

Understanding Pain – Part 1



*Anatomy, Physiology,
and Pharmacology*

*Raymond L. Fowler, MD, FACEP, DABEMS
Chief, Division of Emergency Medical Services
UT Southwestern Medical Center and
Parkland Memorial Hospital*

A photograph of an emergency scene on a city street. A white ambulance with "PARAMEDIC" and "AMBULANCE" written on its side is parked. Several paramedics in dark uniforms and high-visibility vests are loading a patient onto a stretcher. One paramedic is wearing a black vest and glasses. The ambulance has the number "4151" and "9-1-1" on its side. The scene is outdoors on a paved area with buildings and trees in the background.

Sources of Pain

Somatic
Visceral
Neuropathic



Sources of Pain

Somatic – Of (or relating to) the musculoskeletal system, the “soma”



Sources of Pain

Visceral – the internal organs
Inflammation or Injury
More difficult to pinpoint



Sources of Pain

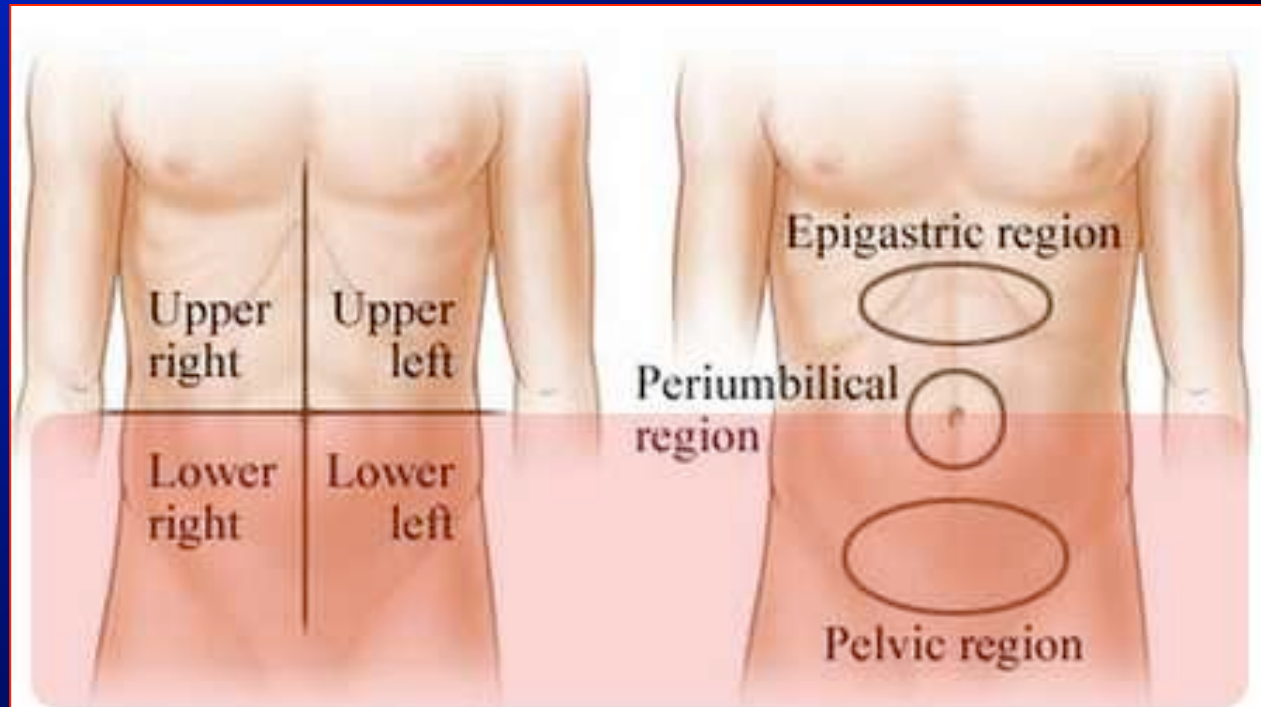
Neuropathic

Due to previous injury or inflammation
D.M., M.S., zoster, etc

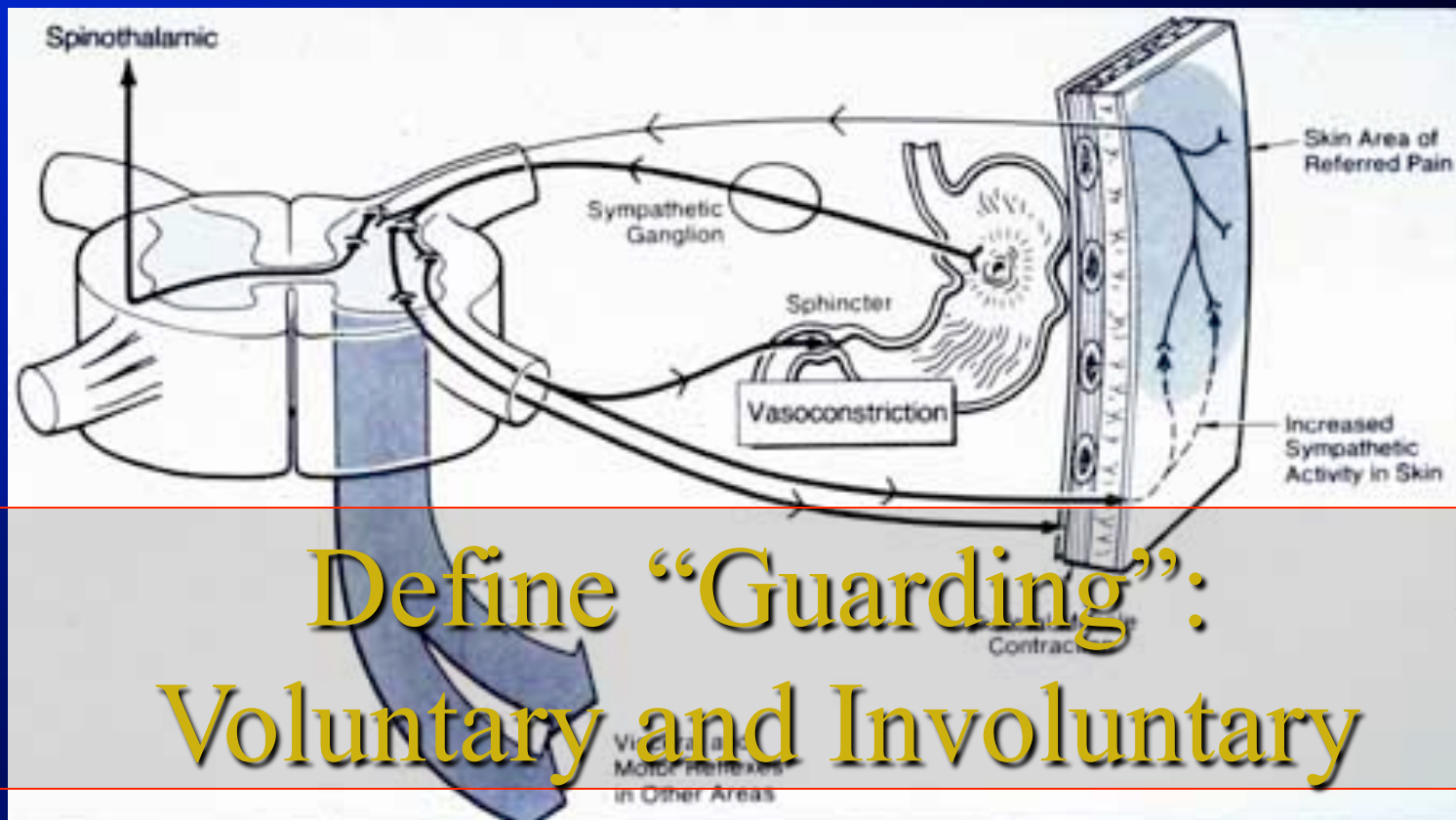
Visceral Pain

- Acute Appendicitis (generalized first, followed by Somatic)
- GSW (somatic AND visceral)
- Pancreatitis (visceral)

