Pediatric Update

Society of Mechanical Ventilation
2023 Conference
Len Y. Tanaka, MD

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Disclosures

This presentations contains a discussion or demonstration of a pharmaceutical or medical device for which FDA has not granted approval. Accordingly, I agree to disclose to the audience whether the pharmaceutical or medical device is classified by the FDA as "investigational" or "off-label" with respect to the intended use.

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Objectives

- Review differences pediatrics versus adult
- Current strategies for neonates
- Pediatric ventilator strategies
- Weaning from ventilator
- Failure modes

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Objectives

- I need a ventilator
- I am on a ventilator
- Get me off this ventilator

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I need a ventilator

- Normal lung
- Abnormal lung
  - Restrictive/obstructive lung disease
    - Asthma, bronchiolitis, chest wall anomaly
  - Injured lung
    - Acute lung injury, ARDS

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Acute Respiratory Distress Syndrome

- Epidemiology -- Why is this important
- Etiology -- What starts this process
- Pathophysiology -- Our current understanding
- Treatment

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Epidemiology

- Incidence (Randolph, 2009)
  - Pediatric ALI-ARDS: 2.2-12/100,000 per year
  - Adult ALI-ARDS: 33.8-306/100,000 per year
  - 1-4% of all PICU admissions
- Mortality
  - Peds: 18% - 27%
  - Adults: 40%
  - Most deaths secondary to sepsis or multiple organ failure

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The JAMA Network

From: **Acute Respiratory Distress Syndrome: The Berlin Definition**

JAMA. 2012;307(23):2526-2533. doi:10.1001/jama.2012.5669

Table 3. The Berlin Definition of Acute Respiratory Distress Syndrome

	Acute Respiratory Distress Syndrome
Timing	Within 1 week of a known clinical insult or new or worsening respiratory symptoms
Chest imaging[a]	Bilateral opacities—not fully explained by effusions, lobar/lung collapse, or nodules
Origin of edema	Respiratory failure not fully explained by cardiac failure or fluid overload Need objective assessment (eg, echocardiography) to exclude hydrostatic edema if no risk factor present
Oxygenation[b]	
Mild	200 mm Hg $< PaO_2/FIO_2 \leq$ 300 mm Hg with PEEP or CPAP $\geq$5 cm H_2O[c]
Moderate	100 mm Hg $< PaO_2/FIO_2 \leq$ 200 mm Hg with PEEP $\geq$5 cm H_2O
Severe	$PaO_2/FIO_2 \leq$ 100 mm Hg with PEEP $\geq$5 cm H_2O

Abbreviations: CPAP, continuous positive airway pressure; FIO_2, fraction of inspired oxygen; PaO_2, partial pressure of arterial oxygen; PEEP, positive end-expiratory pressure.
[a]Chest radiograph or computed tomography scan.
[b]If altitude is higher than 1000 m, the correction factor should be calculated as follows: [PaO_2/FIO_2 × (barometric pressure/760)].
[c]This may be delivered noninvasively in the mild acute respiratory distress syndrome group.

Date of download: 7/18/2012

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Case Presentation

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Jay Kid

- 2 year-old male cared for by baby sitter
- Burns to bilateral feet
- Required fasciotomy due to compartment syndrome
- Rapidly progressive pulmonary edema

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Management Strategies

- Non-invasive vs intubated
- Ventilation
- Oxygenation

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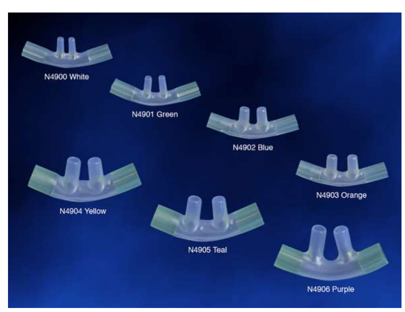
Nasal prongs



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Poiseuille's Law

Predicts volume flow rate in case of laminar flow

RESISTANCE is increased by smaller diameters and smaller radii

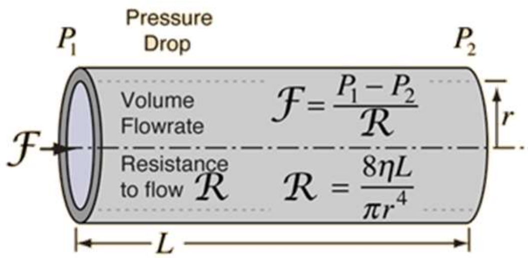
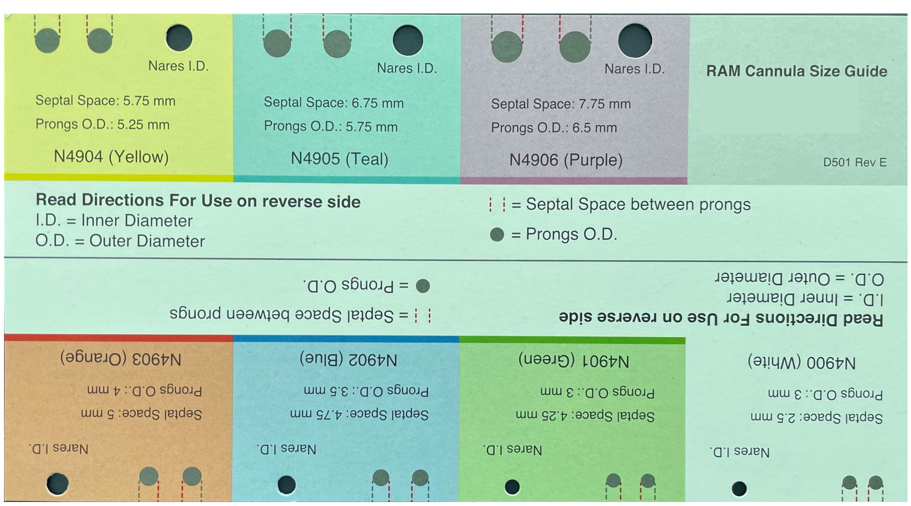
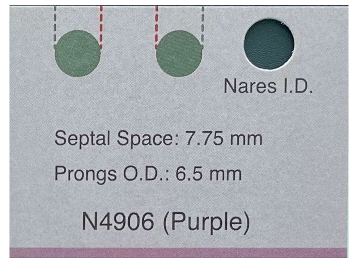


Image from http://hyperphysics.phy-astr.gsu.edu/hbase/ppois.html
Accessed 8/21/2023



Math time!

