Don’t talk to me about spontaneous breathing!

Gavin M Joynt

The Chinese University of Hong Kong

香港中文大學醫學院
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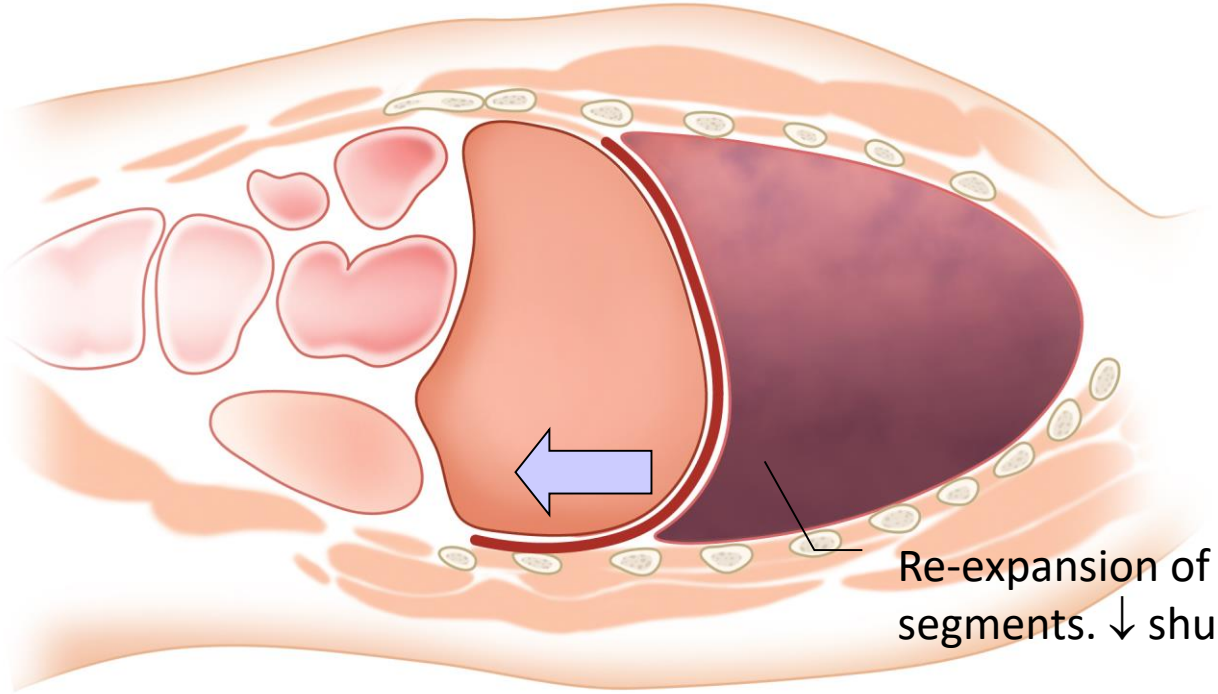
During MV – the good stuff!

- Improves oxygenation
- Prevents disuse atrophy



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Stock MC, et al. Crit Care Med 1987;15:462–466
Putensen C, et al. Am J Respir Crit Care Med 2001;164:43–49
Levine S, et al. N Engl J Med 2008;358:1327–1335

- Can it be bad?
- If so, why is it bad?

And

- When is it bad?
- Is there evidence?
- What can we do to make things better?

