ANGRY PETS & ANESTHESIA

HOW TO HOSPITALIZE THE PATIENT WITHOUT GETTING HOSPITALIZED YOURSELF

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Perioperative stress response in dogs undergoing elective surgery: variations in behavioural, neuroendocrine, immune and acute phase responses

Authors: Siracusa, C; Manteca, X; Cerón, J; Martínez-Subiela, S; Cuenca, R; Lavín, S; Garcia, F; Pastor, J
Source: Animal Welfare, Volume 17, Number 3, August 2008, pp. 259-273(15)
Publisher: Universities Federation for Animal Welfare

Stress-induced immune dysfunction: implications for health

Ronald Glaser [1], Janice K Kiecolt-Glaser

Psychogenic Stress in Hospitalized Dogs: Cross Species Comparisons, Implications for Health Care, and the Challenges of Evaluation

Jessica P. Hekman,[1] Alicia Z. Karas,[2,*] and Claire R. Sharp[2]

Exercise stress, intestinal permeability and gastric ulceration in racing Alaskan sled dogs

Published online by Cambridge University Press: **09 March 2007**

Christopher M Royer, Michael Willard, Katherine Williamson, Jörg M Steiner, David A Williams and Michael David

Show author details

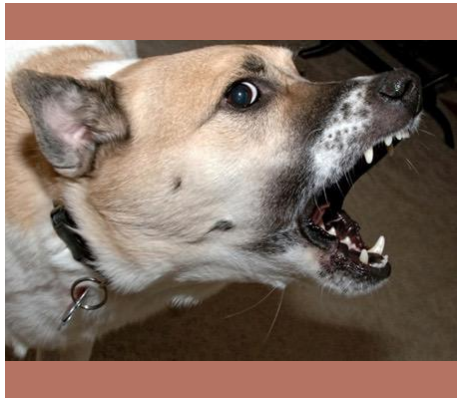
The effects of fear and anxiety on health and lifespan in pet dogs

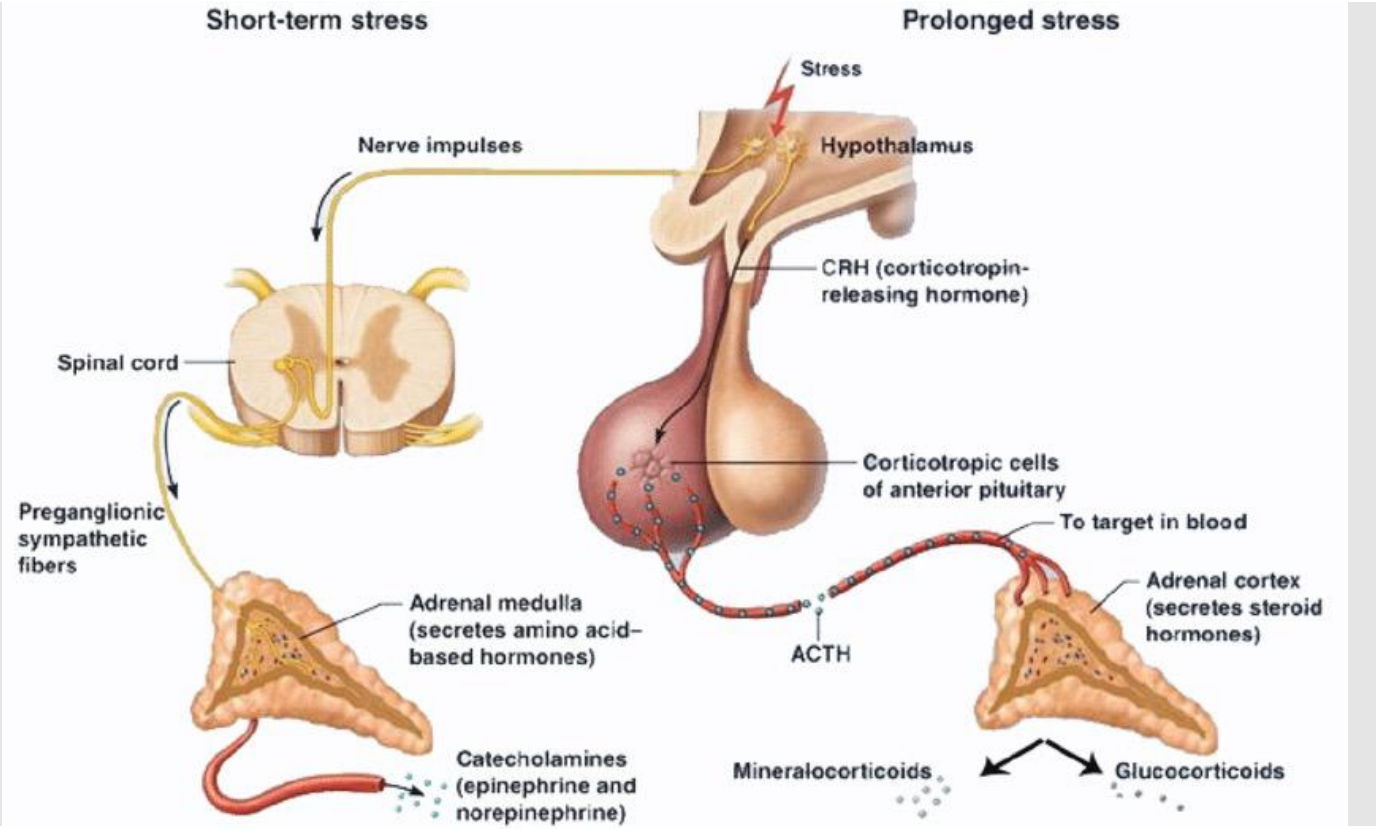
Nancy A. Dreschel

AGGRESSIVE PATIENT PHYSIOLOGY

- *"acute and chronic psychogenic stress can result in negative consequences on both human and non-human animals, contributing to increased patient morbidity or mortality"*
  - ↑ susceptibility to infection and sepsis
  - Impaired antibody responses to vaccination
  - Slowed wound healing
  - Development of gastric ulceration*
- Chronic stress can shorten the patient's lifespan

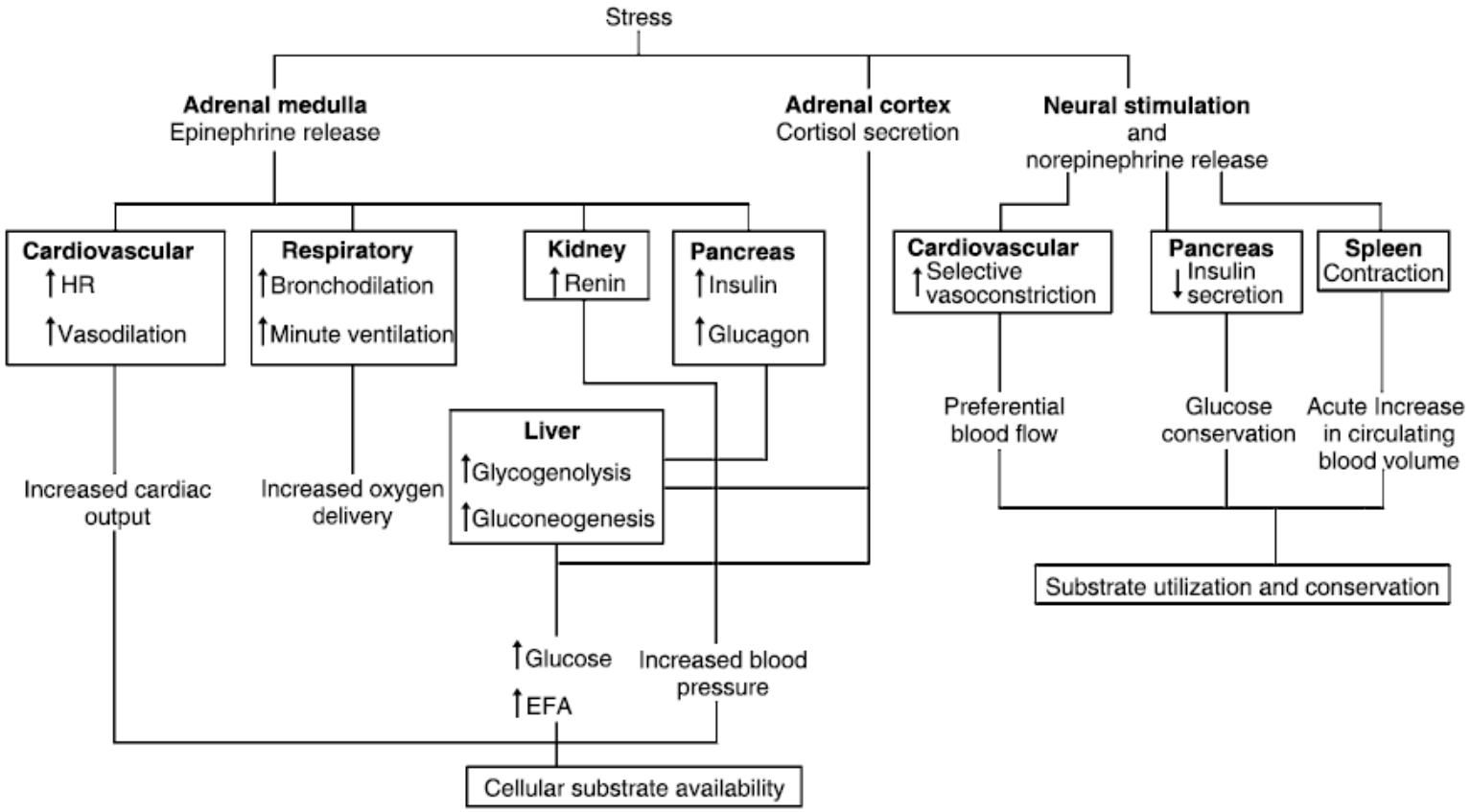
STRESS PHYSIOLOGY





- Hypothalamic-Pituitary-Adrenal Axis (HPA Axis)
  - Stress/Fear/Anxiety → Hypothalamus → secretes corticotropin-releasing hormone (CRH) → corticotropic cells in the AP → release ACTH → adrenal gland (cortex) → secretes cortisol

