Key Points:

- To date, there are four large, single-center, retrospective epidemiologic studies that describe injury types and outcome in canine trauma patients.
- Prospective and retrospective case series and case reports provide additional descriptive information on particular injury types and outcome in canine trauma patients.
- There are scant clinical trials evaluating the impact of interventions on outcome in canine trauma patients.
- Pre-clinical canine trauma models provide additional evidence-based information regarding trauma co-morbidities and evaluate various interventions effect on outcome.

Trauma patterns

Injuries in canine trauma patients have been described in large and small retrospective and prospective studies. Dogs sustaining trauma are usually young to middle aged, and males predominate. A smaller percentage of canine trauma patients are geriatric are more likely to have significant co-morbidities including heart disease, endocrine disease (including diabetes mellitus), and chronic renal disease. Vehicular trauma is by far the most common cause of trauma, with crush/compressive, acceleration/deceleration and “unknown” being reported less frequently. In large studies, survival to discharge is typically 85-88%.

The most common thoracic injuries in dogs are pulmonary contusions and pneumothorax. Also seen are hemothorax, rib fractures, pneumomediastinum, diaphragmatic herniation, and flail chest. Abdominal injury is also common in dogs sustaining blunt trauma. Hemoperitoneum is reported commonly in dogs; urinary tract rupture and abdominal hernias occur in fewer patients but are nonetheless significant and require surgical intervention. Orthopedic injuries are common in canine trauma patients. A large number of dogs experience hind limb orthopedic injuries including pelvic fracture, femur fracture, hip luxation, distal limb fracture, spinal fractures, sacral luxations, and sacral fractures. Less common but still seen are thoracic limb orthopedic injuries including scapular fracture, elbow luxation and radius fracture. Head injury occurs commonly in dogs and is associated with significant morbidity and mortality.

Hypovolemic shock secondary to major bleeding is often seen in polytrauma. Evidence of hypoperfusion and hypovolemia is common in dogs presenting for evaluation of trauma. In a recent retrospective study of canine trauma, the presenting median lactate concentration in dogs requiring ICU admission was 3.5 mmol/L; mild uncompensated metabolic acidosis was also common. While most dogs are treated with intravenous crystalloids for fluid resuscitation, a number of patients also require administration of blood products. In one retrospective study, packed red blood cells (pRBCs) and fresh frozen plasma (FFP) were administered during initial resuscitation in approximately 5% of cases. A significant number of dogs also required blood products later in hospitalization.

Dogs sustaining trauma develop a systemic inflammatory response, and this response underlies the development of multiple organ failure. Canine trauma patients usually present with fever, tachycardia, tachypnea and leukocytosis. Preliminary studies have documented increased circulating concentrations of pro-inflammatory cytokines (TNF, IL-6 and CX-CL8) in dogs with trauma induced systemic inflammation.
A recent retrospective study documented ARDS in 3% of patients (7/235). In addition to these dogs, another 2 dogs in that study required mechanical ventilation due to the severity of pulmonary injury. Only 1 of those 9 ventilated dogs survived to discharge, highlighting the potential for lung injury to contribute to late stage mortality in canine trauma patients. Survival rates for dogs ventilated for management of pulmonary contusions in another study was slightly higher (30%). While not discussed specifically, it appears that these dogs could be considered to have ARDS based on a mean +/- standard deviation PaO₂:FiO₂ ratio of 77.49 +/- 24.8 prior to ventilation.

The coagulation system is activated concurrently with inflammation in the setting of severe trauma. A recent study documented mild PT prolongation (25-50% greater than control) in 13.2% of cases and mild PTT prolongation in 30.2% of cases. Moderate PT prolongation (50-100% greater than control) was observed in 7.5% of dogs, and moderate PTT prolongation in 13.2%.

Other organ dysfunctions of significance that can occur and have been documented in canine trauma include metabolic, renal, hepatic, cardiovascular and gastrointestinal dysfunction. Multiple organ failure (MOF) was reported in 4% of cases in one large retrospective study. In another study, hyperglycemia was reported to be associated with severity of head injury in traumatized dogs, however, was not associated with outcome.

Scoring systems

Scoring systems are used in veterinary medicine as a clinical tool to benchmark performance and development/implementation of protocols for patient triage, monitoring and management. In clinical research, scoring systems are utilized for patient stratification, measurement of the effectiveness of randomization and reduction of bias and confounding. The animal trauma triage (ATT) score has been statistically validated in dogs (and cats) and has been correlated with survival in multiple subsequent retrospective studies. The Glasgow Coma Scale has been modified (mGCS) and shown to correlate with outcome in canine head trauma, although it has not yet been validated. An Abdominal Fluid Scoring system (AFS) determined by ultrasound (abdominal focused assessment with sonography, AFAST) has been evaluated and shown to correlate with increased likelihood for blood product use in canine trauma patients.

Preclinical canine trauma models

In hemorrhage models, animals are bled to a predetermined blood volume, arterial blood pressure, cardiac output or another physiologic endpoint. Subsequently, fluid administration may be performed to create reperfusion injury, as would occur in the clinical setting. Multiple trauma models include combinations of hemorrhage with hind limb crush, long bone fractures or epidural ballooning (head trauma). Laparotomy plus pressure-controlled hemorrhagic shock is probably the best studied animal model of multiple trauma. Preclinical models that study interventions regarding fluid therapy, hypothermic resuscitation and blood product administration can serve to inform management of and improvement of outcome in clinical patients.
References:


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