

# Procedural Sedation

Todd A. Parker, M.D





# Procedural Sedation

- Procedural Sedation and Analgesia (PSA) in the ED is a Core Competency of ED physicians
- Despite increased use, ED PSA still plagued by
  - **Tradition**
  - **Unchallenged dogma**
  - **Unanswered questions**
- Goals today:
  - **Brief overview of PSA**
  - **Pre-sedation evaluation**
  - **Review of the medications**
  - **Review of monitoring**
  - **Recommendations**

**My dogma  
isn't housebroken**

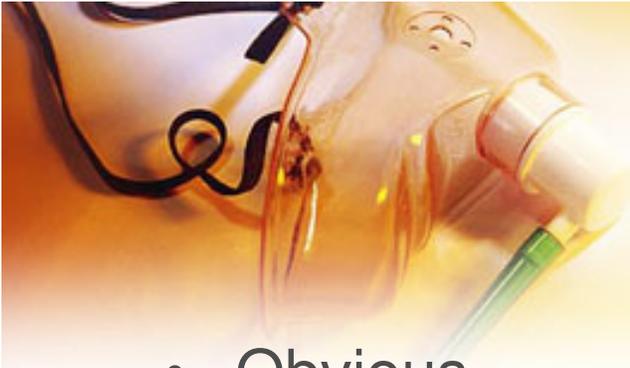




# “Conscious Sedation”

- Oxymoron – implies alert yet sedated
- Goal is rarely to be “conscious”
- Term no longer recognized
- “Procedural Sedation and Analgesia”  
– PSA





# Why Not Anesthesiology?

- Obvious
- From anesthesia literature:
  - **“Complications do occur and are higher in prospective studies than in retrospective series. This suggests a degree of underreporting. Nevertheless, clinically important complications are uncommon.”**

**“The year’s literature reflects the reality that the performance of sedation in the emergency department is advantageous. As the era of evidence-based medicine continues to provide us with more and better information, the combined efforts of both anesthesiology and emergency medicine can hopefully contribute to improving patient safety with respect to procedural sedation.”**



# Sedation Continuum

	<b>Anxiolysis/ Min Sedation</b>	<b>Moderate Sedation</b>	<b>Deep Sedation</b>	<b>General Anesthesia</b>
<b>Responsiveness</b>	Normal response to verbal stimulation	Purposeful to verbal/ light tactile stimulation	Purposeful to repeated / deep stimulation	No response to painful stimulation
<b>Airway</b>	Maintained	Maintained	May need intervention	Usually needs intervention
<b>Ventilation</b>	Normal	Adequate	May need assistance	Usually needs assistance
<b>Cardio-vascular Function</b>	Normal	Maintained	Usually Maintained	May be impaired

A close-up photograph of medical equipment, including a clear plastic drip chamber and a green-tipped syringe, set against a warm, yellowish background.

# Joint Commission

- 2004 Guidance
- Qualitative measures
  - Alleviate anxiety
  - Minimize physical pain/discomfort
  - Maximize anesthesia
  - Control behavior to expedite procedure
  - Minimize negative psychological responses to tx
  - Minimize safety risks to ensure safe discharge
- Thanks!



