PRIMARY SURVEY

Airway

- check while leaving the C-spine immobilized
- generally assume: **anyone with blunt injury above the clavicle is probably a C-spine fractre**
- **Talk to them,** ask them where they are.
- Not answering? **Hurt them.**
  - **Non-purposeful (eg. withdrawing or flexing) motor responses are a STRONG INDICATION FOR INTUBATION**
  - **Crude rule of thumb is a GCS of less than 8**
- This is the point where you should look for facial fractures, foreign bodies, vomit and facial burns
  - When their ability to maintain an airway is at all in doubt, **INTUBATE**

Breathing and Ventilation

- **expose the chest**
- **watch** the chest wall excursion: is it symmetrical?
- **Auscultate** it, high anterior – is air entry equal?

Auscultate apices for pneumothorax, bases for hemothorax

  - **Tension pneumothorax, open pneumothorax, flail chest- these should be identified during the primary survey**
  - **If you find a tension pneumothorax, it becomes your priority. DECOMPRESS THE TENSION PNEUMOTHORAX.**
  - **Get a valve over the open pneumothorax.**

Circulation with haemorrhage control

- **HYPOTENSION is HYPOVOLEMIC in trauma until proven otherwise**
- **3 elements which yield important information in seconds:**
  - **LEVEL OF CONSCIOUSNESS**
  - **SKIN COLOUR – ashen gray?**
  - **PULSE – thready and fast?**
- **BLEEDING:**
  - Control with pressure
  - Control with bone traction, reduction of fractures, pelvic braces, etc
  - Look in the chest abdomen and pelvis
    - **Two large-bore cannulas**
    - **At this point, someone should collect some bloods**
    - **Administer WARM fluids**
    - **Don't put blood products in the microwave.**

Disability

- **LEVEL OF CONSCIOUSNESS:** you should already have an idea of the GCS
  - Eye response and verbal response is already obvious
  - MOTOR response is tricky, that's why you torture them while looking at their airway.
  - Abnormal extension is 2. abnormal flexion is 3, withdrawal is 4, and localization is 5.
- **Lateralising signs:** if they can move, let them wriggle their toes and fingers
- **PUPILS:** if they cant move, that's all you have to go by

EXPOSURE AND ENVIRONMENT

- **STRIP THEM.**
- **At this point, you should log roll them.** May be part of secondary survey
- After that, **WARM BLANKETS AND WARM FLUIDS**

ADJUNCTS TO THE PRIMARY SURVEY

- **ECG**
- **URINARY CATHETER:** unless there is
  - a pelvic fracture
  - perineal bruising
  - blood in the urethra
  - blood in the scrotum
  - high-riding non-palpable prostate
- **NASOGASTRIC TUBE** unless there are midface fractures
  - Otherwise, use an orogastric tube
- Collect a **set of observations and an ABG** after the primary survey
- **XRAYS** should happen at this stage, to check for tube position and so on
  - You can limit yourself to just chest and pelvis at this stage

At this stage, you should think about whether you need to transfer this patient

SECONDARY SURVEY

Starts when the primary survey is completed and resuscitation efforts are under way

- **HISTORY: "AMPLE"**
  - **A**llergies
  - **M**edications
  - **P**ast history
  - **L**ast meal
  - **E**vents and environment of the injury
- **PHYSICAL EXAMINATION:**
  - **HEAD**
    - Scalp lacerations? Fractures?
    - Pupil size again, Visual acuity (how many fingers?..)
    - Conjunctival hemorrhage? Remove the contact lenses.
    - Ocular muscle entrapment
    - Do the GCS score again
  - **FACE**
    - Nothing is urgent except a cribriform plate fracture
    - Thus, look for midface fractures and CSF rhinorrhoea / otorrhoea
  - **C-SPINE and NECK**
    - Palpate with inline stabilization; is there pain?
    - Look for tracheal deviation
    - Look for laryngeal fracture
    - Look for subcutaneous emphysema
    - Auscultate carotid arteries
    - Look for distended neck veins TAMPONADE or TENSION P.
    - Wounds penetrating the platysma should not be explored in ED
  - **CHEST**
    - Look for flail segments; Palpate the whole chest looking for fractures and subcutaneous emphysema
    - Auscultate thoroughly, again.
  - **ABDOMEN**
    - Palpate everywhere
    - Look for flank hematoma
    - Look for a pregnant uterus
  - **PELVIS**
    - Put your finger into any orifice that has blood in it
    - Examine the perineum and scrotum for hematoma
    - Examine ONCE for pelvic mobility
      - Get a pelvic sling brace on if you suspect a fracture
  - **Musculoskeletal system**
    - Feel up and down the spine (already did this during the log roll)
    - Look for obvious long bone fractures
  - **Neurological system**
    - Revise the GCS AGAIN. Look for spinal level. Power, sensation…

