Pre-Hospital Sedation Strategies

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EMS Fellow
University of Virginia
We will discuss...

• What is sedation?
• Commonly used agents
• Some clinical scenarios
• Monitoring level of sedation
• Wrap-up

*No financial disclosures*
What is Sedation?

• Sedation vs analgesia...

• “Conscious” sedation? (Procedural sedation)

• Sedation = ↓ awareness to the environment and ↓ responsiveness to external stimulation
Goals of Intervening?

- Reduce injury / illness pain and suffering
- Facilitate procedures / examination
- Scene safety
Why does your patient need sedation?

- Situation awareness
- Analgesia
- Amnesia
- Anxiolysis
Analgesia

• 20% of all EMS patients have mod-severe pain (Mclean, 2002)

• “NAEMSP believes that the relief of pain and suffering of our patients must be a priority for every EMS system.” (Position statement 2003)
Room for improvement

• Largely ignored in prehospital care education
• Pain management protocols are lacking
• Oligoanalgesia
  – Fear of “masking”
  – Prevent side-effects
  – Unable to obtain IV access
  – Defer pain management to ED
  – Negative feedback from receiving staff
• Pain reduction is closely tied to satisfaction
A1 sedation

• “Analgesia first”

A protocol of no sedation for critically ill patients receiving mechanical ventilation: a randomised trial

Thomas Strøm, Torben Martinussen, Palle Toft

Lancet 2010; 375: 475–80

• 140 critically ill patients expected to remain intubated > 24 hours
<table>
<thead>
<tr>
<th></th>
<th>No sedation (n=55)</th>
<th>Sedation (n=58)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Days without mechanical ventilation (from intubation to day 28)</strong></td>
<td>13.8 (11.0); 18.0 (0-24.1)</td>
<td>9.6 (10.0); 6.9 (0-20.5)</td>
<td>0.0191*†</td>
</tr>
<tr>
<td><strong>Length of stay (days)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intensive care unit</td>
<td>13.1 (5.7--)‡</td>
<td>22.8 (11.7--)‡</td>
<td>0.0316*§</td>
</tr>
<tr>
<td>Hospital</td>
<td>34 (17-65)</td>
<td>58 (33-85)</td>
<td>0.0039*§¶</td>
</tr>
<tr>
<td><strong>Mortality</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intensive care unit</td>
<td>12 (22%)</td>
<td>22 (38%)</td>
<td>0.06</td>
</tr>
<tr>
<td>Hospital</td>
<td>20 (36%)</td>
<td>27 (47%)</td>
<td>0.27</td>
</tr>
<tr>
<td><strong>Drug doses (mg/kg)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Propofol (per h of infusion)</td>
<td>0 (0-0.515)</td>
<td>0.773 (0.154-1.648)</td>
<td>0.0001</td>
</tr>
<tr>
<td>Midazolam (per h of infusion)</td>
<td>0 (0-0)</td>
<td>0.0034 (0-0.0240)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Morphine (per h of mechanical ventilation)</td>
<td>0.0048 (0.0014-0.0111)</td>
<td>0.0045 (0.0020-0.0064)</td>
<td>0.39</td>
</tr>
<tr>
<td>Haloperidol (per day of mechanical ventilation)</td>
<td>0 (0-0.0145)</td>
<td>0 (0-0)</td>
<td>0.0140</td>
</tr>
<tr>
<td><strong>Tracheostomy</strong></td>
<td>16 (29%)</td>
<td>17 (29%)</td>
<td>0.98</td>
</tr>
<tr>
<td><strong>Ventilator-associated pneumonia</strong></td>
<td>6 (11%)</td>
<td>7 (12%)</td>
<td>0.85</td>
</tr>
</tbody>
</table>
*Bispectral Index Scale

Anxiolysis

Moderate

Deep

Unconscious

Awake, Memory Intact

Sedation

General Anesthesia

“Deep” Hypnosis, Memory Function Lost

“Near” Suppression

Increasing Burst Suppression

Cortical Silence
CITY PARKING LIMITED TO

EVEN # SIDE ON EVEN # MONTHS
ODD # SIDE ON ODD # MONTHS
APR. THRU SEPT.

