



A Review of Prehospital Pain Management

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Outline

- Non-medicinal methods (e.g. ice-packs)
- NSAIDs and Acetaminophen
- Morphine
- Fentanyl
- Ketamine... the future?

Nonsteroidal Anti-Inflammatory Drugs (NSAIDs)

- Aspirin, Ibuprofen, Naproxen, Celecoxib
- **Dose (Ibuprofen):** 10mg/kg
(max daily 1200mg-3200mg/day)
- **Onset (oral):** 25-30 mins
- **Peak:** 1-2hr
- **Duration:** 4-6hr
- **Cost:** \$0.11-0.21 / 200mg tablet



Acetaminophen (Tylenol)

- **Dose:** 15mg/kg PO
(max daily dose 4000mg/day)
- **Onset (oral):** 15-20 mins
- **Peak:** 1-1.5hr
- **Duration:** 4-6hr
- **IV:** Should be administered as a 15 min infusion
- **Cost:** \$0.02-0.36 / 325mg tablet



Paramedics replace fentanyl with ice, IV Tylenol to prevent addiction

Fire Chief Kevin Gallagher and Dr. Matthew Bivens are working to close off one avenue that can lead to opioid addiction

Jul 14, 2017

Mass. approves IV Tylenol during hospital transport

The decision, which came down Friday, allows paramedics across the state to administer acetaminophen, Motrin and an IV option of Toradol

Sep 26, 2017

Morphine

- Pure opioid agonist selective to μ – receptors
- **Onset IV:** 5 mins
- **Duration:** 4-5 hours
- **Dose:** 2-10mg IV per 70kg (0.1mg/kg)
- Controlled substance schedule II
- **Cost:** \$0.71 /10mg
- **Shelf life:** 3 years



Fentanyl

- Pure opioid agonist to μ – receptors
- **Onset IV:** Almost immediate
- **Duration:** 30-60 mins
- **Dose:** 50-100mcg IV or 0.5-1.5mcg/kg
- Controlled substance schedule II
- **Cost:** \$0.83/ 100 μ g
- **Shelf life:** 3 years



Advantages of Fentanyl

- x50-100 more potent than morphine
 - Fentanyl 0.1mg = Morphine 10mg
- Quick onset of action
- Preserves cardiac stability
- Less nausea (not validated)
- May cause muscle rigidity (chest wall rigidity)

Fleischman R. et al

Prehospital Emergency Care 2010



NIH Public Access

Author Manuscript

Prehosp Emerg Care. Author manuscript; available in PMC 2011 April 6.

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Prehosp Emerg Care. 2010 April 6; 14(2): 167–175. doi:10.3109/10903120903572301.

Effectiveness and Safety of Fentanyl Compared with Morphine for Out-of-Hospital Analgesia

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Abstract

Background—Fentanyl has several potential advantages for out-of-hospital analgesia, including rapid onset, short duration, and less histamine release.

- Retrospective before and after study from morphine to fentanyl in an ALS EMS system in 2007
- 355 patients Morphine, 363 patients Fentanyl
 - Morphine 2--5 mg IV, repeated q5 mins to a max of 20 mg.
 - Fentanyl 50µg IV, repeated doses of 25--50µg q3--5 minutes to a max of 200 µg.
- Measured change in pain scores
- Measured adverse events (RR, SpO2, sBP, GCS, n/v, use of anti-emetics or naloxone, intubation)
- Fentanyl patients received a higher equivalent dose of opioid (7.7mg M, 9.2mg F)
- Mean decreases in pain score (2.9 vs 3.1, CI -0.3 to 0.7), rate of adverse events (9.9% vs 6.6%, CI -0.8 to 7.3%) similar
- **Similar degrees of out-of-hospital analgesia**, although this was achieved with a higher dose of Fentanyl.
- **Both medications had low rates of adverse events**, which were easily controlled.

