Multicenter prospective evaluation of dogs with trauma

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Objective—To determine hospital admission variables for dogs with trauma including values determined with scoring systems (animal trauma triage [ATT], modified Glasgow coma scale [MGCS], and acute patient physiologic and laboratory evaluation [APPLE] scores) and the usefulness of such variables for the prediction of outcome (death vs survival to hospital discharge).

Design—Prospective, multicenter, cohort study.

Animals—315 client-owned dogs.

Procedures—By use of a Web-based data capture system, trained personnel prospectively recorded admission ATT, MGCS, and APPLE scores; clinical and laboratory data; and outcome (death vs survival to discharge) for dogs with trauma at 4 veterinary teaching hospitals during an 8-week period.

Results—Cause of injury was most commonly blunt trauma (173/315 [54.9%]) followed by penetrating trauma (107/315 [34.0%]), or was unknown (35/315 [11.1%]). Of the 315 dogs, 285 (90.5%) survived to hospital discharge. When 16 dogs euthanized because of cost were excluded, dogs with blunt trauma were more likely to survive, compared with dogs with penetrating trauma (OR, 8.5). The ATT (OR, 2.0) and MGCS (OR, 0.47) scores and blood lactate concentration (OR, 1.5) at the time of hospital admission were predictive of outcome. Surgical procedures were performed for 157 (49.8%) dogs; surgery was associated with survival to discharge (OR, 7.1).

Conclusions and Clinical Relevance—Results indicated ATT and MGCS scores were useful for prediction of outcome for dogs evaluated because of trauma. Penetrating trauma, low blood lactate concentration, and performance of surgical procedures were predictive of survival to hospital discharge. The methods enabled collection of data for a large number of dogs in a short time. (J Am Vet Med Assoc 2014;244:300-308)

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References
crease bias and confounding variables. The ATT score was validated by use of a small population of dogs and cats, and its association with outcome (survival to hospital discharge vs nonsurvival) has been subsequently determined in multiple retrospective studies. In a retrospective study of dogs with head trauma, MGCS scores were predictive for nonsurvival within 48 hours after injury. Most recently, the APPLE scoring system was validated as a user-friendly scoring system for evaluation of dogs admitted to an intensive care unit.

In other veterinary studies, numerous variables and scoring systems have been investigated for evaluation of dogs hospitalized after trauma; however, such studies have had a retrospective design or included dogs evaluated at a single site. The objective of the study reported here was to prospectively evaluate variables at the time of hospital admission for dogs with trauma, with particular emphasis on scoring systems (ATT, MGCS, and APPLE scores) and the usefulness of such variables for prediction of outcomes. Another objective was to determine the potential usefulness of these methods for evaluation of dogs with trauma in future multicenter prospective clinical trials.

**Materials and Methods**

**Animals**—The study was conducted with a multicenter consortium and by use of an online database. Trained personnel at 4 veterinary teaching hospitals (University of Minnesota Veterinary Medical Center, Tufts University Foster Hospital for Small Animals, Ontario Veterinary College Health Sciences Center, University of Pennsylvania Matthew J. Ryan Veterinary Hospital) prospectively recorded information for all dogs evaluated after a witnessed or suspected traumatic incident between June 27 and August 22, 2011. Trauma was defined as any tissue injury that occurred suddenly as a result of an external force, including blunt force injury (eg, motor vehicle accident or fall from a high height), penetrating injury (eg, gunshot, laceration, impalement, injury sustained during an altercation with another animal, or imbedded porcupine quills), or crushing injury. Dogs were excluded if they had acute lameness suspected or determined to be attributable to a cruciate ligament rupture, nontraumatic acute paraparesis (eg, intervertebral disk disease or fibrocartilaginous embolism), or minor superficial bite wounds limited to 1 limb. Owner consent regarding use of data from medical records was obtained for all dogs at the time of hospital admission.

**Data collection**—Study data were collected and managed with electronic data capture tools hosted at the University of Minnesota. The online database was a secure, Web-based application designed to support data capture for research studies and provided an intuitive interface for validated data entry, audit trails for tracking data manipulation and export procedures, automated export procedures for data downloads to commonly used statistical software packages, and procedures for importing data from external sources.

