WHEN CATS GO SPLAT: NURSING THE TRAUMATIZED FELINE

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The reported percentage of pet ER visits due to trauma varies considerably, with estimates ranging from 12-13% of total visits. Free-roaming animals, intact males, and young animals are more likely to experience trauma than those kept indoors or who are neutered/spayed. Trauma is defined by any bodily injury that results in tissue injury due to a violent event. Most traumas are accidental but some are intentional and these cases may require a more diligent documentation process. Trauma comprises both blunt and penetrating injury, burns, crushing injury, high rise syndrome, and a host of other presentations. In cats, ER trauma presentations commonly include vehicular trauma, dog attack, wild animal attack, fall from height, head trauma, spinal trauma, fan belt injury, strangulating/ligature injury, burns (thermal or chemical), and impalement/penetrating FB injuries. While there is a vast body of research devoted to human trauma, there are fundamental differences between veterinary and human trauma patients including the nature of the trauma, quality of prehospital care, management inside the hospital, financial resources available, and quality of life concerns. The Veterinary Committee on Trauma now exists with efforts made to establish a comprehensive database of veterinary trauma patients and to accredit veterinary trauma centers. The epidemiology of veterinary trauma warrants further exploration that will doubtlessly come with time.

In the body, trauma is a complex process modulated through the immune system, nervous system, pain receptors, coagulation cascade, and innate inflammatory responses. The nature of the trauma determines the extent of organ, soft tissue, and orthopedic damage. Physiologic responses are designed to minimize further injury, restore homeostasis, and preserve perfusion. Initially, the sympathetic nervous system releases catecholamines and cortisol, resulting in an increase in heart rate, cardiac contractility, glucose delivery to the brain, and blood pressure due to vasoconstriction. Persistent increases in catecholamines lead to activation of the renin angiotensin system and secretion of vasopressin. Blood flow, initially routed to skeletal muscle and away from the splanchic circulation, is rerouted back to the brain, heart, and lungs and away from the GI and kidneys. Activation of the clotting cascade occurs. At the same time, cytokines are released along with acute phase proteins; the immune system activates as WBCs migrate from the circulating pool to the site of injury. If any of these responses becomes dysregulated, the potential for systemic inflammatory response syndrome and MODS is very real. Due to their smaller size, polytrauma is much more common in cats so a dog attack may cause pulmonary contusions, a pneumothorax, rib fractures, and extensive bruising, while a road traffic accident may result in traumatic brain injury, pelvic fractures, bladder rupture, and pulmonary contusions. Some refer to the initial injury as the "first hit" which will then determine the secondary responses from the body. These responses can be considered the "second hit(s)" and include hypotension, infection, blood loss, and reduced perfusion. Hospital associated infections, anesthesia related complications, and iatrogenic injuries (fluid overload, etc.) fall under the category of second hits.

The approach to the feline trauma patient is similar to that of the canine trauma patient with some key differences. All feline trauma patients should be triaged and assessed immediately by a qualified staff member. When taking a history, a 2-3 minute synopsis should suffice initially—you can always ask additional questions later. The cat should be assessed in such a way that it can be evaluated fully, but rapidly; this may require that it be removed from the carrier or unwrapped from bedding, so use caution since the cat may be in pain or other distress. An enclosed area is ideal. In a broad sense, there are two types of feline trauma patients: those who are unstable and those who are stable, although a seemingly stable patient's status can certainly change rapidly.

When a cat presents to your ER with a history of trauma, it is imperative to proceed with a rapid primary survey to assess key neurologic, cardiac, and pulmonary functions. Assess the patient's respiratory rate while it is at rest and perform thoracic auscultation in all quadrants, paying special attention to crackles, harsh sounds, quiet or dull areas, and reduced heart sounds. Many feline trauma patients compensate quite well for their injuries and tachypnea may be the only sign of significant respiratory compromise. Open-mouth breathing, panting, cyanosis, increased nasal flare, and orthopnea indicate severe respiratory compromise. These patients are NOT stable and require immediate oxygen support. Cats in overt respiratory distress are very fragile and can decompensate rapidly, so it is far better to supplement oxygen while strategizing the rest of the exam than to push the cat past the point of no return. Handling the cat for venipuncture, catheter placement, radiographs, etc. can result in CPA so when in doubt, supplement oxygen and let the cat decompress. Analgesics or sedatives can be administered IM or SQ if needed. While auscultating the thorax, assess pulse quality and cardiac sounds; evaluate the patient for any evidence of penetrating thoracic trauma or chest wounds. Oxygen can be supplemented via mask or cage, depending on what the cat will tolerate. If the cat is alert and responsive but having respiratory distress, this will suffice for a rapid neurologic assessment—a detailed neurologic exam can be conducted later. If the cat is placed in an oxygen cage, you can observe it moving around in the cage to assess gait and get a broad

