

Psychogenic stress in hospitalized veterinary patients: Causation, implications, and therapies

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Abstract

Objective: To review the sources, adverse effects, diagnosis, treatment, and prevention of psychogenic stress in hospitalized human and veterinary patients.

Data Sources: Data were collected by searching PubMed for veterinary and human literature from the past 10 years.

Human Data Synthesis: Psychogenic stress has been linked to immune suppression; gastrointestinal, cardiovascular, and cutaneous diseases; delayed wound healing; alterations in pain perception; and neurologic impairment. Sources of psychogenic stress include environmental alterations such as excessive noise and light, social and physical factors, sleep disruption, drugs, and underlying disease. Nonpharmacologic options for stress reduction include environmental and treatment modifications, music therapy, and early mobilization. Pharmacologic options include sedation with benzodiazepines and dexmedetomidine. Trazodone and melatonin have been examined for use in sleep promotion but are not currently recommended as standard treatments in ICU.




Veterinary Data Synthesis: Activation of the stress response in veterinary patients is largely the same as in people, as are the affected body systems. Possible sources of stress can include social, physical, and environmental factors. No gold standard currently exists for the identification and quantification of stress. A combination of physical examination findings and the results of serum biochemistry, CBC, and biomarker testing can be used to support the diagnosis. Stress scales can be implemented to identify stressed patients and assess severity. Nonpharmacologic treatment options include low-stress handling, pheromones, environmental modifications, and sleep promotion. Pharmacologic options include trazodone, benzodiazepines, dexmedetomidine, and melatonin.

Conclusion: The prevalence and clinical significance of psychogenic stress in hospitalized veterinary patients is unknown. Future studies are needed to specifically examine the causative factors of psychogenic stress and the effects of various therapies on stress reduction. The recognition and reduction of psychogenic stress in veterinary patients can lead to improvements in patient care and welfare.

KEYWORDS

cats, complications, dogs, environmental factors, sleep disturbance, stress response

Evaluation of biomarkers of kidney injury following 4% succinylated gelatin and 6% hydroxyethyl starch 130/0.4 administration in a canine hemorrhagic shock model

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Design: Experimental interventional study.

Setting: University.

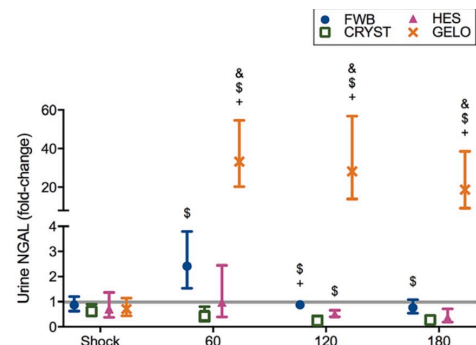
Animals: Twenty-four healthy ex-racing Greyhounds.

Interventions: Anesthetized Greyhounds subjected to hemorrhage for 60 min were resuscitated with 20 mL/kg of fresh whole blood (FWB), 6% hydroxyethyl starch (HES) 130/0.4, 4% succinylated gelatin (GELO), or 80 mL/kg of isotonic crystalloid (CRYST) over 20 min ($n = 6$ per treatment). Concentrations of biomarkers of AKI were measured at baseline, end of hemorrhage, and at 40 (T60), 100 (T120), and 160 (T180) min after fluid bolus. Biomarkers included neutrophil gelatinase-associated lipocalin in urine and serum (uNGAL; sNGAL), and urine cystatin C (uCYS), kidney injury molecule-1 (uKIM), clusterin (uCLUST), osteopontin, gamma-glutamyl transferase, monocyte chemoattractant protein-1 (uMCP), interleukin-6, interleukin-8, protein (uPROT), hyaluronan, and F₂-isoprostanes. Renal histology was scored for tubular injury and microvesiculation. Biomarker fold-change from baseline was compared between groups using mixed effects models (Bonferroni–Holm corrected $P < 0.05$). Frequencies of histology scores were compared by Fisher's exact test.