- Resistance: $R = \frac{8\eta L}{\pi r^4}$
  - White: $R = \frac{8\eta L}{\pi 3\text{mm}^4} = \frac{8\eta}{81\pi} \approx \frac{1}{10}\frac{\eta L}{\pi}$
  - Purple: $R = \frac{8\eta L}{\pi 6.5\text{mm}^4} = \frac{8\eta L}{1785\pi} \approx \frac{4.5}{1000}\frac{\eta L}{\pi}$
- Flow: $F = \frac{P_1 - P_2}{R}$
  - White: $F = \frac{P_1 - P_2}{\frac{1}{10}\frac{\eta L}{\pi}} = 10\pi\frac{P_1 - P_2}{\eta L}$
  - Purple: $F = \frac{P_1 - P_2}{\frac{4.5}{1000}\frac{\eta L}{\pi}} = 222\pi\frac{P_1 - P_2}{\eta L}$



20x

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Neonatal Research

- Lemyre et al. Nasal intermittent positive pressure ventilation (NIPPV) versus nasal continuous positive airway pressure (NCPAP) for preterm neonates post extubation. Cochrane Review
  - RR 0.71, 95% CI 0.61 to 0.82
  - No difference for chronic lung disease, necrotizing enterocolitis, or death
  - NIPPV may be superior to NCPAP for air leak risk RR 0.50, 95% CI 0.28 to 0.89
- Kirpalani et al. NIPPV Study Group. A trial comparing noninvasive ventilation strategies in preterm infants. NEJM. 2013

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Non-invasive Ventilation

- Humidified, high-flow nasal cannula therapy
  - Frat, *et al*. High-flow oxygen through nasal cannula in acute hypoxemic respiratory failure. NEJM, 372(23): 2185, Jun 2015.
- Noninvasive ventilation
  - Cabrini, *et al*. Noninvasive ventilation and survival in acute care settings: a comprehensive systematic review and metaanalysis of randomized controlled trials. Crit Care Med, 43(4): 880-8, Apr 2015.

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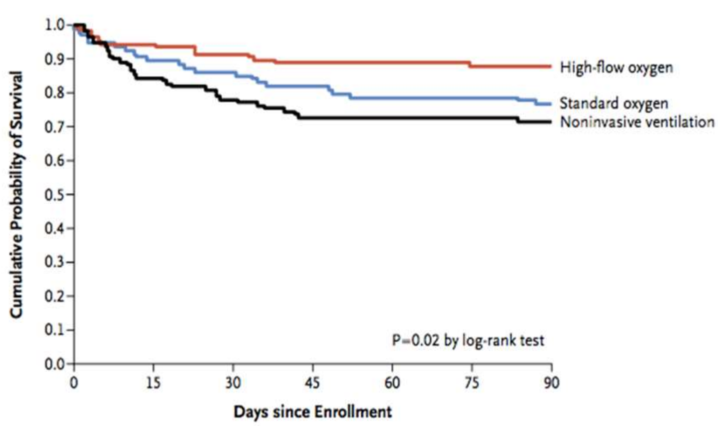
HFNC



No. at Risk

High-flow oxygen	106	100	97	94	94	93	93
Standard oxygen	94	84	81	77	74	73	72
Noninvasive ventilation	110	93	86	80	79	78	77

Frat et al. NEJM 372(23): 2015, 2185-96.

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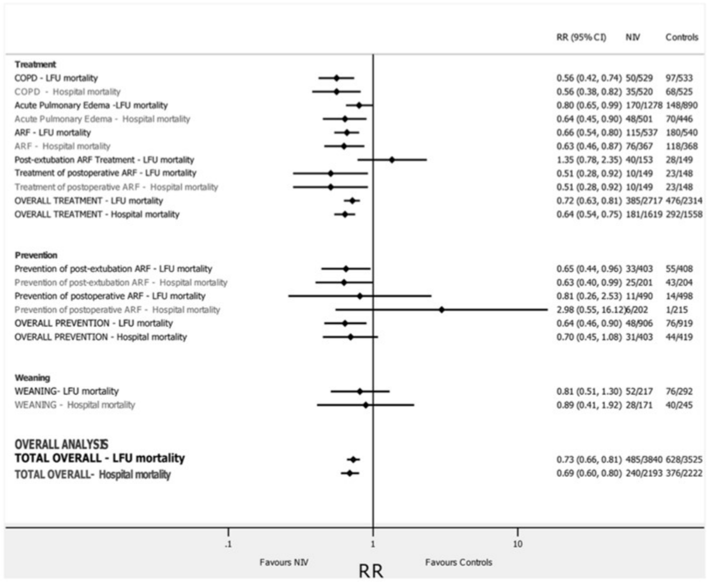
Noninvasive



Cabrini, *et al*. Crit Care Med, 43(4):2015, 880-8

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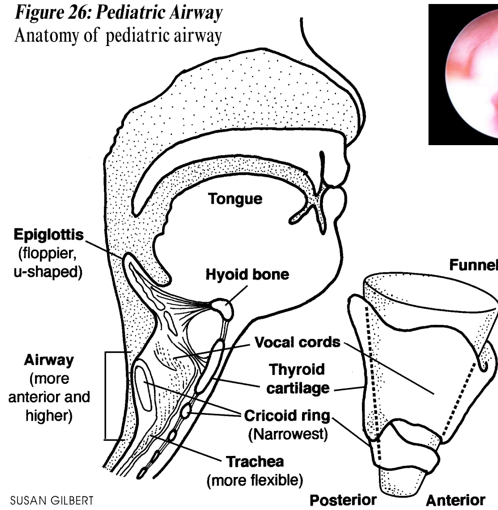
Pediatric Airway

Figure 26: Pediatric Airway
Anatomy of pediatric airway



SUSAN GILBERT

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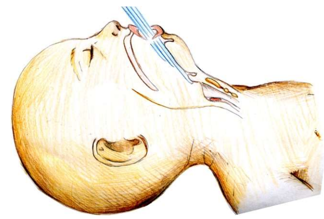
Intubation

- **Blind nasal intubation discouraged**
- **Tongue may cause obstruction**
- **Anterior and cephalad position of larynx**
  - **Cricoid pressure NOT routine**
  - **Straight (Miller) blade**
- **ETT size:**
  - **(16 + age)/4 or (age/4) + 4**
- **Insertion depth:**
  - **3 × ETT size**
- **Plan for failure**