Smith M. et al

The Journal of Emergency Medicine 2012



***Selected Topics:
Prehospital Care***

THE EFFECTIVENESS AND ADVERSE EVENTS OF MORPHINE VERSUS FENTANYL ON A PHYSICIAN-STAFFED HELICOPTER

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- Prospective, double-blinded comparison trial
- Trauma patients, 18-64 years
 - even days: morphine 4mg - 103 patients
 - odd days: fentanyl 50µg - 97 patients
- Medical crew assessed: Numeric pain score, Vital signs, incidence of pruritis/nausea
- Pain Score
 - M : 8.0 +/- 2.0 -> 5.8 +/- 2.7
 - F : 8.0 +/- 1.8 -> 5.5 +/- 2.4
- **No significant differences in analgesia between Fentanyl and Morphine**
- No significant differences in incidence of pruritus or vomiting
- **Either drug can be used safely with equivalent effectiveness**

Wendroth B. et al

Journal of Trauma Nursing 2013

RESEARCH

Morphine Versus Fentanyl for Pain Due to Traumatic Injury in the Emergency Department

Bradley R. Wendroth, PharmD ■ Elizabeth T. Kaneda, PharmD ■ Albert Amini, MD ■
Richard Amini, MD ■ Asad E. Patanwala, PharmD

ABSTRACT

The analgesic response and safety of intravenous morphine versus fentanyl for adult trauma patients who presented to

Currently, the efficacy and safety of fentanyl and morphine have not been compared in the ED setting. However, these agents have been compared in the pre-hospital setting. To assess the relative efficacy and safety of

- Retrospective cohort study in a Level 1 Trauma center ED
- Pain score >4, 168 Trauma patients (84 each)
- Morphine 4mg IV, Fentanyl 50 μ g IV
- Median pain reduction on numerical rating scale was 2 in both groups
- **Fentanyl and Morphine have a similar analgesic response**
- Response and redosing more rapid with Fentanyl
- **No significant difference in adverse events**

Garrick J. et al

Journal of Opioid Management 2011

J Opioid Manag. 2011 May-Jun;7(3):229-34.

Analysis of the paramedic administration of fentanyl.

Garrick JF¹, Kidane S, Pointer JE, Sugiyama W, Van Luen C, Clark R.

⊕ Author information

Abstract

INTRODUCTION: Pain is a common complaint among emergency medical services patients. When compared with the most commonly used morphine, fentanyl has a shorter onset of action, shorter duration, and far fewer side effects making it an appealing candidate for prehospital pain management. This study's intent is to prospectively assess the feasibility and safety of fentanyl for pain in prehospital patients in comparison with morphine.

METHODS: Observational trial to evaluate select characteristics of fentanyl administration. The primary outcome measure was the reduction of pain from time of initial patient assessment to transfer of care (TOC) to emergency department (ED) staff. Secondary outcome measures included the development of adverse outcomes and side effects related to fentanyl administration. Additionally, data obtained were compared with morphine retrospectively from an identical prior time period, ie, 1 year earlier.

RESULTS: About 16.6 percent of the patients who received fentanyl reported subjective pain relief in less than 1 minute, 47 percent in 1-2 minutes, 19.9 percent in 2-3 minutes, and 16.6 percent at greater than 3 minutes. The reduction of pain after fentanyl administration, on a scale of 1-10, was 3.82 points in TOC at the ED. No significant adverse clinical outcomes or incidents of diversion were reported during the trial period.

CONCLUSIONS: Fentanyl can be used safely and effectively for pain control in the prehospital setting.