SYMPATHETIC NERVOUS SYSTEM



- SNS = Fight/Flight/Freeze
- Stress response prepares animal for immediate future via activation of the adrenocortical system→ ↑ and redistributes BF, mobilizes body resources to provide substrates (glucose, FFAs), activates the immune system
- Neuroendocrine and metabolic effects that can result in undesirable hemodynamic changes, limit availability of glucose to the tissues, depress the immune system, prolong healing and tissue repair

SNS VS PSNS

SNS / PSNS Activation

	Sympathetic Stimulation		Parasympathetic Stimulation	
	NT	Effect & Receptor Type	NT	Effect & Receptor Type
Heart	NE	↑ HR (B1 > B2) ↑ Contractility (B1 > B2 > A1) ↑ Conduction (B1 > B2)	ACh	↓ HR ↓ Contractility ↓ Conduction
Arterioles	NE	Coronary: Contraction/dilation (α/β2) Skin/Mucosa: Contraction (α) Skeletal m.: contraction/dilation (α/β2) Cerebral: contraction (α, slight) Pulmonary: contraction/dilation (α/β2) Abdominal Viscera: contraction/dilation (α/β2) Renal: contraction/dilation (α/β2)	ACh	Coronary: vasodilation Skin/Mucosa: vasodilation Skeletal m.: vasodilation Cerebral: vasodilation Pulmonary: vasodilation Abdominal Viscera: -- Renal: --
Veins	NE	Contraction / dilation (α1/β2)	ACh	--
Lungs	NE	Bronchiolar m.: contraction (α1), relaxation (β2) Glands: ↑secretion (β2), ↓secretion (α)	ACh	Bronchiolar m.: contraction Glands: ↑↑mucous secretion
Head	NE	Lacrimal Glands, Salivary Glands, Nasopharyngeal Glands: (↑) secretion, ↑ blood flow	ACh	Lacrimal Glands, Salivary Glands, Nasopharyngeal Glands: ↑↑ secretion
Eye	NE	Radial m. (iris): contraction / mydriasis (α1) Pupillary Sphincter m.: -- Ciliary m.: relaxation (far vision); (β)	ACh	Radial m. (iris): -- Pupillary Sphincter m.: contraction / miosis Ciliary m.: contraction (near vision)
GIT	NE	Motility: ↓motility (α1, α2, β1, β2) Sphincter Muscles: contraction (α) Secretion: inhibition (?)	ACh	Motility: ↑motility Sphincter Muscles: dilation Secretion: ↑secretion
Adrenal Medulla			ACh	↑secretion of Epi / NE

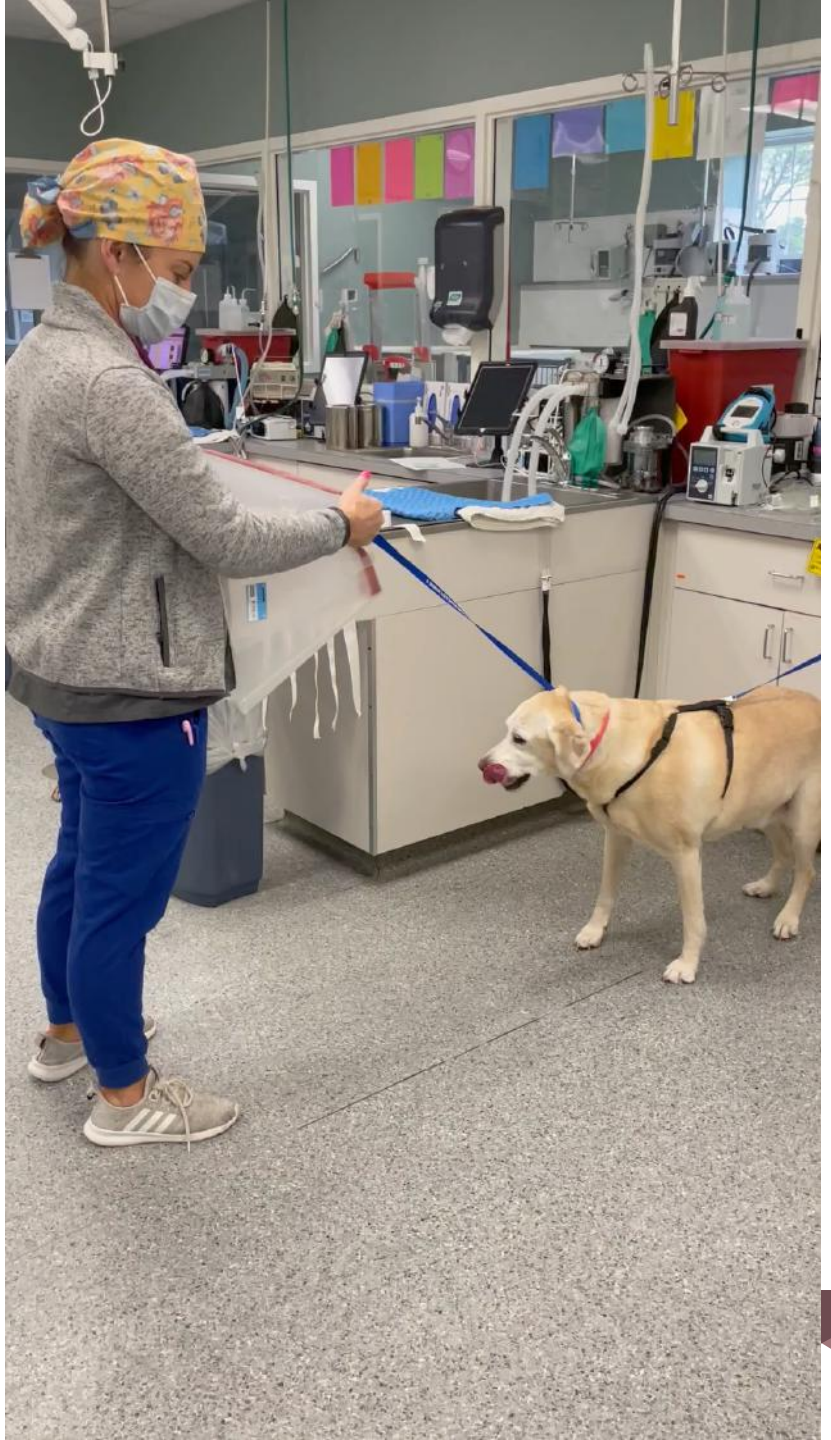
HANDLING AN AGGRESSIVE PATIENT

- Considering the overwhelming evidence that the physiologic consequences of stress and anxiety, it is critical to help decrease or prevent patient stress in the hospital setting
- Fear Free

Our mission is to prevent and alleviate fear, anxiety, and stress in pets by inspiring and educating the people who care for them.

EQUIPMENT

- E-collar
- Muzzle
  - Basket muzzle
  - O_2 muzzle
  - Nylon or leather muzzle
  - "cat hat"
- Leash: 2, ideally
- Harness
- Confident handler
- Mesh carrier



E-COLLAR TRICKS

- Slide E-collar down the slip lead to easily place on the patient
- Can also wrap it around the patient and secure it (works better if Velcro-type e-collar)

WHEN FEAR FREE ISN'T ENOUGH...

- Administration of medication
  - PO
  - OTM
  - IM
  - IV?
  - ~~Inhalant sedation (boxing down)~~

ORAL MEDICATION

Dogs

- Trazodone: 5-7 mg/kg (up to 10 mg/kg)* PO
  - Is the patient on any other serotonin-altering medications?
- Gabapentin 20+ mg/kg PO
  - Renal disease
- Cerenia 2+ mg/kg PO
- Acepromazine 1 mg/kg PO

Cats

- Gabapentin 100 mg/cat PO
  - Caution with renal disease
- Trazodone 25 mg/cat* PO
  - Is the patient on any other serotonin-altering medications?
- Cerenia 2+ mg/kg PO

ADJUNCTIVE AGENTS

Gabapentin

Formulation	50 mg/mL, 50/100/300/600 mg tablets
Route	PO only ☹
Dose	5-20 mg/kg (sedation, pain management); 30+ mg/kg (seizures); toxic dose = 90 mg/kg
Receptors	Na+/Ca++ channel inhibition; mechanism remains unclear
General Effects	Neuropathic pain, sedation, anti-epileptic
CV	NSE
Resp	NSE
GIT/GU	NSE (GIT); caution in cats with severe renal dysfunction (excretion)
Other	Caution in patients with liver dysfunction (metabolism); some patients have idiosyncratic reactions (very sensitive to sedative effects)
Notes	Reversal with flumazenil?