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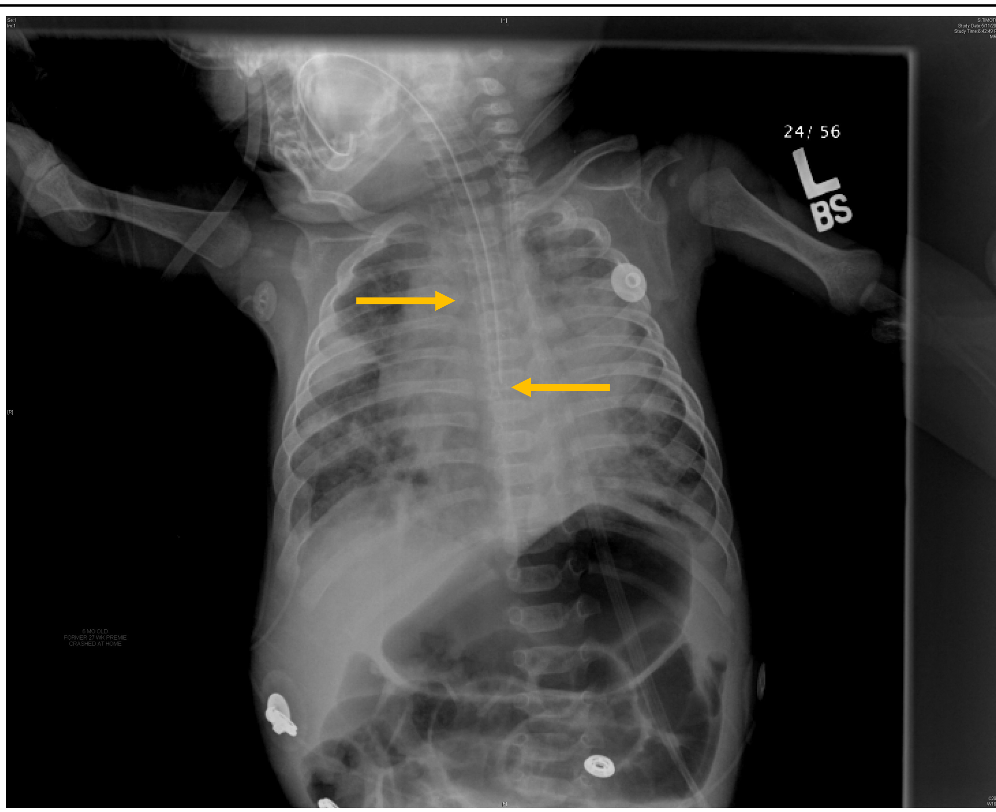

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Objectives

- I need a ventilator
- I am on a ventilator
- Get me off this ventilator

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I am on a ventilator

- Normal lung
- Abnormal lung
  - Restrictive/obstructive lung disease
    - Asthma, bronchiolitis, chest wall anomaly
  - Injured lung
    - Acute lung injury, ARDS

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Management Strategies

- Non-invasive vs intubated
- Ventilation
- Oxygenation

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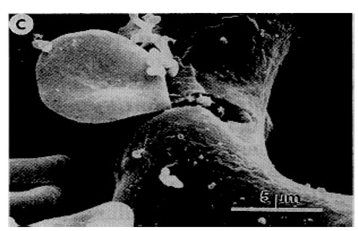
Ventilation

- Shear injury vs. respiratory acidosis

- Minute ventilation:
  - Rate
  - Volume ~ Pressure



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Lung protection improves mortality

- 861 patients, p=0.007

Protected	Unprotected
TV 6 mL/kg, PIP < 30	TV 12 mL/kg, PIP < 50
31% mortality	40% mortality

- Study halted early due to mortality difference

ARDSNet, NEJM 2000.

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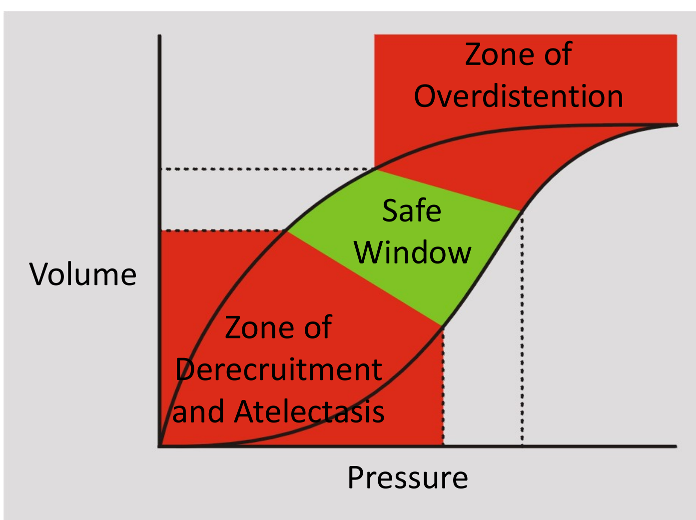
Open Lung Ventilation Strategy: PEEP



Goal is to avoid injury zones
and operate in the safe window

Froese, CCM, 1997

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Oxygenation

- Oxygen Delivery =
  Arterial Content × Cardiac Output
  $CaO_2 = (1.36 \times Hbg \times SaO_2) + (0.003 \times PaO_2)$

- FiO_2
- Mean Airway Pressure

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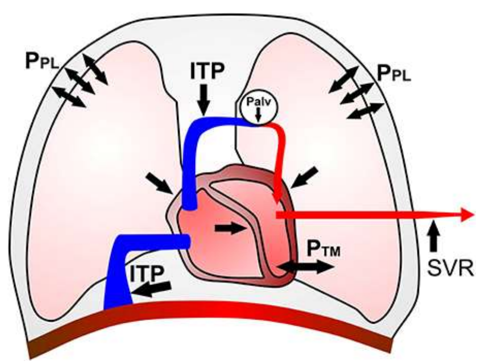
Cardiopulmonary interaction

High PEEP/increased intrathoracic pressure:
→ impedance of venous return to heart

stroke volume = preload x contractility x afterload



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A Ventilator Example:

Modes:

- Assist Control (AC)
- Synchronized Intermittent Mandatory Ventilation (SIMV)
  - Volume Control (VC)
  - Pressure Control (PC)
  - Pressure Regulated Volume Control (PRVC)
- Adaptive Support Ventilation (ASV)
- Bilevel & Airway Pressure Release Ventilation
- Spontaneous:
  - CPAP with pressure support
  - CPAP with volume support

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What settings am I on?

APVsimv; Rate 35; volume 40; PEEP 6; FiO2 0.4

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Ventilator Settings Weight <5 kg

Mode	Time-cycled, pressure-limited
Peak inspiratory pressure	Start at 18–20 cm H_2O and titrate to tidal volume
Tidal volume	~8 mL/kg
Respiratory rate	30–40 breaths/min
PEEP	3–5 cm H_2O
Oxygen	100% (Wean when stable)

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Ventilator Settings Weight >5 kg

Mode	SIMV (pressure or volume)
Tidal volume	8–10 mL/kg (6 mL/kg in ARDS)
Inspiratory time	0.5–0.6 sec (baby), 0.6–0.8 sec (toddler), 0.8–1 sec (older child)
Respiratory rate	Toddlers 25-35, preschool 20-30, school age 15-25 b/min
PEEP	5 cm H_2O
Pressure support	5–10 cm H_2O
Oxygen	100% (Wean when able)

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Ventilator Settings

Rate
- Infant: 30-40
- Toddler: 25-30
- Young child: 20-25
- Older child: 15-20
- Teenager: 12-15

Inspiratory Time
- 0.5 sec
- 0.5-0.6 sec
- 0.6-0.8 sec
- 0.8-1 sec
- 1 sec

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Mode

- Assist Control
  - Pressure or volume
- Synchronized intermittent mandatory ventilation
  - Pressure or volume
- Adaptive
  - Target minute ventilation based on age, weight, & height

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Jay Kid

- 2 year-old male weight 13 kg
- Initially started on high flow nasal cannula at 20 LPM
- Intubated 4.5 cuffed ETT
- What ventilator settings to choose?