Visceral Pain



Visceral Pain



Define "Guarding":
Voluntary and Involuntary



Visceral Pain

Thoughts on “referred pain”



Pain Levels

Arms – C5-8

Nipples – T4

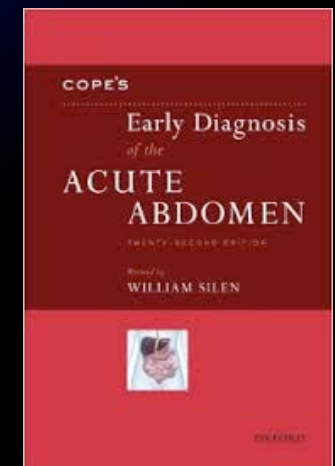
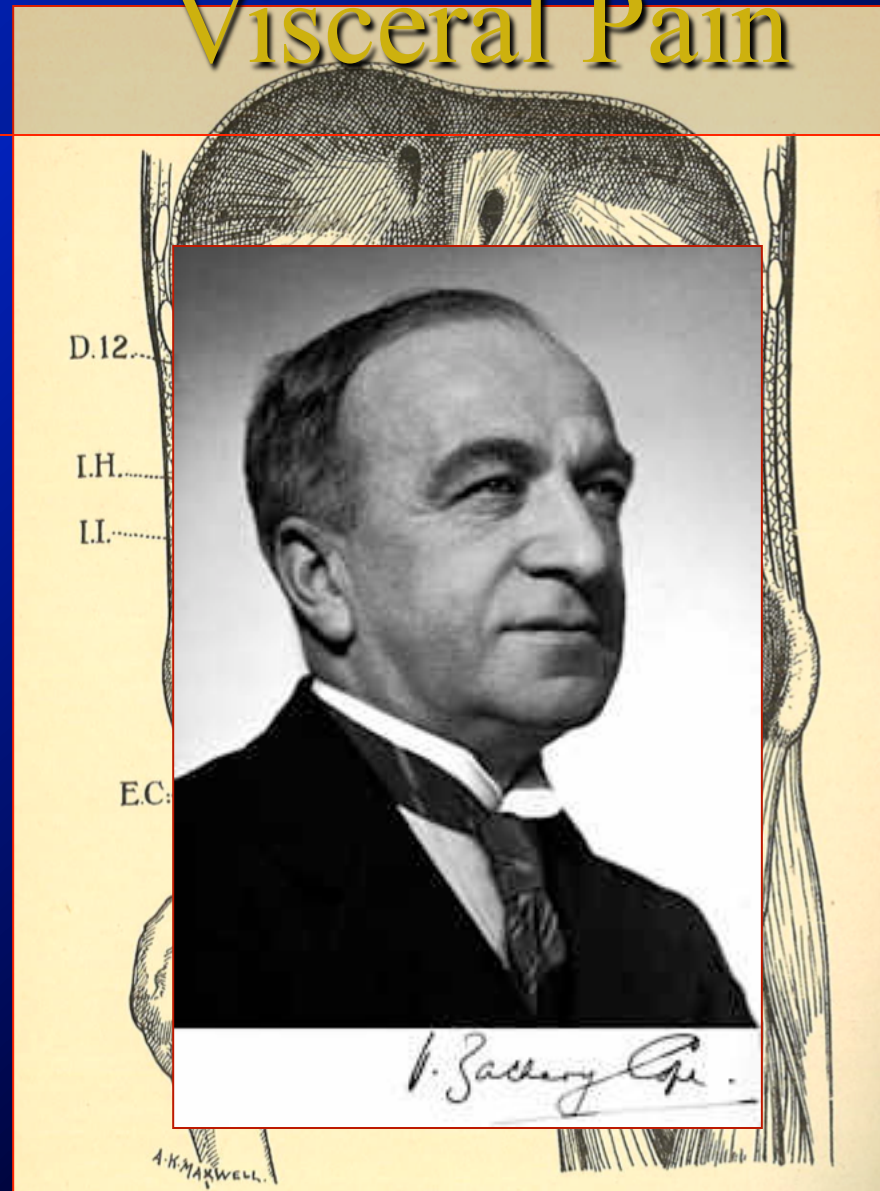
Umbilicus – T10

Patellar reflex – L4

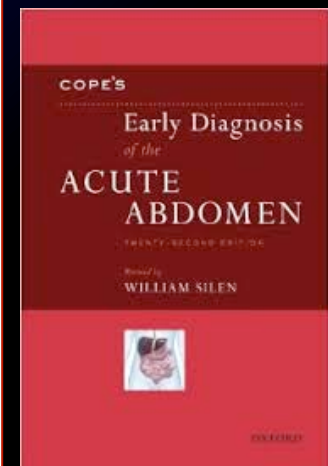
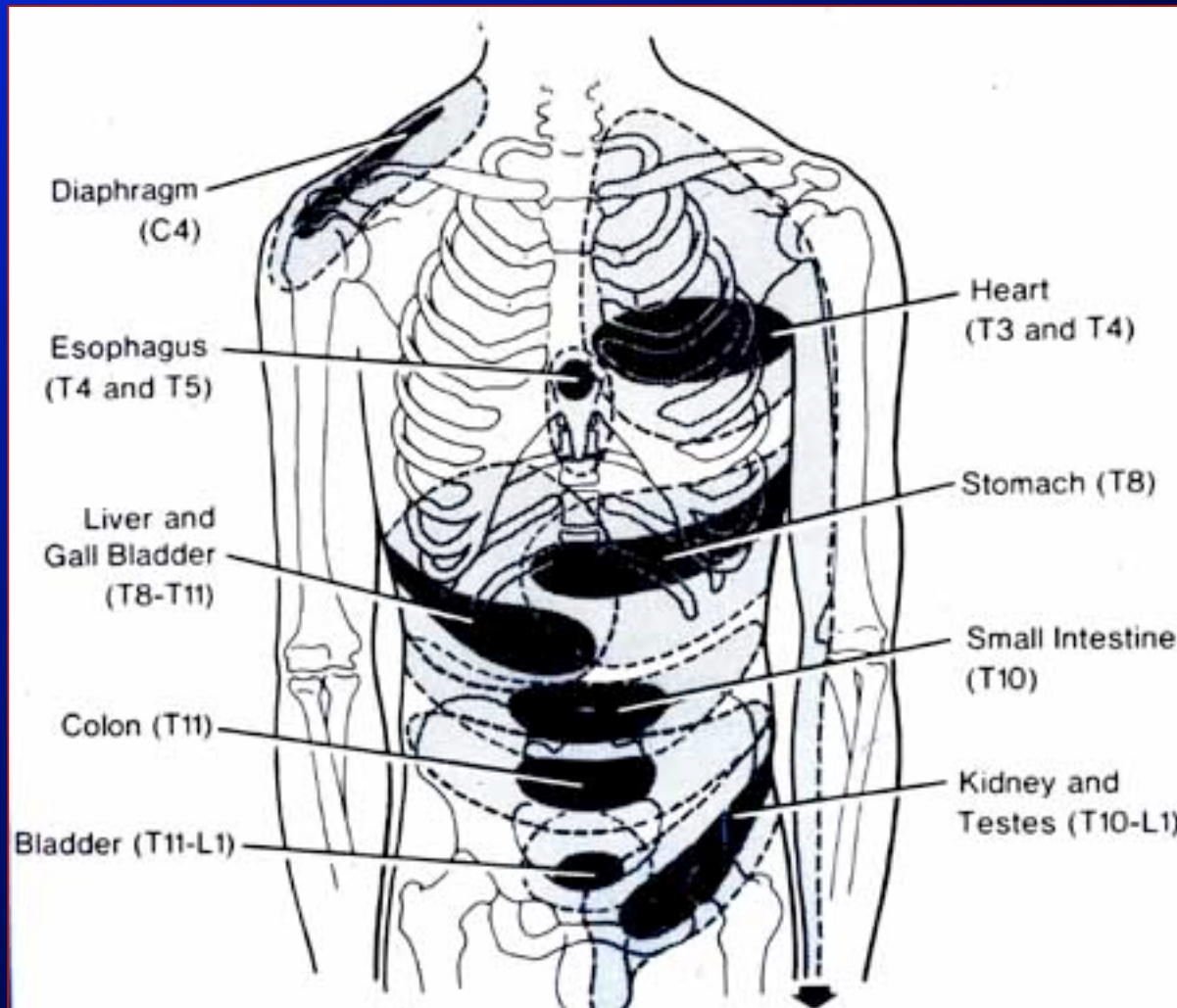
Great toe – L4