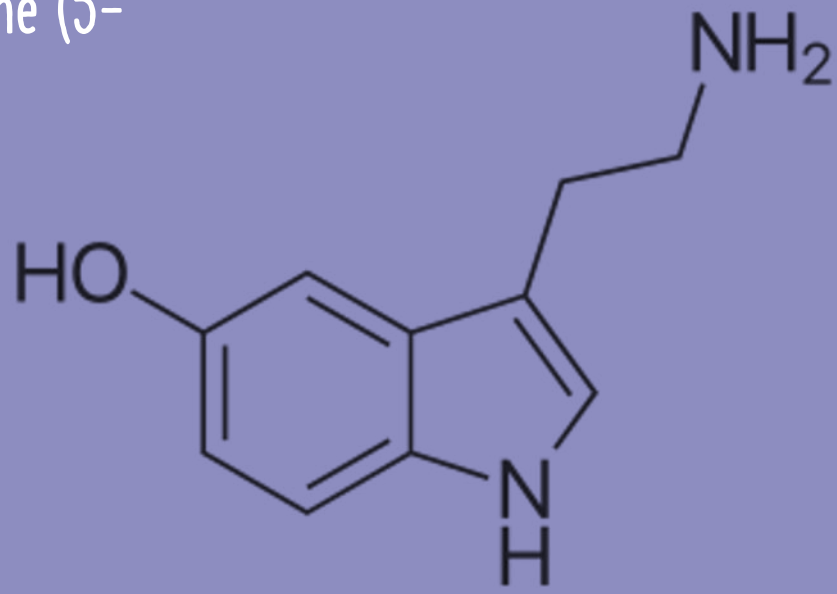
ADJUNCTIVE AGENTS

Trazodone

Formulation	100 mg/mL, 50 mg tabs, 100 mg tabs
Route	PO only ☹
Dose	3-10 mg/kg q 8-12h
Receptors	Serotonin antagonist & reuptake inhibitor (SARI)
General Effects	Anxiolytic, sedative
CV	*may* induce mild bradycardia (usually clinically insignificant)
Resp	NSE
GIT/GU	NSE
Other	Risk SEROTONIN SYNDROME if giving with other serotonin-altering medications (tramadol, fluoxetine, etc.)
Notes	Not labeled for patients < 6 mo

SEROTONIN

- Monoamine neurotransmitter that binds to the 5-hydroxytryptamine (5-HT) receptor
- Neurotransmitter that is derived from L-tryptophan
  - Decarboxylation and hydroxylation of L-tryptophan
  - Quantity produced/released is tightly regulated
- Regulates GI movement, social interactions, pain perception, growth, reproduction, mood, platelet function (hemostasis)
- Also a co-transmitter for other NT systems (GABA, noradrenaline)



SEROTONIN IN NATURE

- In mammals, about 90% of the body's serotonin is produced in (and released in) the GIT, the rest in the CNS and other tissues in the body

- Many plants, fruits, and other invertebrates contain serotonin (regulate GI function, involved in poisonous plant venom/effects)

SEROTONIN & ILLICIT DRUGS

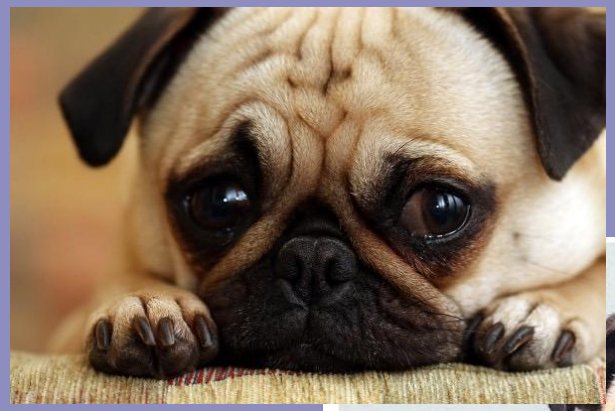
- LSD is very similar to serotonin but has a higher affinity for serotonin receptors, & is taken up preferentially in the synapse → this serotonin inhibition and uptake by serotonin receptors is responsible for hallucinations
- MDMA (ecstasy) has similar effects - increasing the serotonin levels in the synapse, but produces chronic changes in the number of serotonin receptors in the brain

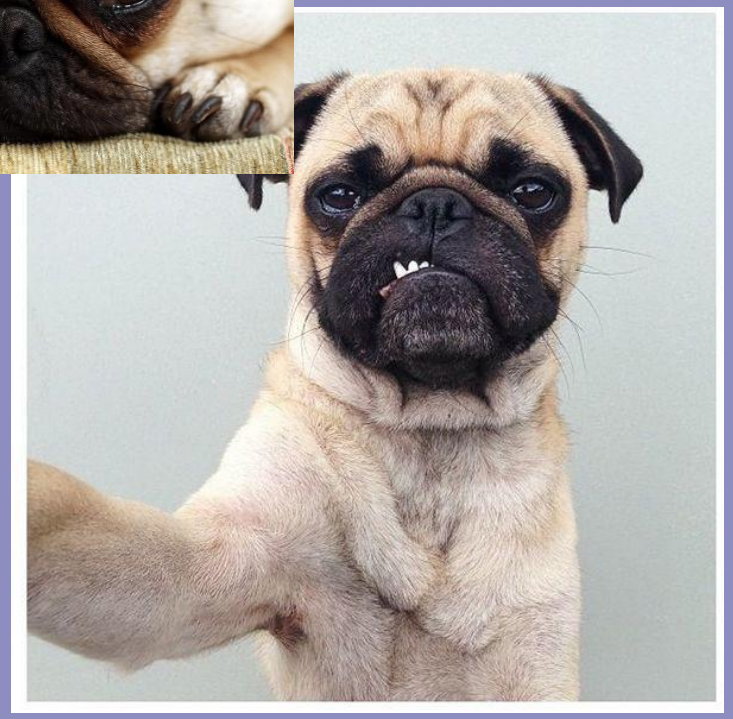
SEROTONIN-ALTERING DRUGS

- MONOAMINE OXIDASE INHIBITORS (MAOIS): prevent breakdown of monoamine NT to increase the concentrations of serotonin in the synaptic cleft
- TRICYCLIC ANTIDEPRESSANTS (TCAS): inhibit reuptake of serotonin and norepinephrine
- SELECTIVE SEROTONIN REUPTAKE INHIBITORS (SSRIS): limit the reuptake of serotonin in the presynaptic nerve terminal
- SEROTONIN ANTAGONIST AND REUPTAKE INHIBITORS (SARIS): antagonize serotonin receptors but also prevent the reuptake of serotonin/norepi/dopamine

- Mainly used to treat:
  - Anxiety
  - Compulsive disorders
  - Aggression
  - Inappropriate elimination

WHY DO WE CARE ABOUT SEROTONIN

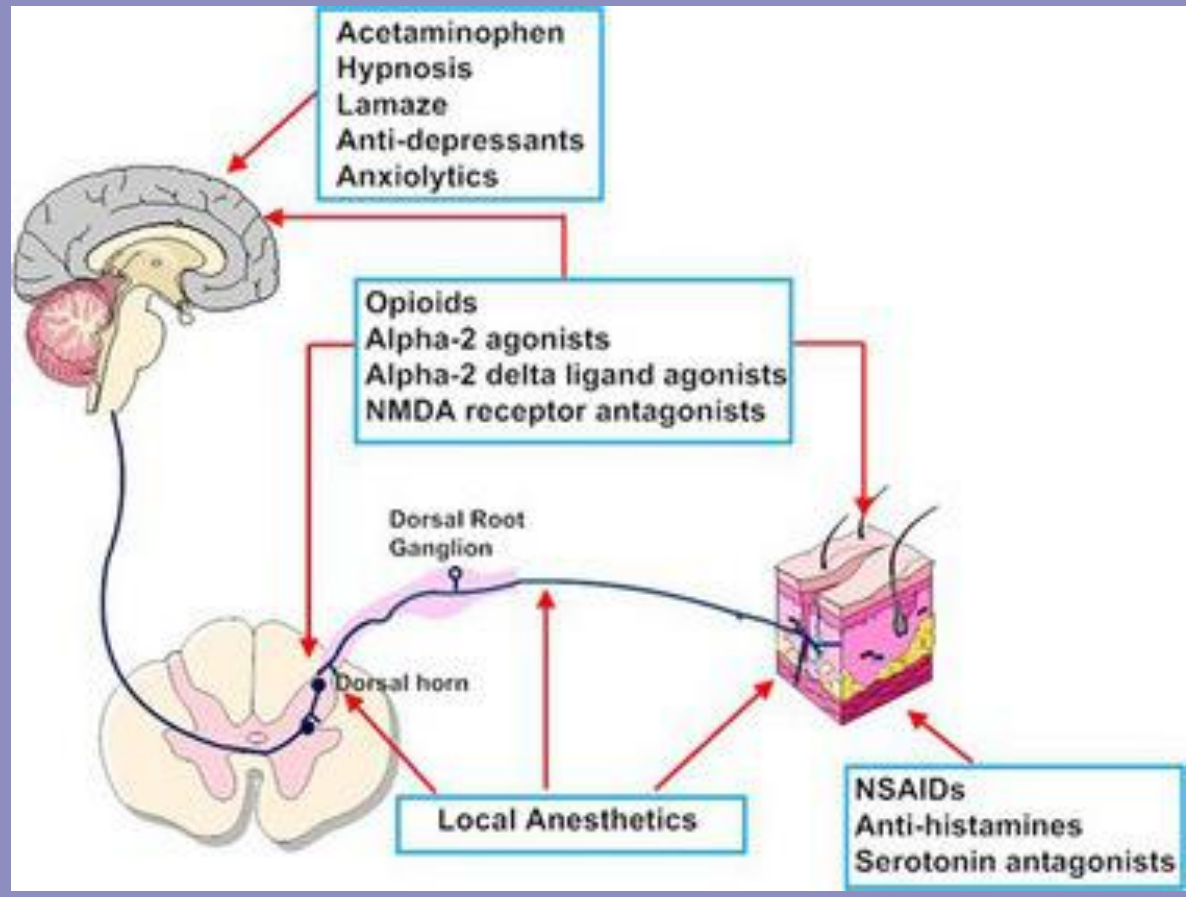




- Deficiency of norepinephrine and serotonin at specific synapses in the brain was associated with depression → increasing this concentration is associated with mania
- Serotonin is directly involved with mood and behavior
- Serotonin is also implicated in nociception in the central nervous system
  - Hyperalgesia with serotonin antagonists
  - Serotonin precursors potentiate opioid analgesia

SEROTONIN & ANESTHESIA

- Serotonin influences nociceptive reflexes at different anatomical levels and is involved in the mechanism of opioid and acupuncture anesthesia
    - Serotonin precursors potentiate opioid analgesia
- Intrathecal and iontophoretic (transdermal) applications of serotonin antagonists produce hyperalgesia
- Electrical stimulation of the brain in areas rich in serotonin produce analgesia
- Nociceptive action - most notably in periaqueductal gray and nucleus raphe magnus
    - Morphine increases serotonin synthesis and turnover rate



