Pacific Tide

An informational newsletter

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About our Author

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Dr. Jessica Kurek graduated from UC Davis School of Veterinary Medicine in 2009. She completed a rotating small animal internship at the University of Pennsylvania in 2010, where a dynamic emergency caseload provided her with a wide breadth of experience in emergency medicine, trauma, and critical care. Her special interests include emergency surgery, trauma, infectious disease, and wildlife medicine. She joined PVSES in August 2010. She is excited to be helping animals back near her hometown and spends her life outside of work with her husband Kyle and daughter Madison, two spoiled Labradors Sandy and Ebony, and their kitties. She also enjoys backpacking, dancing, running, and water sports in her free time.

Jessica Kurek, DVM

Managing the acutely convulsing patient: Generalized tremors, cluster seizures, and status epilepticus

Acutely convulsing patients are a common emergency presentation in our practices. Tremors and seizure activity are caused by an imbalance in neuronal excitation and inhibition leading to a varied range of muscle activity. Convulsions may be due to cluster seizures (defined as 2 or more seizures in a 24 hour period), status epilepticus (continuous seizures without full recovery between seizure episodes), or generalized tremors, all of which require aggressive and immediate intervention. Common intracranial and extracranial causes of seizures, along with common toxicities leading to tremors and/or seizures are summarized below. Clinical differentiation of generalized tremors from cluster or status patients is not always straightforward, as patients in both groups can present with acute onset, varying degrees of mental awareness, focal or generalized convulsions, inappropriate urination/defecation, hypersalivation, and difficulty walking or recumbency. Ultimately, tremors and seizures are initially treated in a similar manner, and thus are both covered in this discussion.

Table 1: Extracranial seizure causes
Hypoglycemia – young and/or small patients, insulin overdose, sepsis, insulinoma, other neoplasia, toxins
Hepatic encephalopathy – portosystemic shunt, microvascular dysplasia, severe chronic hepatitis, other causes of liver failure
Uremic encephalopathy
Hypocalcemia – hyperparathyroidism, sepsis, pancreatitis **Hypothyroidism**
Toxins (see Table 3)

Table 2: Intracranial seizure causes
Idiopathic epilepsy
Inflammatory encephalitidies – GME, NE, NME **Infectious encephalitidies** – viral, bacterial, protozoal
Neoplasia
Cerebral/glial scarring
Cerebral hemorrhage – hypertension, coagulopathy **Developmental disorders** – hydrocephalus, etc **Trauma or post-traumatic disorders**

Table 3: Tremorgenic and seizurogenic toxins
Metaldehyde – Snail/slug bait **Rodenticides** – zinc phosphide, bromethalin, strychnine [anti-coagulants leading to CNS hemorrhage]
Tremorgenic mycotoxins – Penitrem A and Roquefortine – moldy nuts, cheese, breads, legumes, other
Pyrethrins/permethrins – especially in cats **Anticholinesterase insecticides** – organophosphates and carbamates **Other pesticides** – DEET, 4-Aminopyridine, Sodium fluoroacetate **Methylxanthines** – chocolate, coffee **Serotonergic pharmaceuticals** – MAOIs, SSRIs, TCAs **Amphetamines** – pseudophedrine, methamphetamine, cocaine, Adderall, other **Antihistamine overdoses** **Metronidazole** **Alpha lipoic acid** – antioxidant synergistic with insulin; causes hypoglycemia **5-Fluorouracil** – anti-neoplastic **Isoniazid** – antibiotic **Lead Toxicosis** **Hypernatremia** – paintballs, homemade play dough, sea water **Amanita mushrooms, xylitol, and other hepatotoxins** – leading to hypoglycemia

History

Acquiring an accurate and complete history is very important for convulsing patients in order to treat most effectively. History should focus on toxin exposure (don't forget to ask about owner medications!), past behavioral changes indicating intracranial disease, evidence of systemic disease (PU/PD, appetite or weight changes, etc), or coexisting respiratory or cardiovascular disease which can cause syncope or other seizure look-alike disorders. For patients with known seizure disorders, it is imperative to gather details of current medications, recent seizure activity, systemic and neurologic workup, and drug level monitoring. Training your technicians to ask specific questions at triage allows you to garner vital information early on in patient stabilization, before you are able to obtain a complete history of your own.

