Pain & Sedation Management in PICU

Marut Chantra, M.D.


Pediatric
Pediatric
Pediatric

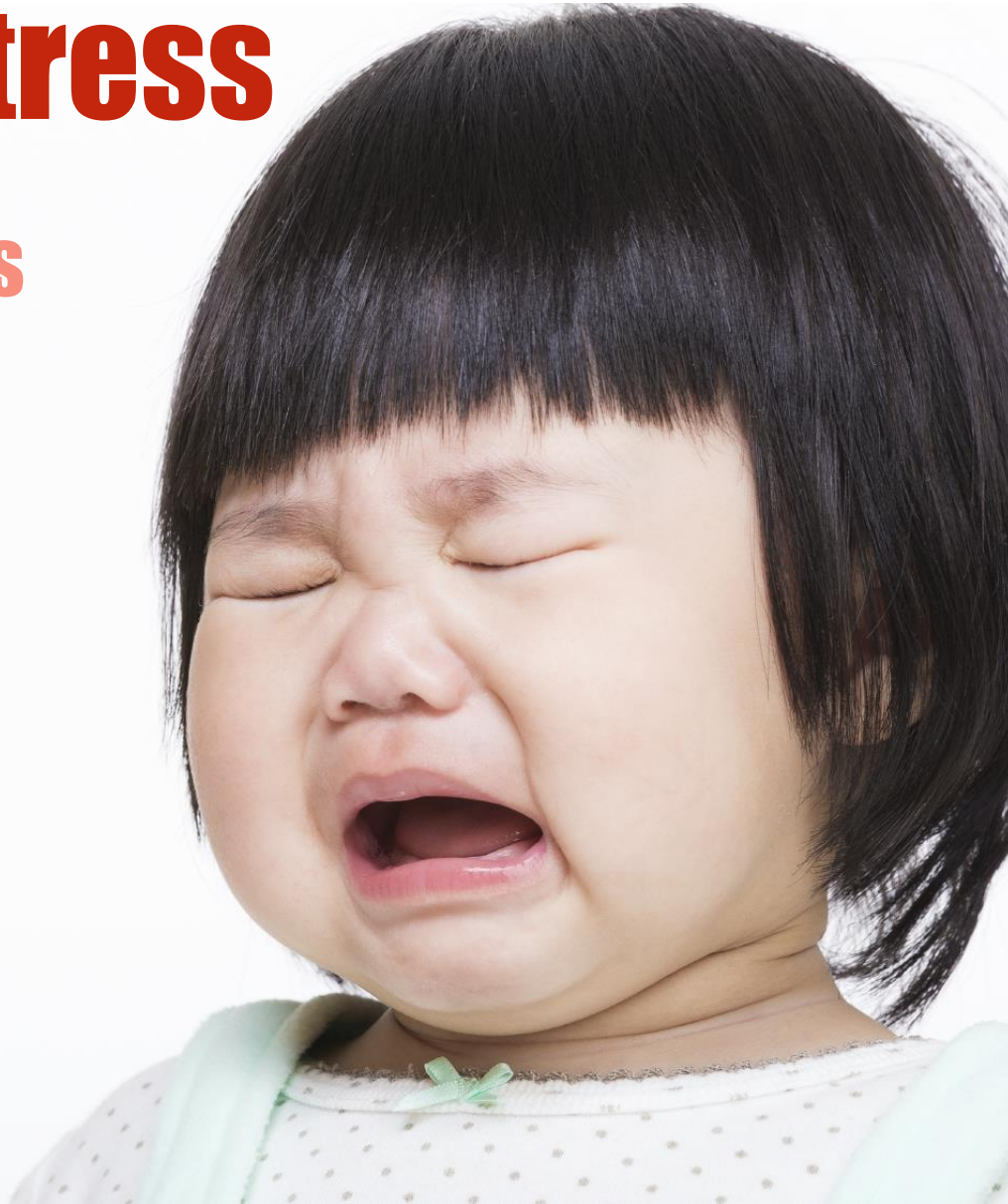
Pain

Diseases
Trauma
Procedures

Rogers' Textbook of Pediatric Intensive Care, 5th ed, 2015

Emotional Distress

Separation from parents
Unfamiliar people
Sleep fragmentation
Fear of pain
Loss of control



Rogers' Textbook of Pediatric Intensive Care, 5th ed, 2015

Goals of Pain & Sedation Management

To provide a child with anxiolysis & comfort
Maintain safety
Promoting sleep
Preventing delirium