Data were transcribed to a paper worksheet and then entered into the online database and retrospectively verified by means of comparison with the completed medical record. Where possible, the online database used dropdown menus (categorical values) or was programmed to only accept certain numbers to minimize transcription errors (eg, dropdown menu for BCS included only numeric values 1 to 9; text box for body weight only allowed entry of numeric values to 1 decimal point). Additionally, 2 authors (KEH and MKH) independently reviewed the data and contacted investigators at each site for clarification or correction of questionable data prior to data analysis.

The following variables were recorded for each dog: ATT score (Appendix 1), MGCS score (Appendix 2), age, sex, BCS, body weight, time and cause of injury, veterinary care prior to arrival at the hospital, whether the trauma was witnessed, preexisting medical conditions, blood product administration, performance of CPR, total cost, and the number and type (soft tissue, orthopedic, or CNS) of surgeries (defined as a surgical episode which may have included ≥ 1 surgical procedures) and surgical procedures (defined as surgical repair of tissues in 1 region) performed (eg, femoral fracture repair and shoulder laceration repair during 1 anesthetic episode would be considered 1 surgery and 2 surgical procedures) and where such procedures were performed (emergency room or operating room). Time from injury to hospital admission was calculated, and cause of injury was further categorized into 1 of 3 groups: blunt trauma (motor vehicle accident, fall, or other), penetrating trauma (bite wounds or penetrating nonbite wounds), or unknown. Age was also categorized as young, middle, or old with correction for body weight performed on the basis of methods used in another study. Animals were categorized by body weight (giant, > 45 kg [99 lb]; large, > 20 kg [44 kg] and < 45 kg; medium, > 10 kg [22 lb] and < 20 kg; small, > 5 kg [11 lb] and < 10 kg; and toy, < 5 kg), then subsequently divided by age in years into young (toy or small, < 7 years; medium, < 6 years; large, < 5 years; and giant, < 3 years), middle-aged (toy or small, 7 to 12 years; medium, 6 to 10 years; large, 5 to 9 years; and giant, 3 to 7 years) and old (toy or small, > 12 years; medium, > 10 years; large, > 9 years; and giant, > 7 years). For dogs that were discharged from the hospital after an initial evaluation and were returned for trauma-associated wound management, the total cost was only recorded for the initial evaluation; however, surgical procedures performed during subsequent evaluations were included in the total number of surgeries if they were performed for problems that were the result of the initial traumatic injury.

Additional data, obtained at the discretion of the attending clinician, were recorded for each dog, including values for calculation of the APPLE score (ie, serum creatinine, albumin, and total bilirubin concentrations; blood lactate concentration; WBC count; SpO2; mentation score; respiratory rate; and body cavity fluid score [0 = no abdominal, thoracic, or pericardial free fluid identified; 1 = abdominal or thoracic or pericardial free fluid identified; ≥ 2 ≥ 2 of abdominal, thoracic, and pericardial free fluid identified]). The ultrasonographically assessed abdominal fluid score indicates the number of abdominal sites in which fluid is detected during a methodical ultrasonographic examination of
the abdomen. The score indicates the number of sites (of 4 specific anatomic regions) in which fluid is detected. Outcome for each dog was classified as survival to discharge from the hospital, euthanasia, or death. Time of death was recorded and categorized as < 2, 2 to < 6, 6 to < 12, 12 to < 24, 24 to 72, or ≥ 72 hours after the initial evaluation at the hospital. For dogs that were euthanized, information regarding the reason (cost or grave prognosis) was also recorded (determined after communication with the attending clinician). Dogs that were euthanized for financial reasons were excluded from outcome analyses.

Statistical analysis—Continuous variables were analyzed for normality with a Shapiro-Wilk test. Descriptive statistics were reported as mean and SD (for data with a normal distribution) or median and range (for data with a nonnormal distribution). Depending on normality of data distribution, a pooled Student t test or Wilcoxon Mann-Whitney test was used to assess differences in the mean or median for clinical and laboratory variables between surviving and nonsurviving dogs. Univariate exact conditional logistic regression was used to assess categorical variables including sex, age category, trauma category, previous illness, performance of surgery, blood product administration, positive results for fluid score or ultrasonographically assessed abdominal fluid score, and whether trauma was witnessed as risk factors for nonsurvival. Univariate exact conditional logistic regression was used to assess the variables age, BCS, body weight, time from injury to hospital admission, MGCS score, ATT score, and to determine the AUC and select the optimum cutoff value that maximized the Youden J statistic (sensitivity + specificity – 1) for sensitivity and specificity reporting. Data analysis was performed by use of computer software. Values of P < 0.05 were considered significant for all comparisons.