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Ventilator Settings Weight >5 kg

Mode	SIMV (pressure or volume)
Tidal volume	8–10 mL/kg (6 mL/kg in ARDS)
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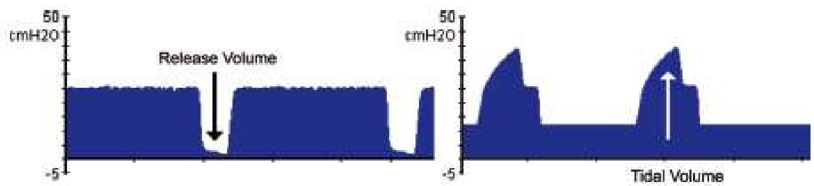
Airway Pressure Release Ventilation (APRV)

- Technique
  - High CPAP with intermittent pressure release phase
  - Spontaneous breathing continues



Habashi, Crit Care Med, 2005.

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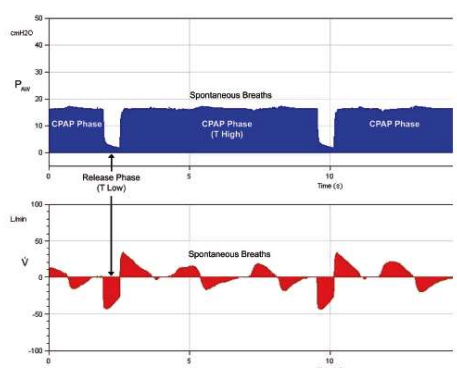
APRV: Theoretical Benefits

- Maintains high MAP
  - Maximize alveolar recruitment
- Decreases VILI
  - □baro/volu/stretch trauma
- Maintains ventilation
  - Pressure release to ventilate
  - Allow spontaneous breathing
- Needs no paralysis
- Maybe needs less sedation



Habashi, Crit Care Med, 2005.

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Limited data: APRV in pediatrics

- Schultz, Pediatr Crit Care, 2001.
  - 15 patients with mild-moderate lung disease.
  - Achieved similar ventilation / oxygenation with lower PIP than SIMV VC.
- Krishnan, Pediatr Pulm, 2007.
  - 7 patient case series.
  - May have some advantages over HFOV.
- Kawaguchi, Clin Resp J, 2015.
  - 13 patient case series
  - Similar blood gas at 1h and 12h versus pre-APRV

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High Frequency Ventilation

- Maintain open lung with less ventilator induced lung injury
- Typically used for patients that "fail" conventional mechanical ventilation.
  - inadequate ventilation (pH<7.25)
  - inadequate oxygenation (SpO2<90% on FiO2>0.6)
- Escalate MAP on HFOV to achieve "open lung."

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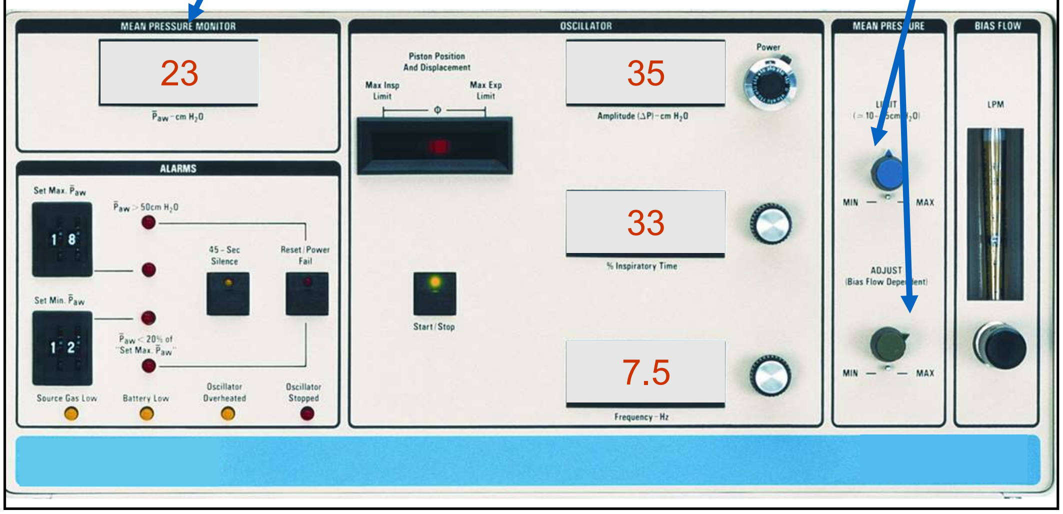
Gupta & Chieftez. SCCM PICU Course: High-Frequency Oscillatory Ventilation. 2004

Paw is displayed here

Mean Airway Pressure (Paw) is controlled here



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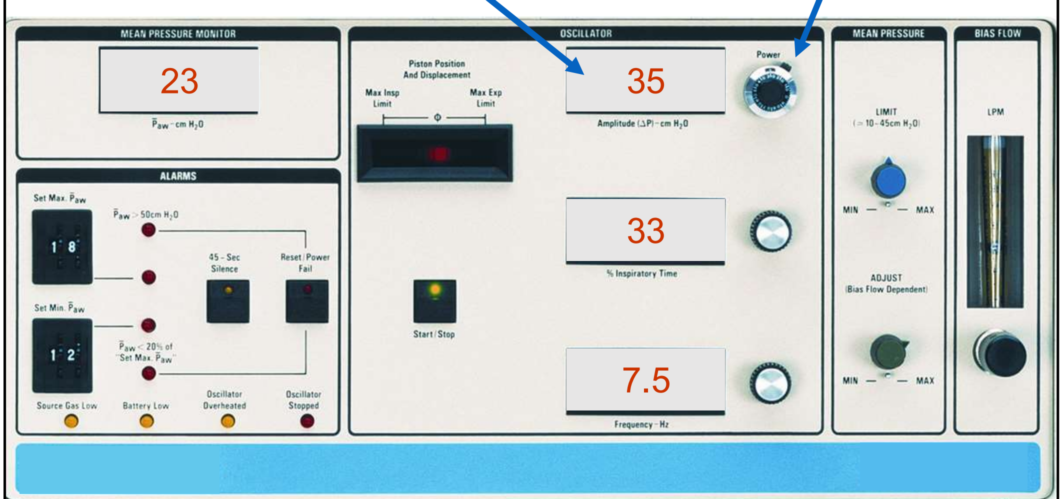
Gupta & Chieftez. SCCM PICU Course: High-Frequency Oscillatory Ventilation. 2004