Rogers' Textbook of Pediatric Intensive Care, 5th ed, 2015

Patient-ventilator synchrony
Prevent unplanned extubation

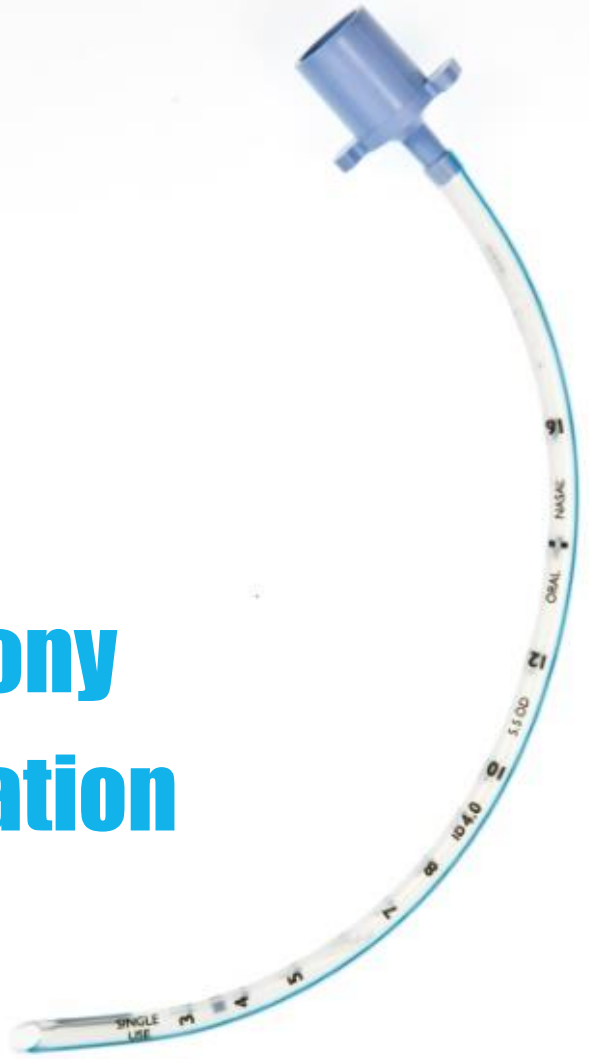


Table 3. The meta-analysis results of nine risk factors of VAP.

Risk factors	Combined researches	VAP group	Without VAP group	Heterogeneity chi-squared		Models of meta-analysis	Pooled OR (95% CI)	Z	P
				P	I^2 (%)				
Sex	6	125	1,448	0.87	0	Fixed effect model	0.98 (0.67-1.43)	0.10	0.92
Age	4	122	3,910	0.0001	85	Random effect model	−10.55 (−37.40-16.29)	0.77	0.44
Lung disease	3	85	1,270	0.38	0	Fixed effect model	1.46 (0.80-2.66)	1.24	0.21
Genetic syndrome	3	59	960	0.52	0	Fixed effect model	2.04 (1.08-3.86)	2.20	0.03
Reintubation or self-extubation	4	123	1,337	0.19	36	Fixed effect model	3.16 (2.10-4.74)	5.54	<0.00001
Tracheostomy	3	109	3,823	0.05	67	Random effect mode	2.07 (0.76-5.64)	1.42	0.16
Transfusion	3	56	886	0.06	65	Random effect mode	1.93 (0.62-5.95)	1.14	0.25
Steroids	3	59	960	0.39	0	Fixed effect model	1.87 (1.07-3.27)	2.18	0.03
H_2 blockers or proton pump inhibitor	4	83	1,310	0.03	67	Random effect mode	0.11 (−0.06-0.29)	1.26	0.21
Bloodstream infection	2	47	846	0.17	48	Fixed effect model	4.42 (2.12-9.22)	3.96	<0.0001
Prior antibiotic therapy	2	48	438	0.83	0	Fixed effect model	2.89 (1.41-5.94)	2.89	0.004
Bronchoscopy	2	67	919	0.78	0	Fixed effect model	4.48 (2.31-8.71)	4.43	<0.00001
Cuffed endotracheal tube	2	29	365	0.13	56	Random effect mode	0.73 (0.16-3.39)	0.40	0.69
Transport out of the PICU	2	29	365	0.70	0	Fixed effect model	2.10 (0.94-4.71)	1.80	0.07

Liu B, et a. Journal of Thoracic disease. 2013

TABLE 1. Bivariate Analysis of Risk Factors Associated With Ventilator-Associated Pneumonia

Risk Factors		n	VAP (n = 108)	No VAP (n = 1,974)	p
Immunosuppressed (%)	Yes	163	14 (8.59)	149 (91.41)	0.0622
	No	1,919	94 (4.90)	1,825 (95.10)	
Bone marrow transplant within 90 d (%)	Yes	35	7 (20.00)	28 (80.00)	0.0017
	Off	2,047	101 (4.93)	1,946 (95.07)	
Replaced endotracheal tube (%)	Yes	325	31 (9.54)	294 (90.46)	0.0001
	No	1,757	77 (4.38)	1,680 (95.62)	
Flexible bronchoscopy (%)	Yes	139	17 (12.23)	122 (87.77)	0.0006
	No	1,943	91 (4.68)	1,852 (95.32)	
High-frequency oscillatory ventilation (%)	Yes	99	15 (15.15)	84 (84.85)	0.0001
	No	1,983	93 (4.69)	1,890 (95.31)	
Part-time ventilation (%)	Yes	156	14 (8.97)	142 (91.03)	0.0368
	No	1,926	94 (4.88)	1,832 (95.12)	
Tracheal intubation type (%)					
Oral	Yes	1,452	79 (5.44)	1,373 (94.56)	0.4286
	No	630	29 (4.60)	601 (95.40)	