Little toe – S1

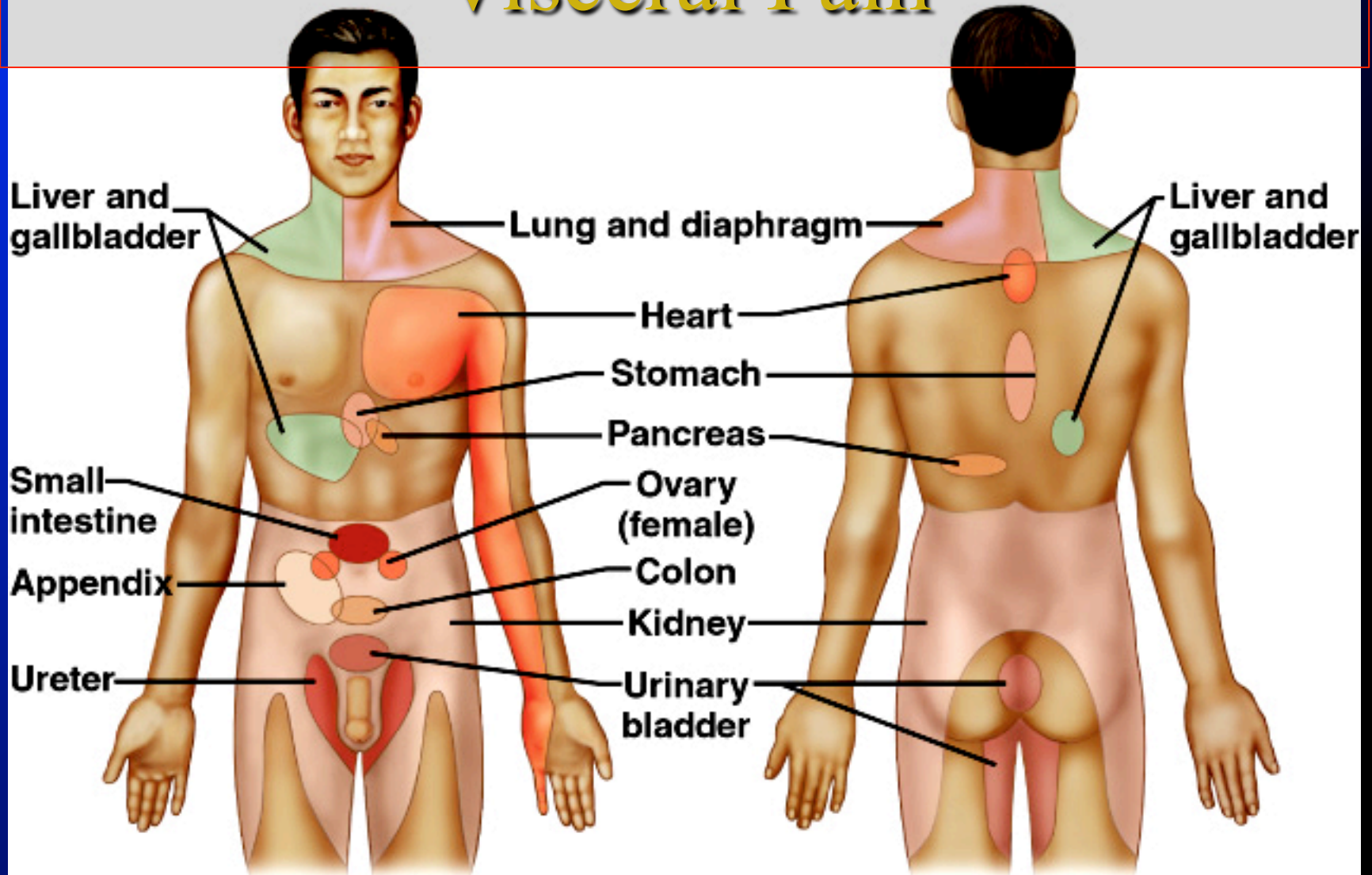
Visceral Pain



Visceral Pain



Visceral Pain



Visceral Pain



Use of Pain Medications:

DO IT!!!

Treating pain:
We do a crappy job of it

- *BioTel Study (<10% get meds)*
 - *Children (“they can wait”)*
- *We do it too slowly (took an hour)*
- *The W.R. = “The suffering room”*

The Necessary Metrics

- 1. Time to evaluation*
- 2. Time to treatment*
- 3. Time to RE-evaluation*

Flamingo



“S
with
be

en –
and ten
ould

you rate your pain??”



The Future Pain Scale

“Ma’am, are you in pain?”

“Would you like something for pain?”

“Ma’am, how is your pain now?”

Perception is $\frac{1}{2}$ of Pain!

