

# **Ketamine in Tactical Combat Casualty Care**

## **DHB Decision Briefing**

**John Gandy, MD**  
**Trauma and Injury Subcommittee**

# Agenda

- Importance of Early Pain Control
- History of Battlefield Analgesia
- Current State of Battlefield Analgesia
- Decision Brief - Ketamine
  - Background
  - Uses
  - Advantages
  - Contraindications and Side Effects
  - Dosage Range
  - Proposed Addition of Ketamine to TCCC Guidelines

# Consequences of Untreated Pain

- Sensitization of pain pathways
- Chronic pain syndromes (CRPS, RSD, Fibromyalgia)
- Short and long term narcotic abuse
- Narcotic addiction
- Depression, suicide
- PTSD

# History

- Opium, wine, grog (rum)
- Morphine isolated from opium, 1803
- Hypodermic needle invented, 1850
- U.S. Civil War, Morphine widely used for pain control
- WW I, Morphine
- WW II, Morphine
- Korea, Vietnam, Beirut, Grenada, Panama, Desert Storm, Somalia...

# History-Morphine

- The “Gold Standard”
- Has reigned on the battlefield for more than 150 years
- Many in the anesthesia and pain management fields feel it is an outdated medicine

“Pain control in Baghdad, 2003, was the same as in the Civil War—a nurse with a syringe of morphine.”



# What's Wrong with Morphine?

- Slow onset of action unless given IV
- Many combat medics describe poor or delayed pain relief in those severely injured
- Poor acute pain relief when administered IM
- May result in hypotension and respiratory depression

## Combat Medic's Take on Battlefield Analgesia

In an ongoing survey of combat medical personnel by the Naval Operational Medical Lessons Learned Center, combat medics have indicated that they **had less experience administering ketamine**; however, it was rated as **more effective** than morphine or fentanyl in providing **rapid relief of severe pain**.



# Current Status

- Analgesics currently carried by Combat Medics
  - NSAID's/Tylenol
  - Morphine IM
  - Morphine IV
  - Fentanyl Lozenge (Transmucosal)

# Future

- Multimodal pain management
- Early treatment of pain with different classes of medications
- Decreased doses and side effects of individual agents
- New medications (ketamine, fentanyl, hydromorphone)
- New routes of administration for ease of use (transbuccal, intranasal, transdermal)

# Ketamine

- Ketamine Hydrochloride, 1962
- Derivative of Phencyclidine
- NMDA receptor antagonist
- At lower doses, potent analgesic and mild sedation
- At higher doses, dissociative anesthesia and moderate to deep sedation
- Gained popularity in the U.S. in the 1990s

# Ketamine

- Unique among anesthetics because pharyngeal-laryngeal reflexes are maintained
- Cardiac function is stimulated rather than depressed
- Works reliably by numerous routes
  - Oral, rectal, intranasal, IM, IV, IO

# Ketamine-Uses

- Single agent surgical anesthesia in austere settings and developing countries
- Anesthesia induction
- Procedural sedation
- Peri-operative pain management
- Cancer breakthrough pain
- Migraine headaches

# Ketamine-Uses

- Chronic pain syndromes
- Chronic severe depression
- Narcotic withdrawal
- Intubation sedation in severe asthmatics
- Sedation for prolonged extrications

# Ketamine-Uses

- Battlefield analgesia and sedation:
  - The Military Advanced Regional Anesthesia and Analgesia Handbook
  - U.S. Special Operations Command Tactical Trauma Protocols
  - U.S. Army Ranger Medic Handbook
  - Pararescue Procedures Handbook

# Ketamine-Safety

- Very favorable safety profile
- Few, if any, deaths attributed to Ketamine as a single agent



# Safety-FDA Insert

- ***"Ketamine has a wide margin of safety; several instances of unintentional administration of overdoses of ketamine (up to ten times that usually required) have been followed by prolonged but complete recovery."***

# Clinical Practice Guideline for Emergency Department Ketamine Dissociative Sedation: 2011 Update

## **Contraindications: Absolute (Risks Essentially Always Outweigh Benefits)**

- Age younger than 3 months (higher risk of airway complications)
- Known or suspected schizophrenia, even if currently stable or controlled with medications (can exacerbate condition)

# Clinical Practice Guideline for Emergency Department Ketamine

## Dissociative Sedation: 2011 Update (Continued)

- ***Contraindications: Relative (Risks May Outweigh Benefits)***

***Increased intracranial pressure (ICP).*** “In this update, head trauma has been removed as a relative contraindication to ketamine while retaining the previous concerns relating to central nervous system masses, abnormalities, or hydrocephalus.”