Immediate treatment

1. If not actively seizing, obtain vitals, perform a complete neurologic exam, and began collecting diagnostic samples (see below)
   A. Place IV catheter in case of recurrent convulsions while discussing case with owners and obtaining diagnostics
2. If actively tremoring or seizing
   A. Immediately administer anti-convulsant therapy:
      Diazepam 0.5-1 mg/kg IV or Midazolam 0.25-1 mg/kg IV
      i. Repeat 2-3 times without significant risk of cardiorespiratory depression
      ii. Alternate route options when IV access cannot be obtained:
         1. Rectal (diazepam 1-2 mg/kg)
         2. Intranasal (both)
         3. Intramuscular (midazolam)
      iii. Higher doses may be needed in patients currently receiving phenobarbital
   B. Place IV catheter
   C. Methocarbamol 50-150 mg/kg IV initial dose if tremorgenic toxin suspected
   D. Perform a cursory exam including heart and lung assessment, hydration, mentation, PLRs and pupil size, abdominal palpation

Initial diagnostics

Immediate diagnostics focus on patient stabilization and identifying extracranial causes:

1. Body temperature – ALWAYS check at initial triage. Hyperthermia is a significant cause of post-seizure complications.
2. Blood sugar – hypoglycemia must be treated primarily in order to control seizures and prevent further complications
3. Calcium (preferably ionized) and electrolytes – calcium supplementation is required to control tremors, rigidity, or seizures due to hypocalcemia

Stabilizing treatment

1. If seizure/tremor activity continues despite initial anticonvulsant therapy, give additional medications as needed:
   A. Phenobarbital 2-8 mg/kg IV q4-6 hrs
      i. Some sources report up to 16-20 mg/kg initial loading dose, which can cause severe sedation and cardiopulmonary depression – best to reach this cumulative dose over 12-24 hours
      ii. Phenobarbital (2-4 mg/kg/hr) and pentobarbital (0.5-4.0 mg/kg/hr) CRIs are also reported but can cause significant cardiopulmonary depression, and are NOT a first line choice for anticonvulsant CRI
   B. Benzodiazepine CRI
      i. Diazepam 0.1-2 mg/kg/hr or Midazolam 0.25-2 mg/kg/hr
         1. Starting dose of 0.5-0.6 mg/kg/hr
         2. Frequent dose adjustment and boluses may be needed initially
      ii. Dilute in 0.9% saline or 5% dextrose to ensure an adequate volume is being given for drug delivery

Stabilizing treatment (con't)

iii. Loading dose of 0.25-0.5 mg/kg is recommended if no benzodiazepines given within previous 20-30 minutes

iv. Protect from light (diazepam and midazolam) and minimize time in plastic syringes/lines (diazepam only) as efficacy will be lost

C. Propofol CRI

i. Initial dose of 1-2 mg/kg IV

ii. Continuous rate of 0.1-0.6 mg/kg/min

iii. Depending on dose, effects vary from moderate sedation to general anesthesia

D. Continue Methocarbamol 50-100 mg/kg IV prn for generalized tremors due to pyrethrins, metaldehyde, other toxins

i. Various sources report a maximum dose of 220-330 mg/kg/day – anecdotally have exceeded this without known sequelae