ADJUNCTS TO THE SECONDARY SURVEY

- **MONITORING:**
  - Capnography
  - Pulse oximetry
  - ECG monitoring
  - Urine output in response to fluids
- **INVESTIGATIONS**
  - Xrays of the limbs, C-spine
  - Pan-CT
  - FAST ultrasound
  - Bloods

AIRWAY

Everybody gets high flow oxygen, full stop.

The following things cause you to reach for the tube:

- **reduced level of consciousness**
- **vomit in the oropharynx**
- **facial fractures, especially midface and mandible**
- **penetrating neck injury → SURGICAL AIRWAY**
- **the agitated patient for some reason refuses to lie supine- ? is their airway obstructing?**
- **IS THE LARYNX FRACTURED? There is a clinical triad:**
  - **Hoarseness**
  - **Subcutaneous emphysema**
  - **Palpable fracture**
  - **This makes you want to do a tracheostomy, or cricothyroidotomy**

OBJECTIVE SIGNS OF AIRWAY OBSTRUCTION:

- **AGITATION = hypoxia**
- **OBTUNDATION = hypercapnea**
- **CYANOSIS**
- **ACCESSORY MUSCLE USE**
- **STRIDOR or any sort of gurgling**
- **PARADOXICAL CHEST EXCURSION** (chest deflates with inspiration, abdomen distends)
-

MANAGEMENT OF A THREATENED AIRWAY

- **The main thing is to keep the C-spine stable**
- **First get their motorcycle helmet off – with inline stabilization**
- **Get some sort of suction, suck away their upper airway mucus and blood or teeth**
- **Put them on high flow oxygen**
- **Do a chin lift/jaw thrust**
- **Get a Guedel airway in (oropharyngeal)**
- **Get your intubation stuff ready:**
  - **Sucker**
  - **Drugs, and someone to give them**
  - **Laryngoscope with working light**
  - **Someone to do inline stabilization**
  - **Someone to apply the cricoid pressure: Back, Up and Rightward Pressure (BURP)**

The cricoid pressure is NOT RELEASED until the cuff is inflated

A DEFINITIVE AIRWAY is

1) an endotracheal tube
2) with an inflated cuff
3) taped to the patients face.

Blind nasotracheal intubation is contraindicated in patients with apnoea.
Seeing as you use their breathing to guide the tube

WHAT MAKES A DIFFICULT AIRWAY

- **the mnemonic LEMON:**
  - **L**ook for external factors, eg. fat neck, small jaw, fish mouth
  - **E**valuate with the 3-3-2 rule:
    - 3 fingers in the open mouth
    - 3 fingers from chin to hyoid
    - 2 fingers from floor of mouth to thyroid cartilage
  - **M**allampati score:
    - Grade 1 = see everything;
    - Grade 2 = see behind the uvula
    - Grade 3 = only see the base of uvula
    - Grade 4 = only see the hard palate
  - **O**bstruction? Eg. trauma, tonsillitis, abscess?
  - **N**eck mobility – virtually absent in the collared trauma patient

TECHNIQUE FOR RAPID SEQUENCE INDUCTION

- **get ready for a surgical airway just in case**
- **get the sucker ready**
- **get the ventilator ready**
- **get the tube ready – check that the cuff inflates**
- **get the laryngoscope ready – check that the lightbulb works**
- **preoxygenate with 100% oxygen**
- **Apply cricoid pressure**
- **Sedate with whatever is handy:**
    - **THIOPENTONE 1-5mg/kg, so ~300mg will usually do**
    - Duration is 5-10 minutes
    - Thiopentone will drop the blood pressure. If this is bad, you may use fentanyl instead, because it has very little effect on blood pressure. In a totally comatose patient, you may consider not sedating at all.
- **Paralyse with whatever is handy:**
    - **SUX 1-2mg/kg, so about 100 mg**
    - Duration is 5 minutes or so
    - **Or: ROCURONIUM 1mg/kg, so about 70-80mg**
    - Duration is 30 minutes! You better get the tube in.
    - We use roc because it has the most rapid onset, 1-2 minutes, and has a minor effect on heart rate.
    - Vecuronium has no cardiac effects but the onset time is 2-4 minutes.
    - We don't use pancuronium because it causes tachycardia and hypertension
- **INTUBATE when they relax**
- **Inflate the cuff and auscultate**
- **Relax cricoid pressure and ventilate**
- **Check for CO2 exhalation with a colorimetric capnographer**

