

Initial management of the trauma patient

Pilar Lafuente DVM, PhD, Dipl ACVS/ECVS, MRCVS
Dept. Veterinary Clinical Sciences, Royal Veterinary College, Hatfield, UK

ABSTRACT

When receiving a trauma patient, the clinician should approach the animal in a calm and methodical manner. Stabilizing the patient takes priority over any orthopaedic injury. Fluid and oxygen therapy should be initiated as soon as possible. Once the animal is stable, orthopaedic and neurological examinations can be performed. When open wounds are present, especially open fractures, initial management of these injuries should be carried out as soon as the patient is stable. The clinician should treat open wounds in aseptic conditions to prevent further contamination. Adequate preparation and abundant flushing of the wound are essential to decrease the contamination.

Surgical debridement of necrotic tissue is performed with a scalpel blade, preserving tendons and nerves. Protective bandages are applied when open wounds are present, and supportive bandages when a fracture is present.

Trauma patients may present to the emergency room in a wide range of states, ranging from stable patients with just mild bruises to unstable polytraumatized animals. Some injuries, such as wounds and fractures, are easily observed, but others may not be so evident. In order to minimize the chances of overlooking potential life threatening conditions, it is essential to approach the trauma patient in a calm and methodical way.

The first step we need to take is to assess the patient for potential life threatening and systemic conditions (Figure 1). The A-B-C protocol (Airway-Breathing-Circulation) is fundamental in determining whether an animal is stable or not, requires emergency intervention and what the initial treatment should be. It is vital to leave the obvious fracture to one side initially and concentrate on the systemic evaluation of the animal. Patients with fractures have usually sustained a severe trauma and frequently the fracture stabilisation needs to be delayed.

Depending on the status of the patient, boluses of fluids may be necessary if shock or hypotension is present. Crystalloid solutions, such as Normosol or Lactated Ringer's are the most commonly used. The shock dose is 60-90ml/kg/hour in the dog and 40-60ml/kg/hour in the cat. One quarter of this dose is given over 5-15minutes and then the animal is reassessed for signs of improvement before the next aliquot is given. Colloids



Figure 1: Physical examination of the trauma patient is essential.

can also be given as the primary resuscitation fluid in boluses of up to 22ml/kg in the dog and 5-10ml/kg in the cat. If both crystalloids and colloids are administered, these doses should be decreased. As oxygen delivery is diminished in animals in shock, oxygen therapy should also be started as soon as possible.

Analgesia of the trauma patient is important not only because of ethical reasons but also to prevent sympathetic stimulation and catabolic states.

Analgesia can be supplied in the form of drugs or other forms:

- **Drugs:** The most commonly used drugs are opioids (i.e. methadone: 0.2 mg/Kg, buprenorphine: 0.02mg/Kg, etc), and NSAIDs (i.e. meloxicam: 0.2mg/Kg, carprofen: 4mg/Kg, etc). However, the adequacy of these specific analgesics needs to be determined according to each case. For example, the administration of NSAIDs may not be adequate in animals in shock or with renal abnormalities.
- **Other modalities:** Analgesia can also be provided by immobilization of fractured limbs. Bandages reduce fracture instability and secondary pain, prevent further damage of tissues (soft tissues and bones) and decrease inflammation. The bandage is applied after the orthopaedic and neurological examination, and

the radiographic evaluation have been performed. It is necessary that this bandage immobilizes the joints proximal and distal to the fractured bone in order to provide adequate stability. Only fractures distal to the elbow and stifle can be correctly immobilized with Robert-Jones bandages.

Fractures of the humerus and femur would require spica splints. Given the voluminous musculature in these areas, fractures at this level are not routinely bandaged. Analgesia and cage rest are provided until definite stabilization of the fracture can be provided.