EVEN # SIDE ON EVEN # DAYS
ODD # SIDE ON ODD # DAYS
OCT. THRU MAR.

ALTERNATE 10AM
Sedation Agents

- Benzodiazepines
  - Midazolam
  - Lorazepam
- Nonbarbiturate
  - Propofol
  - Etomidate
- Opioid
  - Fentanyl
  - Morphine
  - Hydromorphone
- Non-Opioid
  - Ketamine
The best sedative???

• “Lets review the dosing, pharmacokinetics, Vd, metabolism, and clearance...”
65 y.o. female nursing home pt. with respiratory distress...

- Fever since yesterday
- Productive cough
- T 103F, HR 134 ST
- RR 32, SaO2 93%
- BP 68/40
Challenges of sedation in shock

- Reduced perfusion & circulating volume
- Delayed drug delivery
- Reliant on hyper-catecholaminergic state
Options for induction sedative

- Midazolam
- Propofol
- Etomidate
- Ketamine
Midazolam

- GABA-A site
- Good amnesia & anxiolysis
- Induction dose varies (0.1-0.35 mg/kg)
- EEG changes after 3-5 min
- Duration 30 min
Midazolam

• Cardiovascular depression - hypotension seen at 2mg IV

• No analgesia

• Depress respiratory drive

• Long time to onset
Propofol

- GABA-A? Global CNS depression
- Onset 30-60 sec
- Duration 10 min minimum (dose dependent)
- Direct CV suppression
- No analgesia
Etomidate

- GABA-A, RAS
- Onset < 1 min
- Duration 5-8 min, little residual effects
- “CV neutral”
- Adrenocortical suppression 4-6 hrs
- 0.3 mg/kg
- No analgesia
- Shortages...
Ketamine

- NMDA antagonist (thalamocortical & limbic)
- Interaction with opioid receptors
- 1-2 mg/kg dissociative anesthesia
- 0.1-0.3 mg/kg subdissociative
- 4-13 mg/kg IM
Ketamine

- Respiratory drive is maintained, pharyngeal reflexes preserved
- Increased SBP and HR (indirectly CNS outflow)
- Augments opioids
- Onset 30 seconds
- Duration 15-30 min
Ketamine

- Emergence reactions 10-20%
- Hypersalivation
- Laryngospasm
65 y.o. female nursing home pt. with respiratory distress...

- Fever since yesterday
- Productive cough
- T 103F, HR 134 ST
- RR 32, SaO2 93%
- BP 68/40
• Systolic hypotension (+/- vasopressors) is the biggest factor associated with death at time of intubation
• Anesthesiology 1995

The frequency and significance of postintubation hypotension during emergency airway management

• Post-intubation hypotension in **23%**
• Significantly associated with higher mortality & increased LOS
# Anaesthesia in haemodynamically compromised emergency patients: does ketamine represent the best choice of induction agent?