This is displayed as the amplitude or ΔP

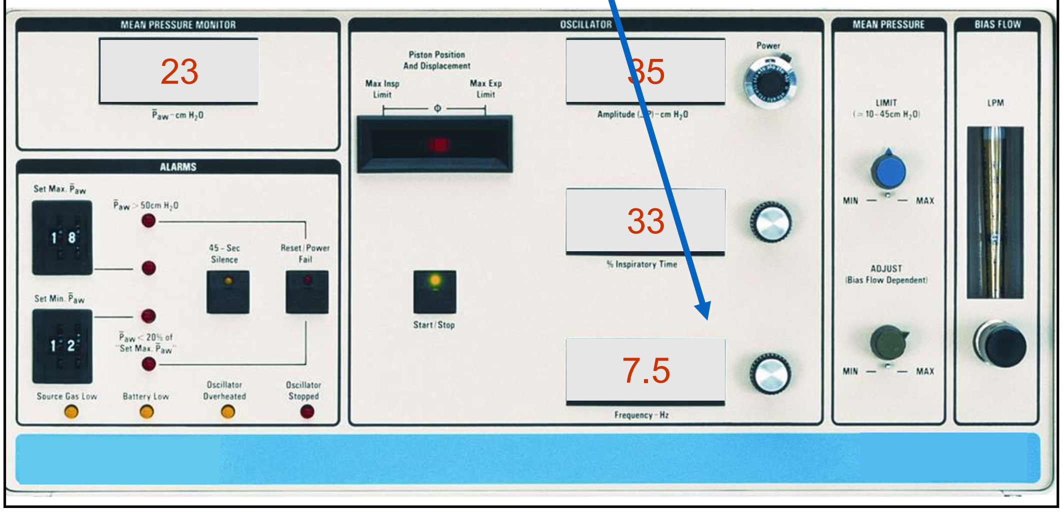
The power dial controls the degree of piston deflection



44

Gupta & Chieftez. SCCM PICU Course: High-Frequency Oscillatory Ventilation. 2004

The frequency is controlled
and read here



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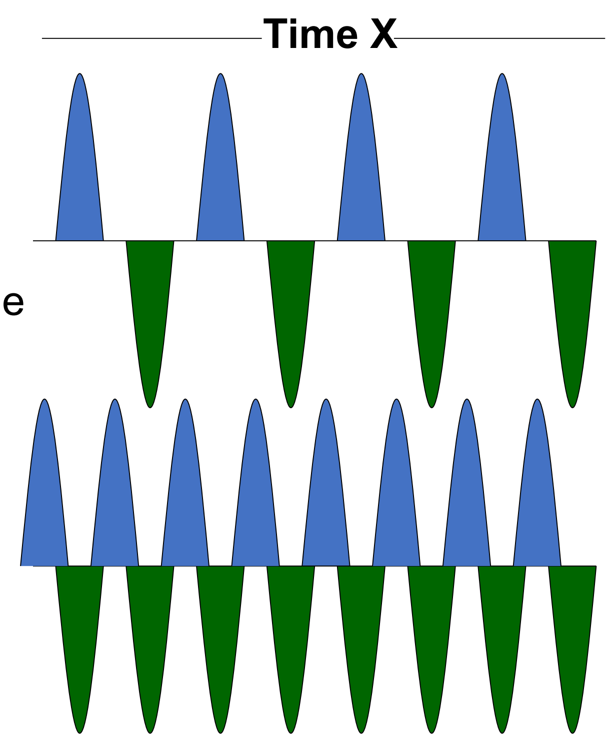
Gupta & Chieftez. SCCM PICU Course: High-Frequency Oscillatory Ventilation. 2004

Frequency (λ)



Lower frequencies have a larger volume displacement and improved CO2 elimination.

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High Frequency Ventilation

- Ferguson *et al*, OSCILLATE Trial Investigators, and Canadian Critical Care Trials Group. High-frequency oscillation in early acute respiratory distress syndrome. N Engl J Med, 368(9):795–805, Feb 2013.
- Young *et al*, and OSCAR Study Group. High-frequency oscillation for acute respiratory distress syndrome. N Engl J Med, 368(9):806–13, Feb 2013

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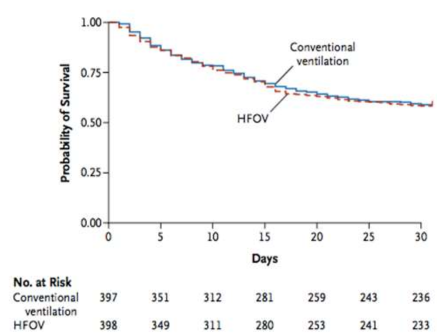
OSCAR (Young, 2015)

- # randomized with ARDS
  - 397 to Conventional Vent
  - 398 to HFOV
- Outcome: 30-day mortality
- Results:
  - Odds ratio for survival in the conventional-ventilation group was 1.03 (95% confidence interval, 0.75 to 1.40; P=0.87 by logistic regression)



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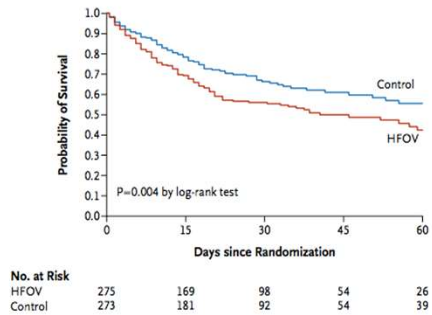
OSCILLATE (Ferguson, 2015)

- # randomized with ARDS
  - 273 to Conventional Vent
  - 275 to HFOV
- Outcome: in hospital mortality
- Results:
  - Relative risk of death with HFOV, 1.33; 95% confidence interval, 1.09 to 1.64; P = 0.005)



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Jay Kid

- Placed on ventilator but developed frothy, bloody secretions
  - HFOV 4 Hz, 60 Amp, MAP 35, 100% oxygen
  - ABG: 7.248 / 37.7 / 56.4 / -10.4 / 16.1

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Monitoring Ventilator

- Invasive:
  - Blood gases
- Noninvasive:
  - End tidal carbon dioxide detector
  - Transcutaneous carbon dioxide detector
  - Near-infrared spectroscopy

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Prone Positioning

- improves V/Q mismatch
- improves lung mechanics
- improves oxygenation

- Sud S et al. Effect of prone positioning…a meta-analysis. CMAJ 2014.
  - 6 trials, n = 1,106
  - decreased mortality risk ratio vs supine
  - prone median 17 hrs/day [4 – 24 hrs] x median 4.6 days [4 – 10 days]