SO, YOU FAILED TO ESTABLISH AN AIRWAY

KEEP TRYING:

- **Get a bougie; it dramatically improves your chances**

OTHERWISE…

- **Laryngeal Mask:** not a definitive airway, but you can ventilate through it while waiting for an anaesthetist to arrive. One generally assumes you always have an anaesthetist on the way.

SO YOU SOMEHOW MANAGED TO INTUBATE: but is it in the right place?

- **Listen to the chest; is the air entry equal?**
- **Capnograpy or colorimetry: non-specific; it proves that the tube is not in the oesophagus, but is it in the bronchus? It could be. How do you know?...**
- **Chest Xray is the only way to find out.**

SURGICAL AIRWAY: when nobody can intubate, or there is no normal anatomy any more.

- **NEEDLE CRICOTHYROIDOTOMY buys you time to think**
    - **Basically, jab a 12 gauge cannula into the cricothyroid membrane while aspirating, and wait until you hit air.**
    - **Then connect the cannula to 15L oxygen**
    - **Connect it with a Y-connector, so you can breathe with your thumb: 1 second on, 4 seconds off.**
    - **This is a CRAP MODE OF VENTILATION: there is not enough exhalation and thus CO_2 builds up.**
    - **Thus, you can only ventilate like this for 40 minutes maximum.**
- **SURGICAL CRICOTHYROIDOTOMY**
    - **Cut vertically above the cricothyroid membrane**
    - **Blunt dissect down to the layer of the membrane**
    - **Cut horizontally along the membrane**
    - **Insert a small 5.0 or 6.0 tube and inflate the cuff**

VENTILATION

OBJECTIVE SIGNS OF IMPAIRED VENTILATION:

- Asymmetrical chest wall excursion
- Decreased or absent air entry
- Tachypnea
- Pulse oximetry

So, say the patient is intubated already:

IS THE OXYGENATION ADEQUATE?

- Pulse oximetry will tell you the SaO_2 but not the PaO_2
    - It is unreliable in
        - poor perfusion
        - anaemia
        - hypothermia
        - blood pressure cuff is above the sensor
        - the sensor is on an injured extremity
        - carboxyhemoglobin or methemoglobin

IS THE VENTILATION ADEQUATE?

- Bagging and masking should be performed by 2 people where possible
-

Physiology and signs of Shock

- **First: recognize the presence of shock;**
- **Second: look for a cause of it while simultaneously treating it**
- **In trauma, the commonest form of shock is HAEMORRHAGIC**

Basic Physiology of cardiac output: familiar facts

- **Cardiac output = heart rate times stroke volume, in litres per minute.**
- **Stroke volume is influenced by preload, contractility and afterload.**
  - **Preload is the volume of venous return**
    - **VENOUS RETURN:**
      - **70% of the blood volume is in the venous circuit**
      - **The venous circuit is driven by pressure;**
      - **When blood volume is lost, the venous circuit suffers, and venous return is reduced.**
  - **Contractility is partially determined by preload – the Frank-Starling principle dictates that the more blood returns to the heart, the harder that blood gets pumped. So to speak.**
  - **Afterload** is the peripheral resistance of the arterial circuit.

TACHYCARDIA: earliest measurable sign of volume depletion

- **This is an attempt to maintain cardiac output (seeing as venous return decreases)**
- **Thus, you replace volume, and the heart rate reduces if you replaced enough of it.**

REPLACE VOLUME! Inotropes are useless; remember:

DEFINITION OF SHOCK IS INADEQUATE TISSUE PERFUSION (WITH OXYGEN)

Inotropes actually make the tissue perfusion worse; it's a loss of volume that's at fault, not vasodilation, so vasoconstrictors really have no role to play.

Shock in a trauma patient mandates immediate surgical involvement

Is my patient in shock?

