Proning: Is Flip/Flopping A Good Thing? NO, hell no…

North Carolina Society for Respiratory Care 2011 Symposium

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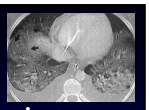
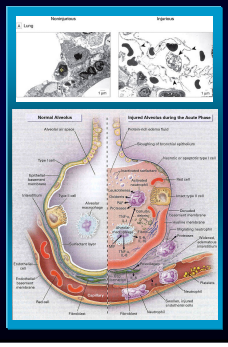
Introduction



- Acute Lung Injury (ALI) and Acute Respiratory Distress Syndrome (ARDS) affects 200,000 patients annually in the US
- Mortality 40%
- Multiple strategies improve oxygenation
- Low tidal volume ventilation (6 cc/kg) reduces mortality
- Rescue therapies are adjuncts with yet to be proven mortality improvement

Pathophysiology of ARDS



- Cellular-mediated injury
- Inflammatory cascade
- Oxidant-induced
  - ✓ O_2^-, peroxynitrates, …
- Alveolar destruction
- Hyaline membrane formation
- Endothelial damage
- Systemic inflammation

Definition of severe ARDS

Score	0	1	2	3	4
PaO_2/FiO_2	≥ 300	225-299	175-224	100-174	< 100
CXR (quadrants)	None	1	2	3	4
PEEP	≤ 5	6-8	9-11	12-14	≥ 15
Compliance	≥ 80	60-79	40-59	20-39	≤ 19

Therapeutic Strategies for ARDS Improving Oxygenation

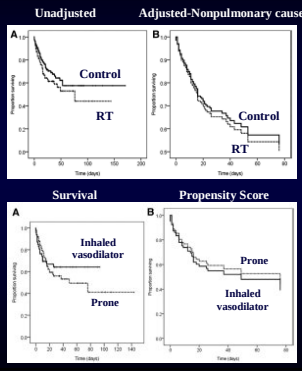
- Heavy sedation and paralysis (asynchrony)
- Fluid conservative hemodynamic management
- Recruitment maneuvers and high PEEP
- Lung protective ventilation (low tidal volume)
- Prone positioning
- Glucocorticoids
- High frequency oscillatory ventilation
- Inhaled Nitric Oxide
- Extracorporeal membrane oxygenation

Rescue Therapies

Therapeutic Strategies for ARDS Improving Mortality

- Only strategy that has been proven by a prospective randomized trial by ARDS Network (9% absolute risk reduction):
  - Low tidal volume (≤ 6 mL/kg) of predicted BW
  - Adequate PEEP levels
  - Limiting trans-pulmonary distending pressure (plateau pressure ≤ 30 cm H_2O)
  - Minimize ventilator induced lung injuries: barotrauma, volutrauma and atelectrauma

Survival Benefits by Rescue Therapies



- Rescue therapy used in 6.3% patients in ARDS-Network trials
- RT applied in younger with severe hypoxemia & elevated MAP
- Use of rescue therapy decreased over time
- No differences in adjusted outcomes

Walkey et al *Crit Care Med* 2011

Physiology of Proning

- First proposed by Bryan in 1974 as physiotherapy for pediatric ICU patients
- Ventilation strategies in supine position tend to result in atelectasis in dependent (dorsal) more perfused regions of the lungs and shunting
- In prone, shift in gravitational forces
  - Reduces atelectasis
  - Minimizes compression of lung parenchyma by heart and mediastinal structures
  - Alveolar ventilation is more homogeneous
  - Improved ventilation perfusion matching

Complications with Proning

- Labor intensive
- Risks of accidental removal of ET tubes, drains and catheters
- Development of pressure ulcers
- Kinking of ET tubes or secretion-induced plugging
- Difficulty accessing & assessing patients for routine care

Facts vs. Fiction

Gastonia, NC "Gastonese"	Columbia, SC "Appalachianese"
Shoe size: 8.5	Shoe size: 16
Favorite food: rice	Favorite food: FLIP 'N - CHICKEN
Profession: doc	Profession: doc + world fishing champion