sense of neurologic function. If possible, a pulse oximetry reading, Doppler blood pressure, and ECG tracing can be taken before starting cage oxygen, but only if the cat is not unduly stressed. If pneumothorax or pleural effusion is suspected, thoracocentesis should be performed ASAP, even if radiographs are not available. TFAST (Thoracic Focused Assessment with Sonography for Trauma) can identify fluid and air accumulation with less stress to the patient than radiographs and will also permit ultrasound- guided thoracocentesis. If the patient's respiratory rate and effort do not improve with supplemental oxygen, anesthetic induction, intubation, and mechanical ventilation may be necessary.

All feline trauma patients should be evaluated for shock with the understanding that shock presents differently in feline patients than canine patients. Compensatory mechanisms such as tachycardia and hyperdynamic signs, such as bounding pulses and injected mucous membranes, may not be seen. Cats in shock may present with either a normal heart rate or bradycardia (HR <160); in addition, hypothermia and hypotension (systolic BP <90 mm Hg) are strongly supportive of shock. Hypothermia affects vasoconstrictive ability, so cats should be carefully warmed prior to the administration of aggressive fluid therapy. Due to their small size and smaller circulating blood volume, cats can experience hypovolemia and anemia due to hemorrhage from wounds or cavitary bleeding, and the feline spleen has a limited ability to contract and add red blood cells to the circulating pool. In addition, cats that have been shaken, as in a dog attack, may have internal hemorrhage that is not apparent from the extent of their exterior wounds. Occult cardiac disease is not unheard of in this species, so each patient should be auscultated carefully before, during, and after fluid resuscitation to monitor for gallop rhythm, heart murmur, or altered lung sounds that may indicate fluid intolerance.

If the primary survey finds the cat to be stable, the rest of the exam can be conducted in a well-lit area on a textured surface. It may help the cat feel more secure if it is kept in the bottom of its carrier until it absolutely must be moved. Multiple studies have been published regarding the strengths and weaknesses of various blood pressure modalities in feline patients, so it may be more important in any given clinic for blood pressure assessment to be systematic (the same equipment, routine, and operators used each time) and used to follow trends. The ISFM has published guidelines for blood pressure assessment in cats that may be helpful. The author prefers to use the coccygeal artery for Doppler blood pressure measurement in feline patients since it is easy to reproduce and patients seem to resent it less than pedal artery measurement. However, if the patient has extensive hindlimb trauma or a history of potentially ischemic injury to the back half of the body, forefoot measurement is a better choice. Earbuds or headphones can be used to minimize auditory stimulus and stress to the patient.

The secondary survey comprises a thorough head-to-tail physical examination and can be conducted once initial interventions are made based on the results of the primary survey. This should include an oral exam, ocular examination, comprehensive orthopedic and neurologic examinations, abdominal palpation, and evaluation of any wounds. Bladder size should be evaluated via palpation and/or ultrasound since bladder rupture and uroabdomen are common sequelae to trauma. If necessary, an indwelling urinary catheter can be placed. Imaging can be conducted along with wound care and fracture stabilization once the patient is stabilized. These elements of therapy should never be attempted in an unstable patient, barring bandages that may need to be placed to occlude active hemorrhage or open cavity wounds.

If the cat is in shock, vascular access becomes a priority. In general, the largest diameter catheter that the vein will support should be placed to facilitate rapid fluid administration. However, in a patient who may have significant peripheral vasoconstriction, it may be better to choose the size catheter that can be most rapidly placed; in most cats, this will be a 22g catheter. The lateral and medial saphenous sites should not be overlooked and the resourceful nurse knows that s/he may not always have their choice of sites in the trauma patient! If needed a larger catheter can be placed once the patient has been volume resuscitated. A central catheter or PICC line will facilitate ease of sampling while minimizing stress for the patient but central venous access is not a procedure to be undertaken in an unstable patient.