Gupta S, et al. Pediatric Critical Care Medicine. 2015


Pain
is a subjective experience

Spagrud LJ, et al. Am J Nurs. 2003

Pain Assessment

Self-report measures

- Visual analogue scale
- Six-Face Pain Scale

Physiologic responses to nociceptive stimulus

- Observational Pain Scale

Behavioral observation

- Facial expression
- Body movements
- Quality of crying

Too much sedation

- Hemodynamic instability
- Delayed ventilator weaning
- Rapid development of tolerance
- Sleep disturbance
- Delirium

Insufficient sedation

- Self-extubation
- Patient-ventilator asynchrony

Silva C, et al. Rev Bras Ter Intensiva. 2013
Rogers' Textbook of Pediatric Intensive Care, 5th ed, 2015

State Behavioral Scale

>−3	Unresponsive	No spontaneous respiratory effort No cough, or coughs only with suctioning No response to noxious stimuli Unable to pay attention to care provider Does not distress with any procedure (including noxious) Does not move
−2	Responsive only to noxious stimuli[a]	Spontaneous yet supported breathing Coughs with suctioning/repositioning Responds to noxious stimuli Unable to pay attention to care provider Will distress with a noxious procedure Does not move/occasional movement of limbs or shifting of position
−1	Responsive to touch or name	Spontaneous but ineffective nonsupported breaths Coughs with suctioning/repositioning Responds to touch/voice Able to pay attention but drifts off after stimulation Distresses with procedures Able to calm with comforting touch or voice when stimulus is removed Occasional movement of limbs or shifting of position
0	Calm and cooperative	Spontaneous and effective breathing Coughs when repositioned/occasional spontaneous cough Responds to voice/no external stimulus is required to elicit response Spontaneously pays attention to care provider Distresses with procedures Able to calm with comforting touch or voice when stimulus is removed Occasional movement of limbs or shifting of position/increased movement (restless, squirming)
+1	Restless and cooperative	Spontaneous effective breathing/having difficulty breathing with ventilator Occasional spontaneous cough Responds to voice/no external stimulus is required to elicit response Drifts off/spontaneously pays attention to care provider Intermittently unsafe Does not consistently calm, despite 5-min attempt/unable to console Increased movement (restless, squirming)
+2	Agitated	May have difficulty breathing with ventilator Coughing spontaneously No external stimulus required to elicit response Spontaneously pays attention to care provider Unsafe (biting endotracheal tube, pulling at catheters, cannot be left alone) Unable to console Increased movement (restless, squirming, or thrashing side-to-side, kicking legs)

[a]Noxious stimuli, endotracheal tube suctioning, or 5 s of nail bed pressure. From Curley MA, Harris SK, Fraser KA, et al. State Behavioral Scale: A sedation assessment instrument for infants and young children supported on mechanical ventilation. *Pediatr Crit Care Med* 2006;7:107–14, with permission.

Curly MA, et al. Pediatr Crit Care Med. 2006

COMFORT SCALE

COMFORT SCALE

ALERTNESS		CALMNESS/AGITATION		RESPIRATORY RESPONSE		PHYSICAL MOVEMENT	
Deeply asleep	1	Calm	1	No coughing and no spontaneous respiration	1	No spontaneous movement	1
Lightly asleep	2	Slightly anxious	2	Spontaneous respiration minimal response to vent	2	Occasional slight movement	2
Drowsy	3	Anxious	3	Occasional cough or resistance to vent	3	Frequent, slight movement	3
Fully awake and alert	4	Very anxious	4	Actively breathes against vent or coughs regularly	4	Vigorous movement, extremities only	4
Hyper-alert	5	Panicky	5	Fights vent, coughing, or choking	5	Vigorous movement, including torso and head	5

MEAN ARTERIAL BLOOD PRESSURE		HEART RATE		MUSCLE TONE		FACIAL TENSION	
Any observation LO	1	Any observation LO	1	Totally relaxed, no tone	1	Facial muscles totally relaxed	1
All six observations within baseline range	2	All six observations within baseline range	2	Reduced tone	2	Facial muscle tone normal, no tension evident	2
One to three of six observations HI	3	One to three of six observations HI	3	Normal tone	3	Tension evident in some facial muscles	3
Four to five of six observations HI	4	Four to five of six observations HI	4	Increased tone with flexion of fingers and toes	4	Tension evident throughout facial muscles	4
All six observations HI	5	All six observations HI	5	Extreme rigidity and flexion of fingers and toes	5	Facial muscles contorted and grimacing	5

Review the medical record for heart rate and blood pressure data recorded over the 24-h period prior to initial COMFORT score determination. Using the following data and equations, calculate the baseline range limits (e.g., HI, LO), and record where appropriate.