Results

Animals—Data were initially recorded for 327 dogs. Data for 12 dogs were excluded from analysis on the basis of exclusion criteria; these dogs were excluded because of a small puncture wound to an extremity (n = 6), chronic orthopedic disease or cranial cruciate ligament rupture (4), chemical burn (1), and hemivertebral causing spinal cord injury (1). Therefore, 315 dogs were included in the study; these dogs were enrolled at Tufts University (107/315 [34.0%]), University of Pennsylvania (101/315 [32.1%]), University of Minnesota (73/315 [23.2%]), and University of Guelph (34/315 [10.8%]). Of the 315 dogs included in the study, 137 (43.5%) were female and 178 (56.5%) were male. Most (95/137 [69.3%]) female dogs were spayed, and most (109/178 [61.2%]) male dogs were castrated. For the 312 dogs with available data, 208 (66.7%), 81 (26.0%), and 23 (7.4%) were classified as young, middle-aged, and old, respectively. Fifty-two of the 315 (16.5%) dogs included in the study were undergoing management of previously diagnosed illness (eg, diabetes, chronic kidney disease, or atopy) at the time of their injury.

Trauma—For the 315 cases of trauma, causes included motor vehicle accidents (94 [29.8%]), bite wounds (84 [26.7%]), falls (57 [18.1%]), unknown (35 [11.1%]), other (24 [7.6%]), penetrating non–bite wounds (12 [3.8%]), and porcupine quills (9 [2.9%]). Blunt trauma (173 [54.9%]) occurred most commonly, followed by penetrating trauma (107 [34.0%]) and trauma of other causes (35 [11.1%]). Trauma was witnessed for 220 (69.8%) dogs. Two hundred seventeen (68.9%) dogs were evaluated at the study center the same day of the injury, 50 (15.9%) the day after injury, 11 (3.5%) 2 days after injury, and 29 (9.2%) 3 days after injury; for 8 (2.5%) dogs, the time from injury to evaluation was unknown.

Treatments and procedures—Of the 315 dogs included in the study, 101 (32.1%) were evaluated by another veterinarian prior to hospital admission. Previously administered treatments included crystalloid fluids (35 [34.7%]), colloid fluids (2 [2.0%]), hypertonic saline (7.5% NaCl) solution (4 [4.0%]), glucocorticosteroids (10 [9.9%]), NSAIDs (30 [29.7%]), or both glucocorticosteroids and NSAIDs (2 [2.0%]). Sedatives or analgesics were administered prior to hospital admission for 60 of 286 (21.0%) dogs for which such information was recorded. Surgery was performed for 137 of 315 (49.8%) dogs (164 surgeries). Most (151/157 [96.2%]) dogs underwent 1 surgery; 6 (3.8%) dogs had ≥ 2 surgeries. Eighty-four of the 164 (51.2%) surgeries were performed in an emergency room, and 80 (48.8%) were performed in an operating room. A total of 174 surgical procedures (repairs) were performed, including 114 (65.5%) soft tissue procedures, 55 (31.6%) orthopedic procedures, and 5 (2.9%) CNS procedures. Soft tissue procedures (eg, wound management) were the most commonly performed procedures in emergency rooms; all orthopedic and CNS procedures were performed in an operating room. Ultrasonography was performed for determination of abdominal fluid score for 37 of 315 (11.7%) dogs; the ultrasonographically assessed abdominal fluid score for most (32/37 [86.5%]) of these dogs was 0. A body cavity fluid score was determined for 54 of 315 (17.1%) dogs; the score for most (42/54 [77.8%]) of these dogs was 0. Only 7 of 315 (2.2%) dogs received blood products (3 dogs received plasma, 1 received packed RBCs, and 3 received both plasma and packed RBCs).