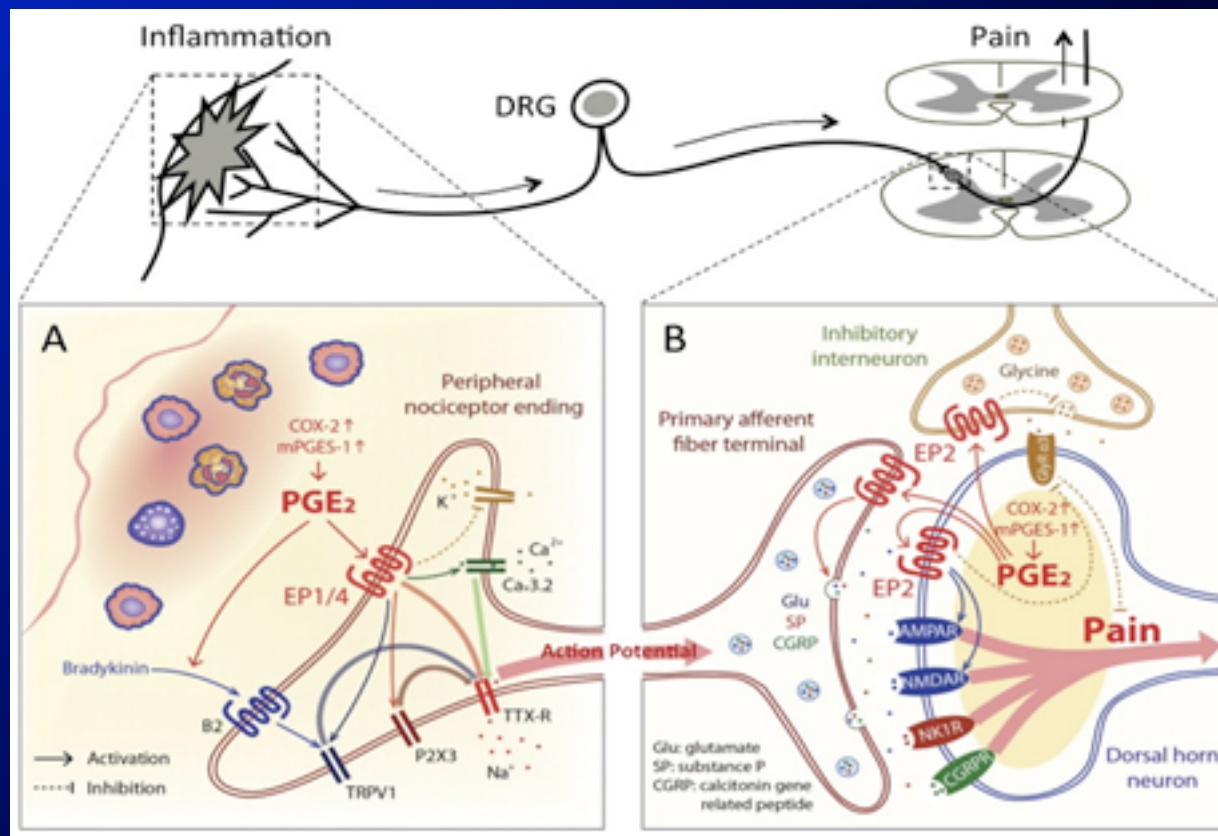
- *EMS “error” with Versed*
- *Converting micrograms to milligrams is a problem!*



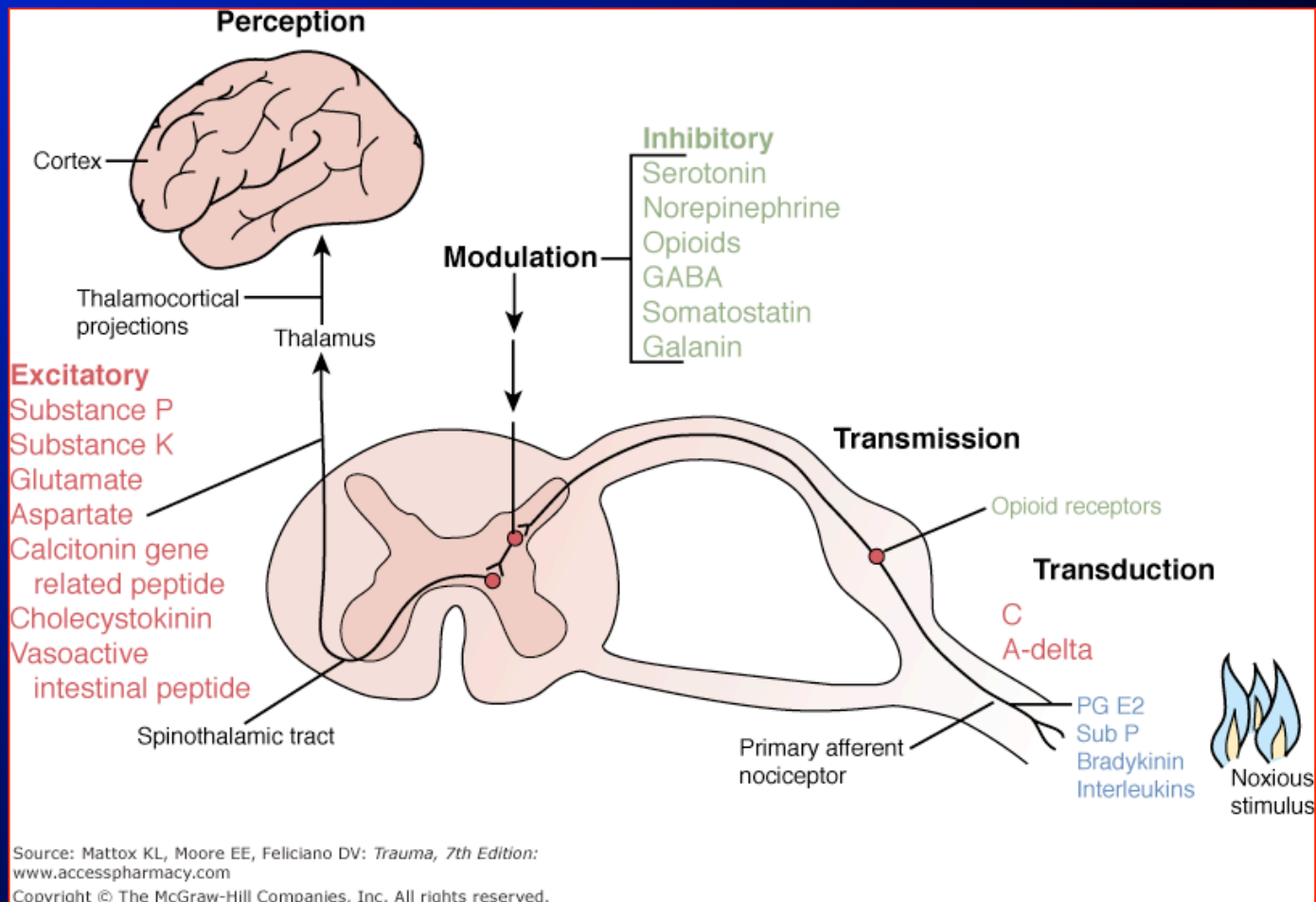
Current Medication Supplies

- *Unavailable medications*
- *Old medications that should cost nothing being re-packaged*
- *Changes in dosing or concentration*