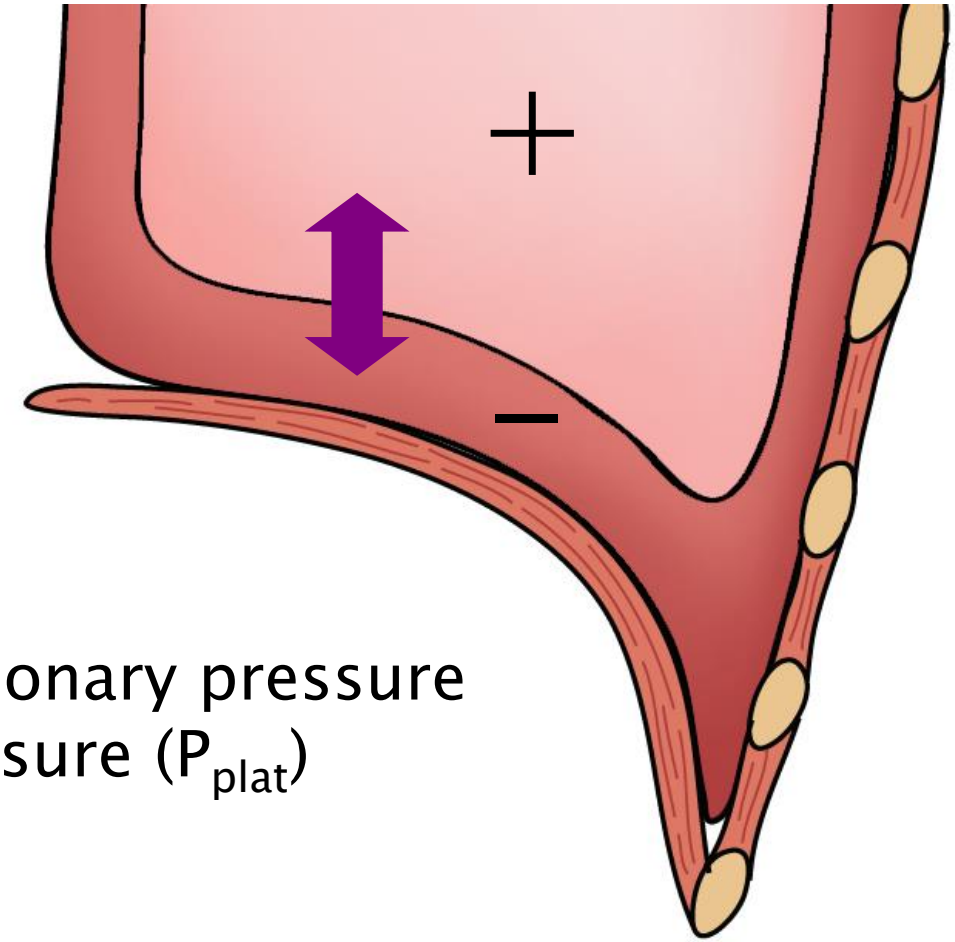
During MV - can SB be bad?

- Animal studies
  - Vigorous spontaneous effort
    - no change in measured plateau pressure (Pplat)
    - Increased lung injury
- Human studies
  - Strong spontaneous effort (pressure targeted modes, or automatic flow compensation)
    - Injury to the lung and possibly diaphragm

Yoshida T, et al. Crit Care Med 2012;40:1578–1585
Yoshida T, et al. Crit Care Med 2013;41: 536–545
Goligher EC, et al. Am J Respir Crit Care Med 2015;192:1080–1088

Why can SB be bad?