C. Morris et al. Anaesthesia, 2009, 64, pages 532–539

<table>
<thead>
<tr>
<th>Intravenous induction agent</th>
<th>Effector site equilibration and $t_{1/2}K_{ee}$</th>
<th>Haemodynamic effects in vivo</th>
<th>Comments and idiosyncratic reactions (see text)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ketamine</td>
<td>Undetermined (see text), but probably $\sim$2 min</td>
<td>$\uparrow$CO, $\uparrow$HR, $\uparrow$ABP, Sympathomimetic</td>
<td>$\rightarrow$ or $\uparrow$CPP and $\rightarrow$ICP with standard anaesthetic management</td>
</tr>
<tr>
<td>Thiopentone</td>
<td>1.5 min</td>
<td>$\uparrow$HR, $\rightarrow$CO, $\downarrow$ABP, $\rightarrow$laryngeal reflexes, $\downarrow$inotrope, vasodilates</td>
<td>Haemodynamically compromised patients unlikely to tolerate induction dose $&gt; 3$ mg.kg$^{-1}$</td>
</tr>
<tr>
<td>Propofol</td>
<td>$\leq$20 min</td>
<td>$\rightarrow$HR, $\downarrow$CO, $\downarrow$ABP, $\rightarrow$Vagotonic, $\downarrow$laryngeal reflexes</td>
<td>Haemodynamic compromise marked in elderly, ASA 3 or more or hypovolaemic patients with ‘standard’ induction dose</td>
</tr>
<tr>
<td>Etomidate</td>
<td>$\sim$2.5 min</td>
<td>$\rightarrow$CO, $\rightarrow$ABP</td>
<td>Prolonged inhibition of steroid synthesis in the critically ill; withdrawn from number of countries</td>
</tr>
<tr>
<td>Benzodiazepenes</td>
<td>$\sim$9 min (e.g. lorazepam)</td>
<td>$\rightarrow$CO, $\rightarrow$HR, $\downarrow$Vagotonic, $\downarrow$CO, $\downarrow$HR, $\downarrow$ABP, $\downarrow$laryngeal reflexes</td>
<td>Induction time of anaesthesia incompatible with RSI</td>
</tr>
<tr>
<td>Phenylpiperidines</td>
<td>$\sim$6 min (e.g. fentanyl)</td>
<td>$\rightarrow$CO, $\rightarrow$HR, $\downarrow$Vagotonic, $\downarrow$laryngeal reflexes</td>
<td>Potent vagally mediated bradycardia can compound effects of hypovolaemia</td>
</tr>
</tbody>
</table>

CO, cardiac output; ABP, arterial blood pressure; HR, heart rate; CPP, cerebral perfusion pressure; ICP, intracranial pressure. ASA, American Society of Anesthesiologists preoperative grade. $\uparrow$, Increased; $\downarrow$, decreased; $\rightarrow$, unaffected.
What’s it gonna be?

- Optimize pre-RSI condition
- Ketamine + PRN fentanyl
- Etomidate as a distant second choice
- Propofol + ACLS
- Midazolam
Dispatched to 88 y.o. male C.A.

- CPR in progress, BVM

- ACLS, defibrillate x 3 then ROSC
• Sats 72% with snoring RR 4-5/min
• BP 95/60
• AFRVR at 140-155 bpm
• You decide to control the airway...
What’s it gonna be?

- Optimize pre-RSI condition

- Ketamine
  - Indirect sympathomimetic via CNS outflow
  - Reduces catecholamine reuptake

- Etomidate

- Propofol at reduced dose (1/10th)
  - Anesth 2004 101:567

- No Midazolam / Fentanyl for this patient
‘NO’ MEANS NOTHING TO A DUCK
33 y.o. male in custody agitated

- Flailing in handcuffs, disoriented
- Large pupils, BP 200/140, HR 135
- “bath salts” in pocket
White Paper Report on Excited Delirium Syndrome

• ACEP 2009
• Agitated or violent patients posing immediate danger to themselves or those around them
• Associated with SCD

<table>
<thead>
<tr>
<th>FEATURE</th>
<th>FREQUENCY % (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain Tolerance</td>
<td>100 (83-100)</td>
</tr>
<tr>
<td>Tachypnea</td>
<td>100 (83-100)</td>
</tr>
<tr>
<td>Sweating</td>
<td>95 (75-100)</td>
</tr>
<tr>
<td>Agitation</td>
<td>95 (75-100)</td>
</tr>
<tr>
<td>Tactile Hyperthermia</td>
<td>95 (75-100)</td>
</tr>
<tr>
<td>Police Noncompliance</td>
<td>90 (68-99)</td>
</tr>
<tr>
<td>Lack of Tiring</td>
<td>90 (68-90)</td>
</tr>
<tr>
<td>Unusual Strength</td>
<td>90 (68-90)</td>
</tr>
<tr>
<td>Inappropriately Clothed</td>
<td>70 (45-88)</td>
</tr>
<tr>
<td>Mirror/Glass Attraction</td>
<td>10</td>
</tr>
</tbody>
</table>
Excited Delirium