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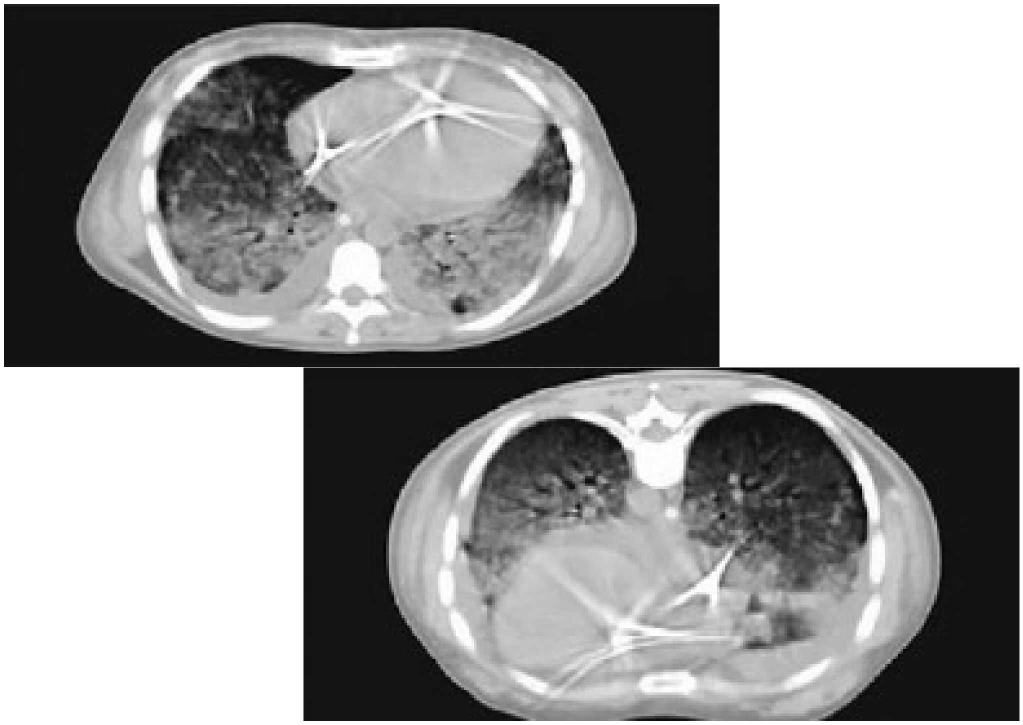

Dickinson S, Park PK, Napolitano LM.. Crit Care Clin 2011.

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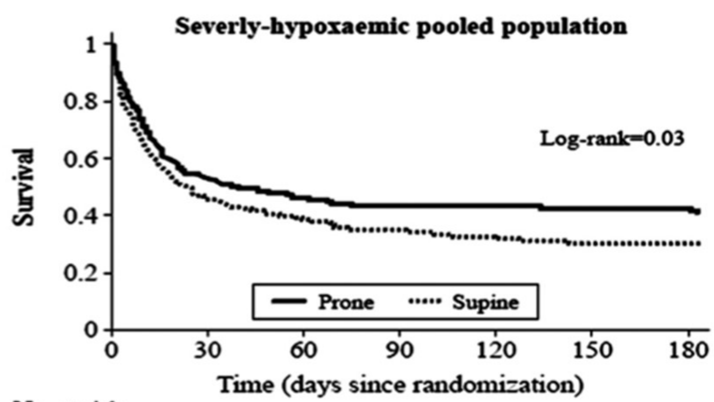
Prone



No. at risk

Prone	226	98	80	71	41	40	40
Supine	260	128	140	93	55	54	54

Gattinoni L, Carlesso E, Taccone P, et al. Prone positioning improves survival in severe ARDS: a pathophysiologic review and individual patient meta-analysis. Minerva Anestesiol 2010;76(6):448–54.

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Inhaled NO

- Inhaled Nitric Oxide
  - 5 RCT and meta-analyses
  - Temporary improvement in oxygenation and decrease in MPAP
  - No effect on mortality or ventilator free days

55

Surfactant

- Pediatrics
  - Willson DF, Thomas NJ, Markovitz BP, et al. Effect of exogenous surfactant (calfactant) in pediatric acute lung injury: a randomized controlled trial. JAMA 2005;293:470–6.
  - Luchetti M, Ferrero F, Gallini C, et al. Multicenter, randomized, controlled study of porcine surfactant in severe respiratory syncytial virus-induced respiratory failure. Pediatr Crit Care Med 2002;3:261–8.
  - Moller JC, Schaible T, Roll C, et al. Treatment with bovine surfactant in severe acute respiratory distress syndrome in children: a randomized multicenter study. Intensive Care Med 2003;29:437–46.
- Adult
  - Anzueto A, Baughman RP, Guntupalli KK, et al. Aerosolized surfactant in adults with sepsis-induced acute respiratory distress syndrome. N Engl J Med 1996; 334:1417–21.

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Surfactant

- Kind of surfactant: natural versus artificial, composition
- Dose: 70-100mg/kg = 90 – 280mL volume
- Administration: divide into 4 aliquots under direct instillation versus aerosolization
- Improved results with combination of other interventions including iNO, proning, recruitment
- Improved results in subgroup with direct lung injury versus sepsis

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CHEST

Original Research

CRITICAL CARE MEDICINE

Methylprednisolone Infusion in Early Severe ARDS*

Results of a Randomized Controlled Trial

G. Umberto Meduri, MD, FCCP; Emmel Golden, MD; Amado X. Freire, MD, MPH, FCCP; Edwin Taylor, MD; Muhammad Zaman, MD; Stephanie J. Carson, RN; Mary Gibson, RN; and Reba Umberger, RN, MS

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Table 3
Methylprednisolone treatment of early ARDS and unresolving ARDS

Time	Administration form	Dosage
Early severe ARDS (P_{AO_2}:F_{IO_2} <200 on positive end-expiratory pressure 10 cm H_20)		
Loading	Bolus over 30 min	1 mg/kg
Days 1–14[abc]	Infusion at 10 mL/h	1 mg/kg/d
Days 15–21[ac]	Infusion at 10 mL/h	0.5 mg/kg/d
Days 22–25[ac]	Infusion at 10 mL/h	0.25 mg/kg/d
Days 26–28[ac]	Infusion at 10 mL/h	0.125 mg/kg/d
Unresolving ARDS (less than one-point reduction in lung injury score by day 7 of ARDS)		
Loading	Bolus over 30 min	2 mg/kg
Days 1–14[abc]	Infusion at 10 mL/h	2 mg/kg/d
Days 15–21[ac]	Infusion at 10 mL/h	1 mg/kg/d
Days 22–25[ac]	Infusion at 10 mL/h	0.5 mg/kg/d
Days 26–28[ac]	Infusion at 10 mL/h	0.25 mg/kg/d
Days 29–30[ac]	Bolus over 30 min	0.125 mg/kg/d

Marik PE, Pastores SM, Annane D, et al. Recommendations for the diagnosis and management of corticosteroid insufficiency in critically ill adult patients: consensus statements from an international task force by the American College of Critical Care Medicine. Crit Care Med 2008;36:1937–49.

