

Approach to Trauma

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Trauma is an exceedingly common presenting complaint in small animal emergency medicine. The basic tenets of emergency medicine focus on the primary survey, including the evaluation and stabilization of the major body systems (heart, brain, lungs) and then the secondary survey with complete patient evaluation. The goal of this talk is to assume understanding of these major principles and to focus upon some tips to promote success in global care of the trauma patient and then specifically in the thoracic trauma patient. These include categories, include the “try not to miss something category” and the “specific injuries category” as well as the “try not to make anything worse category”.

In the **Try not to miss something** category, the following tips are potentially useful.

1. **Look at the total solids, particularly in dogs.** Major trauma is a common cause significant blood loss, but this can occasionally be hard to fully appreciate due to splenic contraction which will temporarily raise the hematocrit. Specific common sites of bleeding include hemoabdomen, and retroperitoneum, and bleeding into fracture sites. Total solids of less than 6 gm/dl (60 gm/L) warrant further evaluation, especially if coupled with persistent tachycardia. Occasionally, pre-existing diseases may result in hypoproteinemia (PLE/PLN etc) but the safest approach is to assume hemorrhage.
2. **Learn Focused Assessment with Sonography for Trauma (FAST).** Abdominal and thoracic ultrasonography is very useful for determining if there is free blood in the abdominal cavity or free blood or pneumothorax in the chest. The concept of FAST scanning in veterinary medicine was further described by Boysen and colleagues, and since that time, multiple studies have documented its utility. Following initial patient survey, and institution of resuscitative measures, a standardized approach to a using ultrasound will help identify fluid more quickly. Most ER practices recommend a brief (< 2 hour) training seminar to cover the basics of imaging, and then a short period of a supervised experience. FAST involves a limited use of ultrasound to answer the question ‘Is there fluid or not?’ and is not designed to evaluate the entire cavity being scanned. The ER clinician should learn specific sites to scan and record these in the medical record. T- FAST refers

to screening the chest for either free air (traumatic pneumothorax) or pleural effusion/pericardial effusion. It is harder to appreciate pneumothorax than effusion. Recall that significant volumes of pleural effusion are more likely to result in signs of hypovolemia than respiratory embarrassment as pleural effusion in trauma is typically blood, although injury associated urinotorax, and bilothorax have rarely been reported.

3. **Learn to use lactate and lactate clearance to help monitor patients.** Lactate elevations in the emergency service primarily reflect tissue hypoperfusion, although other causes such as neoplasia and some drugs may also result in a type B (non-hypoperfusion related) increase in lactate. Recall that seizures or struggles during blood collection (eg. Muscular activity; normal behavior in Jack Russell Terrorists) may result in increased lactate values. Changes in lactate, including failure to normalize, can help alert emergency personnel to dynamics in patient status. A reasonable protocol includes
 - a. Baseline lactate at admission- if < 2.0 mmol/l; treat as clinically warranted and monitor for evidence of hypoperfusion such as tachycardia, tachypnea or altered mentation. Recheck lactate in clinical signs suggests changes.
 - b. Baseline lactate at admission > 2.0 mmol/L.
 - c. Lactate clearance studies
4. **Chest radiographs are a really good idea.** This is specifically true in thoracic trauma. Abdominal films are unlikely to add more information than ultrasound and clinical examination unless there is evidence to the contrary (eg. Ruptured bladder suspect). Chest radiographs are of importance to look for evidence of diaphragmatic hernia, which should be promptly repaired surgically, and for the evaluation of pneumothorax and pulmonary contusion. There is occasionally debate in the literature as to the timing of the chest film, due to the idea that pulmonary contusions get worse in the first 12-24 hours as pulmonary hemorrhage recruits some inflammatory infiltrates. However, clinically, the changes in radiographic appearance are of limited significance. Dogs and cats with severe (eg. life-threatening) contusions will have marked distress shortly after injury.
5. **Remember to see if the legs work.** Spinal fractures are often associated with a poor prognosis, and long bone fractures may be very expensive to repair. It is wise to ask the client if they have seen the patient walk since the accident, if they did walk, it is much less likely there is severe orthopedic disease. Animals laterally recumbent with a Schiff-Sherington position should be quickly evaluated for neurological function in the hind limbs, as this posture is characteristic of spinal fracture. Dogs with spinal fractures with intact sensation have a good to excellent prognosis but dogs with the loss of deep pain sensation have a grave prognosis for return to function.

6. **Don't be afraid of the transfusion or transfuse early/transfuse often!** Recall in trauma that the day started out good, meaning that in the vast majority of animals with trauma, a PCV that is less than 30% is suggestive of severe loss. Thus, if you see a 3 year old lab with a PCV of 27% on presentation, this likely represents close to a 40% blood loss! The impact of fluid dilution is hard to predict. In a non-bleeding dog, the addition of 30 ml per kg of crystalloid could be expected to lower the PCV from 50 to 37% until redistribution occurs and the PCV returns to normal. If you transfuse early, you may be able to avoid playing "catch-up" later. Additionally, avoiding microvascular hypoperfusion may prevent disseminated intravascular coagulation or systemic inflammatory response syndrome. Type specific blood is required in cats, and appealing but not required in first transfusions in dogs. Plasma transfusions are ideally given at a rate of 1:1 with pRBCs, however, this may not be financially or practically feasible. Some practices are evaluating the use of thromboelastography in trauma patients as a marker of coagulopathy.
7. **The number one rule-out for oliguria is inadequate volume resuscitation.** While ruptured urinary tracts are possible, it is much more likely to under-estimate the fluid demands of a trauma patient in the first 8 hours. Urine production should be considered in the face of the volume of fluids given, not just in the > 2 ml/kg/hr. Hypovolemia should be excluded prior to extensive diagnostic efforts.