Will convincing nursing staff technique to prevent VAP

Evidence for Proning

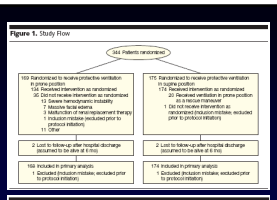


Figure 1. Study Flow

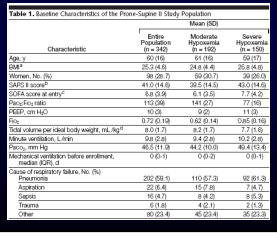


Table 1. Baseline Characteristics of the Prone-Supine II Study Population

Characteristic	Mean (SD) Entire Population (n = 342)	Moderate Hypoxemia (n = 192)	Severe Hypoxemia (n = 150)
Age, y	60 (16)	61 (16)	59 (17)
BMI[a]	25.3 (4.8)	24.8 (4.4)	25.8 (4.8)
Women, No. (%)	98 (28.7)	59 (30.7)	39 (26.0)
SAPS II score[b]	41.0 (14.6)	39.5 (14.5)	43.0 (14.6)
SOFA score at entry[c]	6.8 (3.8)	6.1 (3.5)	7.7 (4.2)
Pao_2/Fio_2 ratio	110 (58)	141 (27)	77 (16)
PEEP, cm H_2O	10 (3)	9 (2)	11 (3)
Fio_2	0.72 (0.19)	0.62 (0.14)	0.85 (0.16)
Total volume per ideal body weight, mL/kg[d]	8.0 (1.7)	8.2 (1.7)	7.7 (1.6)
Minute ventilation, L/min	9.8 (2.8)	9.4 (2.8)	10.2 (2.8)
$Paco_2$, mm Hg	46.5 (11.3)	44.2 (10.0)	49.4 (13.4)
Mechanical ventilation before enrollment, median (IQR), d	0 (0-1)	0 (0-2)	0 (0-1)
Cause of respiratory failure, No. (%)			
Pneumonia	202 (59.1)	110 (57.3)	92 (61.3)
Aspiration	22 (6.4)	15 (7.8)	7 (4.7)
Sepsis	16 (4.7)	8 (4.2)	8 (5.3)
Trauma	6 (1.8)	4 (2.1)	2 (1.3)
Other	80 (23.4)	45 (23.4)	35 (23.3)

- Prone-Supine II study
- MCRCT, un-blinded
- 4-year study, 342 pts
- Lung protective strategy
- Stratified into subgroups of moderate and severe hypoxemia
- 1^0 outcome: 28-day all cause mortality
- 2^{nd} outcomes: 6-mon & ICU discharge mortality, organ dysfunctions & complications

Taccone et al *JAMA* 2009

Taccone et al Trial (con't)

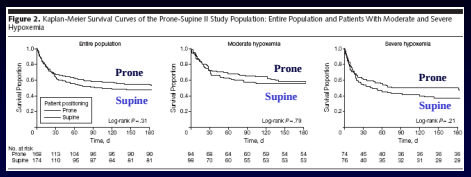


Figure 2. Kaplan-Meier Survival Curves of the Prone-Supine II Study Population: Entire Population and Patients With Moderate and Severe Hypoxemia

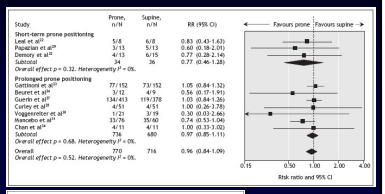
Complications Pronina

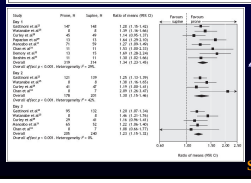
- Need for increased sedation paralysis (1.5x)
- Airway obstruction (1.5x)
- Transient desaturation (1.2x)
- Vomiting (2.2x)
- Hypotension, arrythmias & increased vasopressors (1.4x)
- Loss of venous access (4x)
- Displacement of ET tubes (2x)
- Displacement of chest tubes (3x)

Taccone et al *JAMA* 2009

Effect of Proning on Mortality

- Meta-analysis of 13 trials, 1559 patients
- Prone did not reduce mortality (RR 0.96)
- Neither short nor long-term proning results in mortality benefits
- Prone improved PaO_2/FiO_2 by 34%, 1 hr after proning
- Gattinoni post-hoc analysis lower 10-day mortality in subgroup PF ratio <100



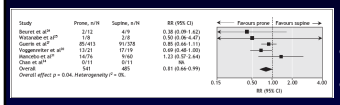


↑PaO2/FiO2

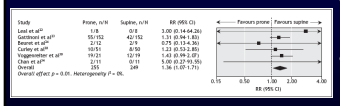
Sud et al *CMAJ* 2008

Effect of Proning on Outcomes

VAP



Risk of Pressure Ulcers

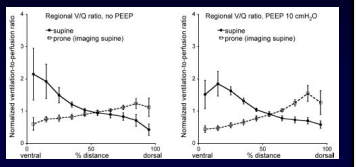


- Prone results in ↓VAP (but not vent-free day)
- ↑ Incidence ulcers
- ↑ Risk of ET tube obstruction
- Poor correlation O_2 and severity of lung injuries
- Improvement in O_2 relatively short
- Insufficient duration of proning (< 17 hrs/d 10d)

Sud et al *CMAJ* 2008

Recent Caveat for Proning

- Swedish study 6 healthy volunteers
- Ventilation perfusion ratios with and without PEEP
- 10-cm H_2O PEEP causes redistribution of blood flow and ventilation that is different in supine vs. prone position
- Addition of PEEP in prone might be less beneficial



Petersson et al *Anesthesiology* 2011

Summary

- Acute hypoxemia remains major challenge in management of critically ill patients
- Lung protective strategy with low tidal volume and adequate PEEP has strongest evidence
- Prompt recognition of severe lung disease (score >3) with hypoxemia, acidosis & ↑ plateau airway pressures should trigger consideration for rescue therapies
- Ventilation in the prone position for hypoxemic respiratory failure improves O_2 and reduces VAP
- Proning appears safe in experienced, well equipped facilities with dedicated staff

Discussion

- Life-threatening hypoxemia, initial ventilatory management should include lung protective strategy, adequate PEEP & recruitment maneuver
- Proceed to prone position or HFOV if hypoxemia persists to previous regimen
- Earlier consideration of prone position for younger patients with severe hypoxemia, longer duration
- Then consider inhaled NO
- Other adjuncts: Glucocorticoids, ECMO

Proning: Is Flip/Flopping A Good Thing?

~~NO, hell no~~… OK, maybe!

Thank you…

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