## Goals of PSA

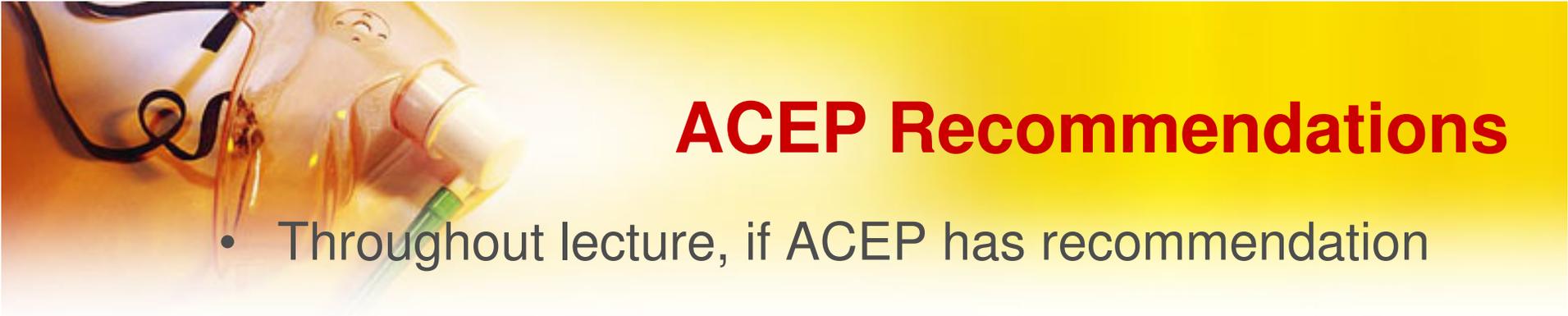
- Define the level, and time, of sedation required
- Obtain the necessary equipment and medications
- ***Qualifications of sedation provider most important***
  - Must understand characteristics of medications
  - Must be able to monitor patients and maintain desired sedation level
  - Must be able to manage complications
    - Hemodynamic instability
    - Respiratory depression and airway compromise

A close-up photograph of medical equipment, including a clear plastic drip chamber and a green-tipped syringe, set against a warm, yellowish background.

## Who is Needed?

- No clear evidence!
  - Depends on complexity
- Ideally separate providers performing procedure and sedation
- If EP performing procedure
  - Qualified, trained support person
- For very low doses, may be EP only
  - Must maintain visual or verbal communication





# ACEP Recommendations

- Throughout lecture, if ACEP has recommendation
- Strength of Evidence – Classes
  - Class I – Interventional Trials, prospective studies
  - Class II – Observational, retrospective, case-controlled studies
  - Class III – Observational reports, Case series, etc
- Level of Recommendations
  - Level A: Generally accepted principles based on Class I or overwhelming Class II evidence
  - Level B: Recommendations with moderate clinical certainty based on Class II or strong Class III evidence
  - Level C: Other strategies based on inconclusive/conflicting evidence, required panel consensus



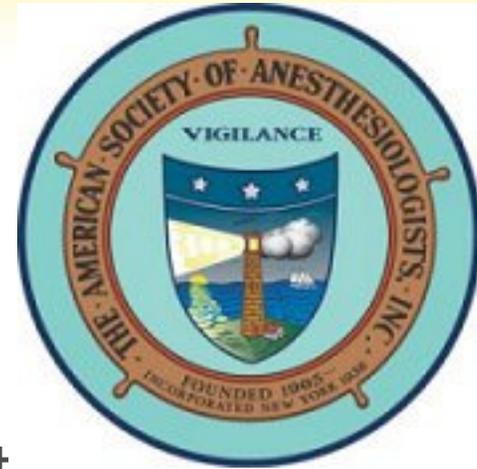
## ACEP Recommendations

- During moderate and deep sedation, a qualified support person should continuously monitor pt
- Sedation should be supervised by EP or another trained, credentialed provider
- Skill set should include management of complications from next highest sedation level
- Level **C** Recommendation
  - No Level A/B recommendations

A close-up photograph of medical equipment, including a clear plastic drip chamber and a syringe with a green plunger, set against a warm, yellowish background.

# Pre-sedation Assessment

- Who should we sedate?
  - ASA I and II – ED
  - ASA III? Depends
  - ASA IV and V – no way
- ASA I – Normal healthy patient
- ASA II – Mild systemic disease
- ASA III – Severe systemic disease
- ASA IV – Severe disease / constant life threat
- ASA V – Moribund, not expected to survive





# Patient Assessment

- Clinical exam is sufficient
  - No literature to support pre-sedation diagnostics
- Identify
  - Medical illnesses / comorbidities
  - Abnormal physical exam findings
  - Medications and allergies
  - Anatomic features affecting
    - Ability to provide PSA
    - Airway management
- Level C Recommendation (no level A or B)



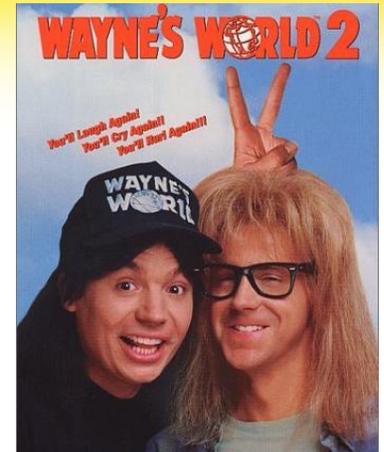
## Consent?