Measurements and main results: In dogs treated with GELO, uNGAL fold-change was markedly greater compared with all other groups at T60, T120, and T180 (all $P < 0.001$), and uCYS was greater at T60 compared with CRYST ($P < 0.001$), and at T120 and T180 compared with all other groups (all $P < 0.001$). Smaller, albeit significant, between-group differences in uKIM, uCLUST, uMCP, and urine protein concentration were observed across the FWB, GELO, and HES groups, compared with CRYST. The GELO group more frequently had marked tubular microvesiculation than the other groups ($P = 0.015$) although tubular injury scores were comparable.

Conclusion: In dogs with hemorrhagic shock, GELO was associated with greater magnitude increases in urine biomarkers of AKI and more frequent marked tubular microvesiculation, compared with FWB, CRYST, and HES.

- Gelatins are alternative colloid to hydroxyethyl starches
- In humans less AKI than HES, similar to crystalloids, but in animal models increased AKI markers
- Bled to maintain MAP <60 for 60min, then infused fluid, wait 3hrs then euth, histo
- Gelatins had higher NGAL, plus tubular microvesiculation on histology
- HES not worse than crystalloids (too short a study? Hypovolemic not sepsis?)



Effect of three resuscitative fluid therapy strategies on NT-proBNP concentration in healthy dogs

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Funding information

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Prior presentation: The results of this project were presented in abstract form at the American College of Veterinary Internal Medicine Forum 2016, Denver, CO.

Abstract

Objective: To determine if 3 resuscitative fluid therapy strategies increase N-terminal pro-brain natriuretic peptide (NT proBNP) levels in healthy dogs.

Design: Randomized crossover trial.

Setting: Veterinary teaching hospital.

Animals: Plasma NT proBNP concentrations were measured in 6 healthy purpose-bred dogs that received 3 resuscitative fluid therapy protocols.

Measurements and main results: Crystalloid, synthetic colloid, or hypertonic saline fluids were administered at resuscitative doses. Blood samples were collected via an indwelling catheter before, and at set time points between 0.5 and 36 h after fluid therapy and analyzed for NT-proBNP. A general linear mixed model was used to estimate the differences in NT-proBNP over time and among treatments. None of the resuscitative fluid therapy protocols caused increases of serum NT-proBNP beyond the previously reported cutoff concentration used to differentiate cardiac versus noncardiac causes of respiratory signs. Dogs receiving crystalloid fluid therapy had the most significant and prolonged increase in serum NT-proBNP concentration above baseline compared to dogs receiving either resuscitative doses of colloids or hypertonic saline.

Conclusions: Serum NT-proBNP concentration in normal dogs was not increased beyond concentrations previously established to equate to cardiac disease after receiving resuscitative fluid therapy with either a balanced crystalloid solution, hypertonic saline, or a synthetic colloid solution in this study.

KEYWORDS

cardiac biomarkers, colloid, crystalloid, hypertonic saline

- Normovolemic dogs
- 90ml/kg crystalloid 1hr, 20mL/kg colloid 20min, 5mL/kg hypertonic saline 15min
- Increased above baseline (more in crystalloid) but not above cut off for cardiac resp distress vs other
- So they think can still use BNP for resp distress in hospitalizaed patients

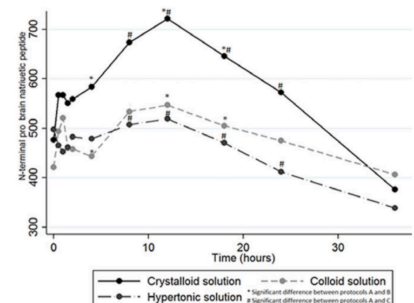


FIGURE 1 Predicted mean plasma NT-proBNP concentrations from 3 different resuscitative fluid protocols. Significant differences noted between protocol A (crystalloid) and B (colloid) at times 4, 12, and 18 h and between protocols A (crystalloid) and C (hypertonic solution) at 8, 12, 18, and 24 h

Evaluation of tissue oxygen saturation in naturally occurring canine shock patients

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Abstract

Objective: To measure tissue oxygen saturation (StO₂) in a population of dogs with naturally occurring shock and to evaluate the relationship of StO₂ with an established veterinary severity scoring system (Acute Patient Physiologic and Laboratory Evaluation) and patient survival.

Design: Prospective observational study.

Setting: University teaching hospital.