Meduri GU, Golden E, Freire AX, et al. Methylprednisolone infusion in patients with early severe ARDS: results of a randomized trial. Chest 2007;131:954–63.

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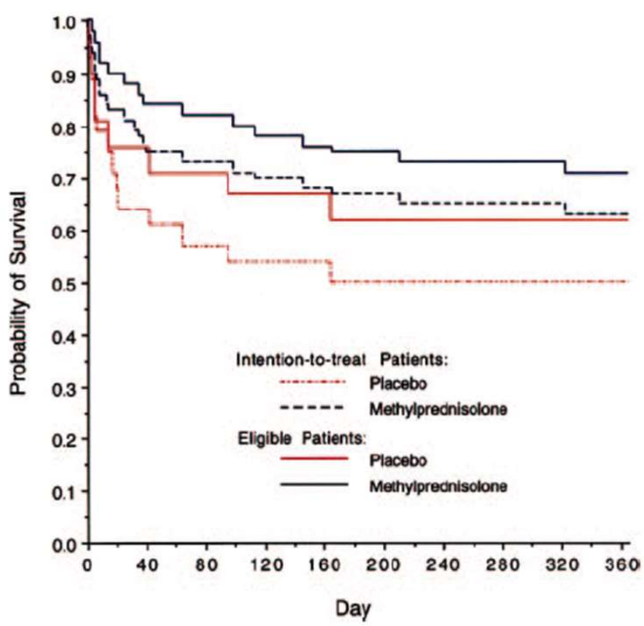

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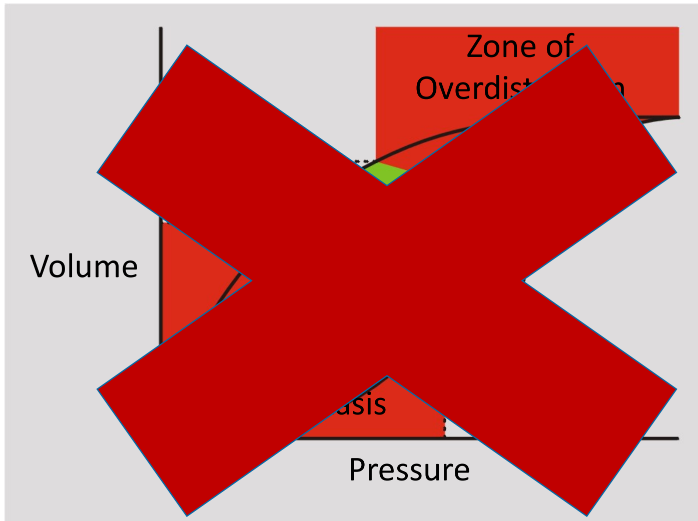
Open Lung Ventilation Strategy: PEEP



Goal is to avoid injury zones
and operate in the safe window

Froese, CCM, 1997

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Role of ECMO: theory

- Allow lung rest and avoids baro-, volu-, stretch trauma.
- Maintains oxygenation and ventilation.
- Done with or without cardiac output support.
- Allows time for the rest of the body to heal, treatments to take effect, and underlying disease process to resolve.

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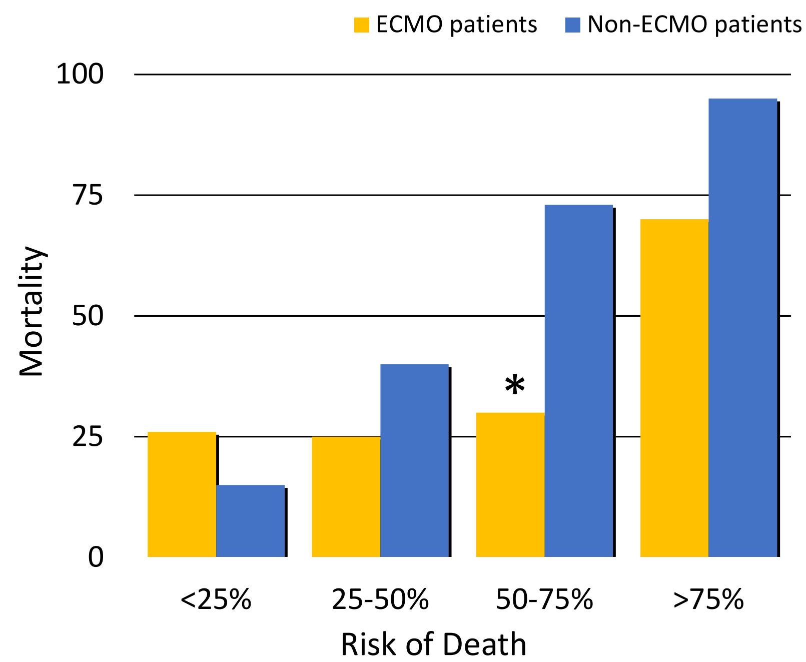

Green et al., CCM, 1996

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77% ECMO survival for pediatric respiratory failure

	VV		VA	
	No.	Survived	No.	Survived
Hypoxemic respiratory failure				
Pneumonia—respiratory syncytial virus	13	11	7	5
Pneumonia—bacterial	8	5	1	0
Pneumonia—viral, other organisms	6	5	1	1
Pneumonia—aspiration	5	5	—	—
Pneumonia—aspiration, near drowning	2	2		
ARDS, postsurgery/trauma	8	7	2	1
ARDS, nontraumatic	15	10	2	1
Acute chest syndrome	2	2	1	1
Hypercarbic respiratory failure				
Status asthmaticus	5	5	—	—
Airway obstruction (tracheal)	1	1	—	—
Total patients	68	56	14	9
Days intubated prior to ECMO				
Median		5	4.5	
Range		1–17	1–15	
Paw at initiation of ECMO				
Median		26	26	
Range		17–44	17–35	
OI at initiation of ECMO				
Median		47	64	
Range		23–133	30–100	

70% ARDS survival

Pettignano, Pediatr Crit Care Med, 2003.