Outcome—A total of 285 of 315 (90.5%) dogs survived to hospital discharge. Of the 30 dogs that did not survive, 5 (16.7%) died, 9 (30.0%) were euthanized because of a grave prognosis, and 16 (53.3%) were euthanized for financial reasons. Of the 30 dogs that did not survive, 3 died and 16 were euthanized within 2 hours after arrival at the hospital, 5 were euthanized 2 to 6 hours after arrival, 3 were euthanized 12 to 24 hours after arrival, and 2 died and 1 was euthanized 24 to 72 hours after arrival. Cardiopulmonary resuscitation was performed for 5 of the 315 (1.6%) dogs in the study; none of those dogs survived to discharge from the hospital (4 died and 1 was euthanized).
The ATT score was the best predictor of outcome: an nonsurvival with 82% sensitivity (95% CI, 78% to 86%; AUC, 0.785). An MGCS score 17 was predictive for 73% to 87%) and 56% specificity (95% CI, 47% to 65%; ≥4.0 mmol/L was predictive for nonsurvival with 80% sensitivity (95% CI, 79% to 87%) and 91% specificity (95% CI, 88% to 94%; AUC, 0.913) for prediction of nonsurvival of dogs with trauma in this study.

**Discussion**

In the population of dogs with trauma in the present study, most animals were young and male, and blunt trauma was the most common cause of injury. The survival rate was high, and many of the dogs that did not survive were euthanized for financial reasons. High ATT scores, high blood lactate concentrations, and low MGCS scores were predictive of nonsurvival. Dogs with penetrating trauma (rather than blunt trauma) and dogs that underwent surgery were more likely to survive to discharge from the hospital versus other dogs.

Blunt trauma (caused by a motor vehicle accident, fall, or crush injury) occurred for approximately 55% of dogs in the study, which was slightly lower than the value determined (62%) for a large population of dogs and cats in a retrospective study. Similar to results of other studies, motor vehicle accidents were the most common cause of injury in this study.
common causes of blunt trauma for dogs in the present study. Penetrating injuries (34% of dogs) were more common for dogs in this study than they were for dogs and cats in another study. Approximately 27% of dogs in the present study had bite wounds, which comprised most of the penetrating wounds; conversely, bite wounds comprised only 10% of injuries in dogs and cats with trauma in the other study. Differences among results of the present study and those of other studies regarding the distribution of types of injuries may have been attributable to differences in geography, time of data collection, species evaluated, and definition of trauma. The retrospective study included 1,000 dogs and cats evaluated at a single site and included animals with burn injuries, whereas another retrospective study included dogs with blunt trauma evaluated at a single teaching hospital.

Scoring systems were a user-friendly and reliable method to predict outcomes for dogs in the present study. Similar to results of retrospective and single-center studies, ATT score was associated with outcome and study. Similar to results of retrospective and single-center methods to predict outcomes for dogs in the present study at a single teaching hospital. The retrospective study included 1,000 dogs and cats evaluated at a single site and included animals with burn injuries, whereas another retrospective study included dogs with blunt trauma evaluated at a single teaching hospital.

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because of trauma may be > 10%. In such populations, the positive predictive value of the ATT score might be higher (perhaps substantially), suggesting this scoring system may be useful for prediction of survival, as was found in the present study.

Blood lactate concentration, although it is an objective measurement, was less predictive of nonsurvival of dogs in the present study than trauma scores. A blood lactate concentration ≥ 4.0 mmol/L at the time of admission had 80% sensitivity and 56% specificity for prediction of nonsurvival. High blood lactate concentrations are detected in dogs with various disorders, including shock, low cardiac output, acute liver failure, severe sepsis, neoplasia, seizures, and poisoning, and in dogs undergoing treatment with certain drugs. Most analyzers that measure blood lactate concentration require a very small volume of blood and are typically available as a point-of-care diagnostic test, making such assays easily accessible for guidance of patient care.17,18 Even though blood lactate concentration determined for a single time was useful for determination of a prognosis for dogs in this study, lactate clearance is likely a better method for prediction of outcome and guidance of treatment for hyperlactemic patients.16

Results of the present study indicated blunt injury was more likely to result in nonsurvival, compared with penetrating injury. Few studies have been conducted regarding penetrating injury patterns in small animals, and no studies have been conducted to determine survival patterns for a large population of dogs with penetrating trauma, to the authors’ knowledge. Dogs in another study1 had injuries attributable to animal altercations (10%), sharp objects (11%), or weapons (2%), but data for dogs with penetrating injuries were not reported. In another study,19 of 84 cats and dogs with gunshot wounds, 81% survived to hospital discharge. Another retrospective study20 included 15 dogs and 1 cat with penetrating injuries; 13 of the dogs in that study survived to discharge from the hospital. Results of studies2-3,6 of dogs with blunt trauma indicate an 85% to 88% survival rate. Because the present study is the first in which dogs with penetrating trauma had a better survival rate than dogs with blunt trauma, further studies with large numbers of dogs are warranted to further investigate this finding; such studies should include evaluation of possible confounding variables such as differences between groups regarding trauma severity scores, time from injury to initiation of care, cost of care, and need for surgical intervention.