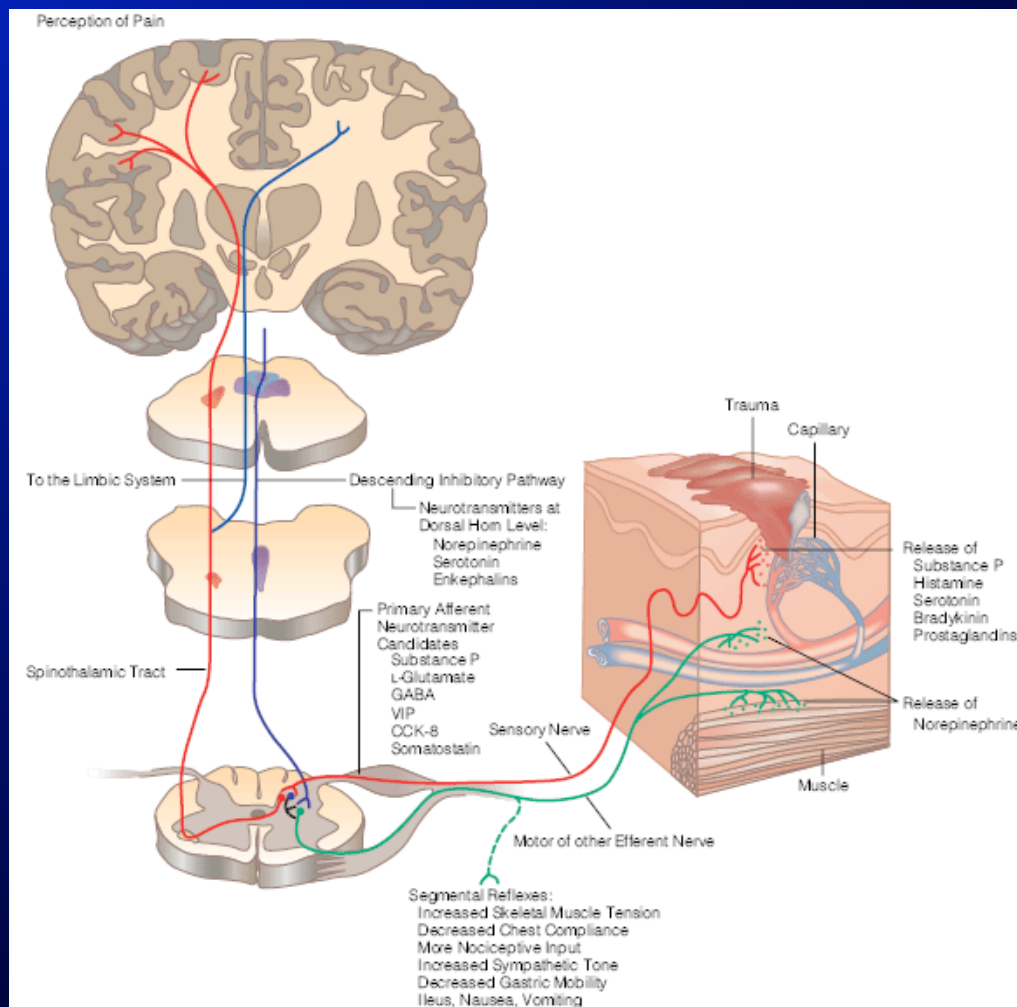
The Origin of Pain



Pain Receptors



Pain Receptors

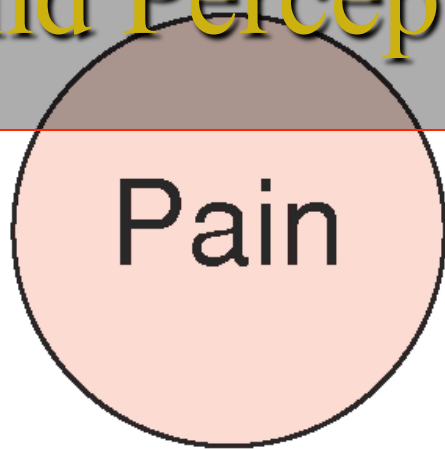


Injury or other
insult occurs,
causing pain



Fear, stress, conflict,
lower pain threshold

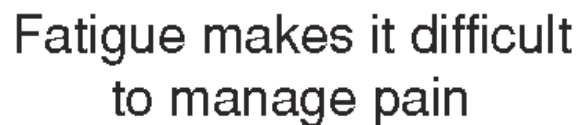
The Fact and Perception of Pain



Lack of knowledge
predisposes
to more pain

Muscle tension

Fatigue makes it difficult
to manage pain



Types of Pain Medications

- *Opiates*
- *Non-opiates*

Non-salicylate Anti-inflammatory Drugs (NSAIDs)

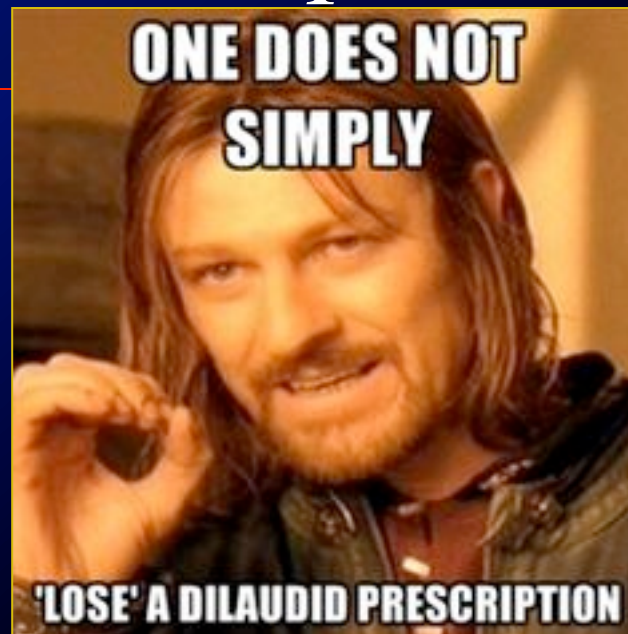
- *There are many*
 - *They work*
- *Greater or lesser degree of platelet inhibition*
- *Equivalent to morphine*
- *My toothache experience*

NSAIDS: *BEWARE!!*

- *ALWAYS WITH FOOD*
- *CAREFUL with ASA allergy*
- *GI: BEWARE (Your job is to help and not hurt)*
- *Many GI hemorrhages (<70?)*
 - *My mom's story*

NSAIDS

- *How often have you seen an “Allergic to NSAID” statement in an opiate dependent patient?*



Acetaminophen

- *The drug of the future*
 - *Exceptionally safe*
 - *Easier tolerated in G.I.*
- *Large regular dosages may cause hepatotoxicity, especially in the alcoholic*
 - *IV preparation available*

Acetaminophen

“Acetaminophen poisoning can cause gastroenteritis within hours and hepatotoxicity 1 to 3 days after ingestion. Severity of hepatotoxicity after a single acute overdose is predicted by serum acetaminophen levels. Treatment is with N-acetylcysteine to prevent or minimize hepatotoxicity.” (emedicine)

Opiates

- 
- *Derived from the “poppy”*
 - *Receptors postulated in 1954*
 - *Synthetics are called “opioids”*

Opiates

- Different opioids have different receptor affinities
→ Different clinical effects
- No agents to reflect need for subtypes
(i.e. μ_1 vs. μ_2)
- Receptors primarily localized to:
 - Periaqueductal gray, medial thalamus
→ (Analgesia)
 - limbic system → → → → → (Euphoria)
 - medulla → → → → → (Respiratory function)
 - Peripheral system (GI tract,
Sensory nerve endings)