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ECMO Clinical Research

- Australia New Zealand H1N1 Experience
  - 68 patients ARDS treatment with ECMO survival 75%
  - Davies et al, JAMA,2009;302(17):1888-95
- CESAR (Conventional vent or ECMO for Severe Adult Respiratory failure)
  - Survival: ECMO 63% vs Conventional 47% (NNT= 6)
  - Lack of standardized conventional mechanical vent protocols
  - Intention to treat analysis (not all in ECMO group got ECMO)
  - But shows protocolized care in expert center improved outcome
  - Peek et al, Lancet, 2009:374(9698):1351-63
- EOLIA (ECMO to rescue Lung Injury in severe ARDS), French RCT
  - CESAR entry criteria with improved methodology
  - ECMO group 44/124 (35%) vs Control group 57/125 (46%)
  - Relative risk, 0.76; 95% confidence interval [CI], 0.55 to 1.04; P=0.09
  - Combes et al. N Engl J Med 2018; 378:1965-1975

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ECMO Triggers

- "Refractory hypoxia/hypoxemia"
  - Neonatal oxygenation criteria:
    Oxygenation Index: $(MAP \times FiO_2)/PaO_2$

    OI ≥ 20: consider ECMO
    OI ≥ 40: ECMO

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ECMO Contraindications

- Mechanical ventilation prior to ECMO; pediatric < 14 days vs. adult < 7 days

- Concomitant illnesses
  - Malignancy (arguable)
  - CNS hemorrhage
  - Severe neurologic compromise
  - Other incurable disease

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Jay Kid

- Sedated & paralyzed
- Norepinephrine infusion
- HFOV increased settings resulted in severe cardiopulmonary interaction
- Renal insufficiency

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Objectives

- I need a ventilator
- I am on a ventilator
- Get me off this ventilator

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Tolerance

- Definition: decreased drug effect after repeated administration requiring increasing dosage for clinical effect
- Morphine tolerance within 6-8 doses
- Midazolam: 72-96 hours
- Retrospective case review withdrawal in 35% (Fonsmark, 1999)

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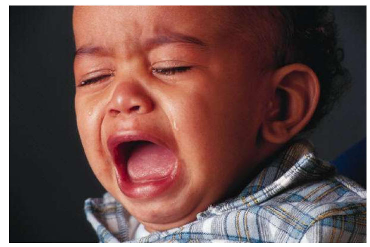
Withdrawal

- Abstinence syndrome:
  - CNS hyperirritability
  - GI dysfunction
  - Autonomic dysfunction
- Narcotic:
  - Diarrhea, hyperventilation, mydriasis, nausea, vomiting



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Wean

- Strategies:
  - Drug choices, rotation, daily interruption
  - Who: ICU, floor, PharmD, Pain service, PMD
  - Monitoring: q 6h for abstinence syndrome
  - Order: ketamine, opioids, benzodiazepines, promethazine, clonidine

Cunliffe, McArthur & Dooley, 2004

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Weaning and extubation readiness in pediatric patients*

Christopher J. L. Newth, MD, FRCPC; Shekhar Venkataraman, MD; Douglas F. Willson, MD; Kathleen L. Meert, MD; Rick Harrison, MD; J. Michael Dean, MD; Murray Pollack, MD; Jerry Zimmerman, MD, PhD; Kanwaljeet J. S. Anand, MBBS, DPhil; Joseph A. Carcillo, MD; Carol E. Nicholson, MD; and the Eunice Shriver Kennedy National Institute of Child Health and Human Development Collaborative Pediatric Critical Care Research Network

Pediatr Crit Care Med 2009 Vol. 10, No. 1

- No predictive factor
- CPAP or spontaneous breathing trial helpful
- Postextubation failure due to upper airway obstruction can occur in up to 40% of cases

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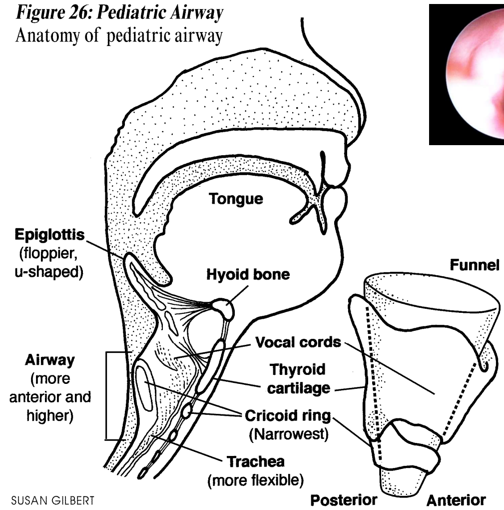
Pediatric Airway

Figure 26: Pediatric Airway
Anatomy of pediatric airway



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Strategies

- Wean rate to facilitate breathing trial
- PEEP of 5 or 6
- FiO_2 0.4 or less
- Cuff leak present?
  - Start dexamethasone?
    - 0.25mg/kg q 6h x 6 doses up to 4mg
  - Consider heliox
  - Racemic epinephrine with extubation attempt
- Extubate to NIV or HFNC

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Pt Diagnosis:
Days Ventilated:

KMCWC PICU EXTUBATION READINESS PROTOCOL

Extubation Attempt #______

- No surgical procedure within next 24 hours
- PaO2 >,= 60mmHg on FiO2 <,= 60%
- Peep <,= 5, Set RR < 20 b/min
- Spontaneous RR acceptable * with minimal sedation**
- Cough/gag present
- Check airway leak. Call MD if leak >,=30.

*acceptable resp rates (bpm)
>5 yo 10-35
2-5 yo 15-40
<2yo 20-60

**acceptable sedation
ability to take deep breath and cough
arousable to pain/voice
able to move 4 extremities

↓↓YES

1. Contact attending or resident ASAP
2. MD to order ; NPO and IV fluids
3. with MD approval, complete the following **EXTUBATION READINESS TEST** after AM vbg/abg (before change of shift or morning rounds). RT to place patient on CPAP/PS of : 10/5 unless other wise specified by MD.

RT must be able to evaluate for 5 minutes for criteria below:

Pass/Fail
- End Tidal CO2 remains <45 (except CLD pts)
- RR acceptable * with minimal sedation**
- Vt > 5ml/kg (adjust for ideal body weight)
- HR does not increased > 20-40 beats/min
- SaO2 >92% (unless cyanotic heart lesion)
- MAP >20 above baseline
- Leak at < 25 cmH2O
- Feeds off for 4 hours

→ **NO**: Resume original settings. Restart feedings. Reevaluate later in shift

↓↓YES

Leave on CPAP/PS for 30-120 minutes
Patient MUST continue to pass same citeria above

→**NO**: Resume original settings. Restart feedings. Reevaluate later in shift

↓↓YES

Contact Physician. Arrange extubation time.

Extubated date/time______________
CPAP/Bipap needed? Y N
HiFlow/Vapoterm? Y N
Reintubated? Y N
Recemic EPI? Y N

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Need Help?

1-800-KAP-PICU

For Transports or for help:
Call (808) 983-6555 and you will be directed to either neonatal or pediatric intake physician

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Questions?

email: lent@hawaii.edu

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