- No literature that it
  - Alters patient satisfaction
  - Alters clinical outcomes
- Do it if you can!
  - Bring the patient into the discussion
  - Implied consent if:
    - Severe anxiety / pain
    - Combativeness
    - Altered mental status



# Fasting

- Risk of aspiration is always a concern
- Must have fasted for six hours
  - **Not!**
- Most data extrapolated from General Anesthesia
  - Most aspiration risk during airway manipulation
- Extent of injury directly related to acidity and volume
  - 0.8ml/kg minimum required





## Challenges to this Dogma

- Silent aspiration occurs in normal sleep
- Fasting > 2 hours – no change in volume or pH
- ASA recommendations
  - 2 hours for clear liquids
  - 6 hours for solids
- Risk of aspiration during **general anesthesia**
  - Multiple pooled studies
  - Aspiration: 1:3420
  - Aspiration mortality: 1:125,109!



## Case Report

- First reported case of aspiration pneumonitis during sedation – Annals 2007
  - 65 yo f with ankle fracture, PMHx only for HTN
  - Sedated 2x in 60 minutes for reduction/revision
  - Large meal with several glasses of wine 6hrs earlier
  - First sedation
    - 100mcg fentanyl and 120mg propofol titrated
    - Vitals remained normal
  - Second sedation
    - 100mcg fentanyl and 60mg propofol
  - Pt vomited, aspirated, required intubation



## Case Report

- Recovered uneventfully
- Post intubation Blood EtOH 74 (0.074)
- EP not present after meds initially administered
  - Orthopedic surgeon and trained nurse

Cheung, K; Watson, M: et al. Aspiration pneumonitis requiring intubation after procedural sedation and analgesia: A case report. *Annals of Emergency Medicine*; Vol 49 Issue 4, Apr 2007.



## GA vs. PSA

- Relative risk likely much lower during PSA
- Most aspirations occur during airway manipulation
- Depth of sedation – goal to maintain airway reflexes
- No inhalational agents (more emetogenic)
- Patients tend to be younger and healthier
  - ASA I and II
  - Majority of GSA patients are ASA III-V



Green, SM. Pulmonary aspiration risk during emergency department procedural sedation – an examination of the role of fasting and sedation depth. Acad Emerg Med 2002:9

# Pre-PSA Fasting



Agrawal D. et al. Preprocedural fasting state and adverse events in children undergoing procedural sedation and analgesia in a pediatric emergency dept. *Ann Emer Med* 2003:42

- 1014 children undergoing PSA in ED
- 56% did not meet recommended fasting criteria
- Adverse events in 68 of 1014 (6.7%)
  - O2 desats <90% or transient apnea
  - Emesis (median fasting time 6.8 hrs solids/5.8 hrs clears)
  - Hypotension
  - Emergence reaction
  - Laryngospasm
- All events treated successfully
- **No difference in rate of events between groups**
- **No aspirations**



## **ACEP Recommendations**

- Recent food intake is not a contraindication to PSA
- Food intake should be weighed against urgency of PSA
  - Emergent reduction of fx/dislocation vs. abscess I&D
- Level C Recommendation (no Level A or B)

# ACEP Recommendations

- What about kids?
- 2007 ACEP consensus statement
- Reviewed 8 studies evaluating fasting vs. nonfasting pts in PSA and adverse events
- Total of 4814 encounters
  - Two cases of questionable aspiration
  - No cases of aspiration pneumonitis
  - Both patients met NPO guidelines
- Recommendation: Procedural sedation may be safely administered to pediatric pts in the ED with recent oral intake
- Level **B** (no Level A or C recommendations)



# Aspiration (of a different kind)



One day, he hoped to hit the big time.