The approach to fluid therapy in trauma patients should be based on the individual case; there is no "one size fits all" approach and much will depend on the status of the patient, resources of the clinic, and type of trauma. Much debate exists as to the most successful approach toward fluid resuscitation of the hemorrhagic shock patient and large volume resuscitation may not be ideal. When administering crystalloids, 40-60 ml/kg is divided into quarter boluses and administered over 10-20 minutes before the patient is re-assessed for response to therapy. Perfusion parameters to reassess following a bolus include mentation, pulse quality, heart rate, extremity temperature, CRT, and blood pressure (with the caveat that blood pressure does not always correlate to oxygen delivery). If crystalloid boluses are not effective, colloid solutions can be administered at 3-5 ml/kg. Given the debate around colloid use in both human and veterinary medicine, colloids may or may not be available in your clinic but they do have a place in some cases. Hypertonic saline is also used for volume expansion at 2-4 ml/kg IV and may be the fluid of choice in cases of head trauma. It is very possible to fluid overload feline patients during resuscitation, so caution should be used, especially in patients who have an arrhythmia or heart murmur. It is sometimes said that the gut is the shock organ in dogs, and the lungs are the organ most affected by shock in the cat. Pleural effusion, pulmonary edema, ARDS, and ALI have all been documented secondary to shock and fluid resuscitation in feline patients.

It is rare that blood products are used in the initial shock resuscitation of cats due to concerns about blood type and compatibility, but canine xenotransfusion has been documented. Research indicates that cats may have innate alloantibodies to canine RBCs. The average lifespan of transfused canine RBCs appears to be ≤4 days and antibodies are produced within 4-7 days of transfusion. Fatal anaphylaxis may occur if canine blood is transfused after this period. If compatible feline blood is available, it or a hemoglobin-based oxygen carrier solution should take priority over canine blood. Canine xenotransfusion is not recommended as a routine procedure.

The role of steroids in shock and trauma is hotly debated. Trauma stimulates endogenous cortisol secretion, which then mediates inflammatory responses and vascular contractility; on a certain level, it may seem that supplementing cortisol would enhance these responses. There are many older trials that seem to show benefits; however, these benefits have not been validated through additional research. There are significant potential negative effects in shock that are mediated by steroids, including hyperglycemia, sodium retention, GI damage, and increased BUN. If a patient has documented CIRCI (critical illness related corticosteroid insufficiency), steroids may be beneficial; however, the understanding of veterinary CIRCI is evolving and the diagnosis should be made with caution. At this time, glucocorticoids are not recommended in patients with trauma, hypovolemic shock, or hemorrhagic shock. If hypotension is persistent, colloid solutions or vasopressor agents should be administered instead of steroids. It is also important to note that steroids provide no analgesia.

The role of pain in trauma cannot be overlooked, and appropriate analgesia should be provided ASAP, ideally through a multi-modal approach. Appropriate pain management not only enhances patient comfort but improves healing, coping, and tractability. Opioid drugs, such as buprenorphine, fentanyl, hydromorphone, and methadone are an excellent starting point since they can be titrated or delivered as a constant rate infusion. Nonsteroidal anti-inflammatory drugs such as robenacoxib can be added once hypovolemia is corrected and kidney function is evaluated. In addition, other drugs such as ketamine or gabapentin also have a role in multi-modal pain relief. Gabapentin has recently been shown to improve stress behaviors in hospitalized cats and may be a good adjunct for cats who require extended hospitalization and associate handling with pain. Butorphanol provides only mild analgesia with relaxation and is not sufficient analgesia for patients with extensive soft tissue or orthopedic injuries. If surgery is required, soaker catheters and regional blocks provide additional analgesic coverage.