- **Traditional:**
  - Antipsychotic + bzd

- **Ideal:**
  - IM or IV
  - Rapid onset
  - Sustained effects
  - Minimal SE

### Table 5. Sedation Agents for ExDS–type symptoms

<table>
<thead>
<tr>
<th>Class</th>
<th>Agent (Trade Name)</th>
<th>Available Routes</th>
<th>Dosing (mg)*</th>
<th>Onset (min)</th>
<th>Duration (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Midazolam (Versed)</td>
<td>IN</td>
<td>5</td>
<td>3-5</td>
<td>30-60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IM</td>
<td>5</td>
<td>10-15</td>
<td>120-360</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IV</td>
<td>2 - 5</td>
<td>3-5</td>
<td>30-60</td>
</tr>
<tr>
<td></td>
<td>Lorazepam (Ativan)</td>
<td>IM</td>
<td>4</td>
<td>15-30</td>
<td>60-120</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IV</td>
<td>2 - 4</td>
<td>2-5</td>
<td>60-120</td>
</tr>
<tr>
<td></td>
<td>Diazepam (Valium)</td>
<td>IM</td>
<td>10</td>
<td>15-30</td>
<td>15-60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IV</td>
<td>5 - 10</td>
<td>2-5</td>
<td>15-60</td>
</tr>
<tr>
<td></td>
<td>†Haloperidol (Haldol)</td>
<td>IM</td>
<td>10– 20</td>
<td>15</td>
<td>180-360</td>
</tr>
<tr>
<td></td>
<td>††IV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>†Droperidol (Inapsine)</td>
<td>IM</td>
<td>5</td>
<td>20</td>
<td>120-240</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IV</td>
<td>2.5</td>
<td>10</td>
<td>120-240</td>
</tr>
<tr>
<td></td>
<td>Ziprasidone (Geodon)</td>
<td>IM</td>
<td>10– 20</td>
<td>10</td>
<td>240</td>
</tr>
<tr>
<td></td>
<td>Olanzapine (Zyprexa)</td>
<td>IM</td>
<td>10</td>
<td>15-30</td>
<td>24 hrs</td>
</tr>
<tr>
<td></td>
<td>Ketamine (Ketaset, Ketalar)</td>
<td>IM</td>
<td>4-5 mg/kg</td>
<td>3-5</td>
<td>60-90</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IV</td>
<td>2 mg/kg</td>
<td>1</td>
<td>20-30</td>
</tr>
</tbody>
</table>

- 21 halol 5mg IM
- 26 droperidol 5mg IM
- droperidol decreased combative ness significantly more than IM haloperidol at ten ($P = .006$), 15 ($P = .01$), and 30 ($P = .04$) minutes
The association between ketamine given for prehospital chemical restraint with intubation and hospital admission


- 49 pts with IM dose 2.2 – 9.4 mg/kg

- 14 required intubation in ED
  - 6.16 vs 4.9 mg/kg

- Trend towards higher dose associated with medical admission
**Ketamine for excited delirium**

- Limited comparison data in prehospital setting
- Rapid onset
- Large therapeutic window
- Seems to work well
- Potential for airway compromise (laryngospasm or hypoxia)
- Emergence in 10-20% (rarely alters clinical course)
What’s it gonna be?

• Physical restraints
• Ketamine 4-5 mg/kg IM
  – Midazolam 2mg IV
• Droperidol 5mg IM + Midazolam 5mg IM
• Haldol 5-10mg IM + Midazolam 5mg IM

• Monitor closely (ETCO2 especially if pt is on O2)
83 y.o. female GLF, private apartment

- Fell from commode 3 hrs ago
- Wedged between toilet and bath tub
- Exquisite left hip pain, LLE appears shortened
- HR 87, BP 185/79
Painful Extrication

• Provide analgesia and facilitate movement

  – Review 1030 trauma patients
  – 26% entrapped
  – No complications (0.5-1 mg/kg IV dose)
Etomidate in Procedural Sedation

Thomas Levins, BSN, RN, CCRN, CFRN

- Air Medical Journal, 2010
- 0.1 mg/kg
- 17 patients
  - Facilitated extrication
  - Isolated extremity splinting
- No hemodynamic complications
- 4 ETI’s, 1 unplanned
What’s it gonna be?