# Medications

- Analgesics
  - Fentanyl (also non-dissociative sedation)
  - Morphine
- Sedatives
  - Versed (no analgesic properties)
  - Ketamine (dissociative)
  - Etomidate (sedative-hypnotic)
  - Propofol (sedative-hypnotic)

# Fentanyl

- Narcotic of choice during PSA
- Rapid onset, short duration of action
- No histamine release
- Few CV side effects
  - Rarely causes hypoxemia, apnea, vomiting, pruritis
- No amnestic effects
  - Should not be used as solo agent
- Dose: 0.5 to 1 mcg/kg IV
  - Halve dose in elderly
  - Do not give IM or PO for PSA



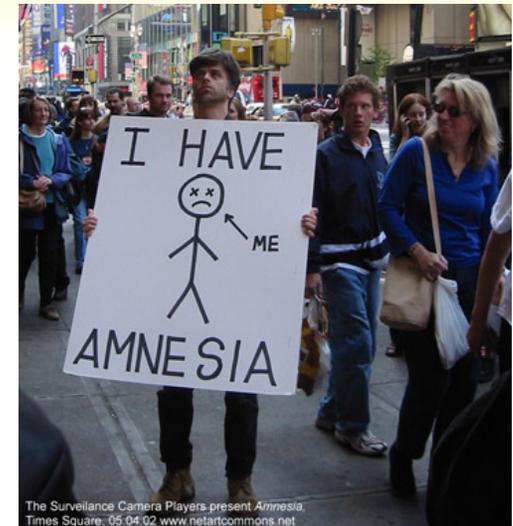


# Morphine

- More histamine release than fentanyl
- Emetogenic
- May result in hypotension
- Dose 0.1mg/kg IV
- Longer onset but longer acting
  - May be a good choice for longer procedures

# Midazolam (Versed)

- Amnestic and anxiolytic properties
- Compared to Ativan and Valium
  - More rapid onset
  - Superior amnestic properties
- IV preferred – IM/PO erratic absorption
  - Dose 0.03 to 0.1 mg/kg
  - Onset 2-5 minutes
  - Duration 30-60 minutes





## Versed

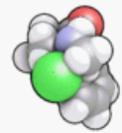
- Concomitant opioids increase risk of respiratory depression
- Two largest studies using midazolam
  - No resp depression with midazolam alone
  - 50% of those receiving midazolam and morphine had transient O<sub>2</sub> sats below 90% or transient apnea
    - 10% with fentanyl
  - All responded to stimulation or minimal BVM

Burton, J. Etomidate and midazolam for reduction of ant shoulder dislocation. *Ann Emerg Med* 2002:40  
Bailey, P. Hypoxemia and apnea after sedation with midazolam and fentanyl. *Anesthesiology*. 1990:73

- Recommendation: If using versed and opioids
  - Give opioid first
  - Use fentanyl

# Ketamine

- Phencyclidine derivative
  - NMDA Receptor antagonist
  - Also binds opioid  $\mu$  receptors at higher doses
- Dissociation between thalamoneocortical and limbic systems
  - Prevents higher centers from perceiving
    - Visual and auditory stimulation
    - Pain
  - Muscle tone (thus airway reflexes) maintained
  - Eyes open – nystagmus





## **Ketamine - Advantages**

- Airway and respirations maintained
- Analgesia in addition to sedation
- Cardiac stability
  - Hypertension and tachycardia
  - Good for sepsis
- Amnestic agent



## Ketamine – Side Effects

- Hypertension and tachycardia
- Vomiting
  - Vast majority after patient awake and oriented
- Emergence reaction
  - Hallucinations / nightmares
  - Rarely in kids (esp <5 yo)
  - Can be blunted by low dose benzos (0.05 mg/kg versed)
- Hypersalivation – can be blunted
  - Atropine 0.02 mg/kg
  - Glycopyrrolate (Robinul) 0.2 mg