Case report | Open Access | Published: 27 August 2019

Serotonin syndrome triggered by postoperative administration of serotonin noradrenaline reuptake inhibitor (SNRI)

Junko Takata ✉, Tomoko Arashi, Ayako Abe, Shoko Arai & Naoko Haruyama

JA Clinical Reports **5**, Article number: 55 (2019) | Cite this article

DEFINITION OF SEROTONIN SYNDROME

- Serotonin Syndrome = group of clinical signs associated with overdose of or ingestion of multiple drugs that increase the free levels of serotonin in the CNS
- Examples:
  - Overdose of fluoxetine
  - Adding multiple SSRIs/MAOIs/SARIs/TCAs together
  - Amphetamine overdose (stimulants: Adderall)

CLINICAL SIGNS

- Altered mental status
- Agitation
- Nervousness
- Myoclonus
- Hyperreflexia
- Tremors
- Diarrhea
- Incoordination
- CV changes (HR increase, BP increase)
- Hyperthermia

DRUGS ASSOCIATED WITH SEROTONIN SYNDROME

- SSRIS: sertraline, fluoxetine (Prozac), fluvoxamine, paroxetine, and citalopram, escitalopram
- SARIS: trazodone, nefazodone
- SNRIS: duloxetine (Cymbalta), venlafaxine (Effexor), atomoxetine (Strattera)
- SRA/SSRAS: MDMA & other amphetamines
- ATYPICAL ANTIDEPRESSANT DRUGS: buspirone, mirtazapine
- TCAS: clomipramine, doxepin, amitriptyline
- MAOIS: phenelzine, selegiline, clorgiline, and isocarboxazid, methylene blue

DRUGS ASSOCIATED WITH SEROTONIN SYNDROME

- ANTICONVULSANTS: valproate
- ANALGESICS: meperidine, fentanyl, tramadol, and pentazocine
- ANTIEMETIC AGENTS: ondansetron, granisetron, and metoclopramide
- ANTIMIGRAINE DRUGS: sumatriptan
- BARIATRIC MEDICATIONS: sibutramine
- NATURAL SUBSTANCES THAT AFFECT SEROTONIN: ginkgo biloba, specific coffee species, purple passionfruit, curcumin (in turmeric), l-tryptophan, *Hypericum perforatum* (St. John's wort), Panax ginseng (ginseng)

DRUGS ASSOCIATED WITH SEROTONIN SYNDROME

- ANTIBIOTICS: linezolide (a monoamine oxidase inhibitor) and ritonavir (through inhibition of cytochrome P-450 enzyme isoform 3A4)
- OVER-THE-COUNTER COUGH AND COLD REMEDIES: dextromethorphan
- DRUGS OF ABUSE: methyl-enedioxy-methamphetamine (MDMA, or "ecstasy"), lysergic acid diethylamide (LSD), 5-methoxy-diisopropyl-tryptamine ("foxy methoxy"), Syrian rue (contains harmine and harmaline, both monoamine oxidase inhibitors)
- OTHER: lithium

DDX FOR SEROTONIN SYNDROME

Anticholinergic Syndrome

- Recent admin or consumption of an anticholinergic
- Normal reflexes, mydriasis, agitated delirium, dry red skin, lack of bowel sounds, urinary retention

Malignant Hyperthermia

- Inhalant anesthesia or succinylcholine admin
- RyR1 receptor mutation
- Hypertonicity, hyperthermia, red flushing mottled with cyanosis; increased $ETCO_2/PaCO_2$

NMS

- SS-like syndrome from dopamine antagonism
- Severe muscle rigidity, hyporeflexia
- Onset 1-2 weeks (66% occurs within 7 days)

HE

- Usually associated with a meal or anesthetic event
- Seizures, altered mentation, high ammonia levels, other signs of PSS or liver dysfunction; consider signalment, bloodwork abnormalities

DDX FOR SEROTONIN SYNDROME

Heat Stroke

- Recent exposure to heat
- Clinical signs associated with SIRS/MODS consistent with heat stroke

Myocardial Necrosis

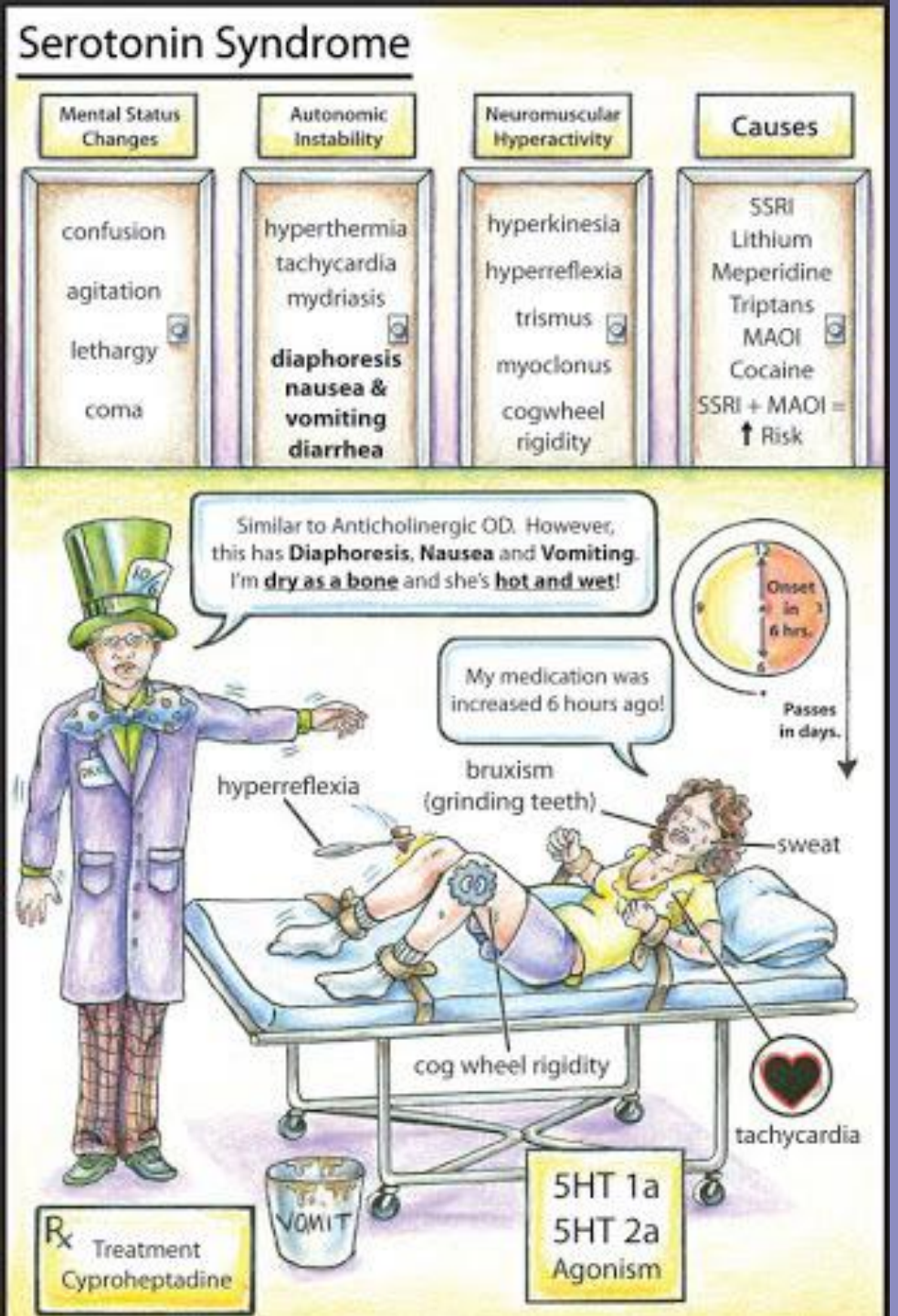
- Murmur, arrhythmias, malaise (due to the primary cause of myocarditis), no medication history

Infectious or Inflammatory

- FUO panel, pertinent travel history
- No medication history
- Onset of clinical signs

Other Toxicities

- Rodenticides, insecticides, organophosphates, molluscicides
- Tremorgenic mycotoxins
- Mushroom poisoning



DDX FOR SEROTONIN SYNDROME

- Differentiating these syndromes:
  - Accurate history
    - Time to development of symptoms
    - Medication history (including history of anesthesia)
      - Consider medications available in the house
  - Physical exam

Many DDX based off the clinical sign of hyperthermia - determine hyperthermia vs. fever and then rule out other causes of hyperthermia

"WE NEED MORE SEDATION"

IM injection - client communication

- Risk of injection without a PE
- May influence examination or limit diagnostics

Dogs

- Dexmedetomidine
- Ketamine vs. Telazol
- Butorphanol vs. Hydromorphone vs. Buprenorphine
- Alfaxalone?
- Ace?

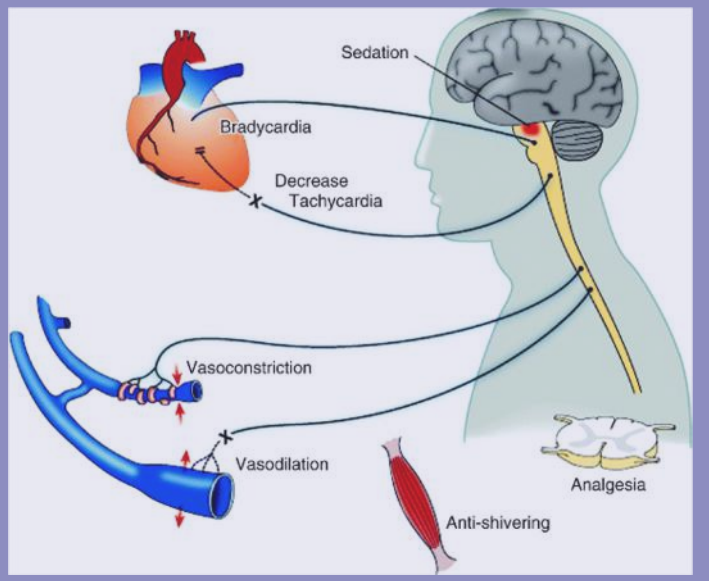
Cats

- Alfaxalone
- Butorphanol vs. Methadone vs. Buprenorphine
- Dexmedetomidine?
- Ketamine
- Ace?