E. Consider inhalant general anesthesia if seizures/tremors persist

F. Levericetam

i. IV formulation is available but minimal experience with use in small animals

2. IV fluids – Very important to maintain perfusion and stable body temperature
3. Aggressive cooling until temperature reaches 103 then monitor temp closely and warm/cool as needed to keep in normal range
4. Decontamination if indicated:
   A. Induce vomiting – only if patient has adequate swallow reflex, appropriate mentation, and high suspicion for toxin ingestion
   B. Enemas (+/- rectal activated charcoal administration)
   C. Gastric lavage with sedation/anesthesia
      i. Endotracheal intubation to protect airway!! These patients are at high risk for aspiration due to large doses of sedative drugs, GI upset from toxins or systemic illness, and seizure/tremor activity
   D. Activated charcoal with sorbitol - risk of aspiration! Consider administering via orogastric tube after gastric lavage
5. Acepromazine
   A. Reserve for patients with a known ingestion of metaldehyde, pyrethrin/permethrin exposure, or exposure to other toxins that are responsive to Acepromazine
6. GI protectants – gastroenteritis and ulceration are common sequelae to prolonged seizures or tremors
   Consider famotidine, pantoprazole injectable/omeprazole oral, sucralfate, anti-emetics
7. Start ongoing oral anticonvulsants once mentation has improved
8. Mannitol – consider in patients with prolonged seizure/tremor activity
   A. Benefits – reduce intracranial edema +/- reduce ICP if needed
   B. Avoid if evidence of intracranial hemorrhage

Monitoring

Careful monitoring is vital to identify and prevent further metabolic or neurologic damage

1. Oxygenation/airway
   Flow by oxygen for heavily sedated patients
   Intubation if needed for patients on anti-convulsant CRIs or under anesthesia
2. Blood glucose – avoid hyper- and hypoglycemia
3. ECG
4. Electrolytes
5. Temperature – prevent hypothermia too!
6. Hydration – PCV/TS, CRT, pulses, MM, weight, skin turgor, UOP
7. Blood pressure –important to help manage for systemic hypertension and monitor for elevated intracranial pressure

8. Assess for post-seizure complications – Increased intracranial pressure, neurogenic pulmonary edema, cardiac arrhythmias, intravascular DIC, myoglobinuria (and possible secondary renal failure)

Ongoing care

It is important to recommend 24 hour monitoring and care of these patients once initial seizure/tremor activity is controlled. Repeat seizure episodes or ongoing tremors at home or in a veterinary hospital without overnight care can lead to serious and life threatening sequelae. Weaning of CRIs is a gradual process that can take 12-48 hours and also requires close monitoring. Paddling movements should be cautiously interpreted when weaning CRIs, as this can be normal when waking up from propofol, barbiturates, and inhalant anesthesia. Always discuss the potential for high costs associated with acutely convulsing patients (short and long term), in addition to the highly variable prognosis depending on underlying cause of convulsions.

Additional diagnostics should be pursued on a case dependent basis after stabilization, and may include complete bloodwork (CBC, Chemistry, T4), urinalysis, drug levels (bromide, phenobarbital), systemic workup for underlying disease (chest/abdominal radiographs, abdominal ultrasound, etc), and primary neurologic workup (CSF tap, advanced imaging). For patients in which toxins are strongly suspected or confirmed, complete systemic workup and neurologist referral may not be necessary, but should still be discussed in case response to therapy is not in concordance with toxin ingestion.

Finally, long term oral anti-convulsant therapy should be initiated in patients with primary tremor/seizure disorders. Drug options include phenobarbital, potassium bromide, Levericetam, Zonisamide, Gabapentin, Felbamate, pre-gabalin. A full discussion of drug selection, doses, and management of long term anti-convulsant therapy is beyond the scope of this discussion. Rescue anti-convulsants should be considered at home for patients prone to cluster seizures (clorazepate, rectal valium).

Client education

As primary care and emergency veterinarians, it is especially important to educate clients on the dangers of household toxins and medications, tremors/seizures as they pertain to metabolic illness, and the importance of seeking emergency medical attention when cluster seizures or status epilepticus occur. Prompt medical treatment is vital in preventing both neurologic and systemic complications of prolonged tremor or seizure activity.

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Our Doctors

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Behavior
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About Our Hospitals

Pacific Veterinary Specialists was founded to provide high quality, specialized medical care to companion animal patients. Our practice is dedicated to serving the veterinary community as a partner in total patient care. We offer comprehensive specialized services including endoscopy, Doppler ultrasound, surgery, 24-hour ICU care, and emergency and critical care. Our staff is committed to providing compassionate and thorough medical care that meets the needs of the patient, client, and referring veterinarian. In September 2011 we opened PVSM and offer internal medicine, oncology, dermatology and cardiology Tuesday through Thursday in Monterey. Behavior consultation by appointment is available on Mondays.

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