# Relative Contraindications: ICP (continued)

“However, newer suggestive evidence indicates that in most patients the resulting pressure increases are minimal, assuming normal ventilation, and that ketamine’s corresponding cerebral vasodilatory effect may actually improve overall cerebral perfusion.”

# Relative Contraindications: Intraocular pressure

***“Increased intraocular pressure.*** Dissociative sedation may represent risk in patients with acute globe injury or glaucoma, given inconclusive and conflicting evidence of increased intraocular pressure with ketamine.”

# Additional Evidence: Intraocular pressure

## Prospective study of 80 patients, ages 1-15 years\*

- **Objective:** To measure IOP in pediatric patients to determine if ketamine is a safe procedural sedation and analgesic agent for patients with eye injuries
- **Implications:** Ketamine may be safely used in situations when there is a concern for an eye injury.
- **Conclusion:** Ketamine does not significantly increase IOP in pediatric patients receiving typical PSA doses in the PED.

\*Mean total ketamine dose was 1.6 mg/kg; mean difference in IOP after 2.5 minutes was 1.6 mmHg

Halstead SM, Deakyne S, Bajaj L, et. Al. The Effect of Ketamine on Intraocular Pressure in Pediatric Patients during Procedural Sedation. Poster presentation at the October 2011 American Academy of Pediatrics Conference.

# Ketamine-Side Effects

- Elevated heart rate
- Elevated blood pressure
- Hypersalivation
- Nausea
- Muscular clonus
- Nystagmus

# Ketamine-Side Effects

- “Bad dreams”
- Hallucinations
- Emergence Phenomena
  - Dose-related
  - 12% of patients
  - Decreased symptoms with benzodiazepines, barbiturates and narcotics



# Ketamine-Side Effects

- Respiratory depression and apnea can occur if Ketamine is administered too rapidly IV
  - Treatment is assisted ventilation

# Operational Considerations

- Ability to preserve spontaneous respirations with complete analgesia is unparalleled
- However, there are a number of characteristics that may impact military operations
  - Spontaneous utterances and purposeless motions in settings that mandate strict noise discipline
  - Need for vigorous active restraint for severe emergence reactions

# Ketamine-Dosages

- Vary widely by user and clinical situation
- Surgical anesthesia
  - 1 mg/kg to 4.5mg/kg IV
  - 6.5 mg/kg to 13 mg/kg IM
- Surgical induction and procedural sedation
  - 1 mg/kg to 2 mg/kg IV
  - 4 mg/kg to 5 mg/kg IM

# Ketamine-Dosages

- Analgesia
  - 0.1 mg/kg to 0.5 mg/kg IV
  - 0.4 mg/kg to 1mg/kg IM

# Ketamine-Proposed Protocol

12. Provide analgesia as necessary.

a. Able to fight:

*These medications should be carried by the combatant and self-administered as soon as possible after the wound is sustained.*

- Mobic, 15 mg PO once a day
- Tylenol, 650-mg bilayer caplet, 2 PO every 8 hours

b. Unable to fight:

*Note:* Have naloxone readily available whenever administering opiates.

- Does not otherwise require IV/IO access
  - Oral transmucosal fentanyl citrate (OTFC), 800 ug transbucally
  - Recommend taping lozenge-on-a-stick to casualty's finger as an added safety measure
  - Reassess in 15 minutes
  - Add second lozenge, in other cheek, as necessary to control severe pain.
  - Monitor for respiratory depression.

# Ketamine-Proposed Protocol

OR

- Ketamine 50-100mg IM
- Repeat dose every 30 minutes to 1 hour as necessary to control severe pain or until the patient develops nystagmus (rhythmic eye movement back and forth)

OR

- Ketamine 50 mg intranasal (using nasal atomizer device)
- Repeat dose every 30 minutes to 1 hour as necessary to control severe pain or until the patient develops nystagmus

- IV or IO access obtained:
  - Morphine sulfate, 5 mg IV/IO
  - Reassess in 10 minutes.
  - Repeat dose every 10 minutes as necessary to control severe pain.
  - Monitor for respiratory depression

# Ketamine-Proposed Protocol

- OR

- Ketamine 20 mg slow IV/IO push over 1 minute
  - Reassess in 5-10 minutes.
  - Repeat dose every 5-10 minutes as necessary to control severe pain or until the patient develops nystagmus
  - Continue to monitor for respiratory depression and agitation

- Promethazine, 25 mg IV/IM/IO every 6 hours as needed for nausea or for synergistic analgesic effect

# Discussion/Vote