CLIENT COMMUNICATION

- Ensure the client understands the risks involved with sedating a patient without a full exam/bloodwork/etc.
  - Risk increases with things like:
    - Age
    - Breed
    - Likely illness or comorbidity (why is it coming to the hospital?)
- DOCUMENT IN THE RECORD

A NOTE ON "CONTRAINDICATIONS"



- Cardiac disease ≠ no dexmedetomidine
- Dexmedetomidine MOA: vasoconstriction + reflex bradycardia
  - Increases myocardial O_2 delivery
  - Increases diastolic filling time → increases preload, increases cardiac DO_2
- Effects are dose, route, patient, drug dependent
- Dexmedetomidine is a powerful, reversable sedative
  - Sometimes, the safety of the patient, owner, and staff provides a relative indication for administration of a drug that would otherwise be potentially questioned due to that patient's comorbidities
  - Once a patient is safely sedated and IV access is achieved - can consider reversal of the sedative, provided you have a plan for continued handling in the hospital

The efficacy and safety of dexmedetomidine in cardiac surgery patients: A systematic review and meta-analysis

Perioperative Dexmedetomidine Improves Outcomes of Cardiac Surgery

Fuhai Ji, Zhongmin Li, Hung Nguyen, Nilas Young, Pengcai Shi, Neal Fleming, and Hong Liu

Circulatory effects of dexmedetomidine in early sepsis: a randomised controlled experimental study

Dexmedetomidine decreases perioperative myocardial lactate release in dogs

EFFECTS OF INTRAVENOUS DEXMEDETOMIDINE ON CARDIAC CHARACTERISTICS MEASURED USING RADIOGRAPHY AND ECHOCARDIOGRAPHY IN SIX HEALTHY DOGS

SEDATIVES: ALPHA-2 AGONISTS

Dexmedetomidine	
Formulation	500 mcg/mL; Sileo OTM gel
Route	IV, IM, SQ, OTM, LRA
Dose	Injectable: 0.5-10 mcg/kg depending on route & desired effect
Receptors	Alpha-2 (CNS, PNS, vasculature, pancreas, etc.)
General Effects	Sedation, analgesia
CV	Alpha-2-mediated vasoconstriction → compensatory bradycardia; increases preload, increases myocardial perfusion, increases diastolic filling time
Resp	Increases tidal volume while decreasing RR → no change in V_{min}
GIT/GU	Cats: IM dexmed → vomiting; decreases aquaporin-2 insertion in nephron and thus causing a diuretic effect
Other	Stops insulin secretion from pancreatic beta cells; increases renal and hepatic blood flow
Notes	Cardiac disease?

REVERSAL AGENTS: ATIPAMEZOLE

- Reversal for alpha-2 agonist: dexmedetomidine
  - Other reversal agents in this class: yohimbine, tolazoline
- When to give?
  - Waking up from sedation - IM
  - ER: significant bradyarrhythmia (escape rhythm) - IM or dilute and titrate IV very slowly
  - CPA - IV
- Can cause severe hypotension, emergence delirium, rapid HR, vomiting, tremors, hypersalivation, exictement - ensure you want to reverse the patient prior to administering atipamezole
- Dose: same volume as dexmed or 10x dexmed dose (3 mcg/kg dexmed = 30 mcg/kg atipamezole; both are the same volume)

OPIOID RECEPTORS

Receptor	Subtypes	Actions
Mu: principally responsible for supraspinal and spinal analgesia; universal site of action for all endogenous opioid peptides Endogeneous agonists = endorphins	Mu-1	Analgesia
	Mu-2	Ventilatory depression, bradycardia, physical dependence, euphoria, GIT signs
	Mu-3	↑GNRH release, ↑ CRH release, inhibition of NE release, downregulates monocyte & granulocyte activity
Kappa: spinal and supraspinal analgesia - inhibition of NT release via N-type calcium channel; less abuse potential Endogenous agonists = dynorphins	K-1	Analgesia
	K-2	Dysphoria, sedation, miosis, diuresis
	K-3	Analgesia
Delta: spinal and supraspinal analgesia (poor); may modify mu receptor mediated antinociception and mediate opioid receptor "crosstalk" Endogenous agonists = enkephalins	D-1 D-2	Ventilatory depression, vomiting, inhibition of dopamine release, constipation, physical dependence, urinary retention, unregulated vascular endothelium

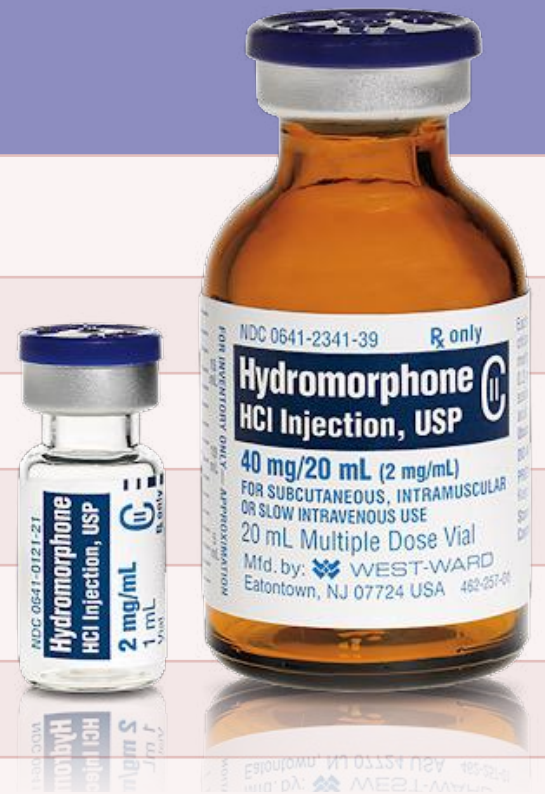
Grimm, K. A., Lamont, L. A., Tranquilli, W. J., Green, S. A., & Robertson, S. A. (2015). *Veterinary anesthesia and analgesia: the fifth edition of Lumb and Jones*.

Flood, P., Shafer, S. L., & Rathmell, J. P. (2015). *Stoeltings pharmacology and physiology in anesthetic practice*.

OPIOIDS

Hydromorphone

Formulation	2 mg/mL; 2 mg tabs; compounded
Route	IV, IM, SQ, CRI, LRA, PO
Dose	0.05-0.1 mg/kg
Receptors	Pure mu agonist
General Effects	Sedation, analgesia
CV	Vagally-mediated bradycardia
Resp	Very high doses can cause resp depression; panting, hyperventilation
GIT/GU	Vomiting (IM), ileus, hypersalivation
Other	Converted to codeine when given PO - bioavailability of PO hydro is ~10% of that of IV hydro
Notes	Reversible (naloxone)



OPIOIDS

Methadone

Formulation	10 mg/mL
Route	IV, IM, LRA (epidural), CRI
Dose	0.25-0.5 mg/kg
Receptors	Pure mu agonist; NMDA antagonist
General Effects	Sedation, analgesia
CV	Vagally-mediated bradycardia (moreso than other pure-mu opioids); complications from histamine release
Resp	Very high doses can cause resp depression
GIT/GU	Vomiting (IM), ileus
Other	Causes increased histamine release vs. other opioids (Morphine, Methadone, Meperidine) - do not use with MCT
Notes	Reversible (naloxone)

Postanesthetic hyperthermia in cats: a retrospective comparison between hydromorphone and buprenorphine

Rebecca L Niedfeldt, BS, DVM • Sheilah A Robertson, BVMS, PhD, Diplomate ACVA, Diplomate ECVA

OPIOIDS & CATS

- Opioid-induced hyperthermia
  - Hydro vs. buprenorphine: 125 cats evaluated
    - group 1 (*n* = 15): acepromazine, no opioids
    - group 2 (*n* = 17): acepromazine & buprenorphine
    - group 3 (*n* = 19): acepromazine, buprenorphine & ketoprofen
    - group 4 (*n* = 45): acepromazine & hydromorphone
    - group 5 (*n* = 29): acepromazine, hydromorphone & ketoprofen
  - 64% of cats in group 4 and 69% in group 5 had rectal temperatures >40 °C (104 °F) at one or more times in the postanesthetic period
  - The highest temperature recorded was 42.5 °C (108.5 °F) in one cat in group 4
- Hydro makes cats HOT

Practical use of opioids in cats: a state-of-the-art, evidence-based review

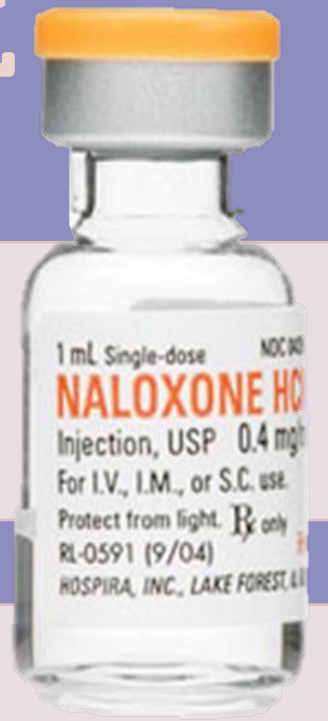
Elisa Bortolami[1] and Emma J Love[2]

jfms Journal of Feline Medicine and Surgery

OPIOIDS AND CATS

- "Postanaesthetic hyperthermia, defined as a rectal temperature higher than 39.2°C, has been associated with opioid administration in cats. Moreover, it was shown in a prospective clinical study of 40 healthy adult cats that body temperature at extubation was inversely related to the degree of postanaesthetic hyperthermia; that is, the colder the cat was at the end of anaesthesia, the higher the temperature was reported to be during recovery."
- Likely that opioids affect the preoptic anterior hypothalamus and change thermoregulatory set point
- Bottom line: keep your cats warm, don't over-interpret hyperthermia, avoid hydromorphone if possible, don't over-treat opioid-induced hyperthermia