## Ketamine - Dose and Use

- Dose:
  - 1-2 mg/kg IV, redose 0.25-0.5 mg/kg if needed
  - 4-5 mg/kg IM, redose 1 mg/kg if needed
- Redosing: Judge on arousal and movement
- Contraindications
  - Infants < 3 months
  - History of psychosis
  - Airway abnormalities
  - Severe CV disease
  - Any process with possible elevated ICP
  - Thyroid disease
  - Active respiratory disease\*



# ACEP Recommendations

- Fentanyl and Versed can be safely administered and are effective for procedural sedation in the ED
  - Level **B** Recommendation
- Ketamine can be safely administered to children for procedural sedation and analgesia in the ED
  - Level **A** recommendation
- More later





# Etomidate

- Sedative/Hypnotic
- Rapid onset / Short duration of action
- Anesthetic and amnestic properties
  - No analgesic properties
- Dose 0.1-0.2 mg/kg IV
  - Onset within one minute
  - Redose as necessary 0.05 mg/kg



# Etomidate – Safety Profile

- Minimal cardiovascular effects
  - Four trials, 243 pts
  - One episode of transient hypotension
    - Responded to IV fluids
- Minimal respiratory depression
  - One clinically significant case – intubation
  - > 75 yo male, dose 0.33mg/kg
- Nausea and vomiting slightly more common
- Myoclonus
  - 0% to 21% rate
  - Brief (usually 1 min or less) but may be dramatic
  - Often associated with respiratory depression
- Adrenal Suppression
  - Likely not an issue for ED PSA – enough said!



# Propofol

- Non-opioid, non-barbiturate, sedative-hypnotic
  - No analgesic properties
- Rapid onset, short duration of action
- Predictable efficacy, especially for deep sedation
  - Criticism! Concern for ease of General Anesthesia
  - Easy to overshoot
- Dose: 1-1.5 mg/kg initially
  - 0.5 mg/kg redose as necessary



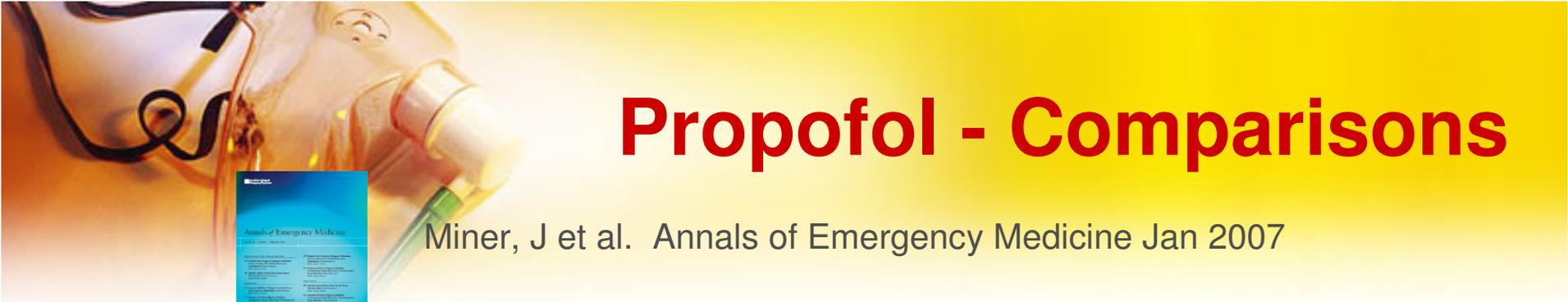
# Propofol – Safety Profile

- Hypotension
  - Less so in sedation doses
- Transient apnea
- Rare:
  - Nausea/vomiting
  - Myoclonus
- Localized pain at injection site
  - Mitigated with lidocaine



# Propofol - Comparisons

- Fastest recovery time (all agents)
- Vs Midazolam/Fentanyl
  - Kohl et al: Pooled data from four studies
  - Mean difference in recovery 25.3 minutes
    - 12.3 mins vs. 37.6 mins post-procedure
    - 2 PSA/day = 292 hours/year
  - No difference in safety profile
    - One intubation with propofol
    - Attributed to iatrogenic narcotics prior to PSA
  - Cost savings
    - \$17.33 per sedation direct costs
    - \$597 per sedation incremental costs!

