

Diagnostics and Imaging of the Trauma Patient

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1) Initial stabilization is the most immediate concern

- Keep in mind that the animal may present in compensatory shock and may appear normal
- IV catheter placement initially is helpful should the patient decompensate
- A full physical is your first step in diagnosing the main problem
- Once the patient is stable think about imaging

2) Decide where to look first

- Fractured bones, especially when it's an open fracture, draw attention quickly. However these fractures are unlikely to cause death unless significant hemorrhage is present.
- Significant bleeding should be addressed, but otherwise the patient should be assessed for internal injury rather than stabilizing the fracture.
- Look at the clinical picture of the animal, dyspnea could indicate a thoracic injury, obtunded mentation despite sufficient fluid resuscitation could indicate brain trauma
- Wounds localized mainly to hind limbs point toward abdominal/pelvic injury
- Wounds localized mainly to forelimbs hint toward possible thoracic or brain trauma

3) Look at the whole patient

- Although certain hallmarks can give you an idea of where to start looking, keep in mind that hidden injuries could be anywhere on the trauma patient
- Remember that the patient can decompensate after initial treatment of shock, be ready for anything (fluids, drugs, intubation materials, etc.) and don't forget to monitor vitals during imaging

4) Imaging

- X-rays and ultrasound can be very useful to find hidden injuries
- Sedation may be necessary to obtain diagnostic films, there is a risk involved with sedating a compromised patient but causing stress with physical restraint could be just as detrimental
- Have reversal agents ready in case the need arises
- Pulmonary contusions take 4-6 or up to 24 hours to show up on x-rays, judicious IV fluid administration is recommended if present
- Hemothorax/pneumothorax can be seen on x-rays and u/s. Thoracocentesis may be necessary, significant respiratory signs usually seen when >20ml/kg of fluid or air is present
 - Hemo/pneumothorax is usually self limiting in the trauma patient but repeated chest taps may be required, chest tubes may be necessary, and blood products may be needed if patient loses significant amounts of blood
 - Compare PCV of fluid to PCV of peripheral blood. If fluid PCV is greater than peripheral PCV, an active bleed is likely. The fluid should not clot.

- Rib fractures can be seen on x-rays, often causes dyspnea. Can cause pneumothorax if it's an open fracture. Sometimes a sucking sound can be heard through the puncture wound while the animal breaths.
- Diaphragmatic hernia can be diagnosed when abdominal organs are seen in the chest on x-rays. Organs may slide in and out of the chest, so x-rays could miss this diagnosis
 - Patients with diaphragmatic hernias can range from nearly asymptomatic to very dyspnic, some will do better if front end is kept elevated, increased thoracic effort may be seen to compensate for the diaphragm's impairment
 - Sometimes accompanied by significant pleural effusion which can obscure x-ray image and hide the presence of a hernia
 - Suspect a hernia if the full contour of the diaphragm cannot be seen
 - U/S can be used to visualize the hernia, but this can be difficult
 - A contrast study may be required if a hernia is suspected but can't be visualized
 - Liver, stomach, small intestine, and/or spleen are the most common organs involved
- Hemoabdomen shows up as loss of detail on x-rays, fluid seen on U/S, may be accompanied by abdominal distension
 - Abdominocentesis can help to diagnose and characterize the hemoabdomen
 - Compare PCV to that of peripheral circulation. Abdominal fluid should not clot, if it does clot the sample taken likely struck a vessel or organ, or it is possible that the abdominal bleed is active and rapid
 - Use of ultrasound to collect sample can help to ensure quality of sample. Also ultrasound abdomen to look for actively bleeding masses or organs.
 - If PCV of fluid is greater than that of peripheral circulation, it is indicative of an ongoing bleed. Serial monitoring of abdominal fluid and peripheral PCV is important, if abdominal PCV continues to climb an exploratory laparotomy may be necessary. Also patient may require blood products.
 - Look for intracellular bacteria which would indicate a septic abdomen
- Check for integrity of urinary bladder, intestines, and gall bladder among other organs with both x-rays and ultrasound
 - Pelvic fractures increase the likelihood of urinary bladder rupture
- Spinal luxations and fractures can often be seen on x-ray
 - Use caution when moving any animal with suspected spinal injury
 - Symptoms can range from slight ataxia to tetraplegia/deep pain negative
 - May not always show up on x-rays, CT or MRI may be required
 - Intervertebral disc extrusion requires CT or MRI to diagnose
 - Can be extremely painful