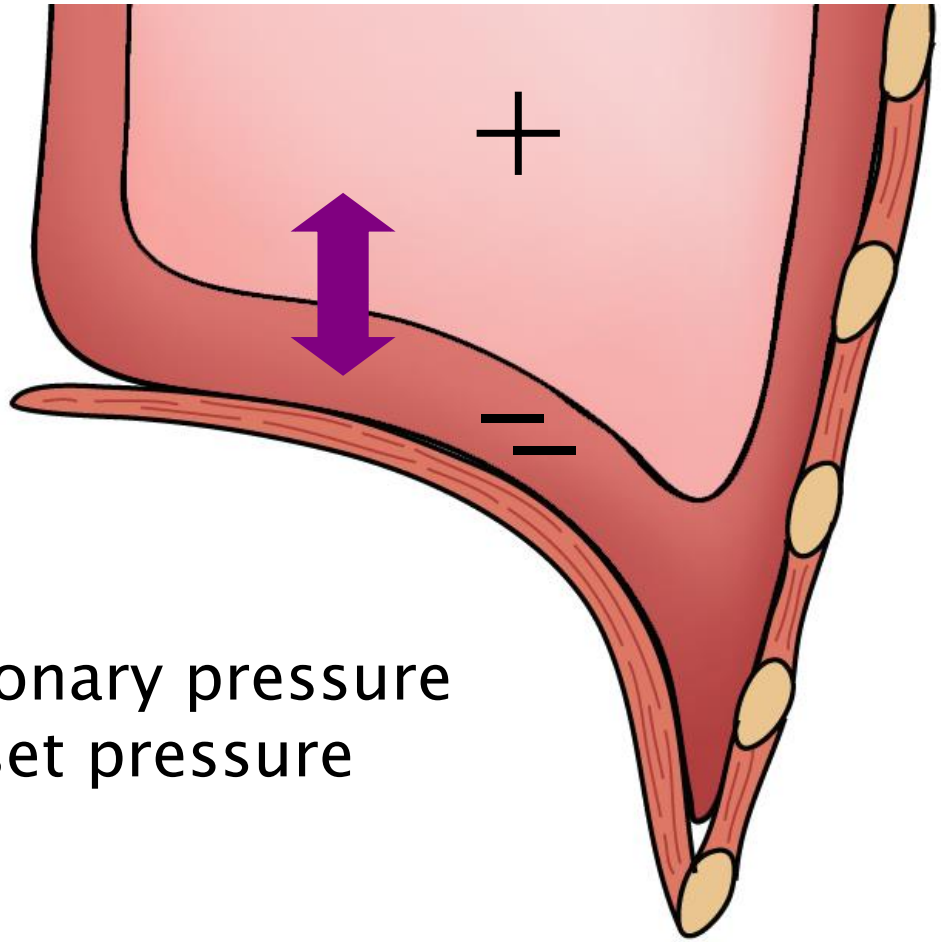
$P_L = P_{AW} - P_{PL}$



Transpulmonary pressure
~ set pressure (P_{plat})

Why can SB be bad?