- Observational trial
- Reduction of pain, adverse events compared with morphine studied retrospectively
- Reduction of pain was 3.82
- **No significant adverse clinical outcomes**
- **Fentanyl can be used safely and effectively in the setting of prehospital pain control**

Conclusions

- Limited studies, particularly in the prehospital setting
- So far, most studies show no difference in effect nor in adverse outcomes
- More prospective studies are needed to directly compare the 2 interventions

Ketamine

- NMDA-Receptor antagonist (Analogue of PCP), μ , κ -opioid receptors
- Dissociative anesthetic, analgesic, amnestic, anxiolytic
- Airway, Tone, Reflex maintained
- Schedule III Controlled Substance
- 50mg/mL (10mL) \$4.28
- 100mg/mL(5mL) \$9.78



Dosing

- IV, IM, IN, PO
- IV onset 30 sec, last 5~10 min
- IM onset 3-4 min, last 12~25 min
- Analgesic
 - IM/IV: 0.3mg/kg ★
- Procedural Sedation
 - IM: 2-4 mg/kg
 - IV: 0.2-0.8 mg/kg
- Anesthesia
 - IM: 6.5-13 mg/kg
 - IV: 1-4.5 mg/kg



Adverse Effects

- Laryngeal spasm – can be BVMed
- Excessive salivation
- Vomiting
- Increases cardiac demand
- **Emergency reactions**
 - Can occur ~24hrs post administration
 - May be reduced by Benzodiazepine pretreatment
- Avoid use in Schizophrenia patients



Benefits of Ketamine

- Effective analgesia, amnesia
- Airway responses are protected
- Minimal cardiovascular effects
- Rapid onset
- Short duration
- Wide safety margin

Ketamine Use Outside CA

- Most widely used anesthetic in the world!
- Used extensively in EMS systems in other countries
- Many states have Ketamine as an option for RSI
- Increasing number of states are using for analgesia
- OH, FL, MN, CO, TX, WI, VA, DC –
Excited Delirium

Into the Literature...

- Limited reports in prehospital use:
 - Case studies
 - Retrospective reviews
 - Observational Studies
- Adverse Outcomes
- Prehospital Analgesia
- Excited Delirium (usually involves higher doses)



ELSEVIER

Annals of Emergency Medicine

Volume 66, Issue 3, September 2015, Pages 222-229.e1



Pain management and sedation/original research

Intravenous Subdissociative-Dose Ketamine Versus Morphine for Analgesia in the Emergency Department: A Randomized Controlled Trial

- Prospective, randomized, double-blind trial
- Evaluated patients age 18-55, experiencing pain >5
- Received either IV Ketamine 0.3mg/kg or Morphine 0.1mg/kg
- 45 patients per group enrolled, the **primary change in mean pain scores was not statistically different** in the two groups. No difference in reports of adverse events.
- **Conclusion: Sub-dissociative IV ketamine provides analgesic effectiveness and apparent safety comparable to IV Morphine for short term treatment of acute pain.**

ORIGINAL CONTRIBUTION

Randomized Controlled Feasibility Trial of Intranasal Ketamine Compared to Intranasal Fentanyl for Analgesia in Children with Suspected Extremity Fractures

Stacy L. Reynolds, MD, Kathleen K. Bryant, MD, Jonathan R. Studnek, PhD, Melanie Hogg, Connell Dunn, Megan A. Templin, MS, Charity G. Moore, PhD, MSPH, James R. Young, MD, Katherine Rivera Walker, BSN, and Michael S. Runyon, MD, MPH

- Randomized control trial comparing 1mg/kg **IN Ketamine** to 1.5 mg/kg IN Fentanyl for children (4-17yrs) with acute pain from an isolated extremity fracture
- **Pain relief was similar** in the 2 groups, with ketamine having **more side effects than Fentanyl** (although minor)

Ketamine as an analgesic in the pre-hospital setting: a systematic review

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- 837 hits-> **6 Articles** reported on Ketamine as an analgesic in the prehospital setting
- 2 prospective RCTs
- 2 studies -> Ketamine provided safe and effective pain relief
- 1 study -> Ketamine reduced amount of morphine but not associated with reduction in pain intensity
- 1 study -> higher prevalence of adverse effects following ketamine
- Other studies -> No significant side effects, Ketamine is safe

- **Ketamine is safe and effective.**
- **The addition of Ketamine as an analgesic agent may improve management of patients with acute traumatic pain in the prehospital setting.**