- **TACHYCARDIA is usually the first sign**
- **CUTANEOUS VASOCONSTRICTION** is usually the next sign
  - **At this stage, the patient begins to look like a typical "shocked" person, ashen-gray and tachycardic.**

A tachycardic trauma patient with cool peripheries is in shock until proven otherwise

The elderly, who are beta-blocked or have pacemakers, wont get tachycardic. Instead their pulse pressure will narrow, indicating a reduced cardiac output.

- **HYPOTENSION is a late sign, it means compensatory mechanisms have failed;**
  - **Usually at this point 30% of the blood volume is already lost**
- **Raised ABG lactate** is nearly always useless, but gives you an idea of how long the person has been in shock, and whether your management is improving perfusion. A severely shocked patient will have a lactate rise even AFTER good resuscitation, because of "washout" of lactate from the hypoxic tissues.

Why is my patient in shock?

It's a trauma patient. The shock is either hemorrhagic or non-hemorrhagic.
Its generally assumed that its going to be hemorrhagic 90% of the time.
Also, most patients with non-hemorrhagic shock will respond well to fluid resuscitation.

HEMORRHAGIC SHOCK is the default shock.

You assume the patient is hypovolemic, and treat the hypovolemia.
Large amounts of IV fluids is the key.
While you do this, you look for non-hemorrhagic causes.

NON-HEMORRHAGIC SHOCK

- **TENSION PNEUMOTHORAX**
  - **Picked up during the primary survey, or on chest Xray**
- **CARDIOGENIC**
  - **BLUNT CARDIAC INJURY with subsequent heart failure, picked up on ECG**
  - TAMPONADE with dilated neck veins and an effusion picked up on FAST or on the chest X-ray
  - AIR EMBOLUS
  - Myocardial infarction associated with hypovolemia (or perhaps the heart attack which caused the accident)
- **NEUROGENIC**
  - **NOT the result of an isolated intracranial injury! They don't cause shock.**
  - **Rather, the result of spinal cord transection**
  - **This is HYPOTENSION WITHOUT TACHYCARDIA**
  - **The peripheries will be WARM.**
  - **You usually can predict when this is going to happen during the "D" part of the primary survey, when you notice your patient cant move.**
- **SEPTIC SHOCK**
  - **Usually the result of waiting for transfer for too long, or penetrating abdominal injuries.**

Losses from fluid shifts: not only hemorrhage, but oedema, also contributes to loss of volume.

Haemorrhagic shock in the trauma patient

Circulating volume: 7% of total lean body weight (adjust this in obese people)
For kids, its 9% of lean body weight

Hemorrhage is classified according to clinical signs.
Volume replacement rate does not rely on this initial classification.
The replacement rate should be guided by response to replacement.

- **CLASS 1 HAEMORRHAGE:**
  - **15% of blood volume is lost**
  - **Mild tachycardia** is the only sign
  - **Blood volume is restored within 24 hours**
  - **May not need fluid replacement**

- **CLASS 2 HAEMORRHAGE:**
  - **15-30% of blood volume is lost: 750 to 1500ml of blood**
  - **Tachycardia**
  - **Tachypnoea**
  - **Narrowed pulse pressure**
  - Urinary output may not be affected!

- **CLASS 3 HAEMORRHAGE:**
  - **30-40% of blood volume is lost – around 2000ml**
  - **Marked tachycardia**
  - **Tachypnoea**
  - **Hypotension**
  - **Significant changes in mental state**
  - **Significant drop in urine output**

- **CLASS 4 HAEMORRHAGE:**
  - **Over 40% of blood volume is lost**
  - **Massive tachycardia**
  - **Extreme hypotension**
  - **Unobtainable diastolic pressure**
  - **Negligible urine output**
  - A loss of over 50% of blood volume causes a loss of consciousness

WHY IS THIS IMPORTANT?

If a medically normal 70kg trauma patient arrives to ED with a low systolic blood pressure, you can work out that they must have lost AT LEAST 30% of their blood volume (30% of 5L = 1.5 litres)

This helps you work out how much you need to replace, with the "3 for 1" rule.
I.e. this guy will need 4.5 litres of crystalloid to resuscitate.

Initial management of haemorrhagic shock in the trauma patient

STEP 1: STOP THE BLEEDING. If you know where it is.

AIRWAY and BREATHING: get 100% oxygen into them

CIRCULATION: control bleeding from external wounds by direct pressure

may want to get them in a pelvic compression sling if the pelvis is fractured

DISABILITY: look for spinal trauma; could this be spinal shock?