Animals: Twenty-five adult dogs presenting in shock, as determined by the presence of hypotension, the calculated shock index, and hyperlactatemia.

Interventions: StO₂ was measured prior to any therapeutic interventions. Blood samples were also collected for measurement of plasma lactate, complete blood count, and a serum biochemical profile. Abdominal and thoracic focused assessment with sonography was also performed.

Measurements and Main Results: Dogs enrolled in this study had lower mean (\pm SD) StO₂ values ($65.12 \pm 17.7\%$) than previously reported in experimental models of canine hemorrhagic shock. There was a moderate correlation between lower StO₂ and increasing Acute Patient Physiologic and Laboratory Evaluation scores. A single StO₂ value, assessed prior to therapeutic intervention, was not a sensitive predictor of mortality in this population.

Conclusions: Dogs with naturally occurring shock have lower mean StO₂ values than those previously reported in dogs with experimentally induced shock. A lower initial StO₂ was associated with worse disease severity but was not a significant predictor of survival in this population.

- Dogs in shock had lower StO₂ than healthy dogs (previously reported)
- Some correlation with APACHE score
- No correlation with mortality

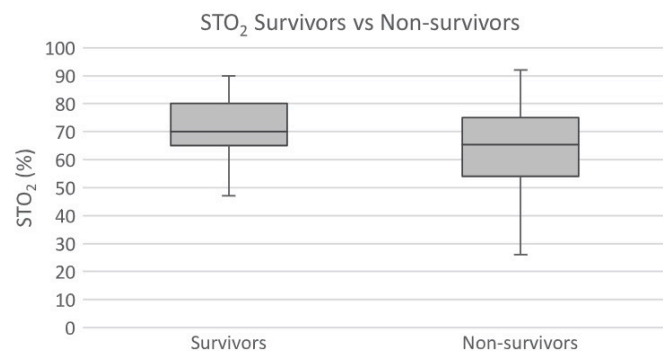



FIGURE 5 Box and whiskers plot depicting the initial StO₂ in survivors and nonsurvivors

Comparison of biomarkers adiponectin, leptin, C-reactive protein, S100A12, and the Acute Patient Physiologic and Laboratory Evaluation (APPLE) score as mortality predictors in critically ill dogs

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Abstract

Objectives: To determine if selected serum biomarkers are superior to the acute patient physiologic and laboratory evaluation (APPLE) complete score in predicting 30-day mortality in a non-homogeneous disease population of critically ill dogs.

Design: Prospective cohort study comparing the serum biomarkers adiponectin, leptin, C-reactive protein, and S100A12 concentrations between surviving and nonsurviving critically ill dogs.

Setting: University small animal teaching hospital.

Animals: Seventy critically ill dogs were prospectively recruited, and an APPLE complete score was calculated within 24 hours of being admitted to the intensive care unit. Logistic regression models were fit to estimate the association between biomarkers and 30-day survival. Results were interpreted at the 5% level of significance.

Measurements and main results: Leptin was the only biomarker that was significantly correlated with the APPLE complete score ($P < 0.001$). Only the APPLE complete score ($P = 0.003$) and illness duration of < 1 day ($P = 0.043$) were significantly associated with outcome.

Conclusion: Based on the results of this study, there appears to be no benefit in using biomarkers over the APPLE score for disease severity stratification. Serum leptin concentration was significantly correlated with disease severity as determined by APPLE scoring. Longer duration of illness prior to admission was associated with a higher risk of death. APPLE scores were highest in dogs with infectious and immune-mediated diseases and bite wounds.

- Looked at biomarkers and apple scores in 70 critically ill dogs
- Leptin was similar to apple score
- Apple score, and illness duration < 1 day were only things significantly associated with survival
- No benefit in biomarkers over apple scores

Risk factors, characteristics, and outcomes of acute respiratory distress syndrome in dogs and cats: 54 cases

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Presented in poster form at the 15th European Veterinary Emergency and Critical Care congress, Lyon, France, June 2015.

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Abstract

Objective: To characterize the clinical features of the acute respiratory distress syndrome (ARDS), risk factors, and outcome in dogs and cats. The study also aimed to evaluate the current veterinary criteria for the diagnosis of ARDS by comparison of clinical diagnostic criteria with necropsy findings.