Once the animal is stable and anaesthetised, orthopaedic and neurological examinations can be performed. On occasions, these examinations are difficult to do in the conscious dog. The ability of the animal to walk is evaluated since it provides important information regarding his orthopaedic and neurological status. Reflexes, deep pain and cutaneous sensation are evaluated in the animal awake. Unfortunately conscious proprioception and other reflexes may be delayed when opioids have been previously given, so whenever possible, these should be checked prior to opioid administration.

A more thorough exploration can be done with the animal under sedation or general anaesthesia. Limb vascularization, sensation and pulses are checked in fractured limbs.

Radiographs are taken of the thorax and abdomen if necessary. If any abnormality is found during orthopaedic exploration, orthogonal radiographs of the affected limb/area are taken under sedation or general anaesthesia.

Quick survey radiographs can be taken in the conscious animal, which would help in the initial management of the patient and communication with the client. Diagnostic



Figure 2: a) Mediolateral and b) craniocaudal radiographs of a comminuted, open fracture of the radius and ulna in a dog.



Figure 3: CT scan of a cat with multiple skull fractures.

radiographs can be delayed until the time of surgical stabilization and then be taken with the animal under general anaesthesia (Figures 2a and 2b). In the presence of complex and comminuted fractures, radiographs of the contralateral limb would help the planning for the surgical repair of the fractured bone. Advanced imaging, such as Computed Tomography (CT) or Magnetic Resonance Imaging (MRI), is on occasions necessary to diagnose and plan surgical treatment of some fractures. CT modalities are especially useful in the diagnosis of fractures in the skull (Figure 3) or carpus/tarsus.

Fractures can be classified as closed or open, depending on the presence of skin defects.

CLOSED FRACTURES

There is no communication between the fractured bone and the environment. Fractures distal to the elbow or stifle can initially be immobilized with bandages. Robert-Jones bandages or splints are adequate for this purpose, but often require sedation or general anaesthesia to be applied. Fractures proximal to the elbow or stifle are difficult to stabilise with bandages. However, musculature is abundant in these areas and provide support of the fractured bone, so no bandages are generally applied.

If a bandage has been placed, it needs to be monitored frequently and changed if it gets wet or dirty, the patient is uncomfortable and tries to chew it, or swollen or cold toes are felt.

OPEN FRACTURES

The fractured bone is communicated with the environment through open skin wounds. These fractures are considered contaminated (Bacteria are present but they are not multiplying and causing tissue damage). An infected fracture is that where bacteria are multiplying and causing tissue damage. The 'golden period' is the period of time between contamination and infection, which is usually 6-8 hours after initial trauma.

Open fractures can be classified according to the degree



Figure 4: Grades of open fractures.

of soft tissue damage (Figure 4):

- **Grade I:** The skin is penetrated from the inside by the fractured bone, which then generally retracts. The wound is less than 1cm in diameter and the soft tissues are only contused. The contamination is low and if cleaned and flushed during the 'golden period', these fractures can be treated as closed fractures.
- **Grade II:** The wound occurs from outside and is usually larger than 1cm in diameter. The soft tissue damage is more extensive and the degree of contamination is higher than grade I open fractures.
- **Grade III:** There is extensive soft tissue damage that may require reconstruction techniques. There is often soft tissue avulsion, degloving or neurovascular injury.
- **Grade IV:** Soft tissue damage is massive and requires amputation.

Open wounds can be classified according to the degree of contamination into

- **Clean:** Surgical wound, created in aseptic conditions.
- **Clean-contaminated:** The degree of contamination is minimal and it can be easily removed. In this group we can include wounds from surgical procedures where the gastrointestinal, urinary or respiratory systems have been accessed.
- **Contaminated:** This wound shows abundant contamination with the presence of foreign material. Gunshots and fight wounds are included in this category.
- **Dirty/infected:** An infectious process is already present and the concentration of bacteria in the wound is superior to 10^5 bact/gram of tissue.