A background image showing medical equipment, including a ventilator and a syringe, with a yellow gradient overlay.

# Propofol - Comparisons

Miner, J et al. Annals of Emergency Medicine Jan 2007

- Propofol vs. Etomidate
  - 214 patients randomized to two groups
  - Desat < 92% 9.1 (P) vs. 9.5% (E)
  - BVM 4.6% vs. 3.8%
  - Stimulation 11.9% vs. 11.4%
  - Decrease in systolic BP 7.9% vs. 3.8%
  - Myoclonus 1.8% vs. 20.0%
  - Mean recovery 6.8 vs. 8.8 minutes post-procedure
  - Successful procedure 97.2% vs. 89.5%

# ACEP Recommendations

- Propofol can be safely administered for PSA in the ED. Should be titrated to clinical effect to maximize safety.
  - Level **B** recommendation
- Etomidate can be safely administered for PSA in the ED
  - Level **C** recommendation





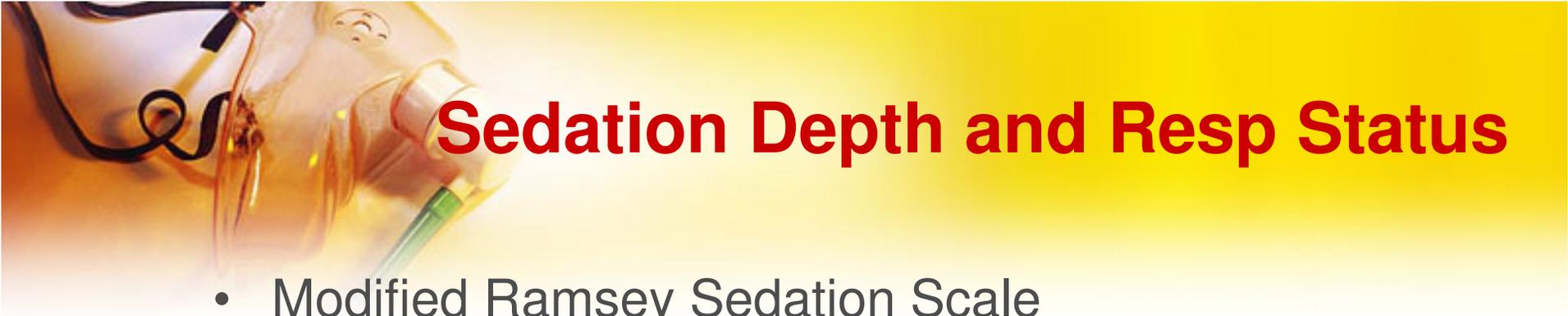
# Equipment

- What should be on hand?
  - Oxygen
  - Suction
  - BVM / Intubation
  - IV access
    - Optional if ketamine being used
  - Reversal agents
    - Narcan and flumazenil if appropriate



## Monitoring

- **JC and NMCP:**
  - Monitor pts continuously objectively and clinically
  - No mandated requirement for sedation depth
    - Modified Ramsey scale most utilized
- **ACEP Recommendations**
  - Obtain and document vital signs before, during, and after PSA.
  - Monitor the patient's appearance and ability to respond to verbal stimuli during and after PSA
  - Level **C** Recommendation (no Level A or B)



# Sedation Depth and Resp Status

- Modified Ramsey Sedation Scale
  1. Anxious, agitated, restless
  2. Cooperative, oriented, tranquil
  3. Responds to commands only
  4. Responds to gently shaking
  5. Responds to noxious stimuli
  6. No response to noxious stimuli



Miner, et al EtCO<sub>2</sub> monitoring during Procedural Sedation. 9: 2002

- Compared sedation scale and EtCO<sub>2</sub> as predictors of resp depression
  - No correlation between sedation scale and EtCO<sub>2</sub>
  - EtCO<sub>2</sub> monitoring (increase of 10 or EtCO<sub>2</sub>>50) predicted all cases of resp depression