Design: Retrospective study.

Animals: Fifty-four client-owned animals, 46 dogs and 8 cats.

Interventions: Medical records were reviewed for patients with the diagnosis of ARDS based on previously published clinical criteria or necropsy diagnosis. Signalment, clinical findings, and outcome were recorded.

Measurements and Main Results: Animals were grouped according to a clinical or necropsy diagnosis: 43/54 (80%) were diagnosed with ARDS based on clinical criteria (group 1) and 11/54 (20%) were diagnosed with ARDS based on necropsy only (group 2). In group 1, 22/43 (51%) had a necropsy, which confirmed ARDS in 12/22 (54%). Direct (pulmonary) causes of ARDS were more common than indirect causes in dogs, while cats had a similar occurrence of direct and indirect causes. The most common risk factors identified in dogs were aspiration pneumonia (42%), systemic inflammatory response syndrome (SIRS) (29%), and shock (29%). All cats diagnosed clinically with ARDS had SIRS with or without sepsis. Of the animals with a clinical diagnosis of ARDS, 49% received mechanical ventilation and 58% received treatment (with or without mechanical ventilation) for 24 hours or longer. The overall case fatality rate was 84% in dogs and 100% in cats.

Conclusions and Clinical Relevance: As described in human literature, pneumonia was the most common risk factor in dogs with ARDS, whereas it was SIRS for the cat population. The high mortality rate and discrepancy between the clinical diagnosis and necropsy findings may highlight limitations in the clinical criteria for the diagnosis of ARDS and treatment in dogs and cats.

- retrospective
- Necropsy diagnosis or if met criteria ->
- Pulmonary causes most common in dogs
- Direct and indirect equally common in cats (only 8)
- Aspiration pneumonia most common cause in dogs
- All cats had SIRS +/- sepsis
- Approx. 50% ventilated
- Mortality 84% dogs, 100% cats

The medical records of all cases with a clinical diagnosis of ARDS were reviewed and included in the study if they met all 4 of the following clinical criteria:

1. Acute onset (<72 h) of respiratory distress. The onset of respiratory distress was defined as the time of initiation of oxygen therapy for the purposes of this study.
2. The presence of a concurrent disease, trauma, drug, or toxin was required as an inclusion criteria. The presence of a specific, known risk factor was not required as an inclusion criteria for this study to allow the possible identification of disease processes associated with ARDS that have not been previously described.
3. Evidence of pulmonary capillary leak without increased pulmonary capillary pressure by the presence of bilateral infiltrates on thoracic radiographs or bilateral-dependent density gradient on thoracic computed tomography (CT), suggestive of ARDS or noncardiogenic pulmonary edema (NCPE) as reported in the radiology report by a board-certified radiologist. As pulmonary artery occlusion pressure was not measured in the animals in this study, the medical records were searched for clinical evidence of left atrial hypertension. Cases were excluded if thoracic radiographs or echocardiography performed by a board-certified cardiologist suspected left-sided congestive heart failure (CHF). Cases were also excluded if they clinically improved after a furosemide therapy trial.
4. Hypoxemia, defined as a PaO₂/FIO₂ (P/F) ratio of ≤ 300 . In the absence of arterial blood gas analysis, an SpO₂/FIO₂ (S/F) ratio ≤ 315 was used to define hypoxemia, as has been reported previously.¹⁷⁻²⁰ For the purpose of this study, all identified animals were considered to have ARDS. No subcategorization into ALI was made.

All cases with a necropsy diagnosis, as reported by a board-certified pathologist, of ARDS were included. For inclusion in the study, histologic findings had to include alveolar inflammation, edema, necrosis with formation of hyaline membranes, vascular congestion, or at least one of these histologic findings along with type II alveolar cell proliferation or interstitial fibrosis.¹⁴

Comparison of pentobarbital-phenytoin alone vs propofol prior to pentobarbital-phenytoin for euthanasia in 436 client-owned dogs

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Presented in part as an abstract at the 2016 International Veterinary Emergency and Critical Care Symposium, Grapevine, Texas.