REVERSAL AGENTS: NALOXONE



Dose = 0.04 mg/kg (Naloxone = 0.4 mg/mL)

- kg/10 = mL
- 30 kg = 3 mL Naloxone

Administration:

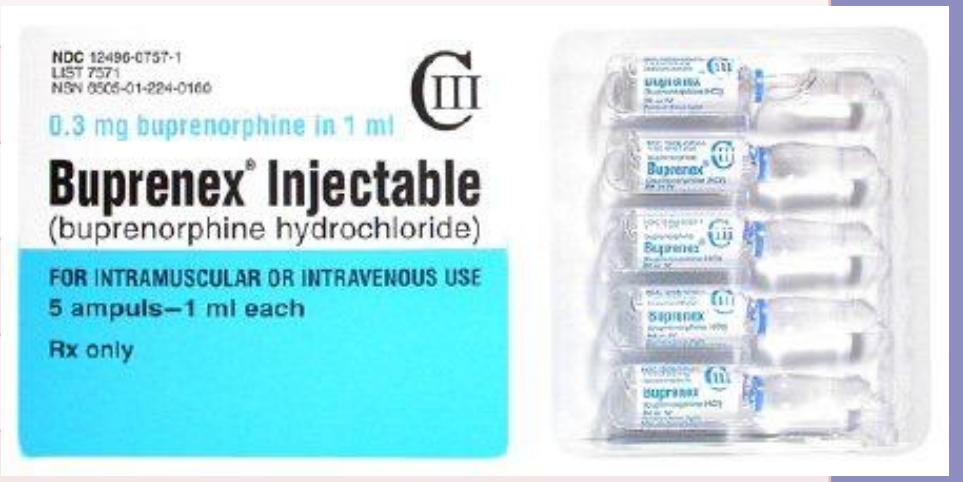
- CPR: give full dose IV
- Non-ER: Dilute (I prefer 3 mL for cats, 6-12 mL for dogs) and give 0.5-1 mL IV q 30-60 seconds until desired effect is achieved

Re-narcotization can occur within 45-60 min!

OPIOIDS

Buprenorphine

Formulation	0.3 mg/mL; 1.8 mg/mL; ZooPharm
Route	IV, IM, SQ, OTM, LRA
Dose (route-dependent)	0.02-0.03 mg/kg q 6-8h IV/IM/OTM (buprenex or simbadol) 0.18-0.24 mg/kg SQ q 24h (Simbadol = SQ in cats ONLY)
Receptors	Partial mu agonist (ceiling effect)
General Effects	Moderate analgesic
CV	Possible mild decrease in HR (vagal)
Resp	Potentially slightly decreased RR
GIT/GU	Significantly less GI signs compared to pure mu agonists
Other	Very difficult to reverse
Notes	Ceiling effect; questionable time to effect**, lasts 6-8h (24h with SQ in cats) Difficult to reverse due to binding affinity



OPIOIDS

Butorphanol

Formulation	10 mg/mL; 1/5/10 mg tablets
Route	IV, IM, SQ, PO, CRI
Dose	Injectable: 0.2-0.4 mg/kg; PO 0.5-1 mg/kg
Receptors	Mu antagonist, kappa agonist
General Effects	Sedation, cough suppression, NO ANALGESIA
CV	May cause mild bradycardia
Resp	Anti-tussive effects
GIT/GU	NSE
Other	Lasts ~45 minutes
Notes	Can use to partially reverse pure-mu agonist opioids

INJECTABLES: DISSOCIATIVES

Ketamine	
Formulation	100 mg/mL
Route	IV, IM, SQ, CRI, LRA; *OTM (allegedly...clinically this does not work)*
Dose	0.5 mg/kg SQ; 1-5 mg/kg IV/IM; 2-40 mcg/kg/min CRI
Receptors	NMDA receptor antagonist
General Effects	Centrally-acting sedative and analgesic; helps with wind-up and chronic pain
CV	Can induce SNS-associated tachycardia; caution in SNS-depleted patients; can induce cardiac arrhythmias (esp. in patients with cardiac disease)
Resp	Can cause apneustic breathing pattern
GIT/GU	NSE
Other	Will increase ICP if given alone; recommended for seizure patients and other patients with intracranial disease provided the patient is appropriately sedated and is ventilating (or being ventilated well)
Notes	Not recommended for patients under 3wks of age; not reversible

INJECTABLES: DISSOCIATIVES

Telazol (tiletamine/zolazepam)	
Formulation	100 mg/mL
Route	IM, IV
Dose	1-4 mg/kg
Receptors	NMDA receptor antagonist, $GABA_A$ receptor agonist
General Effects	Heavy sedation
CV	Can increase HR (like ketamine); can also induce myocardial depression
Resp	Can induce apneustic breathing
GIT/GU	NSE
Other	Typically reserved for aggressive patients given IM; can use as co-induction
Notes	Reconstituted formula only lasts 4 days outside of the fridge; not recommended for patients < 3 weeks of age; not (completely) reversible

INDUCTION AGENTS

Alfaxalone	
Formulation	10 mg/mL
Route	IV, IM, CRI
Dose	0.5-3 mg/kg
Receptors	$GABA_A$
General Effects	Sedation, unconsciousness
CV	Mild to moderate bradycardia, hypotension
Resp	Mild to moderate apnea
GIT/GU	NSE
Other	Safe for c-sections; safe for cardiac patients; can cause dysphoric and very active recoveries (especially CRIs); not "safer than propofol"
Notes	Consider volume if giving IM; not reversible

IM DOSING: K9

Dexmedetomidine	Butorphanol	Ketamine/Telazol	Alfaxalone
• 5-10 mcg/kg	• 0.4 mg/kg	• 2-5 mg/kg	• 1-3 mg/kg

IM DOSING: FEL

Dexmedetomidine	Butorphanol	Ketamine	Alfaxalone
• 5-10 mcg/kg	• 0.4 mg/kg	• 3-7 mg/kg	• 2-4 mg/kg

COMMON K9 COMBINATIONS

PO MEDS

- Cerenia (2+)
- Trazodone (5-7)
  - *other drugs
- Gabapentin (20+)
  - *renal
- +/- Clonidine (0.1-0.5)
- +/- Acepromazine (1 if tabs; 0.05 if OTM)
- +/- OTM Detomidine gel (40-80 mcg/kg)

IM COMBOS: CHOOSE ONE

- Dexmedetomidine (10) + butorphanol (0.4)
- Dexmed (10) + torb (0.4) + ketamine (3)
- Dexmed (10) + torb (0.4) + telazol (4)
- Dexmed (5) + torb (0.4) + alfaxalone (2)
- Alfaxalone (3) + torb (0.4)

Pharmacokinetics of detomidine following intravenous or oral-transmucosal administration and sedative effects of the oral-transmucosal treatment in dogs

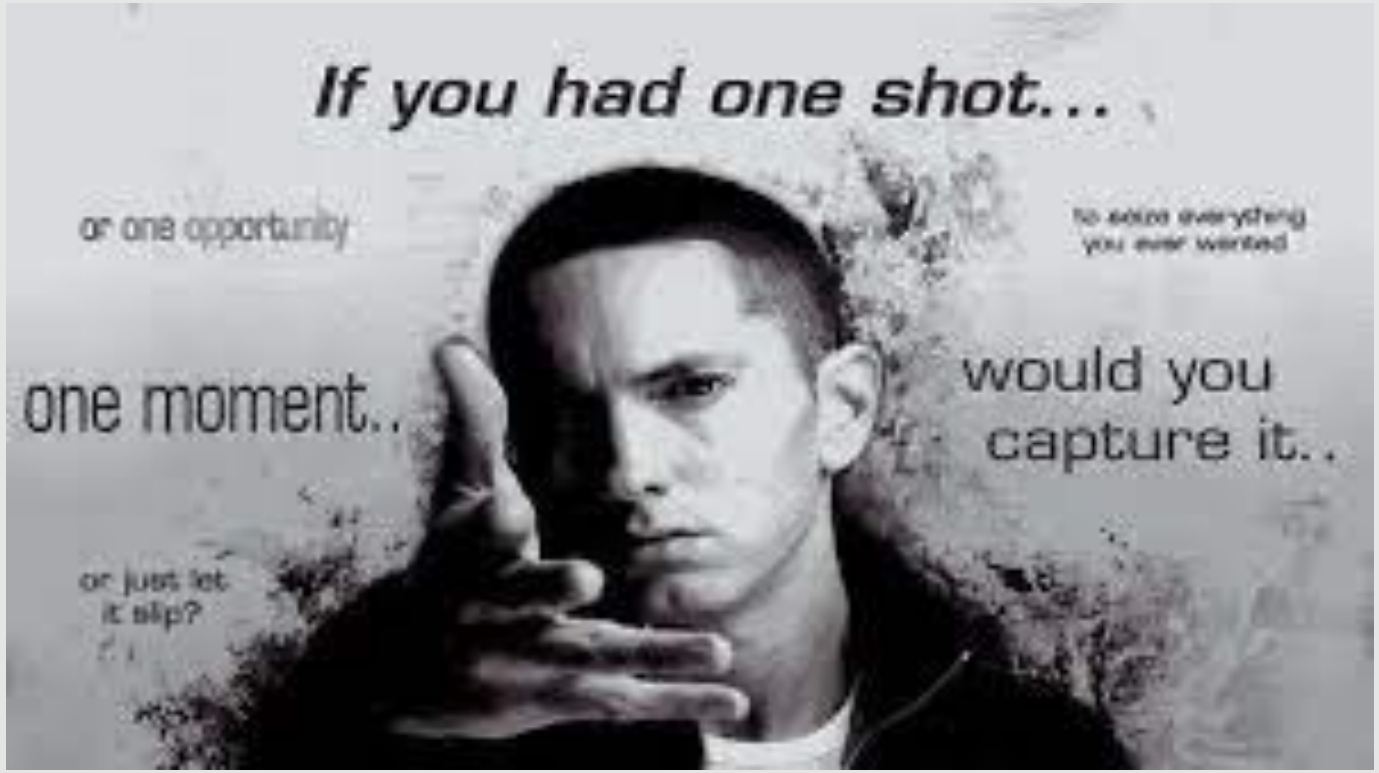
Kristen M Messenger, Marie Hopfensperger, Heather K Knych, Marl