Specific Injuries

8. **Slow rollovers** have a higher likelihood of ruptured bladders and diaphragmatic hernias as these injuries are more common when the pressure on the structure is slowly increased and maintained. Ruptured bladders may be diagnosed via imaging, or through evaluation of abdominal fluid. Abdominal fluid in specific will have higher potassium and creatinine values than serum. Abdominal effusion from ruptured bladders tend to cause marked pain from chemical peritonitis, seemingly more so than from straight hemoabdomens. After the presence of urine in the abdominal cavity is established, imaging studies are warranted to localize the site of the tear. Most uroabdomens result from bladder tears, but other sources of leakage are also possible, such as the urethra or the ureters. It is of course desirable to know the sources of the leakage prior to surgery, as some repairs are much more challenging than others. For diaphragmatic hernias, radiographs are often adequate to highlight the tear; but when there are not, it is more challenging to establish the diagnosis, and may include ultrasonography, contrast studies or surgical exploration.
 - a. **Ruptured bladders** should be repaired when the patient is stable. There is not a benefit to delaying surgery; however, if the patient is unstable (hyperkalemic or shocky) simple placement of an abdominal drainage catheter is often very successful in controlling the electrolyte disturbances and uremia. Exchanges are not required but can be perused if desired.

- b. **Diaphragmatic hernia** should be repaired in a timely fashion. Older literature suggested to wait 24 hours until surgery, however, this was based on retrospective data that was flawed as dogs that were more severely injured often went to surgery urgently, and then died, so that non-survival was a side effect of severity of injury, not the timing of surgery.
9. **Degloving wounds looks bad, but most heal well.** Animals often have rapid healing in response very severe loss of skin and soft tissue. Hocks in particular with often look horrid; but will heal with bandage changes, often not requiring surgical stabilization (particularly in cats). Following cardiovascular stabilization, the patient should be anesthetized and the wound completely cleaned of debris and dead tissues. Wet to dry bandages should be applied until there is a clear tissue bed – recall that the role of the wet to dry bandage is to pull debris off with each bandage change. Therefore, when the wound is clean and beginning to granulate, a non-adherent bandage should be applied. The frequency of bandage change should be daily at first, then may be extended to every 2 or 3rd day. Bandage material can be pricy, and often time-consuming to replace the bandages, but wounds do tend to heal very well. It is important to ward off the urge to close wound that will be under “just a little” tension; these will invariably break down, and be more frustrating and expensive to treat. Antimicrobials are indicated until the tissue bed is healthy.
10. **It is hard to keep a young cat from healing.** Pelvic and distal limb fractures will heal with cage rest. Orthopedic injuries are often most appropriately treated with surgical fixation. However, in many cases, rest with result in a very functional outcome. Cats are MUCH less likely than dogs to suffer thoracic trauma and to subsequently survive to reach the hospital.
11. **One concept that is well worth implementing is protocol-driven resuscitation.** This involves creating a standing list of orders for each trauma patient, and to mandate that each step (goal) is reached prior to patient discharge. Veterinarians as a group tend to prefer to be independent; however, emergency practices are often staffed by newer or less experienced clinicians and technicians. However, even experienced clinicians are prone to fatigue, distraction and complacency. Minimizing errors is a vital step in improving patient care and has been shown to be life-saving and fiscally wise in human medicine. The role of specific protocols in emergency medicine remains to be determined. However, a simple option might be as follows:

Proposed Trauma protocol

Alert senior clinician and technician of impending arrival and ETA if known. If possible, have ready area prepared

Arrival

1. Immediate primary survey- heart, brain, lungs, obvious fractures/degloving. Place continuous EKG
2. Place 1-2 large bore IV catheters. Begin IV fluids at 20 ml/kg (crystalloids).
3. Collect samples for point of care testing- PCV/TS/Dextrose/Azo/Lactate at minimum, ideally to include more extensive testing.
4. If solids < 6 gm/dl (60 gm/l) actively look for hemorrhage; perform FAST exam of abdomen and chest, look for fluid, and pneumothorax.
5. Continue fluid resuscitation until HR < 140 bpm.
6. Titrate analgesics (pure opioids) to provide adequate pain relief.

Try not to make anything worse

The major ways to make trauma worse are **1) over-zealous use of fluids 2) failure to look adequately for all injuries/make sure they make sense and 3) Inappropriate repair of injuries or use of medications**

Fluid therapy is critical for adequate recovery from major injuries. It is essential to balance out intravascular volume requirements with the potential to create a dilutional coagulopathy and to have fluids extravasate.

- a. Early recommendation of “shock” dose fluids are currently considered flawed, as dilutional coagulopathy is a considered a real risk. Additionally, temporarily increasing intravascular volume may “pop” off the clot of a major bleed, resulting in hemorrhage and subsequent inability to clot. From a lung perspective, extravasated fluid affects gas exchange and may contribute to hypoxemia and to pulmonary failure.
- b. Recall that animal should walk with most injuries. If you detect a femoral fracture, but the dog will not walk on the other 3 legs, there may also be a pelvic fracture. If the front foot is dragging and the dog can't position it correctly, it is unlikely the buprenorphine he got 3 hours ago. The figure below showed a HBC dog with a temporary tracheostomy that was closed after the tracheostomy was removed. Note the SQ emphysema.

- c. NSAIDs, steroids and furosemide are excellent medications, but have little to no role in the acutely injured patient in whom cardiovascular stability can't be assured.