It is essential to clean and flush the wounds as soon as possible after trauma (in the 'golden period'), to decrease the risk of infection of the wound and bone. Infection

can compromise wound healing, bone healing and may systemically affect the patient. This initial management of wounds generally requires deep sedation or general anaesthesia of the patient, so it is vital to make sure the animal is stable before undergoing sedation/anaesthesia. Alternatively, regional or local analgesia can be used.

Initial management of open wounds and fractures entails some steps.

1. PREPARATION

It is important to use a sterile technique when managing open wounds and fractures in order to decrease the risk of further contamination or spreading bacterial contamination. People involved in the treatment of the wound need to wear sterile gloves, apron, mask and cap, and it is recommended that the patient is placed in a metallic table that allows flushing and draining. A wide area around the wound is to be clipped.

To prevent clipped hair from falling into the wound, sterile water-soluble lubricating gel can be applied in the wound before clipping and then be removed when flushing is done (Figure 5). The skin around the wound is scrubbed with chlorhexidine, taking care not to apply it inside the wound as it may delay healing.

2. CLEANING

For the flushing to effectively remove bacteria from the



Figure 5: Water-soluble gel applied to the wound before clipping.

wound, a pressure of 8psi needs to be achieved. Using an 18G needle and a 35cc syringe, allows obtaining this pressure level and it's the recommended technique. For a more efficient flushing, the bag of sterile crystalloids can be connected to a three-way-stopcock, which has the syringe and needle connected to different ends (Figure 6). Flushing should be abundant to be able to remove gross contamination of the wound. This should preferably be performed with sterile crystalloid solution. Using tap water in contaminated wounds has not been associated

with higher infection rates, however it may contain lead and selenium that could be cytotoxic. Antiseptic solutions that can be used are chlorhexidine diacetate in a concentration of 0.05% (1:40 dilution in saline) or iodine solution in a 1% concentration (1:10 dilution in saline).

Both are effective, but chlorhexidine solution has demonstrated a better reduction in the bacterial load. It is important to take a swab of the wound after flushing to be submitted for culture and sensitivity, so that the most appropriate antibiotic treatment can be administered.

3. DEBRIDEMENT

Debridement of the wound can be achieved by surgical, mechanical or enzymatic techniques: Surgical debridement:

- The degree of debridement varies depending on the type of wound and degree of injury and contamination. Incisions may not require debridement while wounds with severe tissue injury and contamination may require extensive debridement, or several sessions. Layer debridement is usually recommended over en-bloc debridement (removal of the wound as a block, leaving surgically created clean margins than can be closed primarily), as it allows progressive debridement and evaluation of viability of the tissues. Tendons and nerves are anastomosed; and bone fragments are left in place whenever possible. Any other



Figure 6: Flushing the wound with diluted chlorhexidine. A three-way-stopcock connects the syringe, needle and a bag with crystalloid fluids.

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References:
1. See diagram of larval 'Oryzlin, M.V. et al. Comparative Speed of ICE of Ictanectin, Imidacloprid, and Fipronil (S-Methoprene Spot-On Formulation) against Fleas on Cats. Veterinary Therapeutics Vol 6, No. 3 (2005 - 2006).
2. Phase Studies 29828-30-07-073 and 29828-30-07-183. *Milbemax® SPC
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Figure 7: Surgical debridement of skin with a scalpel blade.

necrotic or devitalized tissue is removed from the wound. Muscular tissue is especially sensitive to necrosis and it is debrided if it doesn't bleed, it is friable or it is devitalized. Skin is debrided according to its availability. Initially, it might be difficult to evaluate its viability due to the temporary vasoconstriction and oedema post injury. Viable skin may not bleed. Therefore, if in any doubt, cutaneous debridement should be postponed 48-72 hours until a clear color demarcation can be observed. It is recommended to use scalpel blade rather than scissors, as blades lead to less tissue injury (Figure 7).