# Sedation Depth and Resp Status



Miner, et al Bispectral electroencephalographic analysis of patients undergoing procedural sedation in the ED. 10: 2003

- Compared BIS score / resp depression / pt recall
  - BIS Score between 70-85 optimal depth, no increased risk of resp depression
  - < 70 Resp depression
  - >85 Sub-optimal sedation
  - Several smaller studies with similar results



## Pulse Oximetry?

- Makes sense, right?
- But no studies demonstrating decreased pulse ox alone correlated with bad outcome
  - If level of consciousness and resp efforts can be monitored
  - Pulse ox may remain normal well after resp depression
- Pulse ox – no substitute for clinical judgment
  - Use as reliable adjunct
- **ACEP Recommendation**
  - Pulse ox should be used in patients at increased risk of developing hypoxemia, i.e. high doses or multiple drugs, or in pts with significant comorbidities
  - Level **B** recommendation



# Sedation Depth and Resp Status

- Capnography (EtCO<sub>2</sub> monitoring)
  - Miner studies clearly demonstrated EtCO<sub>2</sub> better predictor of resp depression than clinical eval
  - Defined as EtCO<sub>2</sub> >50, increase >10, or SpO<sub>2</sub> <90
  - Resp depression ≠ desaturation <90%!



Burton et al Does EtCO<sub>2</sub> monitoring detect respiratory events prior to current sedation monitoring practices? 13:2006

- Resp Depression detected in 20/60 patients
- Capnography changes occurred 12 to 271 seconds prior to change in O<sub>2</sub> sats in 14/20
  - Change by 10, <30, or >50



# Significance of EtCO<sub>2</sub> Values

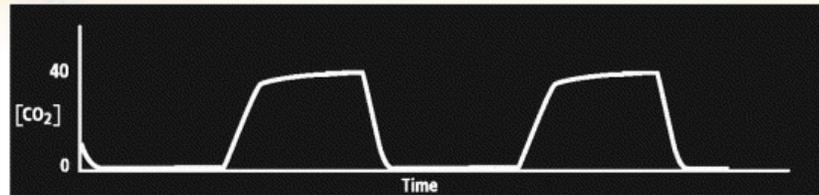
- Physiology
  - Change in 10, > 50 obvious
  - But <30? What about the other 6?
  - Bradypneic vs. Hypopneic hypoventilation
    - Bradypneic: RR slow more than TV increases (Opioids)
    - Hypopneic: TV decreases more than RR slows (Sedatives)

Hypoventilation Type	Resp Rate	Tidal Volume	Tidal Vol/ Dead Space	EtCO <sub>2</sub>	PaCO <sub>2</sub>
Bradypneic	↓↓↓	↓	Slight ↓	↑	↑
Hypopneic	↓	↓↓↓	↑↑↑	↓ to no change	↑

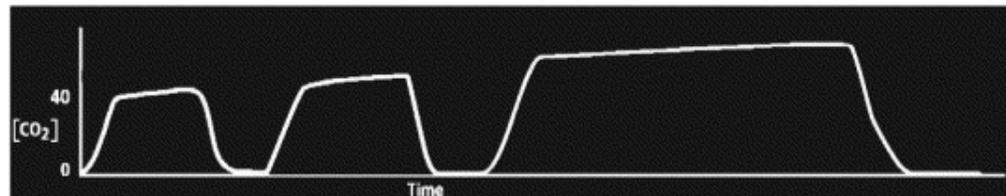
- Therefore, Hypopneic hypoventilation results in decreased or unchanged EtCO<sub>2</sub> but increased PaCO<sub>2</sub>