Heart Rate:

1. Range of Normal Values

Age (y)	Rate (beats/min)
0–1	120–180
>1–2	100–130
>2–4	90–120
>4–8	80–110
>8	70–100

2. Study Limit Calculations

Observed baseline heart rate = lowest heart rate within the range of normal values charted over the 24-h period preceding observation #1 = _____

LO limit heart rate = Observed baseline − (Observed baseline × 0.15) = _____

HI limit heart rate = Observed baseline + (Observed baseline × 0.15) = _____

Mean arterial pressure (MAP):

1. Range of Normal Values

Age (y)	Pressure (mm Hg)
0–1	47–82
>1–5	60–90
>5–7	60–93
>7–10	67–100
>10–12	68–102
>12–14	72–107

2. Study Limit Calculations

Observed Baseline MAP = lowest MAP within the range of normal values charted over the 24-h period preceding observation #1 = _____

LO limit MAP = Observed baseline − (Observed baseline × 0.15) = _____

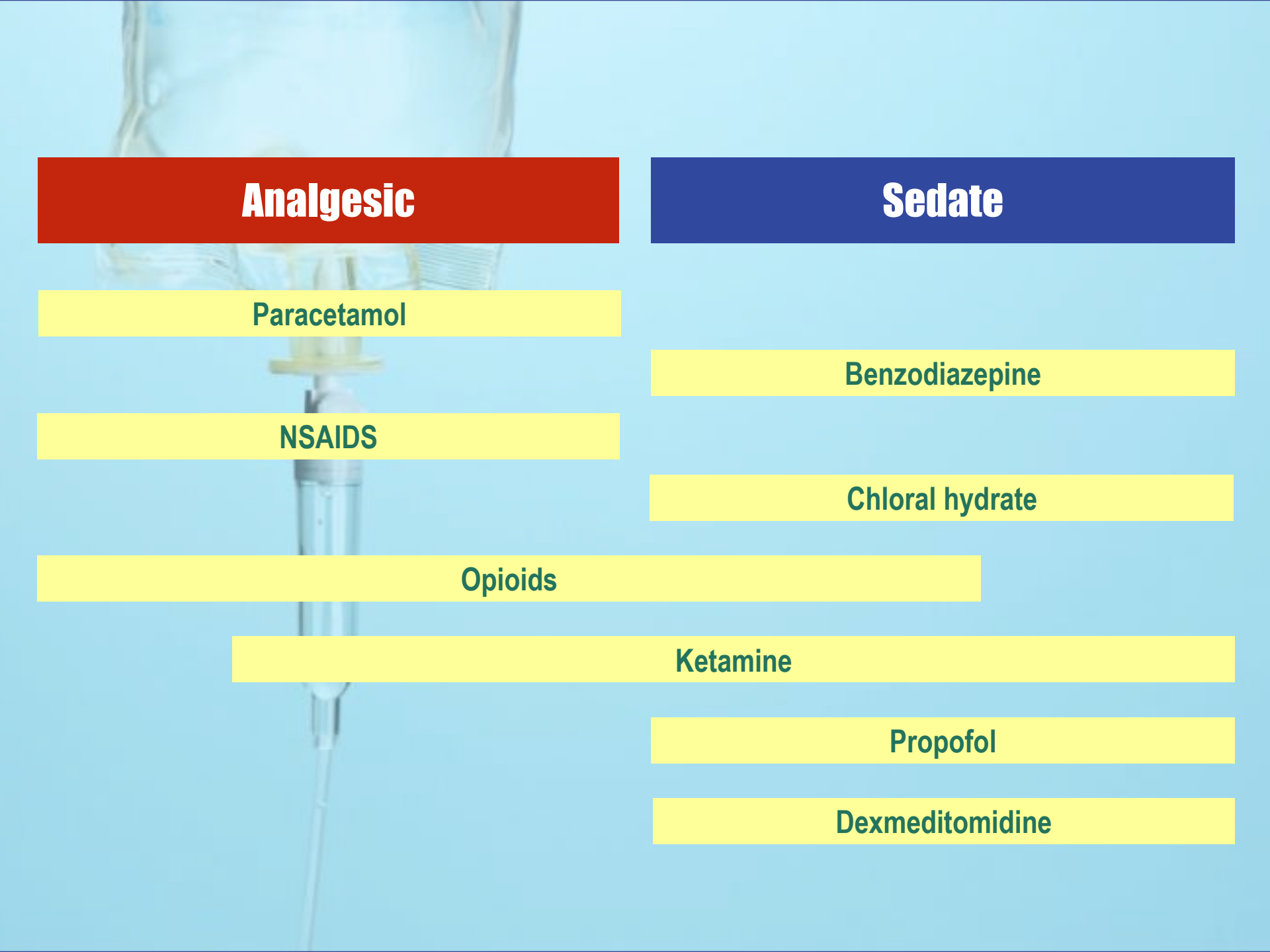
HI limit MAP = Observed baseline + (Observed baseline × 0.15) = _____

Adapted from Ambuel B, Hamlett KW, Marx CM, et al. Assessing distress in pediatric intensive care environments: The COMFORT scale. *J Pediatr Psychol* 1992;17:95–109.