- Mechanical debridement: It is performed by means of adherent bandages. Wet-to-dry (used in viscous exudative wounds) and dry-to-dry bandages (used in profuse exudative wounds) are most commonly used. Wet-to-dry bandages are composed of gauze moist with sterile saline that is applied directly over the wound (Figure 8). It is important to try to prevent the wet swab from covering intact skin around the wound, as this skin could become macerated. Then a dry layer of gauze is applied on top, which will work absorbing the exudate and drying-off the first layer (Figure 9). Mechanical debridement of the wound takes place



Figure 8: 'Wet-to-dry' bandage: moist gauze is applied over the wound.



Figure 9: 'Wet-to-dry' bandage: dry gauze are applied over the moist swabs to absorb the exudate.

when the primary layer is removed. In the dry-to-dry bandage, both layers are dry but, as it is applied in highly exudative wounds, the effect is similar to wet-to-dry bandages. Both bandages cause a mechanical debridement of the wound that is non-selective, harming the new regenerating cells and eliminating an exudate that is rich in growth factors and cytokines. Care should be taken when removing the contact layer, as debris from the gauze can be left in the wound. At least daily changes are performed and sedation of the patient is sometimes necessary as removal of the contact layer can be painful.

- Enzymatic debridement: This type of debridement plays a less important role in the treatment of open wounds in small animals. Some of the products that can be used are trypsin and chymotrypsin, which are applied topically. The advantages of enzymatic debridement include the fact that it does not require sedation/anaesthesia, and that it preserves important structures, such as nerves. Disadvantages include the higher cost, time requirement and frequently inadequate debridement.



Figure 10: Intermediate layer: application of cotton roll and conforming gauze.



Figure 11: Application of a splint to provide further support to the fracture.

4. PROTECTION

A protective and supportive bandage needs to be placed to prevent contamination of the wound, to debride the wound and support the fractured bone. Bandages should have three layers:

- Contact layer: Saline soaked or dry gauze in wet-to-dry or dry-to-dry bandages, or other non-adherent and moist retentive dressing material (i.e. hydrocolloids, hydrogels, honey, etc).
- Intermediate bandage layer: It absorbs exudates and provides support. The clinician can use cotton rolls or commercial products derived from cotton that are easier to apply. This cotton layer should be compressed carefully with conforming gauze so it provides support and compression to the fractured limb (Figure 10). In animals with fractures distal to the elbow or stifle, a splint can be applied to provide more support (Figure 11). If the open fracture is proximal to these joints, then a spica splint should be applied around the thorax or abdomen.
- Outer bandage layer: Porous and cohesive material are most commonly used (Figure 12). This layer prevents the exudate from getting in contact with the environment, avoiding contamination in both



Figure 12: Outer layer: Porous and autoadhesive material is applied.



Figure 13: The bandage is left open distally to evaluate the toes several times a day.

directions. It is important to leave the distal end of the bandage open so that the toes can be evaluated daily for any swelling or a decrease in temperature, signs of excessive tightening of the bandage (Figure 13). In areas of the trunk or other areas where a standard bandage may be difficult to apply, the bandage material can be stabilized with umbilical tape passed through suture loops located at the edges of the wound (Figure 14).

USE OF ANTIBIOTICS

1. Systemic antibiotic treatment

- a. Prophylactically: Antibiotic treatment is instituted as soon as possible, as it has been reported that it decreases the risk of infection if administered in the first three hours. Broad-spectrum antibiotics are initially given until the results of culture and sensitivity are received. The most common antibiotic drugs used are cephalosporins (22 mg/kg) or penicillins (15mg/kg); They can be administered intravenously during anaesthesia induction and then every 90 minutes intraoperatively.
- b. Therapeutically: Administration of antibiotics should be based on the results of the culture and sensitivity.



Figure 14: Bandage stabilization with umbilical tape through suture loops located at the edges of the wound.

The majority of the superficial infections are caused by *Staphylococcus* spp and *E. coli*, which are usually susceptible to cephalosporins (22mg/kg TID) or amoxicillin-clavulanate (15 mg/kg BID in dogs; 62,5mg BID in cats). Bite wounds are frequently contaminated by *Pasteurella* spp, so amoxicillin and ampicillin are generally adequate. Once granulation tissue is present over the wound, antibiotic treatment is not necessary.