(xx) after drug = dose in mcg/kg or mg/kg

ANGRY CAT COCKTAIL

- PO Meds (if able):
  - 20-30 mg/kg gabapentin PO
  - +/- trazodone 5-8 mg/kg OR tramadol 4-5 mg/kg PO (not both)
- IM sedation:
  - Alfaxalone 2-4 mg/kg IM +
    - Opioid of choice: butorphanol 0.4 mg/kg (not painful) or methadone 0.5 mg/kg (if painful)
    - +/- dexmedetomidine 5-10 mcg/kg
    - +/- ketamine 3-5 mg/kg
      - **recommend not using in cats with potential for heart disease, UO, or other complications where you'd want to be able to reverse medications

BOTTOM LINE

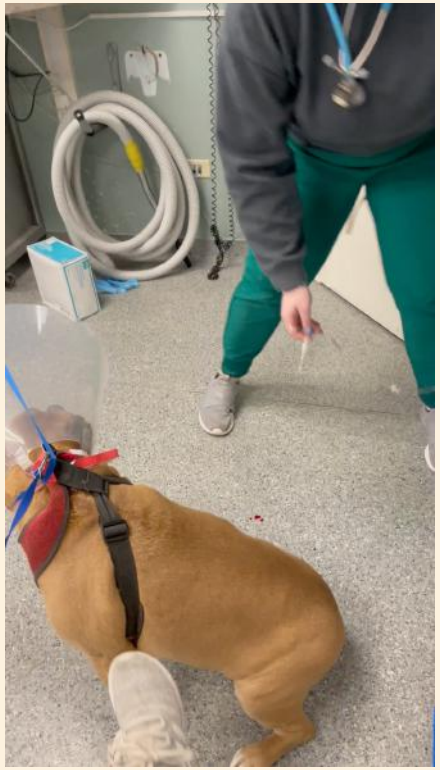


- Can you justify the use of a sedative cocktail with your (potentially limited) knowledge of the patient's health status, PE, and comorbidities?
- <u>Ideally, you give enough the first time</u>
  - Do not be afraid of big doses, especially when using reversible drugs
  - You may only have one opportunity
- Always have a backup plan for:
  - Not enough sedation
  - Too much sedation

HOW TO GIVE THE DRUGS

- Considerations:
  - Volume - is the volume a reasonable amount to give IM?
    - Ideally < 3 mL
  - Equipment
    - Staff and patient safety
    - K9: E-collar, Muzzle, 2 leashes + harness
    - Fel: E-collar OR consider mesh carrier; cat gloves
    - Long needle (patients >15 kg) +/- extension set
- Preparation
  - IVC supplies
  - Backup plan for additional drugs
  - Intubation supplies

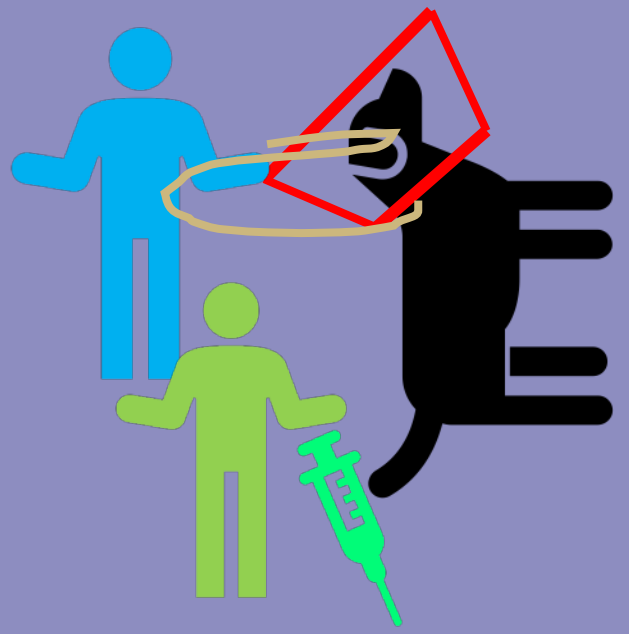
IM INJECTION



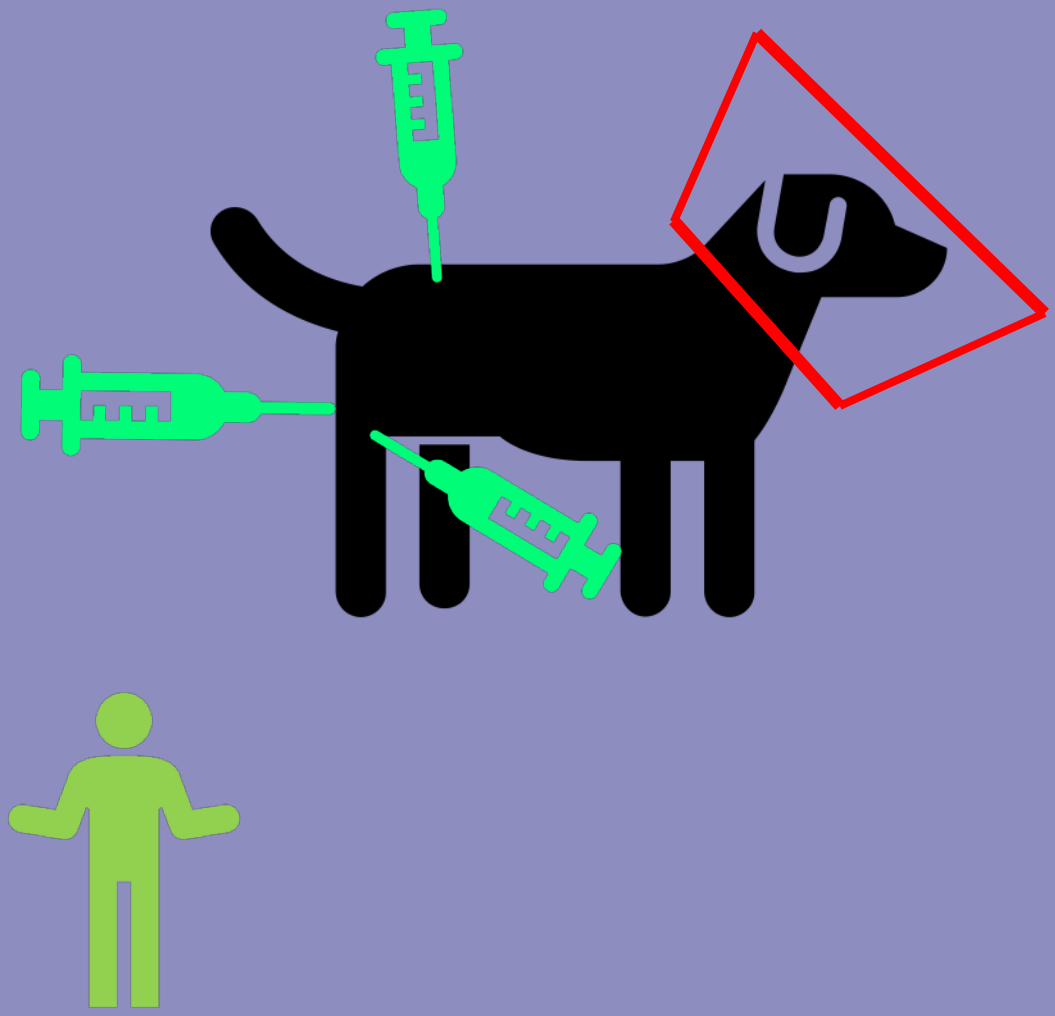
CROSS-TIE

WALK AND POKE

- The dog MUST have an appropriately-fitted E-collar in place prior to trying this technique
- Position the dog so that its RIGHT side is near the wall (leave little room for movement)
- Position the handler (blue) so that they are on the LEFT side of the dog
    - Ensure they are at the point of the dog's shoulder - just behind the e-collar
- Position the anesthetist (green) DIRECTLY BEHIND the handler with the drugs in their RIGHT hand
- As the three of you walk down the hallway, the handler (blue) maintains their position with their knee right at the point of the shoulder behind the E-collar, the anesthetist follows closely behind and is able to inject the dog as it is walking



- Inject the patient in the leg (lumbar muscles are unlikely to be as successful) - with the needle facing the back of the dog
    - The dog will walk ONTO the needle instead of jumping OFF with a needle facing towards the head of the dog
    - Lumbar muscles: easy to evade
    - Hind leg muscles: jumps off the needle



OTHER CONSIDERATIONS

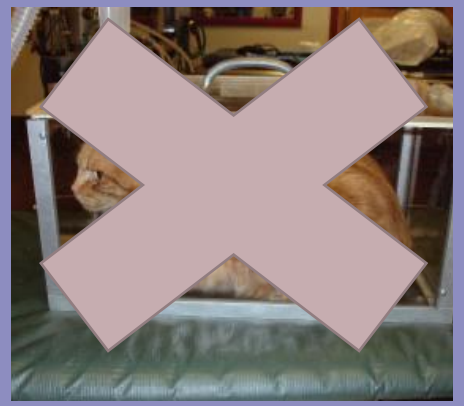
- Patient location
  - Outside (controlled area – ideally fenced)
  - Separate entrance (not through the lobby)
  - With or without the owner
- Type of restraint
  - Walking down a hallway
  - E-collar restraint
  - Muzzle training
  - "cross-tied"