Pre-hospital use of ketamine for analgesia and procedural sedation

P P Bredmose, D J Lockey, G Grier, B Watts, G Davies

- London Helicopter EMS Physician – Paramedic team
- Retrospective trauma database review 5/1999-11/2004, 1030 pts
- Database looking for airway complications, emergence reactions
- No adverse events (airway loss/ emergence phenomenon) documented
- **Ketamine is relatively safe** when used by physicians in **prehospital trauma care**

Ketamine in prehospital care

K Porter



Emerg Med J 2004;21:351–354. doi: 10.1136/emj.2003.010843

- 32 patients 1992-2002 Retrospective cohort review
- Immediate care practitioner as a part of British Association of Immediate Care Scheme
- No significant airway problems after Ketamine or Ketamine + MDZ administration.
- BP maintained, no increased bleeding
- Hypersalivation 1 case not clinically problematic
- **Ketamine provided safe and effective analgesia** for this cohort of trauma patients including children, adults, polytrauma, patients with AMS, hypotensive patients due to trauma.

INTERNATIONAL EMS

A COMPARISON OF KETAMINE AND MORPHINE ANALGESIA IN PREHOSPITAL TRAUMA CARE: A CLUSTER RANDOMIZED CLINICAL TRIAL IN RURAL QUANG TRI PROVINCE, VIETNAM

Kim Phung Tran, MD, PhD, Quynh Nguyen, MD, MPH, Xuan Nhuan Truong, MD, Viet Le, MSci, Van Phu Le, MD, Nam Mai, MD, MPH, Hans Husum, MD, PhD, Ole Kristian Losvik, MD


- Prospective, cluster-randomized design
- 169 Ketamine, 139 Morphine pts rural Vietnam
- Compared VAS
- Analgesic effects no difference
- Vomiting rate lower in Ketamine group (5% vs 19%)
- Hallucination/agitation rate higher in Ketamine group (11% vs 1.5%)
- **Ketamine had similar analgesic effects with morphine.**
- *Lower* risk of vomiting / airway problems
- *Higher* risk of hallucination / agitation

ORIGINAL RESEARCH

Open Access

Ketamine for prehospital trauma analgesia in a low-resource rural trauma system: a retrospective comparative study of ketamine and opioid analgesia in a ten-year cohort in Iraq



Ole Kristian Losvik^{1,4*} , Mudhafar Kareem Murad², Eystein Skjerve³ and Hans Husum⁴

- Restrospective study looking at trauma victims in Iraq warzone
- Compared 3 groups: No analgesia, Pentazocine and Ketamine
- In patients with Injury Severity Score >8, **ketamine was associated with a significantly better effect on the systolic blood pressure** compared to opioid analgesia ($p = 0.03$).

Conclusion

- More research is needed, as always
 - More specifically on Ketamine for pre-hospital *analgesia*, versus for excited delirium
- Ketamine seems to be an effective analgesic with no increase in adverse outcomes compared to pre-existing pain medications, and a more favorable effect on vital signs

EMS Ketamine Trial in California



California Ketamine Trial

PARAMEDIC

- Ketamine
 - Dissociative anesthetic
 - Analgesia at low doses
- **“Trial Study” Protocol**
 - If pain score is 5 or above, mix **0.3 mg/kg Ketamine** (max dose = 30mg) in 50 - 100cc NSS or D5W, and administer slow IV drip over 5 minutes
 - Place “Ketamine Administered” wrist band on patient
 - Assess and document pain score every 5 minutes for duration of transport
 - If after 15 minutes or more, the pain score is 5 or higher, may administer a second dose of 0.3 mg/kg Ketamine (max dose = 30mg) in 50 - 100cc NSS or D5W, and administer slow IV drip over 5 minutes

California Ketamine Trial

Ketamine Eligibility Criteria

- 15 years of age or older
- GCS of 15
- Acute Traumatic or Burn injury

Ketamine Exclusion Criteria

- Known/Suspected Alcohol/Drug Intoxication
- Known/Suspected Pregnancy
- Allergy to Ketamine
- Received narcotic analgesics of ANY form within the past 6 hours

Thoughts?

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