Opiate Receptors

	Receptor	Clinical Effect
Mu	μ_1	Supraspinal analgesia (Provides most analgesia effects) Peripheral analgesia
	μ_2	Spinal analgesia Respiratory (Depression) Gastrointestinal (\downarrow motility \rightarrow constipation) Miosis Euphoria Physical Dependence
Kappa	K_1	Spinal Analgesia Miosis (less contribution than μ_2)
	K_2	Dysphoria Psychotomimesis (disoriented and/or depersonalized feelings)
	K_3	Supraspinal Analgesia
Delta	δ	Spinal Analgesia

Receptors

Mu	μ_1	Supraspinal analgesia Peripheral analgesia Euphoria
	μ_2	Spinal analgesia Respiratory depression Physical dependence GI dysmotility Miosis
Kappa	κ_1	Spinal analgesia Miosis
	κ_2	Psychotomimesis Dysphoria
	κ_3	Supraspinal analgesia

Many of the Side effects

This analgesia is not reversed by mu-selective antagonists

Less than done by mu

The crazy effects

Delta (δ) Spinal analgesia

Injectable Opiates

- *Morphine*
- *Heroin (diacetyl morphine)*
 - *Demerol*
- *Dilaudid (hydromorphone)*
 - *Fentanyl*
 - *Nubain*
 - *Stadol*

Injectable Opiates

- *Combo of Fentanyl (short acting) and Dilaudid, both given at once!!*

Oral Opiates

- *Morphine, including L.A.*
- *Heroin (diacetyl morphine in UK, Netherlands, Germany, etc)*
 - *Demerol*
 - *Dilaudid*
- *Codeine, hydrocodone, “Ultram”*
 - *Methadone*
 - *Oxycodone, oxycontin*

Topical Opiates

- *Fentanyl patch (Duragesic)*
 - *12 to 100 ug per hour*
 - *Highly addictive*



Neuropathic Pain

MEDICATIONS FOR NEUROPATHIC PAIN STARTING WITH A FIRST-LINE DRUG

AGENT	STARTING DOSE	TITRATION INTERVAL	NEUROPATHIC CONDITION
Nortriptyline	25 mg hs	Every week (by primary caregiver)	PHN Sciatica
Gabapentin	300 mg od	Every three days, increase by 300 mg (to bid, then tid before increasing each dose)	Diabetic PHN Sciatica
Pregabalin	25 mg od	Every one to two weeks (by primary caregiver)	Diabetic Fibromyalgia
Carbamazepine	200 mg od	Every three days, increase by 200 mg (to bid, then tid before increasing each dose)	Trigeminal neuralgia Resistant occipital neuralgia

Pain Medication Problems

- *Unavailable medications*
- *Old medications that should cost nothing being re-packaged*
- *Changes in dosing or concentration*

Pediatric Pain Treatment

- *AMR Ambulance last 12 months*
- *~35,000 uses of narcotics in peds*
- *Not a SINGLE use of Narcan*
- *Coverage of ~4 million pop.*

Looking to the Future



Dissociative Associations: >1800 Uses of Ketamine (and counting) in the Land O'Lakes

Marc Conterato, MD, FACEP
Office of the Medical Director, NMAS
Hennepin County EMS System



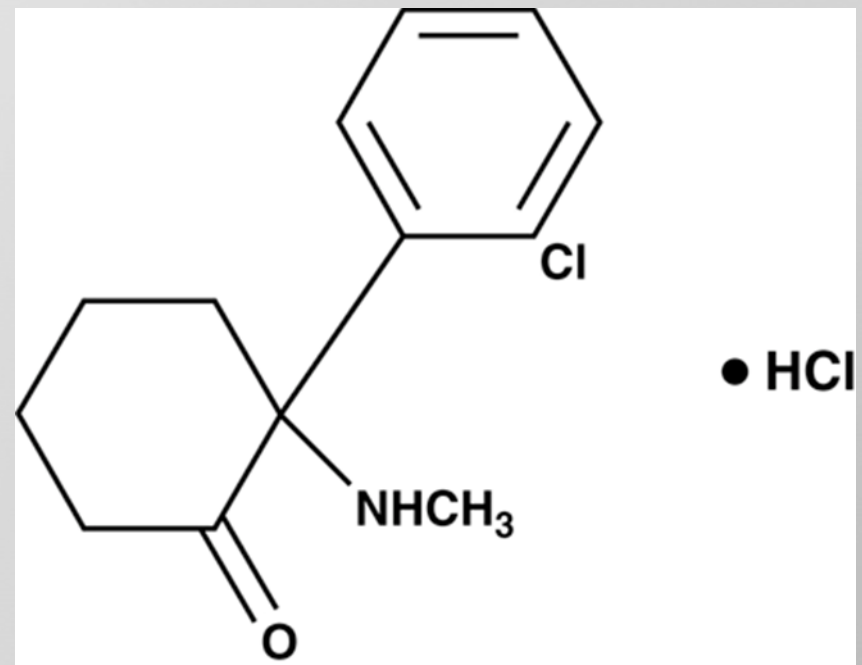


Dissociative Associations: Questions to Answer

- What is ketamine?
- What conditions are we using ketamine for, and what is the efficacy rate?
- What are the results after 4 years of use?
- What are the complications/adverse reactions that we have seen?

Ketamine

- **Generic Name:**
Ketamine
Hydrochloride
- **Trade Name:** Ketalar
- **Classification:**
Sedative, Analgesic



Actions

- Phencyclidine derivative causes dissociative anesthesia
- Profound sedation and uncouples cortical pain perception.
- Airway reflexes remain intact
- Releases endogenous catecholamines
 - maintain blood pressure and heart rate
 - dilates bronchial smooth muscles
 - stimulates beta receptors in the lungs

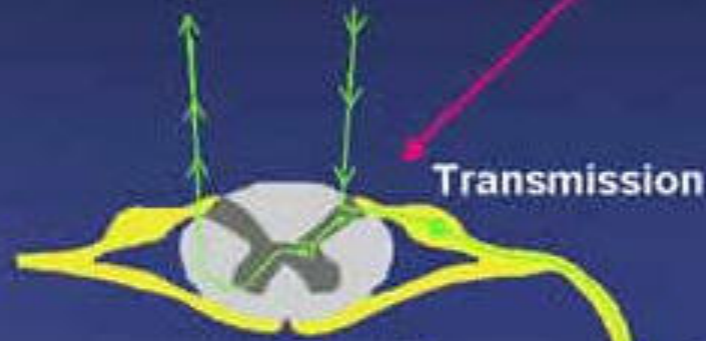
Ketamine

Perception



Ketamine

Modulation



Transmission

Transduction

Lavand'homme et al.
Anesthesiology
2005; 103: 813-820

Ketamine



So good,
the horses want it back

Indications

- Used for sedation of patients with behavioral emergencies or agitated delirium.
- Used for sedation of intubated or soon to be intubated patients with hypotension or hypovolemia.
- May be used for analgesia and sedation for painful procedures or painful conditions.