Ambuel B, J Pediatr Psychol. 1992

Bispectral Index (BIS)

www.wikipedia


Analgesic
Sedate
Paracetamol
Benzodiazepine
NSAIDS
Chloral hydrate
Opioids
Ketamine
Propofol
Dexmeditomidine

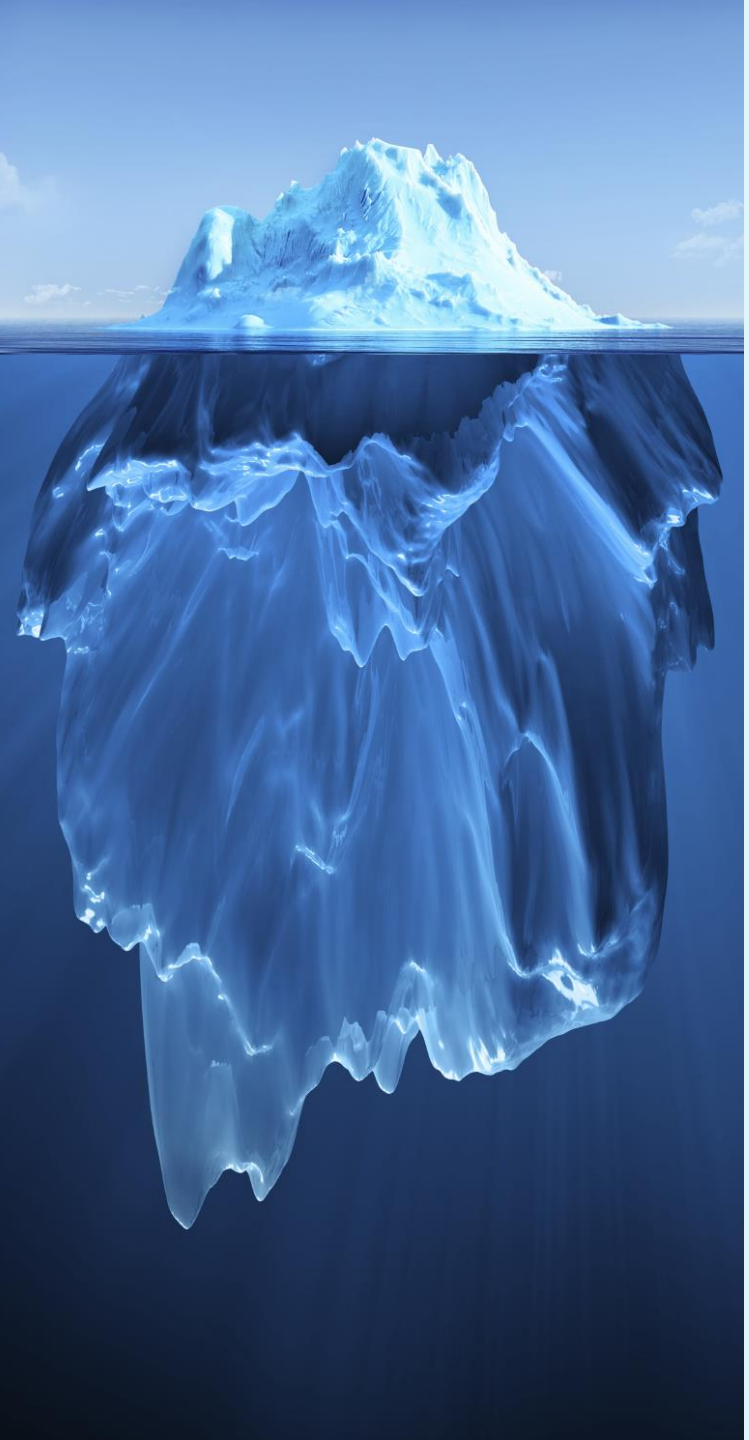
Drugs	Property	Note
Morphine	Slow onset Long acting Euphoria	Respiratory depression Histamine release Constipation
Fentanyl	Rapid onset Short acting	Respiratory depression No histamine release Muscle rigidity
Midazolam	Anxiolytic Short acting	Decrease sympathetic outflow
Ketamine	Rapid onset	Catecholamine release Bronchodilator Increase secretion and saliva Possible increase intracranial pressure
Dexmedetomidine	Less effect on hemodynamic	Bradycardia High price

Titrate to effect & Continuous monitor

Procedural Sedation

- ❑ Targeted level of sedation
- ❑ ASA classification
- ❑ Drugs or food allergy
- ❑ Previous sedation/anesthesia history
- ❑ Risk for difficult airway