EXPOSURE: look for sources of bleeding elsewhere; try to keep them warm as you do this

GASTRIC DECOMPRESSION:

- most important in children, who get gastric dilation for some reason.
- In adult trauma, the stomach also dilates. You need to prevent aspiration.

URINARY CATHETER:

- Assesses for genitourinary trauma (hematuria)
- Monitors the perfusion of the kidneys, thus monitoring response to fluids

VASCULAR ACCESS

- 2 x 16 gauge cannulas
- Rate of flow through a tube is proportional to the forth power of the radius, and inversely proportional to its length
- Best spots are the cubital veins
- All else fails: saphenous cutdown, intraosseous or central venous access

INITIAL FLUID THERAPY

- Warm saline, 2 litres, or 20ml/kg for kids
- Initially, as fast as it will go
- The response to this challenge will determine the next steps.

The 3 for 1 rule:
For every 1 litre of blood lost, replace 3 litres of crystalloid

The above is a vague estimate.
HOWEVER, if the patient fails to respond to an estimated volume, you need to reassess the situation to figure out what the other causes of shock might be

In penetrating trauma with haemorrhage, you may want to delay giving tons of crystalloid until the bleeding is controlled.
This is because aggressive volume replacement can make the bleeding worse.

So now, you have a patient with an established airway, ventilating satisfactorily, and fluids are running into both arms. Next steps:

EVALUATION OF RESPONSE

all the signs of shock should start to go away; but this is not very sensitive.

- **URINE OUTPUT: the best monitor of organ perfusion**
  - **For adults, you should get 0.5ml/kg/hr, or around 35-40ml/hr for a 70kg man**
  - **For kids, its 1ml/kg/hr**
- **If you have central access, CVP is probably better than urine output.**

- **ACID-BASE BALANCE:**
  - **Initially, the trauma patient will be alkalotic from hyperventilating.**
  - **Long-standing or severe shock may produce metabolic acidosis.**
  - **Base deficit and lactate are good markers of this.**
  - **They can also be used to monitor improvement; the base excess should get less negative, and the lactate should drop.**

Rapid response: a return to hemodynamic normality

- this means they probably lost 20% or less of their blood volume
- slow the fluids down to a maintenance rate, and get the surgeon
- get cross-matched blood for these patients.

Transient response: perfusion indices improve, and then deteriorate again

- this means they probably lost 20-40% of their blood volume
- CONTINUE the fluids at their original rate
- ALSO GET TYPE-MATCHED BLOOD- transfusion is needed
- They are clearly still bleeding. Get the surgeon.

No response:

- the patient is clearly exsanguinating
- **immediate definitive management is needed**
- consider non-hemorrhagic causes of shock at this stage (did you miss a tamponade or tension pneumothorax?)

MODIFY RESUSCITATION ACCORDING TO THE RESPONSE

all the signs of shock should start to go away; but this is not very sensitive.

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DOES MY PATIENT NEED BLOOD PRODUCTS?

- **Get cross-matched blood for patients who are rapid responders**
- **Get type-matched blood for transient responders**
- **Get O-Negative blood for exsanguinating non-responders**

Brain-injured patients will have worse coagulopathy because the dying brain releases tissue thromboplastin, which activates the extrinsic pathway and causes consumption coagulpathy

COAGULOPATHY:

- **Severe injury = consumption of coagulation factors**
- **Massive transfusion of packed cells and crystalloid = dilution of coagulation factors**
- **Thus, you monitor their coags, fibrinogen and platelet count.**
    - **Coags / fibrinogen becoming abnormal = Fresh Frozen Plasma or cryoprecipitate**
    - **Platelets being depleted = platelet transfusion**

THINGS TO THINK ABOUT

- **Don't mistake blood pressure for a measure of cardiac output.** It doesn't say anything about tissue perfusion.
- **Elderly patients wont get tachycardic.** CVP monitoring is best for these people
- **Patients with pacemakers wont get tachycardic** and CVP monitoring is the best way to monitor how well you have filled them with fluids
- **Athletes will compensate for blood loss in a remarkable way,** and then crash horribly. Usual responses to hypovolemia may be absent until its too late.
- **Pregnant women are hypervolemic** and will not manifest hemodynamic changes until they lose a hugely dangerous amount of blood.
- **HYPOTHERMIA cause coagulopathy and prevents normal responses to resuscitation** so warm the patient and warm their fluids