- Skull fractures can sometimes be seen on x-ray but soft tissue damage or swelling of the brain will require MRI or CT to diagnose.
 - Care should be taken in potential brain trauma patients to not increase intracranial pressure. Judicious crystalloid administration to treat shock symptoms, use colloids if able.
 - Treat seizures with 0.5mg/kg diazepam
 - Assess mentation and PLR for signs of herniation, Mannitol may be required.
- Remember that diagnosing any one of these conditions does not rule out any of the others. Continue to look at the whole clinical picture of the patient for new developments.
 - Continue to check the patient's PCV/TS, blood glucose, and lactate routinely, this can help to find a problem that imaging might not show.
 - Don't forget about pain management
 - If in doubt supplement with oxygen

Procedures:

- Thoracocentesis
 - Materials: Butterfly or over the needle catheter (22-16 gauge), 3-way stopcock, extension set, large syringe, sterile gloves, clippers, chlorhexadine and alcohol scrub, canister for fluid
 - Sedation may be needed in fractious patients but it is often well tolerated by the animal
 - First, clip and prep the area to be tapped. Aim for the 7th or 8th intercostal space, if fluid is to be tapped aim more ventral than center, if air is to be tapped aim just dorsal to this area.
 - Have one person who will be sterilely gloved place and hold the needle still, a second person will hold the syringe and draw the fluid/air.
 - The sterilely gloved person will palpate the intercostal space and horizontally place the needle keeping in mind that the vasculature runs on the caudal side of the ribs, so place the needle just cranial to the rib. While advancing the needle a "pop" will likely be felt as you advance into the thoracic cavity.
 - Once into the cavity rotate the needle ventrally so that it is parallel to the thoracic wall. Now the second person works the syringe and stopcock to remove as much of the air/fluid as possible. Keep track and record the amount removed.
 - When negative pressure is felt the needle holder can turn the needle like the hand of a clock careful not to lacerate the lungs while the syringe holder lets suction off and on. It is recommended to use minimal pressure when pulling back, about 3-5ml at a time, for patient comfort.
 - It is occasionally necessary to perform an auto transfusion in cases where the patient has acutely bled a large amount of fluid with a relatively high PCV into either the thorax or abdomen. In a case like this, tap as previously mentioned and as soon as one syringe of fluid has been drawn, give the blood sterilely through an IV catheter back to the patient. Be sure to use a blood filter to catch any clots that may be in the fluid. Keep track of the amount of fluid drawn and given back to the patient. Continue to monitor the patient closely during this process and check PCV's often after completion and thereafter.

- Nasal Oxygen
 - Materials: Red rubber catheter (5F-10F depending on the size of patient), proparacaine drops or lidocaine, sterile lube or lidocaine jelly, oxygen source with flow meter, sterile tubing, suture, skin staples, marker, Christmas tree or adapter to fit red rubber to O2 tubing.
 - First measure red rubber from the tip of the nose to the medial canthus of the eye, use marker to make a line on the catheter at that point. Use the largest catheter that will fit the patient.
 - Place a few drips of proparacaine or lidocaine into the nostril and let it set for a couple of minutes.
 - Aim red rubber ventromedial in the nostril to pass through the ventral meatus. If catheter won't advance or crunching is felt, the catheter is likely in the wrong place. Pressing dorsally on the nose with the other hand can aid in passing the catheter ventromedially and through the meatus.
 - Pass catheter to the point of the previously made mark, bend the rest of the catheter laterally under the commissure of the nose and suture, glue, or staple in place. Our normal protocol is to fingertrap suture at the end of the nose and use skin staples to secure over the head between the eyes.
 - Connect O2 and run at a rate that the patient will tolerate and helps with their dyspnea, bilateral placement may be needed to provide the desired effect.
 - We use water diffusers to humidify the oxygen so that the patient's mucous membranes aren't overly dried out.

- Abdominocentesis
 - Materials: clippers, chlorhexadine and alcohol scrub, 22 or 20g needles, syringes, ultrasound, and blood collection tubes.
 - Abdominocentesis is usually done diagnostically rather than therapeutically. Therefore only a few milliliters of fluid are usually pulled. However if large amounts of fluid are present and the patient would benefit from the removal of the fluid, a therapeutic centesis can be performed. There is also the possibility of needing to auto transfuse (as discussed under thoracocentesis).
 - First, clip the hair of the ventral abdomen with the animal in lateral recumbency and aseptically prep the site.
 - If ultrasound is available, find a pocket of fluid with the ultrasound and advance needle with syringe attached into the fluid pocket and aspirate. If therapeutic abdominocentesis is to be performed, use of extension set and 3-way stopcock as described under thoracocentesis is beneficial. Place fluid in purple and red top tubes. If bloody make sure the red top doesn't clot. If it does clot a blood vessel or an organ have likely been hit by the needle.
 - If ultrasound is not available a blind abdominocentesis can be performed by placing 22 or 20g needles into the four quadrants of the abdomen. Fluid will often drain from the needle with no aspiration. Catch fluid in purple top and red top tubes for fluid analysis. Suction with a syringe can be used if fluid does not drain out.

If you have any questions please feel free to email me at dvander4@utk.edu