Procedural Sedation

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The Game Plan

- Who shouldn't get sedation
- Pros and cons of different agents
- What to do if something goes wrong
- Literature review
- Focus on Ketofol

Should I Be Doing This?

- PS&A is not for everyone!
  - Time for procedure too long/ too short
  - Unsafe prior experience
  - Nightmare airway
  - Lack of personnel
  - Unstable patients/ ASA class V
  - Which drugs are safe/ appropriate

The Perfect Drug
### The Perfect Drug
- Analgesia
- Anxiolysis
- Amnesia
- Behavioral modification
- Maintains CV and respiratory status
- Easy to dose
- Quick on/ quick off
- No adverse side effects/ allergic rxn
- Multiple routes of administration
- Safe all ages/pregnancy
- Inexpensive
- High satisfaction

### The Drugs
- Chloral Hydrate
- Nitrous Oxide
- Benzodiazepines
- Barbiturates
- Ketamine
- Etomidate
- Propofol
- Ketofol

### Attending Wisdom

**How Do We Choose??**

### Attending Wisdom

**Chloral Hydrate**
- Dose: 25-100 mg/kg PO/PR
- Onset: approximately 40 minutes
- Duration: 60 minutes (up to 24 hours)
Chloral Hydrate

Pros
- Pure sedative
- No analgesia
- Vomiting
- Disinhibition

Cons
- Lots of experience

Nitrous Oxide

Pros
- Dose: 50-66% N2O/O2
- Onset: 3-5 minutes
- Duration: 3-5 minutes

Cons
- Amnesia
- Analgesia
- Anxiolysis
- Vomiting
- Accumulates
- Increased cerebral blood flow
- Upredictable
- Abuse potential

Nitrous Oxide

Benzodiazepines

Pros
- Dose: 0.03-0.1 mg/kg IV
- Onset: 3-5 minutes
- Duration: 30-60 minutes

Cons
- Decent amnesia
- Lots of experience
- Reversal: Flumazenil
- No analgesia
- Respiratory depression
- Hypotension
- Disinhibition
And the Winner Is...

- Lorazepam (Ativan)
- Diazepam (Valium)
- Midazolam (Versed)

Midazolam (Versed)

- 3-4 times more potent than Ativan
- Meta-analysis showed increased satisfaction and amnesia
- Onset: 3-5 minutes
- Duration: 30-60 minutes
- Dose: 0.03-0.1 mg/kg

McQuaid et al, A Systematic review and MA of RCT of MS for routine endoscopic procedures GI Endoscopy 2008; 67(6)

Before...

After...

“It’s Like Drinking a 6-pack of Beer”
Barbiturates

- Dose: 1-1.5 mg/kg
- Onset: < 1 minute
- Duration: < 10 minutes

Act act GABA receptor complex

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
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<tbody>
<tr>
<td>Amnesia</td>
<td>No analgesia</td>
</tr>
<tr>
<td>Anxiolysis</td>
<td>Hypotension</td>
</tr>
<tr>
<td></td>
<td>Laryngospasm</td>
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</table>

Methohexital (Brevital)

- Onset < 1 minute
- Duration <10 minutes
- Dose 1-1.5 mg/kg
  - 3 syringe method

Ketamine

- PCP derivative
- “Vitamin K” “Special K”
- Dissociative anesthetic
- Trance-like cataleptic state
- Dissociates thalamo-neocortical and limbic areas

Ketamine

- Dose: 1-2 mg/kg IV, 4-5 mg/kg IM
- Onset: 1-3 minutes
- Duration: 10-15 minutes

Pros
- Analgesia
- Amnesia
- Maintain airway reflexes
- No pain perception

Cons
- Sympathomimetic
  - ICP, IOP, BP
- Laryngospasm
- Emesis
- Emergence reaction
  - muscle tone
  - Patient still moves
  - Hyper-salivation
Ketamine Contraindications

- Infants < 3mo
- Severe CAD
- Significant hypertension
- Increased ICP or IOP
- Psychosis
- Tracheal surgery

Too much of a good thing?

- Reports of overdoses collected
- Dosages ranged from 5x to 100x the intended dose of Ketamine
- Brief respiratory depression
- Brief assisted ventilation
- Prolonged sedation
- No adverse outcomes

Minimizing Emergence

- Recovery
  - What goes in must come out
  - Minimize stimulation
    - quiet room
    - lights dimmed
    - parent at bedside
    - benzodiazepines?

Does Adjunctive Midazolam Reduce Recovery Agitation After Ketamine Sedation for Pediatric Procedures? A Randomized, Double-Blind, Placebo-Controlled Trial

- RDB PC, N = 104, median age 6 years
- 0.05 mg/kg midazolam IV vs. placebo
- Agitation, crying, hallucinations, nightmares
- No difference in outcomes
- Not many overall events!

Ketamine With and Without Midazolam for Emergency Department Sedation in Adults: A Randomized Controlled Trial

- PDBPC 2x2 Trial, N=182
  - 0.03 mg/kg IV midazolam vs. placebo
  - Ketamine either 1.5 mg/kg IV or 4 mg/kg IM
- Agitation: 8% with vs. 25% without
- LOS not affected by midazolam
- Physician/ nurse satisfaction same
- Patient satisfaction 21% higher with midazolam
“Who’s your favorite superhero?”