Head injury is a common presentation in traumatized cats, second only to extremity injury, and may be accompanied by facial or jaw fractures and ocular injury. Jaw fractures account for 15-23% of all fractures in feline patients. If a cat has facial trauma, it should be assumed that brain injury has occurred until proven otherwise. The normal response of a cat to accident and transport to a veterinary hospital should be alertness and a degree of heightened vigilance; dull mentation is abnormal, although pain and shock can negatively affect responsiveness. A full neurologic exam should be conducted in the patient once it has been determined that s/he is cardiovascularly stable and respiration is not compromised. This will aid in lesion localization and give an idea of prognosis. The Modified Glasgow Coma Scale (MGCS) is an effective tool that can be used throughout a cat's hospitalization to assess response to treatment (most research on the MGCS has been conducted in dogs). In patients with severe brain injury, neurologic function should be reassessed as frequently as every 15-30 minutes. Supplemental oxygen should be administered to all cats with TBI. Treatment for increased intracranial pressure includes the use of hyperosmolar agents such as mannitol and hypertonic saline. Mannitol, an osmotic diuretic, enhances cerebral blood flow and is dosed at 0.25-1.0g/kg IV over 20 minutes Q8H. It should not be used in hypovolemic patients. Hypertonic saline has osmotic effects similar to those of mannitol but can be used in hypovolemic patients at a dose of 3-5 ml/kg IV over 15 minutes. In addition to its osmotic effects, hypertonic saline provides volume expansion capability and some positive inotropic effects. Procedures that may transiently increase ICP (such as jugular venipuncture or nasal feeding tube placement) should be avoided in head trauma patients. If the patient is having seizures, the first line therapy is a benzodiazepine such as midazolam at 0.2-0.5mg/kg IV. If this is successful at first but breakthrough seizures occur, a CRI can be administered. Levetiracetam can also be administered IV at 20mg/kg. If seizure activity is not controlled with intermittent or CRI benzodiazepines, it may be necessary to start a CRI of propofol with the understanding that these patients will require a high level of nursing care including recumbent and intubated patient care.

Due to their size, it is rare that feline patients present with only one type of trauma; long term hospitalization and staged surgery may be required (for example, a patient with pulmonary contusions and pelvic fractures may have to wait for repair until the contusions resolve). Many of these patients will also require nutritional support. The easiest way to supplement calories is to place a nasoesophageal or nasogastric feeding tube and provide RER with a liquid diet. The tube can be used once placement is verified radiographically, and there are a variety of liquid diets available. The most common approach is to administer a liquid diet via syringe pump as a CRI, starting at ¼ RER and working up to full RER over a series of days. Nasal feeding tubes are not appropriate for patients who may have TBI. If it can be combined with another anesthetic event, an esophagostomy tube can be placed for long term nutritional support, especially in patients

with facial trauma or jaw fracture(s). Esophagostomy tubes permit the feeding of calorically dense blenderized diets as bolus feedings; an additional advantage is that the client can be trained to use the tube, thereby permitting the patient to be discharged sooner. Feeding tubes provide accurate delivery of calories and may be a better choice than appetite stimulants, such as mirtazapine.

A significant consideration in treating the feline trauma patient is the role of TLC and respectful handling. Feline trauma patients frequently have reduced mobility and special needs. Soft bedding, scrupulous attention to cleanliness, frequent pain assessment, and feline-friendly nursing practices are essential for this patient population. Urinary catheterization may be necessary in patients with bladder rupture or may be elected to keep the patient clean, and in these cases, close attention must be paid to maintaining the unit to minimize the risk of infection and to quantifying urine output. Patients without a urinary catheter may require a "handi-capable" litter pan with low sides that is easy to enter and exit. For cats that are fractious or very frightened, placing an IV extension set on their catheter will facilitate drug delivery from a distance, thereby minimizing handling stress for the cat. In cats that cannot be handled safely, the extension set will permit the patient to be sedated from a distance for daily physical examinations or bandage changes. Chemical restraint should always be selected over rough handling when it comes to interacting with this patient population and provides enhanced safety for personnel. If the patient has bandages, they must be monitored frequently for signs of slippage, soil, damage, and contamination. As patients recover, controlled exercise and rehabilitation may be called for—sometimes this is as easy as giving the cat room to move and explore outside the cage. At our facility, we have had good success by housing recovering cats in large dog runs to encourage range of motion. Soft and inflatable E-collars, baby and toddler t-shirts, catheter guards, and orthopedic stockinette are all low-stress ways to protect wounds, bandages, and catheters while respecting the patient's needs.

Feline trauma patients are frequently polytrauma patients. Initial goals include the evaluation of cardiac, pulmonary, and neurologic function and rapid intervention for respiratory compromise, shock, and pain. Following stabilization, a thorough physical examination should be conducted along with imaging. Analgesia is never optional and nutritional support is strongly recommended since many feline trauma patients will not eat in the hospital or have injuries that make eating difficult. Throughout, careful consideration should be given to the needs of the cat.

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