Ketamine Onset

- IV 1-2 minutes
- IM 3-8 minutes

- Compared to Versed IV onset 1-5 minutes, IM 10-20 minutes
- Compared to Ativan IV onset 1-5 minutes, IM 20-30 minutes
- Compared to Haldol IV 10 minutes, IM 20 minutes

Duration

- Analgesia: 10-15 minutes IV, 15-30 minutes IM.
- Sedation: Variable- at least as long as analgesia and IV may be up to 60 minutes and IM may be up to 90-150 minutes
- Longer with addition of narcotics/benzos

Severe behavioral emergencies



- 4-5 mg/kg IM or 1-2 mg/kg IV/IO, followed by midazolam 2 mg IV/IO on arrival to the ED.

Rapid Sequence Intubation



- 1-2 mg/kg IV/IO (give 0.5 mg/kg/min for intubation, total dose over 60 seconds)

Post-intubation Sedation



- 0.5 mg/kg IV/IO repeated every 15 minutes as needed to maintain an adequate sedation level.

Acute/Adjunctive Pain Management

- 0.1 mg/kg IV/IM/IO with a maximal initial dose of 10mg, may repeat every 15 minutes for additional pain relief up to total maximum of 0.5 mg/kg.
- Take 0.1 ml ketamine and dilute in a 1 ml syringe with 0.9 ml of saline and administer slowly (3-5 minutes) through the highest access port on the IV line.
- Pediatric dosage is 0.1 mg/kg under age 14 to a maximum of 10 mg.

AT A LOCAL VETERINARY CLINIC AFTER HOURS...

YO, CLIFF, IT'S TEN O'CLOCK. WHERE'S THE KETAMINE?

I DON'T KNOW, BUTCH! SOME KIDS BROKE IN AND TOOK ALL THE HALLUCINOGENS!

WELL THAT'S JUST GREAT! WHAT ARE WE SUPPOSED TO DO FOR FUN NOW? THIS PLACE IS SO LAME... IF ANYONE NEEDS ME, I'LL BE IN MY KENNEL LICKING MYSELF.





Use in Behavioral Emergencies in Minnesota

- 77 patients of which 70 were defined as primary behavioral emergencies.
- 51% had suspected intoxication (ETOH/other), 40% unknown.
- 81.6% were identified as male.
- TASER deployed in 4%, 26% unknown.
- 82% required no further ketamine administration.
- Administration was rated 91% effective for this condition by EMS staff.

Use for induction of RSI in Minnesota

- In 47% the indication was for trauma, 34% for altered LOC, and 13% for respiratory compromise.
- 56.5% of patients were identified as male, and 41.3% identified as female.
- In 72.5% had no other sedatives/analgesics administered within 30 minutes of ketamine.
- Staff rated ketamine as 98% effective for induction in RSI.
- Staff rated ketamine as 92.5% effective in providing prolonged sedation after RSI was performed.

Use in Sedation in Minnesota

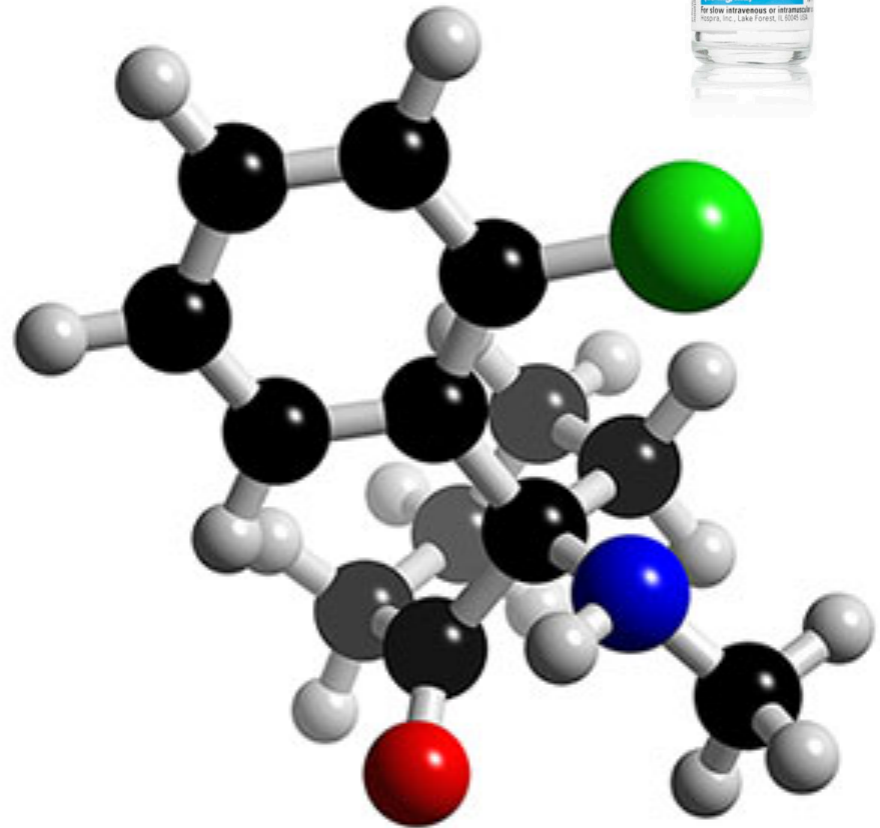
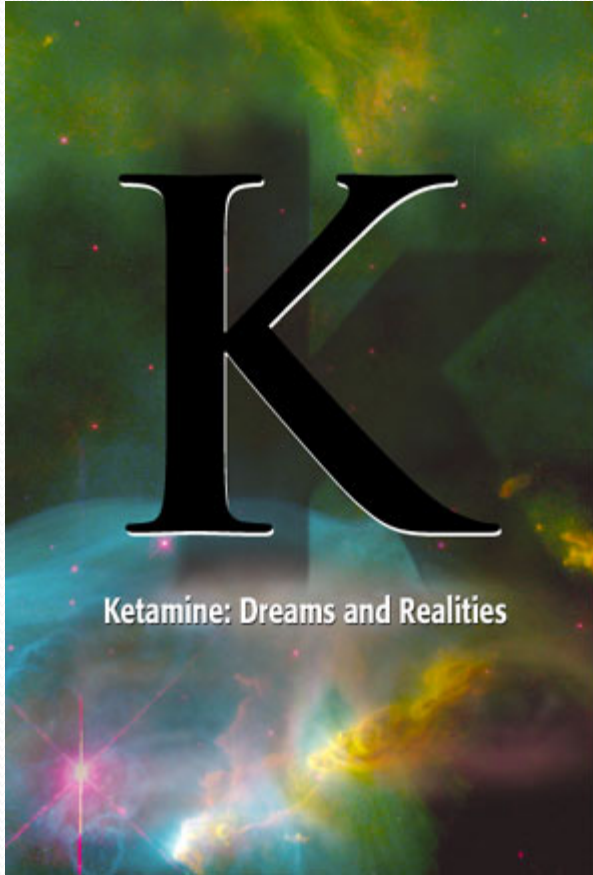
- In 41% the indication was for altered LOC, 25.5% for respiratory compromise, and 25.5% associated with trauma.
- 70.4% of patients were male, and 15.5% had suspected intoxication.
- In 49% of patients, other analgesics/sedatives were given within 30 minutes of ketamine administration.
- BUT, in 80% of patients, this was the last sedative medication given.
- Only 3 adverse reactions were reported.