Etomidate
- New induction agent in Europe 1972
- First used in the US in 1982
- Nonbarbiturate hypnotic
- Works via GABA receptors
- Highly lipophilic

Dose: 0.1-0.2 mg/kg IV
Onset: 1 minute
Duration: 5-10 minutes

Pros
- Quick on/off
- No histamine release
- Minimal CV/resp effect
- ± Amnesia
- Handy

Cons
- Myoclonus
- Nausea/vomiting
- No analgesia
- 12-24 hr inhibition of adrenal axis

Propofol: History
- England 1973
- Sedative hypnotic
- First clinical trial 1977
- High incidence of anaphylaxis
- Lipid-based emulsion 1983
- US launch 1989
**Formulation**

- 1% propofol
- 2.25% glycerol
- 10% soybean oil
- 1.2% egg phospholipid
- EDTA

**Administration**

- Mix with 1% lidocaine
- Pre-oxygenate
- Minimum 2 people
- Slow push
- Give only what is necessary

**Propofol**

- Dose: 0.5-1.0 mg/kg IV
- Onset: < 1 minute
- Duration: 3-5 minutes

**Propofol: The Science**

- Consecutive cases over 2 years (n=397)
- 1 mg/kg propofol and 0.5 mg/kg
- ↓BP 84% of patients
  - 92% resolved <2min
  - 100% resolved <7min
- ↓O2 saturation 5% of patients
  - Only 0.8% required BVM
  - 0 intubations

Bassett et al, Propofol for procedural sedation in children in the emergency department Annals of Emergency Medicine 2003; 42
Propofol: Head to Head Trials

- Randomized prospective ortho
- 51 Propofol and 52 Methohexital
- Success rate 98% P and 94% M
- RD 49% P and 48% M
- Sedation depth equal
- Pain, recall, satisfaction similar

Miner et al, RCT of Propofol versus methohexital for PS during fracture and dislocation reduction in the ED Acad Emerg Med 2003; 10(9)

Propofol vs Etomidate

- Randomized prospective NB
- 109 Propofol and 105 Etomidate
- Success rate 97.2% P and 88.6% E
- RD 42.2% P and 34.3% E
- Myoclonus 20% with Etomidate

Miner et al, RCT of Etomidate versus Propofol PS in the ED Ann Emerg Med 2007; 49(1)

Compare and Contrast

<table>
<thead>
<tr>
<th></th>
<th>Prop</th>
<th>Ket</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood pressure</td>
<td>Dec</td>
<td>Inc</td>
</tr>
<tr>
<td>Emetic</td>
<td>Anti</td>
<td>Pro</td>
</tr>
<tr>
<td>Analgesia</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Emergence reactions</td>
<td>Blunts</td>
<td>Frequent</td>
</tr>
</tbody>
</table>
Ketofol

- Multiple definitions
  - 50:50 mix at half doses
  - Pretreat with half dose ketamine
- Minimize adverse events
- Can mix in same syringe
- Common in anesthesia

Ketofol - Arguments

**Pros**
- Safe, effective
- Smoother sedation
- More stable CV
- Less propofol
- Less emergence
- Less emesis

**Cons**
- ? Fentanyl replacer
- Propofol hypotension transient
- Added agent
- Lit: Failure blinding
- Less propofol, so what?

A Prospective Evaluation of “Ketofol” (Ketamine/Propofol Combination) for Procedural Sedation and Analgesia in the Emergency Department

- Prospective case series (n=114)
- 1:1 Ratio median dose 0.75mg/kg
- Success rate 96.5%
- Hypoxia 2.6%
- Emergence reaction 2.6%
- No hypotension or vomiting
- Patient, nurse, & physician satisfaction “10”

Annals 2007
• N=136 kids; primarily ortho injuries
• Ketofol satisfaction scores much higher

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<thead>
<tr>
<th></th>
<th>Ketofol</th>
<th>Ketamine</th>
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</thead>
<tbody>
<tr>
<td>Procedural Success</td>
<td>96%</td>
<td>100%</td>
</tr>
<tr>
<td>Sedation time</td>
<td>13 min</td>
<td>16 min</td>
</tr>
<tr>
<td>Recovery time</td>
<td>10 min</td>
<td>12 min</td>
</tr>
<tr>
<td>Vomiting</td>
<td>2%</td>
<td>12%</td>
</tr>
</tbody>
</table>

• DBRCT; N=193 adults and kids
• Up front bolus of ketamine vs. placebo
• Procedural success 100%
• Increased physician and nurse satisfaction
• Less total propofol use
• Trend towards better sedation quality

• N=728; Primarily ortho procedures
• 1:1 mix in same syringe
• Procedural success in 98% of cases
• BVM 2.1%; Emergence reaction 3.6%
• Median staff satisfaction 10/10
• 97% of patients would do it again!

“I saw everything…”

Summary
• It’s kinda cool
• Strong arguments for and against
• Used commonly by anesthesiologists
• Patients seem to like it
• Definitely safe
• Don’t knock it till you try it!

Lessons Learned
• Procedural sedation is not for everyone
• There is no perfect drug
• Know the properties of your drug
• Choose based on time, patient, etc, etc
• What goes in must come out
• Ketofol is safe - try it!
• Have a good sense of humor