Approximately half of the dogs in the present study underwent surgery; this finding was similar to the proportion of dogs with severe blunt trauma that underwent surgery in another study.3 Interest廷ly, the distribution of soft tissue (approx 66% of dogs) and orthopedic (approx 32%) injuries in the present study was different than the distribution of soft tissue (37%) and orthopedic (63%) injuries of dogs in another study.3 In the present study, surgical intervention was associated with survival. A reason for this finding was not determined; owner willingness to treat dogs (including surgical treatments) rather than euthanizing animals because of the cost of surgery might have affected that finding. Alternatively, use of monitoring and analgesia during surgery and postoperative care may have contributed to the high survival rate for such dogs.

An objective of this study was to obtain data for a population of dogs that would be useful in the planning of future clinical studies of dogs with trauma. In this study of dogs, the overall rate of survival to discharge from the hospital (approx 91%) was slightly higher than the value reported in other studies2,5-6 of large numbers of dogs (85% to 88%). This finding may have been attributable to the prospective design of the present study, which likely led to inclusion of dogs with a low severity of trauma that may not have been included in a study with a retrospective design. In addition, dogs with various types of trauma (ie, penetrating, blunt, and other) were included in the present study. Given the high rate of survival to hospital discharge in dogs in this study, future interventional studies intended to improve outcomes should include evaluation of alternate primary outcomes such as frequency of comorbidities (eg, development of multiple organ failure and coagulopathies), duration of hospitalization, and cost of care.

A common challenge in veterinary clinical research is the influence of euthanasia on survival analysis. During the present study, efforts were made to determine the estimated cost of treatment and prognosis communicated to owners by the attending clinician at the time of euthanasia. These data were obtained to increase the accuracy of exclusion from analysis of animals that were euthanized because of cost, versus retrospective interpretation of the reasons for euthanasia on the basis of information in medical records. Recording of data regarding prognoses for dogs with spinal injuries was challenging; even though the prognosis for survival to discharge recorded for such dogs was typically good, the prognosis for return to function was not recorded and might have influenced owner’s decisions. In future prospective studies of animals with trauma, the prognosis regarding return to function for dogs with brain or spinal injury should be recorded, in addition to the prognosis for survival to hospital discharge. Unfortunately, euthanasia of dogs may also have confounded evaluation of the time to death after initial evaluation. Most dogs that were nonsurvivors died or were euthanized within 2 hours after the initial evaluation at the hospital; such dogs were typically euthanized. Of the dogs that died without euthanasia, 3 died within 2 hours after the initial evaluation and 2 died 24 to 72 hours after that time. Although the number of such animals was too small to determine definitive conclusions, this pattern of time to death was similar to the pattern for humans with trauma; humans with trauma who do not survive typically die within a few hours after trauma or a few days after that time.21

Results of this multicenter, prospective study of dogs with trauma indicated ATT and MGCS scores, blood lactate concentration, type of injury, and surgical intervention were associated with outcome. The overall rate of survival to hospital discharge was high. In the present study, a multicenter collaborative group successfully used a secure Web-based data-capture system14 for collection of data from a large number of dogs during a short period. Although people working at multiple sites voluntarily spent a large amount of time...
obtaining data during an 8-week period in this study, the ability to obtain data for > 300 dogs in such a short time suggests similar collaborations and data capture systems may be useful in future, large-scale clinical trials for the investigation of veterinary patients with trauma.

a. REDCap [database online]. Clinical and Translational Science Institute, University of Minnesota, Saint Paul, Minn.