2. Local antibiotic treatment

In general, these topical agents tend to interfere with the wound healing process, so its use is not generalized. Topical antibiotics that can be used include triple antibiotic ointment (bacitracin-neomycin-polymyxyn), nitrofurazone, silver sulfadiazine and gentamicin.

REFERENCES

1. Stanzani G, Otto CM: Shock. In Tobias KM, Johnston SA (ed): *Veterinary Surgery: Small Animals*. St Louis, Missouri, Elsevier. Saunders, 2012, pp: 73-93.
2. Piermattei D, Flo G, DeCamp C. *Handbook of small animal orthopedics and fracture repair*. 4th edition, Saunders, 2006.
3. Grant GR, Olds RB: Treatment of open fractures. In Slatter D. *Textbook of small animal surgery*. (ed 3). Philadelphia, WB Saunders, 2003, pp 1793-1797.
4. Waldron DR, Zimmerman-Pope N: Superficial skin wounds. In Slatter DH (ed): *Textbook of small animal surgery* (ed 3). Philadelphia, WB Saunders, 2003, pp 259-273.
5. Hosgood G: Open wounds. In Tobias KM, Johnston SA (ed): *Veterinary surgery: small animal*. Missouri, Elsevier Saunders, 2012, pp 1210-1219.
6. Dernel WS: Initial wound management. *Vet ClinNorth Am Small AnimPract*2006; 36(4): 713-738.
7. Campbell BG: Dressings, bandages, and splints for wound management in dogs and cats. *Vet ClinNorth Am Small AnimPract*2006; 36(4): 759-791.
8. Krahwinkel DJ, Boothe HW: Topical and systemic medications for wounds. *Vet ClinNorth Am Small AnimPract* 2006; 36(4): 739-757.

Reader Questions and Answers

1. A SIX-YEAR-OLD POMERANIAN DOG WITH A SUSPECTED OPEN FEMORAL FRACTURE ARRIVES TO YOUR CLINIC. WHICH OF THE FOLLOWING INITIAL MANAGEMENT STEPS IS INCORRECT:

- a) Systemic evaluation of the patient
- b) Placement of a Robert-Jones bandage
- c) Administration of opioids
- d) Lavage and debridement of wound

2. WHEN DEALING WITH OPEN FRACTURES:

- a) It is essential to clean and flush the wounds as soon as possible
- b) Limb vascularization, sensation and pulses are checked once the animal is sedated
- c) Antibiotic treatment is recommended once the results of the culture and sensitivity are back
- d) Dry-to-dry bandages are applied to viscous exudative wounds

3. DURING THE MANAGEMENT OF OPEN FRACTURES:

- a) A pressure of 18psi should be reached with the lavage fluids
- b) Using a 2% solution of chlorhexidine has demonstrated a better reduction in the bacterial load

- c) En-bloc debridement is recommended over layer debridement to decrease the risk of infection
- d) Tendons and nerves are anastomosed

4. PLACEMENT OF A BANDAGE BEFORE SURGICAL STABILIZATION OF THE FRACTURE:

- a) Provides analgesia to the patient
- b) Prevents contamination of open wounds
- c) Needs to immobilize the joints proximal and distal to the fractured bone
- d) All of the above

5. REGARDING THE USE OF ANTIBIOTICS WITH OPEN FRACTURES, CHOOSE THE INCORRECT SENTENCE.

- a) Cephalosporins can be used as prophylactic antibiotic treatment
- b) A sample for culture and sensitivity should be taken after cleaning the wound
- c) Intravenous antibiotics should be given every 60 minutes intraoperatively
- d) Topical antibacterial agents may interfere with the wound healing process

ANSWERS: 1. B, 2. A, 3. D, 4. D, 5. C.