Abstract

Objective: To report the incidence of adverse events during euthanasia of client-owned dogs administered either intravenous pentobarbital/phenytoin (PP) or PP after propofol delivery.

Design/Setting: Prospective, observational, multi-site study.

Animals: Four hundred thirty-six dogs undergoing client-elected euthanasia over a 1-year period.


Interventions: Interventions included placement of an IV catheter and delivery of euthanasia agents (PP for the PP group, propofol followed by PP for the propofol group). Seven pre-determined adverse events were recorded: agonal breaths, urination, defecation, vocalization, muscle activity, dysphoria, and catheter complications. Euthanasia scores for each patient were defined as the sum of all adverse events (0–7) the patient exhibited.

Measurements and Main Results: Two hundred thirty-six dogs were in the PP group and 200 dogs were in the propofol group. No significant differences were detected in the dose of PP administered (166.9 ± 105.6 mg/kg for PP group, 182.6 ± 109.8 mg/kg for propofol group). Propofol dogs received 4.5 ± 2.9 mg/kg propofol. The incidence of ≥ 1 adverse event was 35.2% in the PP group and 26.5% in the propofol group ($P = 0.052$). Mean euthanasia scores (0.47 PP group, 0.32 propofol group) were not significantly different ($P = 0.08$). Propofol significantly reduced the incidence of muscle activity (6% vs. 14%, odds ratio 0.39; $P = 0.0079$).

Conclusions: There was no difference in the likelihood of the studied adverse events during client-elected euthanasia in dogs when propofol was used prior to PP. There was a significant reduction in perimortem muscle activity if propofol was given prior to PP.

- No significant difference in euthanasia scores (complication score)
- Propofol did reduce incidence of muscle activity (6 vs 14%)

Clinical experience utilizing a novel fluoroscopic technique for wire-guided esophagojejunal tube placement in the dog and cat: Twenty cases (2010–2013)

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Copenhagen, Denmark, 2013.

Abstract

Objective: To describe the clinical use of a novel, minimally invasive technique for fluoroscopic wire-guided esophagojejunal tube (FEJT) placement in dogs and cats.

Design: Retrospective study (February 2010–September 2013).

Setting: University veterinary teaching hospital.

Animals: Eighteen dogs and 2 cats with intolerance of, or contraindications to, gastric feeding that underwent attempted FEJT placement.

Interventions: All patients underwent attempted FEJT placement using a novel fluoroscopic wire-guided technique.

Measurements and Main Results: Patient data were collected including information about the FEJT placement and utilization of the tube postplacement. The primary diagnosis in dogs undergoing FEJT placement was pancreatitis in 61% of cases. The ability to achieve postpyloric access with the technique was 95% (19/20). Mean duration of the procedure in dogs where FEJT placement was successful was 63.8 minutes (SD, 28.6; min-max, 30–120 min). Mean fluoroscopy time was 19.4 minutes (SD, 11.5; min-max, 5.2–42.1-min). Esophagostomy site infection was a complication of FEJT placement in 2 dogs. The mean duration the FEJT remained in place in dogs was 3.8 days (SD, 2.2; min-max, 1–7 days), and mean duration of feeding was 3.6 days (SD, 2.2; min-max, 1–7 days). Vomiting was noted in 89% of patients prior to FEJT placement and was significantly reduced to only 24% of patients postplacement ($P = 0.0001$).

Conclusions: FEJT placement is a viable technique for providing postpyloric nutrition in dogs and cats intolerant of, or with contraindications to, gastric feeding.

- For short term post pyloric feeding
- Anesthetized
- Red rubber E tube, then guidewire thing, then feeding tube (8F)

Computed tomographic features of intra-abdominal hypertension in three dogs

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*These authors contributed equally to this work.

Abstract


Objective: To describe computed tomographic (CT) features of intra-abdominal hypertension (IAH) in 3 dogs with abdominal distension.