Pre-sedation Assessment



Level of Sedation

Minimal sedation
Moderate sedation
Deep sedation
General anesthesia

American Academy of Pediatrics, 2006

ASA Classification

ASA	Description
1	Normal healthy patient
2	Mild systemic disease with no function limitation
3	Severe systemic disease with functional limitation
4	Severe systemic disease that is a consent threat to life
5	Moribund patient not expected to survive without operation
6	Brain-dead patient
E	Emergency operation

Fuhrman & Zimmerman Pediatric Critical Care, 4th ed. 2011

Risk for difficult Airway

Snoring
Tonsillar hypertrophy
Large tongue
Severe obese
Neck/mediastinal mass
Facial anomaly
Neck movement limitation
Mallampati score
History of difficult airway

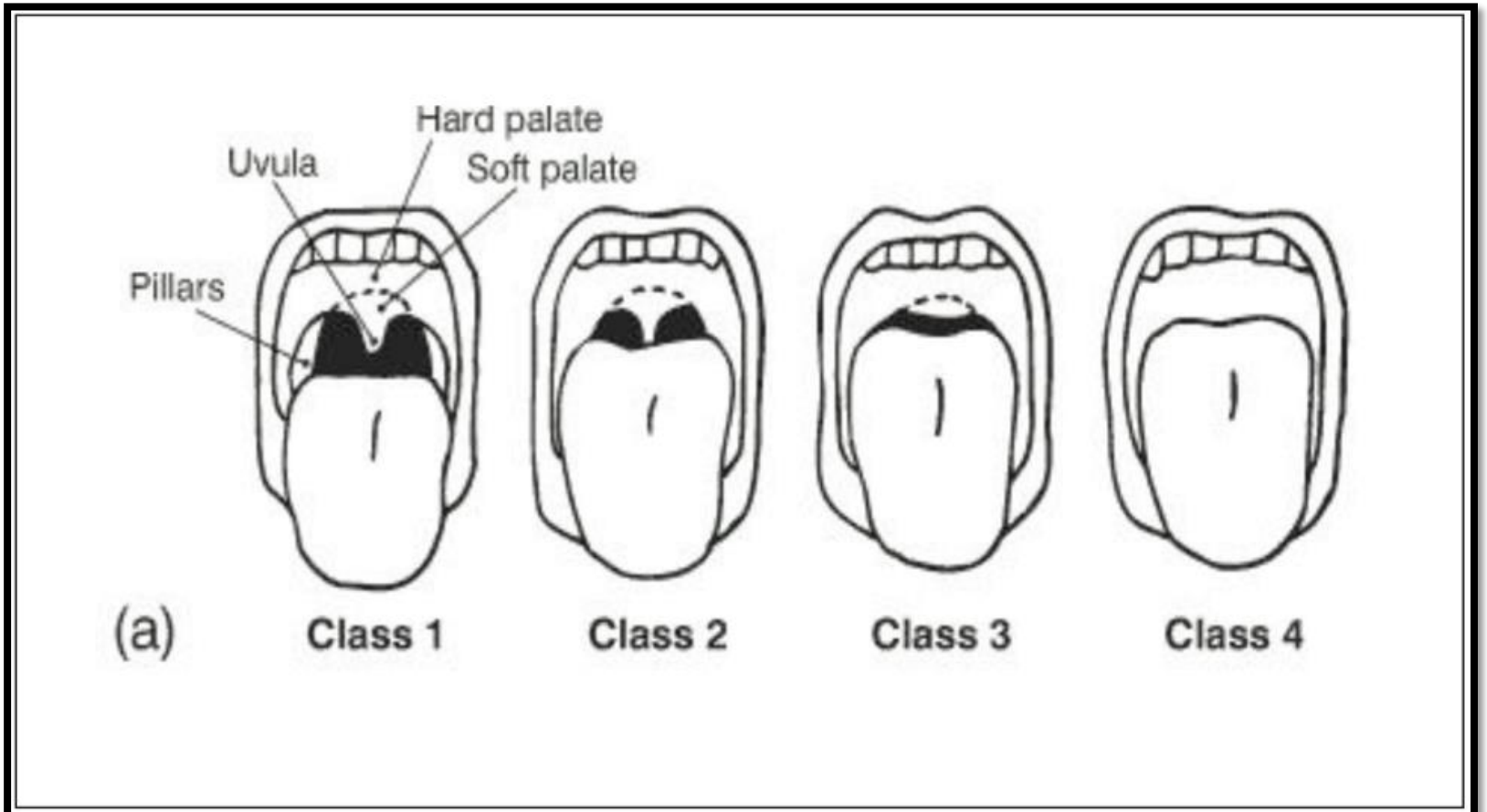
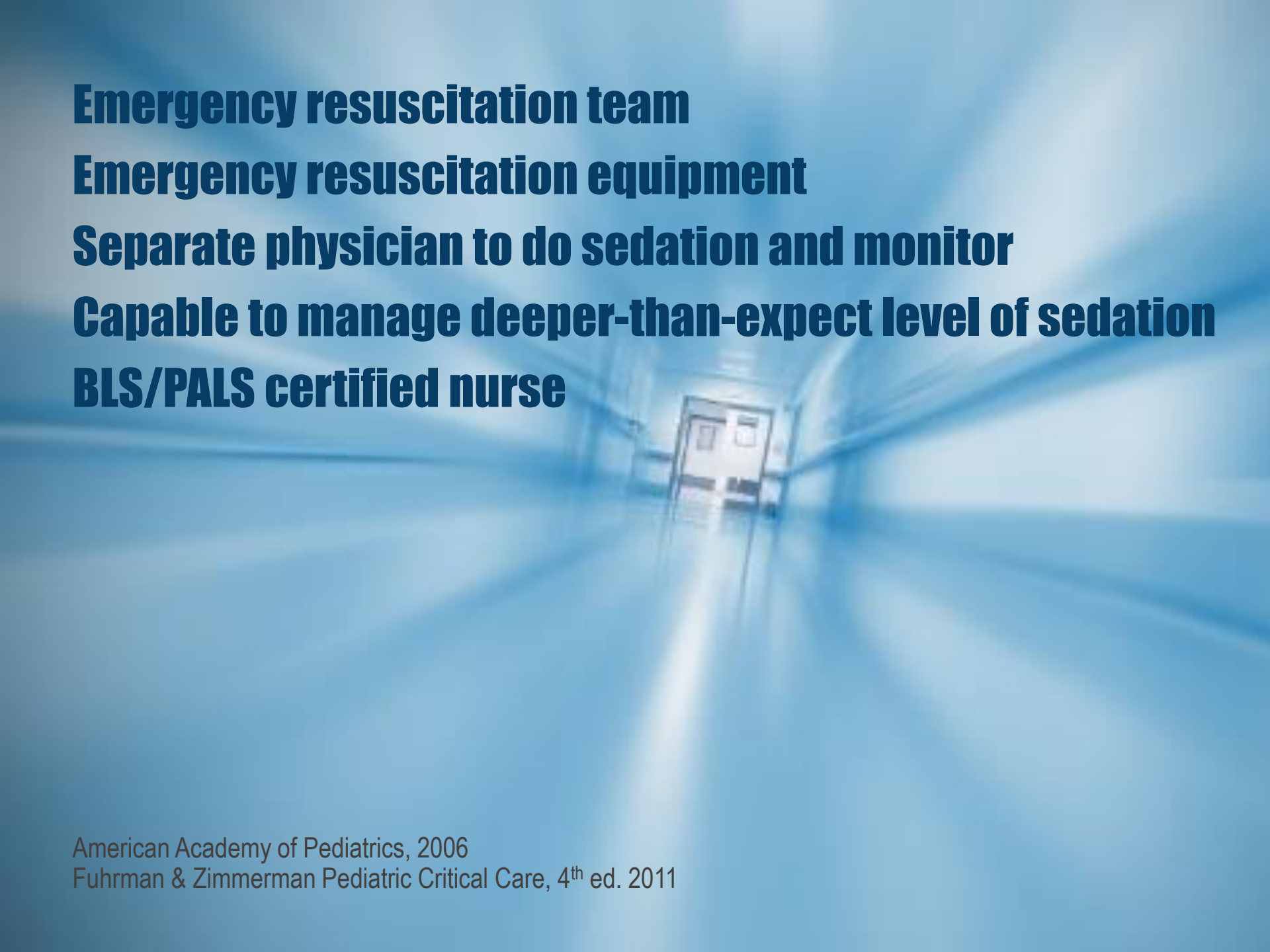