# Significance of EtCO<sub>2</sub> Values

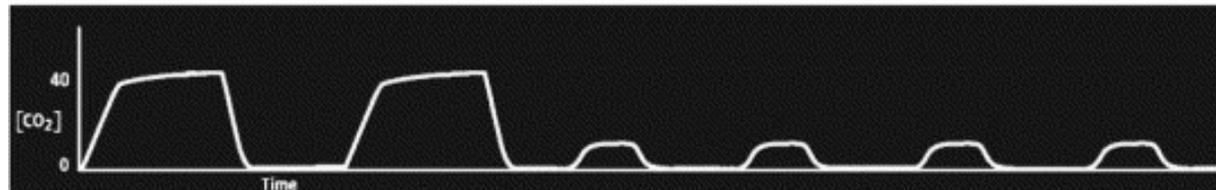
- Normal capnography



- Bradypneic Hypoventilation



- Hypopneic Hypoventilation



- Waveform just as important as value!
  - Recognizing waveform change may provide warning



## EtCO<sub>2</sub>

- Best predictor of respiratory depression
- Much quicker recognition than pulse ox
- Changes in EtCO<sub>2</sub> may not correlate with changes in pulse ox
- Clinical significance (morbidity/mortality) uncertain
- ACEP Recommendation:
  - Consider capnometry to provide additional information regarding early identification of hypoventilation
  - Level **C** Recommendation



## What About Supplemental O<sub>2</sub>?

- Goal to increase oxygen reserves / delay desaturation
- Superoxygenated pts desat only after prolonged apnea
- Minimizes pulse ox as warning for resp distress
  - ED physicians rarely recognize resp depression in absence of desaturation



## Supplemental O2 – 2 studies

- Deitch et al: Two prospective studies
  - 2007: Supp O2 in PSA with versed/fentanyl
    - **2L** O2 by NC
    - No clinically significant difference (14% vs. 13%)
    - Median Ramsey score 4
  - 2008: Supp O2 in PSA with propofol
    - **3L** O2 by NC
    - Reduced desaturation from 28 to 18%
    - Median Ramsey Score 5
    - First study to show trend toward benefit
- Interesting
  - Clinical significance remains uncertain
  - More studies needed (High flow O2, NRB)



## Let's summarize with some recommendations:

- Provider
  - Ideally separate sedation and procedure physician
  - Simpler procedures – trained assistant
    - Single provider doing sedation, monitoring, procedure not recommended!
- Patient selection
  - ASA I and II preferred
  - ASA III – maybe
  - ASA IV or V – anesthesia
  - Perform adequate pre-sedation history and physical



## Recommendations:

- Pre-PSA Fasting
  - Recent food intake likely not a barrier
    - One reported case!
  - Weigh risk vs. urgency
    - Involve parents in decision
- Analgesia
  - Fentanyl drug of choice
  - Morphine – may be better for longer procedures



## Recommendations:

- Sedation

- Versed (with fentanyl)

- Safe profile
- Slightly lower success rate
- Much longer recovery time

- Ketamine

- Safe, mild side effect profile
- Rapid onset and recovery
- Analgesic properties
- Higher schedule
- Emergence Reaction
  - May be blunted with low dose versed



## Recommendations:

- Sedation

- Etomidate

- Excellent CV and respiratory profile
- Rapid onset and recovery
- Excellent success rate
- Myoclonus may be a concerning side effect
- Adrenal suppression? Likely insignificant

- Propofol

- Rapid onset and recovery
- Good side effect profile
  - Slightly higher risk of hypotension
- Most time saving and cost effective option
- Very high success rate



## Recommendations:

- Equipment
  - Have monitoring, O<sub>2</sub>, suction, airway, and reversal agents handy
- Monitoring
  - Pulse Ox
  - Capnography likely beneficial
  - Supplemental O<sub>2</sub> of undetermined benefit
  - BIS of undetermined benefit



## Slightly OT: Oral Sucrose

- **Level A Recommendations**
  - Oral sucrose can be used to reduce distress due to minor painful procedures in neonates (<28 days old)
- **Level B Recommendations**
  - Effective dose 2 ml of 24% or 50% sucrose
  - Better effectiveness with pacifier
  - Safe for full term neonates and infants
- **Level C Recommendations**
  - Less effective in infants between 1-6 months
  - Higher effective doses in these infants (up to 2ml 75% sucrose)
  - Should be given 2 minutes prior to procedure
  - Safe to give to low birth weight preterm neonates

# QUESTIONS?