Use in Pain Management

- In 57.2% of patients, the indication was for traumatic pain, and 42.4% for non-traumatic pain.
- In 72.3% of patients, no other analgesics/sedatives were administered within 30 minutes of Ketamine administration.
- In greater than 96.6% of patients, the medication was administered intravenously.
- Adverse reaction for this use was reported at < 0.02%.
- Staff felt that ketamine was 82% effective for pain management in this usage.

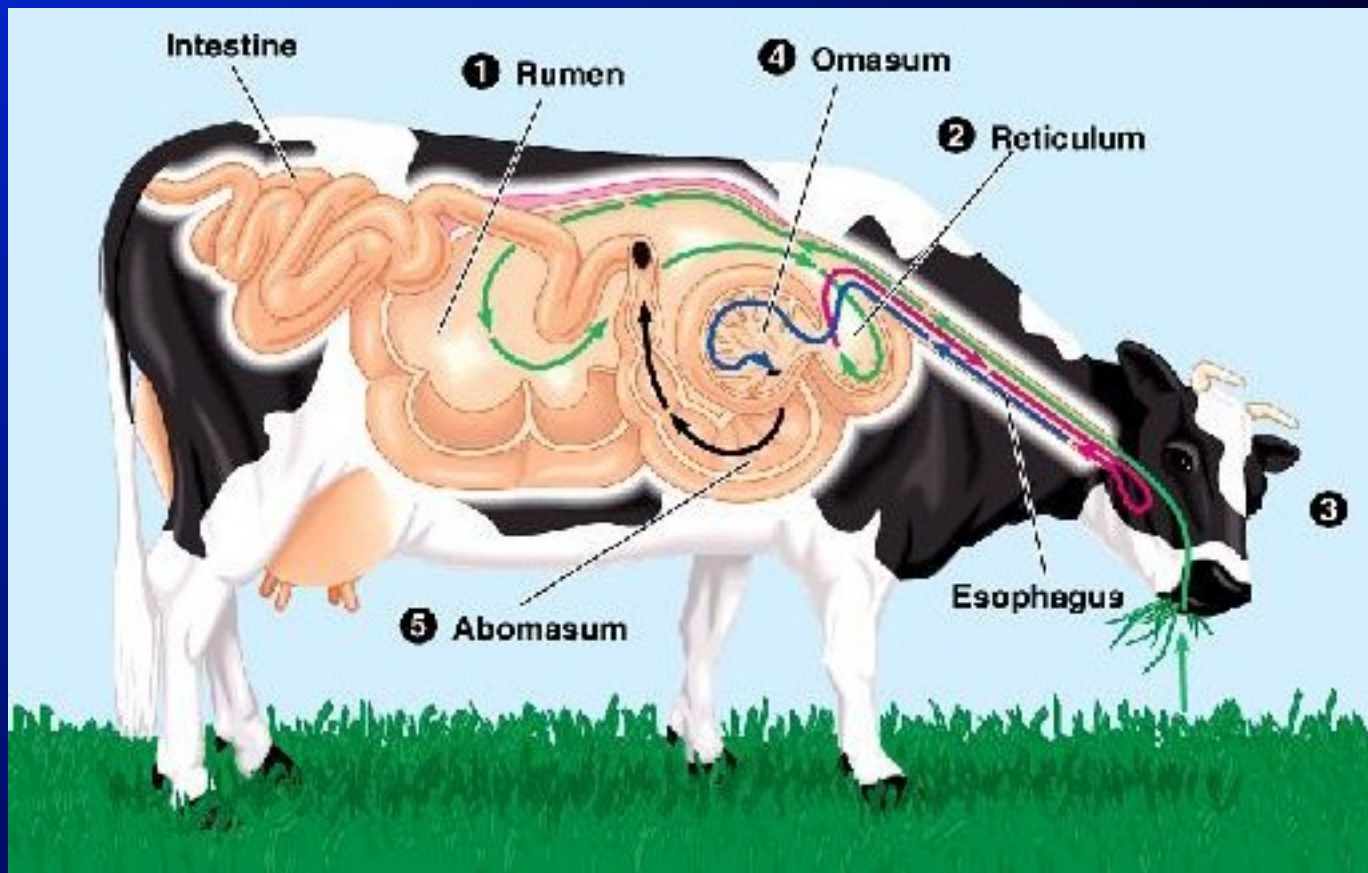
Adverse Reactions in Minnesota Experience

- Allergic reaction-none
- Laryngospasm-none
- Emergence reaction- 6 patients (0.003%)
- Required intubation (non-RSI)- 8 patients (0.004%)
- Heart rate change >20%- 8 patients (0.004%)
- SpO₂ change >10%- 6 patients (0.003%)
- Death-2 patients (0.001%)
 - 1 in association with blunt trauma, and 1 in association with a behavioral emergency.
 - (association, not causation)





Ruminations upon Closing



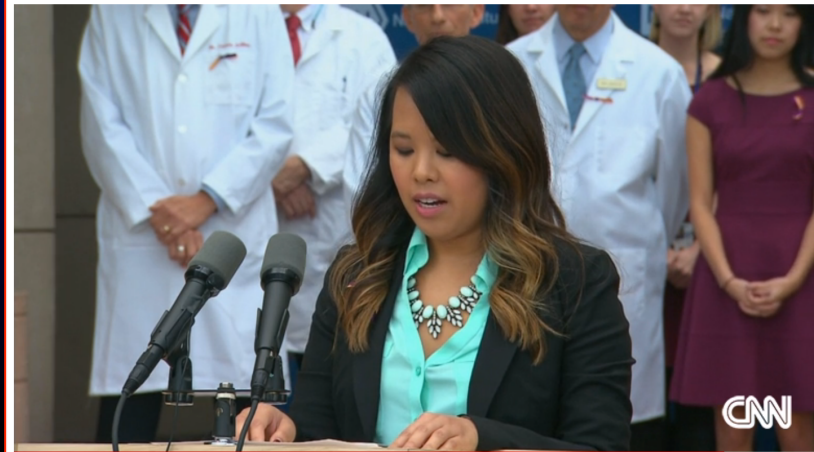


**BREAKING
NEWS**

Shooter targeted friends at school cafeteria ta
witness. "It wasn't just random." Watch live no

What will nurse do after beating Ebola? Hug her dog, of course

By **Michael Martinez** and **Mark Bixler**, CNN
updated 3:19 PM EDT, Fri October 24, 2014



Source: CNN

The “dirty facts” of the treatment of pain

- ✧ *We often do it too little and too late*
- ✧ *We often treat others in a manner different than what we would want to be treated*
- ✧ *Most providers are not familiar with the broad scope of treatments for pain*
- ✧ *Pain scales are essentially worthless*

There will likely be various presentations of pain that will be difficult to treat!



We can choose to act, or
we can be passive



A young man and woman are shown in profile, facing each other and shouting. The woman is on the left, and the man is on the right. They are both wearing light-colored clothing. The background is a plain, light color. The image is framed by a thin red border.

I AM
SHOUTING!!!



*May you live in
interesting times*

*Crisis is **DANGER**
mixed with opportunity*

*Always create the crisis
on YOUR timeline!*



? or !

www.rayfowler.com