References


Continued on next page.
## Appendix 1

The ATT scoring system used to assess dogs with trauma.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Perfusion</th>
<th>Cardiac</th>
<th>Respiratory</th>
<th>Eye, muscle, and integument</th>
<th>Skeletal</th>
<th>Neurologic</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Mucous membranes pink and moist</td>
<td>Heart rate 60–140 beats/min</td>
<td>Regular respiratory rate with no stridor</td>
<td>No or partial thickness abrasion or laceration</td>
<td>Weight bearing in 3 or 4 limbs</td>
<td>CNS: conscious and alert to slightly dull with interest in surroundings</td>
</tr>
<tr>
<td></td>
<td>Capillary refill time 0–2 s</td>
<td>Normal sinus rhythm</td>
<td>No abdominal component to respiration</td>
<td>No fluorescein uptake in eye</td>
<td>No palpable fracture or joint laxity</td>
<td>Peripheral nervous system: normal spinal reflexes; purposeful movement with nociception in all limbs</td>
</tr>
<tr>
<td></td>
<td>Rectal temperature ≥ 37.8°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Femoral pulses strong or bounding</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>1</td>
<td>Mucous membranes hyperemic or pale pink and tacky</td>
<td>Heart rate 140–180 beats/min</td>
<td>Mildly increased respiratory rate and effort with or without abdominal component</td>
<td>Full-thickness abrasion or laceration with no deep tissue involvement</td>
<td>Closed appendicular or rib fracture or any type of mandibular fracture</td>
<td>CNS: conscious but dull, depressed, or withdrawn</td>
</tr>
<tr>
<td></td>
<td>Capillary refill time 0–2 s</td>
<td>Normal sinus rhythm or &lt; 20 ventricular premature complexes/min</td>
<td>Mildly increased upper airway sounds</td>
<td>Corneal laceration or ulcer of eye without perforation</td>
<td>Single joint laxity or luxation including the sacroiliac joint</td>
<td>Peripheral nervous system: abnormal spinal reflexes with purposeful movement and nociception intact in all 4 limbs</td>
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<tr>
<td></td>
<td>Rectal temperature ≤ 37.8°C</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td>Fair femoral pulses</td>
<td></td>
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<tr>
<td>2</td>
<td>Mucous membranes very pale pink and very tacky</td>
<td>Heart rate &gt; 180 beats/min</td>
<td>Moderately increased respiratory effort with abdominal component and elbow abduction</td>
<td>Full-thickness abrasion or laceration with deep tissue involvement, but arteries, nerves, and muscles intact</td>
<td>Multiple closed appendicular or rib fractures; multiple mandibular fractures; multiple joints with laxity or luxation; multiple pelvic fractures; multiple limb fractures at or distal to carpus or tarsus</td>
<td>CNS: unconscious but responds to noxious stimuli</td>
</tr>
<tr>
<td></td>
<td>Capillary refill time 2–3 s</td>
<td>Consistent arrhythmia</td>
<td>Moderately increased upper airway sounds</td>
<td>Corneal perforation with punctured globe or proptosis</td>
<td>Single long bone, open fracture proximal to carpus or tarsus with cortical bone preserved</td>
<td>Peripheral nervous system: absent purposeful movement with intact nociception in ≥ 2 limbs or nociception absent only in 1 limb</td>
</tr>
<tr>
<td></td>
<td>Rectal temperature &lt; 37.8°C</td>
<td></td>
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<tr>
<td></td>
<td>Detectable but poor femoral pulses</td>
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<tr>
<td>3</td>
<td>Mucous membranes gray, blue, or white</td>
<td>Heart rate ≤ 60 beats/min</td>
<td>Markedly increased respiratory effort or gasping or agonal respiration or irregularly timed effort</td>
<td>Penetration of thoracic or abdominal cavity</td>
<td>Vertebral body fracture or luxation (except coccygeal)</td>
<td>CNS: nonresponsive to all stimuli and refractory seizures</td>
</tr>
<tr>
<td></td>
<td>Capillary refill time &gt; 3 s</td>
<td>Erratic arrhythmia</td>
<td>Little or no detectable air passage</td>
<td>Full-thickness abrasion or laceration with deep tissue involvement and artery, nerve, or muscle compromise</td>
<td>Multiple long bone, open fractures proximal to tarsus or carpus</td>
<td>Peripheral nervous system: absent nociception in ≥ 2 limbs; absent tail or perianal nociception</td>
</tr>
<tr>
<td></td>
<td>Rectal temperature &lt; 37.8°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Femoral pulse not detected</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Continued on next page.
## Appendix 2