Figure 1. The Mallampati score:

Class 1. Complete visualization of the soft palate
Class 2. Complete visualization of the uvula
Class 3. Visualization of only the base of the uvula
Class 4. Soft palate is not visible at all

http://www.cathlabdigest.com/files/6%20Ginapp%20AskClinIns_pg%2026_Fig%201.png

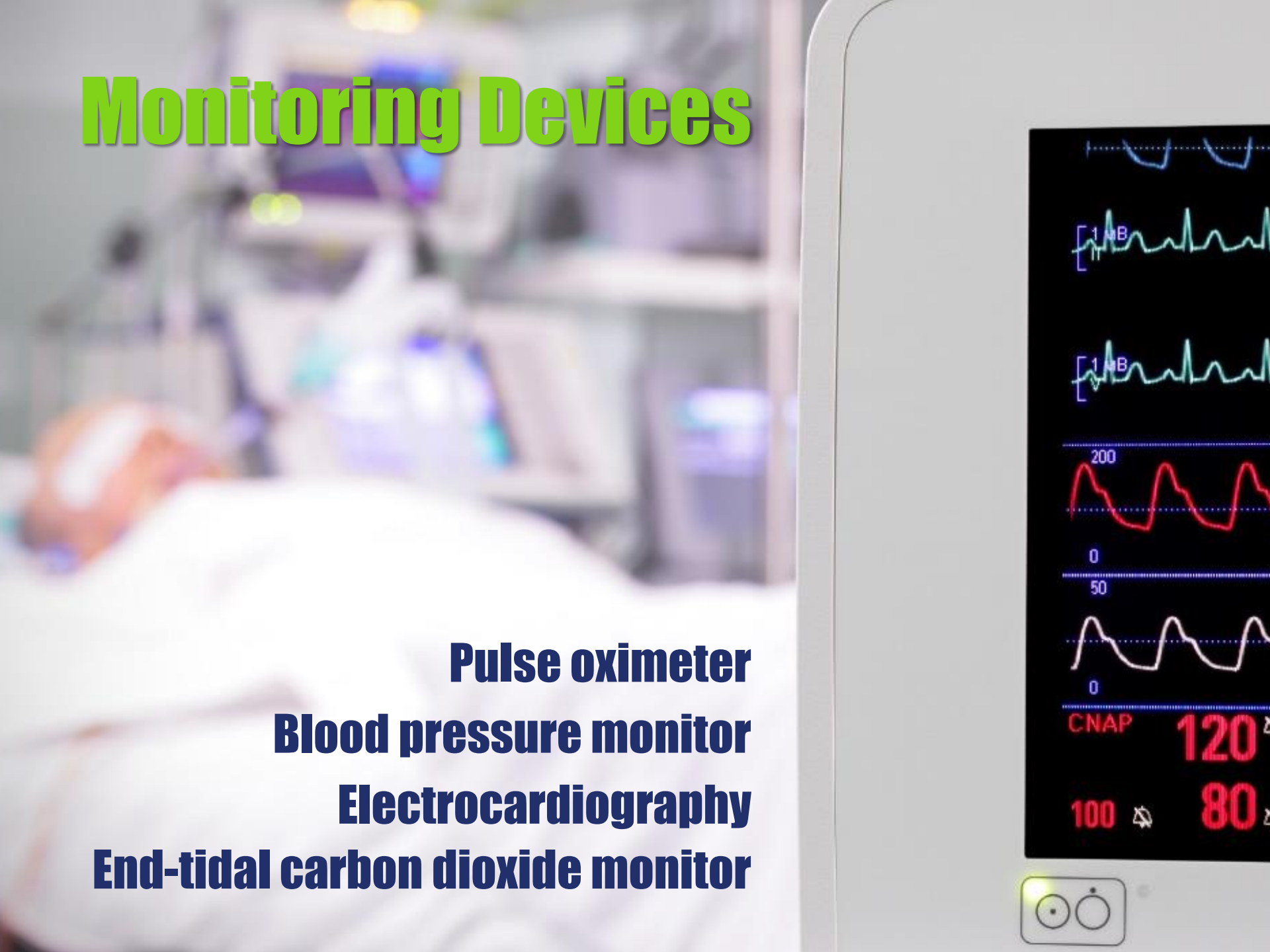


American Academy of Pediatrics, 2006
Fuhrman & Zimmerman Pediatric Critical Care, 4th ed. 2011

Equipment

- Oxygen delivery system
  - Cannula
  - Bag-mask, AMBU bag
- Suction
- Laryngoscopy and endotracheal tube
- Emergency cart include defibrillator

Monitoring Devices



Pulse oximeter

Blood pressure monitor

Electrocardiography

End-tidal carbon dioxide monitor

Patient Preparation

Informed consent

IV access

NPO time

NPO time

Ingested Material	Minimum Fasting Period (hours)
Clear liquids	2
Breast milk	4
Infant formula	6
Nonhuman milk	6
Light meal	6

www.asahq.org/publicationsAndServices/NPO.pdf

Monitoring

Level of consciousness

Vital signs every 5-15 minutes

Signs of airway obstruction

Fentanyl

Sedative and analgesia
Fast onset (immediate)
Short acting (0.5-1 hours)
No histamine release
Respiratory depression
Skeletal muscle rigidity (high dos

Midazolam

Anxiolysis, antegrade amnesia
Not analgesia
Intermediate onset (1-3 min)
Short duration (15-30 min)
Intravenous or intranasal
Synergize with opioids in sedatio
Paroxysmal response
Decrease sympathetic outflow

Ketamine

Anesthesia, analgesia

Induction medicine

Intravenous or intramuscular

Need intensive monitoring

Fast onset (< 30 sec)

Short acting (5-10 min)

Catecholamine release

Propofol

Need intensive monitoring

Very fast onset (< 30 sec)

Very short acting (3-10 min)

Decrease blood pressure

Propofol infusion syndrome

Etomidate

Induction for intubation

Very fast onset (30-60 sec)

Ultra-short acting (2-3 min)

Not depress myocardial function

Block 11-beta-hydroxylase

Not for septic shock


Post-sedation monitor
level of consciousness
Airway protective reflex
Vital signs


Sweet Dream