

Finally, we reviewed a few key concepts including the consideration of an underlying medical condition precipitating the traumatic event (seizures, substances, hypoglycemia, suicide attempt) and their treatment, evaluating the need and mode for transfer to a more appropriate early on and consulting appropriate specialists, opportunities to discussion injury prevention and finally considering the potential of child maltreatment in pediatric traumas.