REASSESSMENT: COMPLICATIONS OF RESUSCITATION

- **The commonest complication is INADEQUATE REPLACEMENT.**
- **The commonest reason for poor response to fluids is ONGOING HAEMORRHAGE**

MONITORING THE CVP:

- **Its also an indirect measure of cardiac function.**
- Cardiac function is actually the relationship between stroke volume and ventricular end-diastolic volume
- **Initially measured CVP may be inaccurately high,** especially in patients with COPD, pulmonary fibrosis, generalized vasoconstriction, or patients who were given vasopressors.
- **If you replace fluids aggressively, and the initially low CVP has only A MINOR RISE, these people should be placed in the "non-responder" category.**
- **If the CVP just keeps dropping, you need to keep replacing fluid, your patient is probably still bleeding somewhere. These people should be placed in the "transient responder" category**
- **If the CVP rises abruptly and keeps going up, you are either**
    - **Replacing enough fluids**
    - **Replacing too much fluids**
    - **Or, the cardiac function is compromised:**
        - **TAMPONADE**
        - **TENSION PNEUMOTHORAX**
        - **Poor positioning of the CVP sensor probe**
- **Athletes will compensate for blood loss in a remarkable way,** and then crash horribly. Usual responses to hypovolemia may be absent until its too late.
- **Pregnant women are hypervolemic** and will not manifest hemodynamic changes until they lose a hugely dangerous amount of blood.
- **HYPOTHERMIA cause coagulopathy and prevents normal responses to resuscitation** so warm the patient and warm their fluids

Thoracic Trauma in the PRIMARY SURVEY

- some FACTOIDS:
  - 10% of blunt injuries and 15-30% penetrating chest injuries need thoracotomy

Things you pick up in the primary survey:

AIRWAY OBSTRUCTION:

- Laryngeal fracture:
  - Hoarseness
  - Subcutaneous emphysema
  - Palpable fracture
- Upper chest injury with POSTERIOR DISLOCATION OF THE CLAVICLE
  - This causes the airway to be obstructed by the head of the dislocated clavicle
  - You need to reduce this, or you wont be able to ventilate
  - You can either hyper-extend the shoulders, or grab the clavicle with something like a clamp or towel clip, and manually drag it anteriorly, out of the airway.
  - This reduction will usually be stable after you do this.
- Upper chest injury with POSTERIOR DISLOCATION OF THE CLAVICLE
  - This causes the airway to be obstructed by the head of the dislocated clavicle
  - You need to reduce this, or you wont be able to ventilate
  - You can either hyper-extend the shoulders, or grab the clavicle with something like a clamp or towel clip, and manually drag it anteriorly, out of the airway.
  - This reduction will usually be stable after you do this.

BREATHING and VENTILATION: this is where the money is.

- NUDITY IS VITAL.

  You need to get a good look at
  - Neck veins – distended in tamponade or pneumothoroax
  - Chest wall movements
  - External chest injuries
- Cyanosis
- Tachypnoea
- YOU ARE LOOKING FOR 5 THINGS:
  - Tension pneumothorax
  - Open pneumothorax
  - Flail chest
  - Pulmonary contusion
  - Hemothorax

CIRCULATION:

- This is where you pick up
  - Massive hemothorax
  - Cardiac tamponade

INJURIES YOU NEED TO FIND IN THE PRIMARY SURVEY

Tension pneumothorax

- Most common cause: positive pressure ventilation in an intubated patient.
- Everyone knows the signs, but lets go though them anyway:
  - FALLING CARDIAC OUTPUT
  - DILATED NECK VEINS
  - TRACHEAL DEVIATION
  - TACHYPNOEA
  - HYPER-RESONANT HEMITHORAX ON PERCUSSION
- **This is a clinical diagnosis. DON'T WAIT FOR X-RAYS**
- **LARGE NEEDLE in the 2nd intercostal space, midclavicular line.**
- That buys you time; you convert a tension pneumothorax into a simple pneumothorax.
- The idea is to finish your primary survey and get a chest drain in.