NO CHAMBER INDUCTION

- "Mask or chamber inductions can cause stress, delayed airway control, and environmental contamination and are not recommended by the authors." (Grubb et al. 2020) **this is from the 2020 AAHA guidelines
- "A disadvantage of this technique is the unavoidable release of anesthetic gases and exposure of personnel when the cat is removed from the chamber." (Rodan et al. 2011)
- "Induction of anesthesia should be achieved with injectable agents. Mask and chamber inductions may cause a life-threatening stress response, and the dose of inhalant required to induce anesthesia causes significant cardiovascular depression. Furthermore, these techniques expose personnel to high levels of waste anesthetic gases." (Allen, Molly; 2021: https://www.dvm360.com/view/anesthesia-for-the-geriatric-patient)

NO CHAMBER INDUCTION

- "Chamber induction in unpremedicated, agitated cats is the least desirable technique described in these Guidelines, since an agitated cat will require more inhalant anesthetic to achieve the desired endpoint. This increased inhalant anesthetic requirement results in severe depression of the cardiovascular system. Additionally, an increased release of catecholamines predisposes the cat to development of cardiac arrhythmias." (Robertson et al. 2018)
- "The use of an induction chamber with gas anesthetic as a method of restraint may mean less control of the patient's airway and raises concerns about other safety issues for the cat and the staff." (Robertson et al. 2018)
- "Exposure to waste anesthetic gases* can cause serious injury and permanent damage." (https://www.osha.gov/SLTC/wasteanestheticgases/solutions.html)



THEY'RE SEDATED...NOW WHAT?

- Obtain IV access immediately
  - This is essentially non-negotiable
  - Consider location: HL may be more advantageous
- Monitor!!!!! PROVIDE OXYGEN
- Do your PE
- Intubate if unable to protect their airway
- If surgery is indicated - go to surgery
- If not, consider waiting until you are absolutely sure you want that patient awake before you reverse drugs
  - If a dissociative was given, consider waiting to reverse other sedatives for at least 30 minutes so the patient does not wake up dysphoric on ketamine
  - Consider partial reversal of sedatives (dexmed); opioid reversal is usually not necessary

INTRA-OP

- Ensure patient has appropriate pain management - sometimes patients are easier to work with when they are not painful
- LRA
  - Heavily consider for making sure patient does not need additional pain management when they wake up
  - But be careful - do you want a 50kg angry dog to be non-ambulatory for 24h after an epidural?

POST-OP HOSPITALIZATION

1

Consider CRI for continued sedation

- Dexmedetomidine
- Opioids?

2

Continue PO meds

- NG tube to facilitate administration?

3

Consider how much nursing care the patient *truly* needs

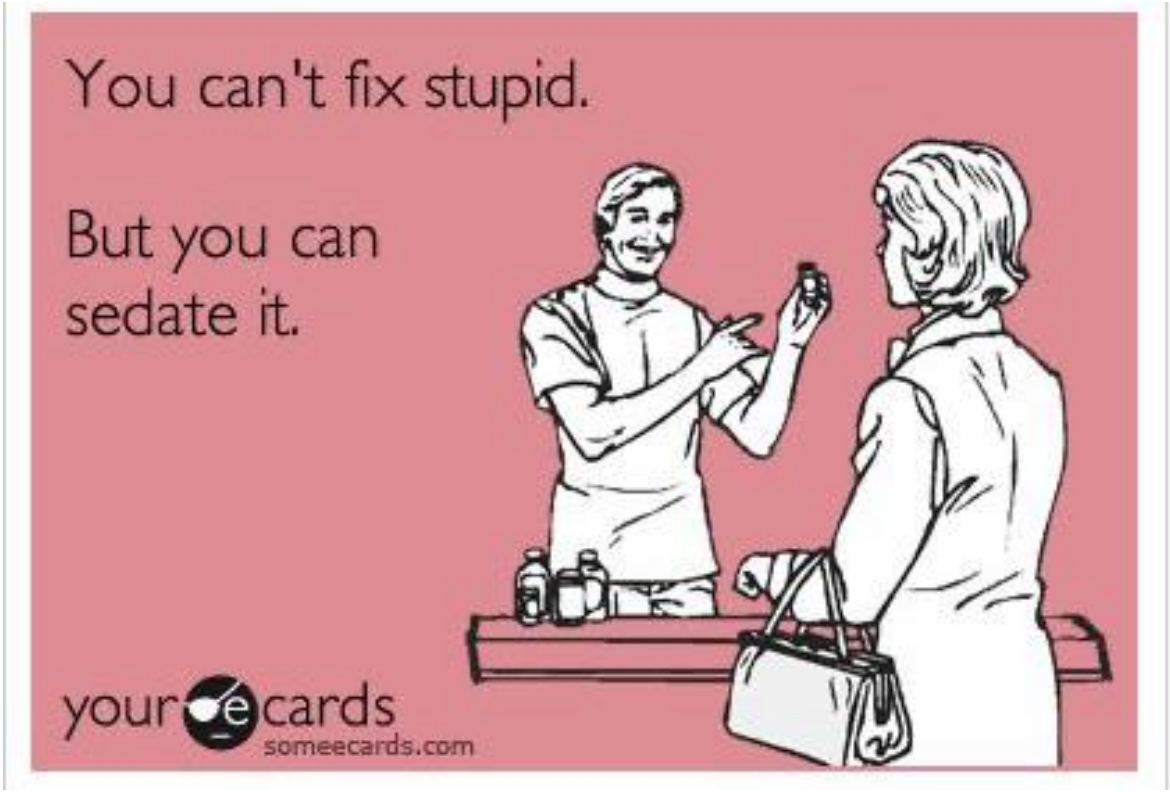
- Is a TPR 4x/day reasonable?

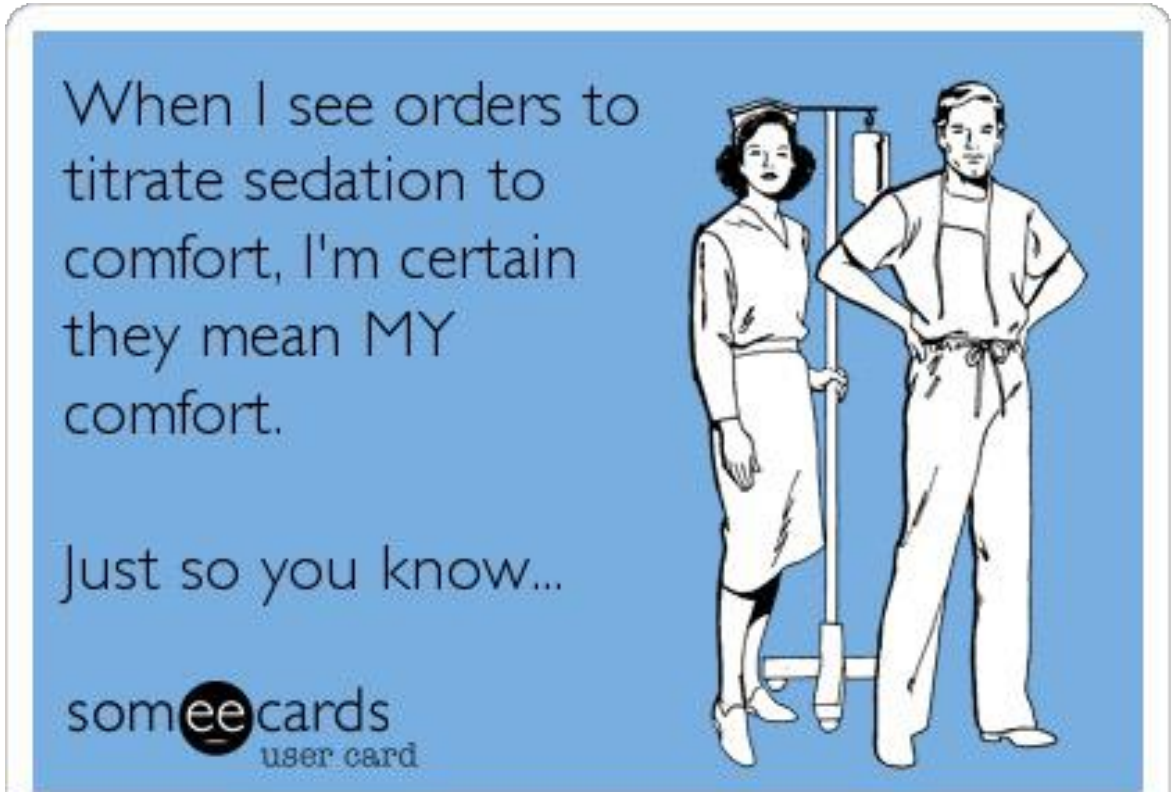
DEXMED CRI

ALWAYS PLACE A U-CATH IN PATIENTS ON A DEXMED CRI OR THOSE OTHERWISE RECUMBENT AND UNABLE TO AMBULATE

DON'T FORGET TO INCLUDE APPROPRIATE NURSING CARE FOR A SEDATED PATIENT: ROTATION, PROM, ETC.

- 1-5 mcg/kg/h
- Easy math:
  - Weight (kg)/100 = #mL dexmed (500 mcg/mL) to add to 5 mL NaCl
    - = 1 mL = 1 mcg/kg
  - Examples:
    - 30 kg dog: 0.3 mL dexmed + 4.7 mL NaCl = 30 mcg/mL
    - 5 kg dog: 0.05 mL dexmed + 4.95 mL NaCl = 5 mcg/mL





OTHER POST-OP SEDATIVES

- Butorphanol CRI (if not a painful procedure): 0.2-0.5 mg/kg/h
- Fentanyl CRI: 3-7 mcg/kg/h
- Acepromazine 0.015-0.02 mg/kg IV q 4-6h

TIME TO GO HOME

- Ensure patient is as clean, dry, presentable, etc. as possible
- Consider sedating (even just propofol) to ensure that they are able to be given back to their owner in a reasonable state
- IVC removal at the last possible second?