Case Summary: Three dogs with anorexia, distended abdomen, or labored breathing were presented for CT imaging. All 3 dogs were premedicated with IV butorphanol (0.2 mg/kg). A Foley urinary catheter was aseptically placed and the transvesical technique was used to obtain intra-abdominal pressure (IAP). The IAP measurements were obtained with the dogs in a standing position after a stabilization period of 5 minutes. The mean IAP values for each of the 3 dogs were 26.0, 12.0, and 13.0 mm Hg. Anesthesia was induced with IV propofol (2.0–4.0 mg/kg, to effect) in all 3 dogs and maintained with sevoflurane in 2 dogs. Compression of the caudal vena cava and elevation of the diaphragm were observed in all 3 dogs, whereas renal compression and the extension of peritoneal fluid to the vaginal canal and cavity were seen in the dog with the highest IAP.

New or Unique Information Provided: Compression of the caudal vena cava, direct renal compression, and the extension of peritoneal fluid into the vaginal canal and vaginal cavity are consistent with a diagnosis of IAH. Measurement of IAP and detection of these CT features should alert clinicians to the possible presence of IAH in veterinary patients.

- One dog 26mmHg, one 12, one 13
- All had caudal vena cava compression and elevated diaphragm
- More severe had renal compression and extension of peritoneal fluid into vaginal canal

Acute liver failure in two dogs following ingestion of cheese tree (*Glochidion ferdinandi*) roots

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Abstract

Objective: To describe the management and resolution of acute liver failure (ALF) in two dogs following ingestion of cheese tree (*Glochidion ferdinandi*) roots.

Case Summaries: A 2-year-old male entire Bullmastiff and a 5-year-old female neutered German Shepherd dog were presented for acute-onset lethargy and vomiting after chewing on tree roots of a cheese tree. Both dogs developed clinical abnormalities consistent with ALF, including hepatic encephalopathy, marked increase in alanine aminotransferase activity and bilirubin concentration, and prolonged coagulation times. Treatment included administration of intravenous fluids, hepatoprotectants, vitamin K₁, antibiotics, lactulose, antacids, antiemetics, and multiple fresh frozen plasma transfusions. Follow-up examinations performed 30 days after initial presentation revealed the dogs to be clinically healthy with serum biochemical and coagulation profiles within reference intervals.

New or Unique Information: This is the first report describing ALF in two dogs following ingestion of cheese tree (*G. ferdinandi*) roots. In this clinical setting, despite a poor prognosis, survival and recovery of adequate liver function were possible with medical management.

- Cheese trees are Australian
- Apparently their roots cause acute liver failure

Acute barium poisoning in a dog after ingestion of handheld fireworks (party sparklers)

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Abstract

Objective: To report a case of acute barium poisoning in a dog subsequent to ingestion of a common handheld pyrotechnic (sparkler).

Case summary: A 5-year-old female neutered German Shorthaired Pointer presented with acute onset of generalized flaccid muscle paralysis and fasciculations, ptyalism, and an irregular heart rhythm. Marked hypokalemia (1.9 mmol/L [mEq/L]; reference range [3.5–5.8 mmol/L [mEq/L]], acidemia (pH 7.20; reference range 7.38–7.44), and hypoventilation (PvCO₂ 55 mm Hg; reference range 40–50 mm Hg) were present on admission. Treatment consisted of fluid therapy, aggressive IV potassium chloride supplementation, gastric lavage, and oral magnesium sulfate administration. Based on history and clinical presentation, barium intoxication after ingestion of handheld firework (sparklers) was suspected and a serum sample was submitted for barium analysis. The serum barium concentration determined by inductively coupled plasma/mass spectrometry was 2,000 µg/L, a 3 orders of magnitude elevation above previously reported normal values in dogs. Within 18 hours of admission, the clinical signs resolved and the blood potassium concentration normalized. The animal was discharged home 36 hours after admission. On follow-up performed after 1 and 5 years, no health issues were apparent.

New information provided: To the authors' knowledge, this is the first report of acute, life-threatening barium toxicosis characterized by flaccid paralysis, acidemia, and severe hypokalemia occurring in a dog after ingestion of a popular pyrotechnic (sparkler) containing barium nitrate. Clinical signs may resolve within 24 hours with appropriate supportive care including aggressive potassium supplementation and chelation therapy.

- Apparently sparklers have barium
- Apparently barium can cause flaccid paralysis and hypokalemia
 - o We use the insoluble form, the soluble form causes the toxicity
- Can be chelated with oral magnesium; transforms soluble barium into insoluble