- Analgesia first
- Etomidate 0.1 mg/kg IV
- Ketamine 0.5-1 mg/kg IV
In-field amputation while entrapped
One step further...

• Post-intubation sedation
  – Keep oriented
  – Preserve sleep architecture

• Prevent Delirium
Early Intensive Care Sedation Predicts Long-Term Mortality in Ventilated Critically Ill Patients


- Large multicenter prospective study

- 251 intubated patients

- Deep sedation at 4 hours is a negative predictor of the time to extubation, hospital death, and 180-day mortality

- Conclusions: Early sedation depth independently predicts delayed extubation and increased mortality, making it a potential target for interventional studies.
# Monitoring Sedation

## Table 1. Richmond Agitation-Sedation Scale

<table>
<thead>
<tr>
<th>Score</th>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>+4</td>
<td>Combative</td>
<td>Overtly combative or violent; immediate danger to staff</td>
</tr>
<tr>
<td>+3</td>
<td>Very agitation</td>
<td>Pulls on or removes tube(s) or catheter(s) or has aggressive behavior toward staff</td>
</tr>
<tr>
<td>+2</td>
<td>Agitated</td>
<td>Frequent nonpurposeful movement or patient–ventilator dyssynchrony</td>
</tr>
<tr>
<td>+1</td>
<td>Restless</td>
<td>Anxious or apprehensive but movements not aggressive or vigorous</td>
</tr>
<tr>
<td>0</td>
<td>Alert and calm</td>
<td></td>
</tr>
<tr>
<td>−1</td>
<td>Drowsy</td>
<td>Not fully alert, but has sustained (more than 10 seconds) awakening, with eye contact, to voice</td>
</tr>
<tr>
<td>−2</td>
<td>Light sedation</td>
<td>Briefly (less than 10 seconds) awakens with eye contact to voice</td>
</tr>
<tr>
<td>−3</td>
<td>Moderate sedation</td>
<td>Any movement (but no eye contact) to voice</td>
</tr>
<tr>
<td>−4</td>
<td>Deep sedation</td>
<td>No response to voice, but any movement to physical stimulation</td>
</tr>
<tr>
<td>−5</td>
<td>Unarousable</td>
<td>No response to voice or physical stimulation</td>
</tr>
</tbody>
</table>
Monitoring Sedation

- Behavioral Pain Scale. Crit Care Med 2001;29(12):2258

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facial expression</td>
<td>Relaxed</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Partially tightened (e.g. brow lowering)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Fully tightened (e.g. eyelid closing)</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Grimacing</td>
<td>4</td>
</tr>
<tr>
<td>Upper limbs</td>
<td>No movement</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Partially bent</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Fully bent with finger flexion</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Permanently retracted</td>
<td>4</td>
</tr>
<tr>
<td>Compliance with ventilation</td>
<td>Tolerating movement</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Coughing with movement</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Fighting ventilator</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Unable to control ventilation</td>
<td>4</td>
</tr>
</tbody>
</table>

Reproduced from Payen et al. (2001)
Effects of the use of the Richmond Agitation Sedation Scale (RASS) on time to post-intubation sedation in the pre-hospital setting

- 165 intubated patients transported 10/1/2012 through 7/1/2013

- Average time to sedation was 12 minutes and longest time 20 minutes

- January – April average time to initial sedation was 7 minutes with longest time of 10 minutes

- May – July average time to initial sedation was 4 minutes, with longest time of 8 minutes
Average Time to Sedation

<table>
<thead>
<tr>
<th>Months</th>
<th>2012</th>
<th>2013</th>
</tr>
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<tr>
<td>Oct</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nov</td>
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<tr>
<td>Dec</td>
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<td>Jan</td>
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<td>Mar</td>
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<td>Apr</td>
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<tr>
<td>May</td>
<td></td>
<td></td>
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<tr>
<td>Jun</td>
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</table>

Minutes

Implementation Period