The MGCS used to assess dogs with trauma.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor activity</td>
<td></td>
</tr>
<tr>
<td>Normal gait and normal spinal reflexes</td>
<td>6</td>
</tr>
<tr>
<td>Hemiparesis, tetraparesis, or decerebrate activity</td>
<td>5</td>
</tr>
<tr>
<td>Recumbent, with intermittent extensor rigidity</td>
<td>4</td>
</tr>
<tr>
<td>Recumbent, with constant extensor rigidity</td>
<td>3</td>
</tr>
<tr>
<td>Recumbent, with constant extensor rigidity with opisthotonus</td>
<td>2</td>
</tr>
<tr>
<td>Recumbent, with hypotonia of muscles and depressed or absent spinal reflexes</td>
<td>1</td>
</tr>
<tr>
<td>Brainstem reflexes</td>
<td></td>
</tr>
<tr>
<td>Normal pupillary light reflexes and oculocephalic reflexes</td>
<td>6</td>
</tr>
<tr>
<td>Slow pupillary light reflexes and normal to reduced oculocephalic reflexes</td>
<td>5</td>
</tr>
<tr>
<td>Bilateral unresponsive miosis with normal to reduced oculocephalic reflexes</td>
<td>4</td>
</tr>
<tr>
<td>Pinpoint pupils with reduced to absent oculocephalic reflexes</td>
<td>3</td>
</tr>
<tr>
<td>Unilateral, unresponsive mydriasis with reduced to absent oculocephalic reflexes</td>
<td>2</td>
</tr>
<tr>
<td>Bilateral, unresponsive mydriasis with reduced to absent oculocephalic reflexes</td>
<td>1</td>
</tr>
<tr>
<td>Level of consciousness</td>
<td></td>
</tr>
<tr>
<td>Occasional periods of alertness and responsive to environment</td>
<td>6</td>
</tr>
<tr>
<td>Comatose or delirium; capable of responding but response may be inappropriate</td>
<td>5</td>
</tr>
<tr>
<td>Semicomatose; responsive to visual stimuli</td>
<td>4</td>
</tr>
<tr>
<td>Semicomatose; responsive to auditory stimuli</td>
<td>3</td>
</tr>
<tr>
<td>Semicomatose; responsive only to repeated noxious stimuli</td>
<td>2</td>
</tr>
<tr>
<td>Comatose; unresponsive to repeated noxious stimuli</td>
<td>1</td>
</tr>
</tbody>
</table>


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### From this month’s AJVR

**Characteristics of respiratory tract disease in horses inoculated with equine rhinitis A virus**

Andrés Diaz-Méndez et al

**Objective**—To develop a method for experimental induction of equine rhinitis A virus (ERAV) infection in equids and to determine the clinical characteristics of such infection.

**Animals**—8 ponies (age, 8 to 12 months) seronegative for antibodies against ERAV.

**Procedures**—Nebulization was used to administer ERAV (strain ERAV/ON/05; n = 4 ponies) or cell culture medium (control ponies; 4) into airways of ponies; 4 previously ERAV-inoculated ponies were reinoculated 1 year later. Physical examinations and pulmonary function testing were performed at various times for 21 days after ERAV or mock inoculation. Various types of samples were obtained for virus isolation, blood samples were obtained for serologic testing, and clinical scores were determined for various variables.

**Results**—ERAV-inoculated ponies developed respiratory tract disease characterized by pyrexia, nasal discharge, adventitious lung sounds, and enlarged mandibular lymph nodes. Additionally, these animals had purulent mucus in lower airways up to the last evaluation time 21 days after inoculation (detected endoscopically). The virus was isolated from various samples obtained from lower and upper airways of ERAV-inoculated ponies up to 7 days after exposure; this time corresponded with an increase in serum titers of neutralizing antibodies against ERAV. None of the ponies developed clinical signs of disease after reinoculation 1 year later.

**Conclusions and Clinical Relevance**—Results of this study indicated ERAV induced respiratory tract disease in seronegative ponies. However, ponies with neutralizing antibodies against ERAV did not develop clinical signs of disease when reinoculated with the virus. Therefore, immunization of ponies against ERAV could prevent respiratory tract disease attributable to that virus in such animals. (Am J Vet Res 2014;75:169–178)