Open pneumothorax

- This is a large obvious defect in the chest wall.
- If the hole is bigger than two thirds of the tracheal diameter, air will preferentially use the wound to enter the chest. This is not ideal.
- **FLAP DRESSING: close the wound with a sterile dressing, with one free end which will act s a valve**
- **CHEST DRAIN is the definitive management. Place it far from the wound**

Flail chest and pulmonary contusion

- Once you have exposed your patient, large flail segments will become obvious
- TWO PROBLEMS:
  - Abnormal chest wall movement – which alone contributes little to hypoxia
  - Underlying lung injury – pulmonary contusion – contributes to hypoxia
  - Also, pain of the broken ribs is counterproductive to respiration.
- **There may be paradoxical movement of the chest wall**
- **OR, there may be RESTRICTED movement, because of "splinting"** i.e. the patient tries not to inhale too much
- **Management: OXYGENATION and ANALGESIA**
  - **ANALGESIA better be good; epidural, intercostal block, PCA**

Massive Hemothorax

- Until you get xrays, you may not know about it;
- In a supine patient, xrays may not be obviously suggestive of hemothorax
- You might have creps in the bases, you might not
- **HOWEVER, the main indication of hemothorax is a continuing and puzzling failure to respond to fluid challenges;** and then you find absent breath sounds….

YOU NEED A CHEST DRAIN. **If over 1500ml comes out, you need a thoracotomy.**
If your patient fails to respond or only transiently responds to fluids, you need a thoracotomy

Medial penetrating injuries alert you to the possibility of this: the greater vessels may have been injured.

Cardiac Tamponade

Cardiac Tamponade

- **Hard to pick up: the history of the injuries will give you best indications.**
- **PENETRATING INJURIES, eg. stingray barb stabwounds, are the biggest risk factor**
- **BLUNT INJURIES can cause tamponade because of vessel disruption**

Beck's Triad

- **increasing venous pressure –** distended neck veins
- **decreasing arterial pressure**
- **muffled heart sounds**

- Hmm, the neck veins wont be distended in a hypovolemic trauma victim
- The heart sounds will not be easily audible in a noisy ED resus bay
- Tension pneumothorax can mimic all of the above, esp. on the left side.

Kussmauls Sign

- **When breathing spontaneously, venous pressure RISES with inspiration**
- **This means, venous blood cant really return to the heart; when the intrathoracic pressure decreases in inspiration, instead of filling the right ventricle the venous blood pools in the JVP (it has nowhere to go, because the tamponade prevents filling of the floppy right ventricle)**

- **To get a proper Kussmauls sign, you need to see the JVP (not likely in a stiff-collared patient) or a CVP measuring probe (unlikely to be available during the primary survey)**

FAST ultrasound echo:

- **assesses the "collapsing" right ventricle**
- **may show an actual fluid layer in the pericardium**
- **HAS A 5-10% FALSE NEGATIVE RATE.**

- **If there is a surgeon on hand, the patient needs to go to theatre for definitive management of this.**
- **If there is no surgeon, pericardicentesis can relieve the tamponade TEMPORARILY. Its not a definitive treatment.**
- **You may try to insert a flexible catheter into the pericardial sack while waiting for surgery**

YOU NEED TO GIVE FAST FLUIDS. It wont fix anything, but it might maintain the failing venous return.

Resuscitative thoracotomy

So, your patient has PEA or is in cardiac arrest.

CPR is useless in a hypovolemic patient.

PATIENTS WHO ARRIVE TO ED

- **with penetrating chest injuries** **BLUNT INJURIES DON'T QUALIFY**
- **without a pulse**
- **with cardiac electrical activity**

ARE CANDIDATES FOR RESUSCITATIVE THORACOTOMY

- **A SURGEON MUST BE PRESENT FOR THIS**

Patients with penerating chest injuries who need CPR in the field need to be assessed for signs of life. This means

- **reactive pupils**
- **spontaneous movements**
- **spontaneous ECG activity**

If they have none of those, resuscitation efforts should cease.

WHAT DO YOU ACCOMPLISH WITH A RESUSCITATIVE THORACOTOMY:

- **Evacuation of the pericardial tamponade**
- **Direct control of thoracic hemorrhage**
- **Open cardiac massage**
- **Cross-clamping of the descending aorta to increase supply to the brain and heart, and to decrease blood loss below the diaphragm**

Thoracotomy in ED is rarely effective.

Stab wounds survive more often than gunshot wounds

In general survival rate is 18% to 33%

"The surgeon who should attempt to suture a wound of the heart would lose the respect of his surgical colleagues" - Theodore Bilroth, 1882 – from this online articlehttp://www.trauma.org/archive/thoracic/EDToperative.html

This source also wisely advises, *"The first time you see a Gigli saw should not be the first time you perform a thoracotomy."*