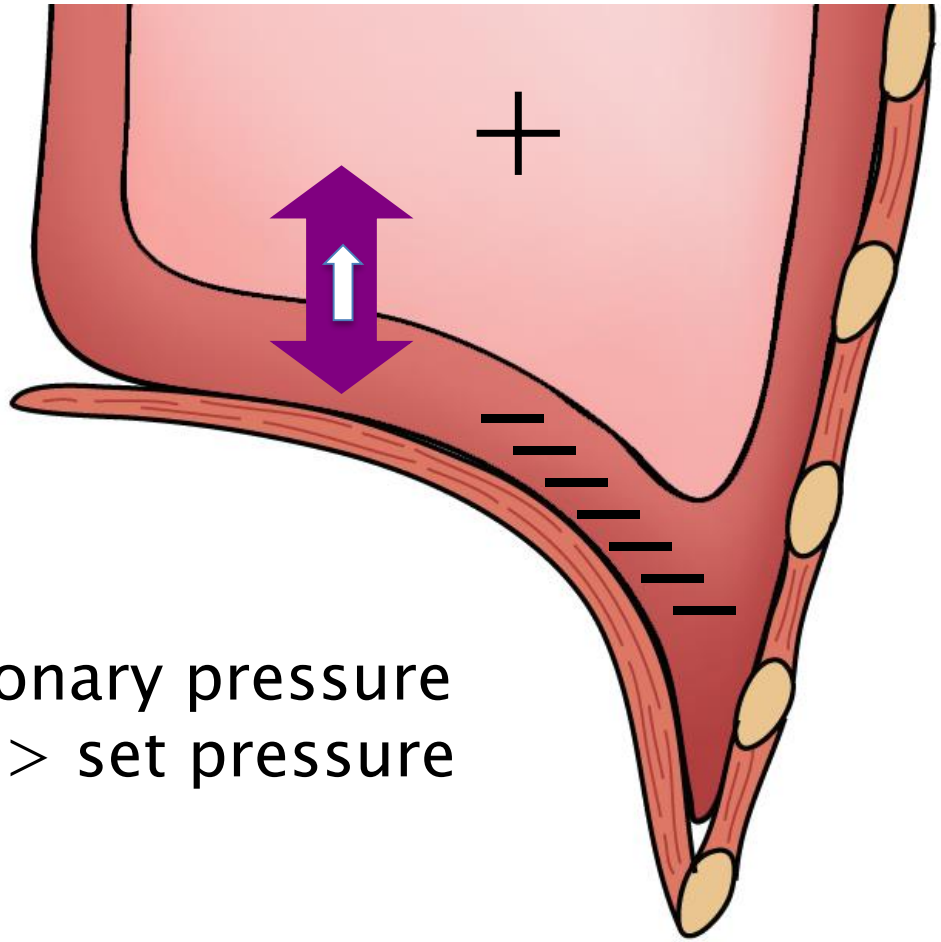
$P_L = P_{AW} - P_{PL}$



Transpulmonary pressure may be > set pressure

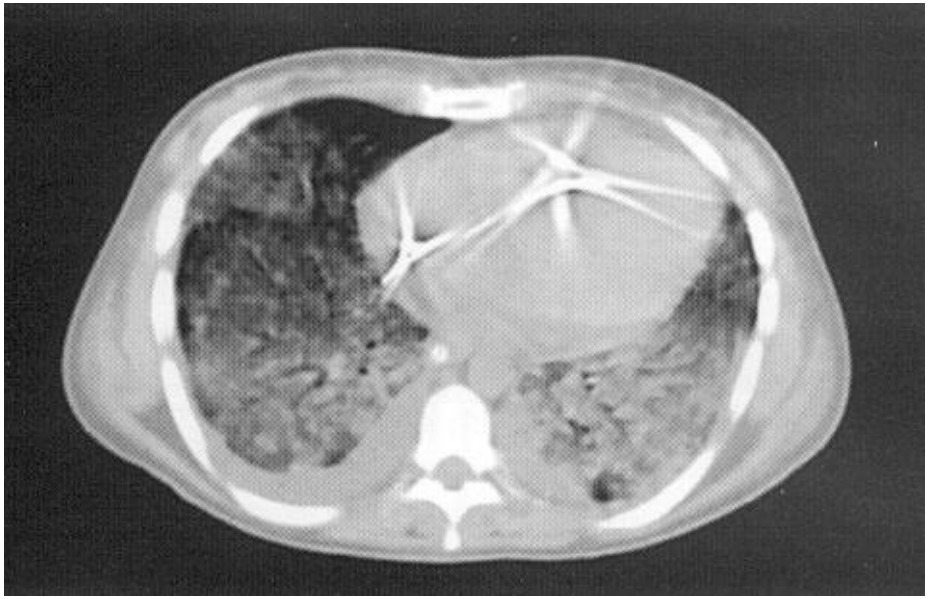
Why can SB be bad?

$P_L = P_{AW} - P_{PL}$



Transpulmonary pressure may be >>> set pressure

Severe ARDS



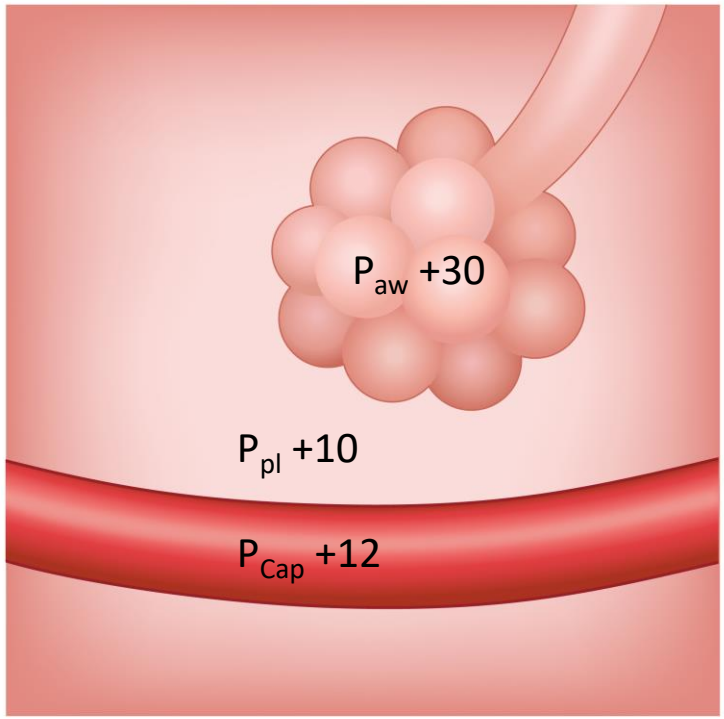
⇧Respiratory drive
(hypercapnia, acidemia, hypoxia,
Inflammation – pulm + systemic)

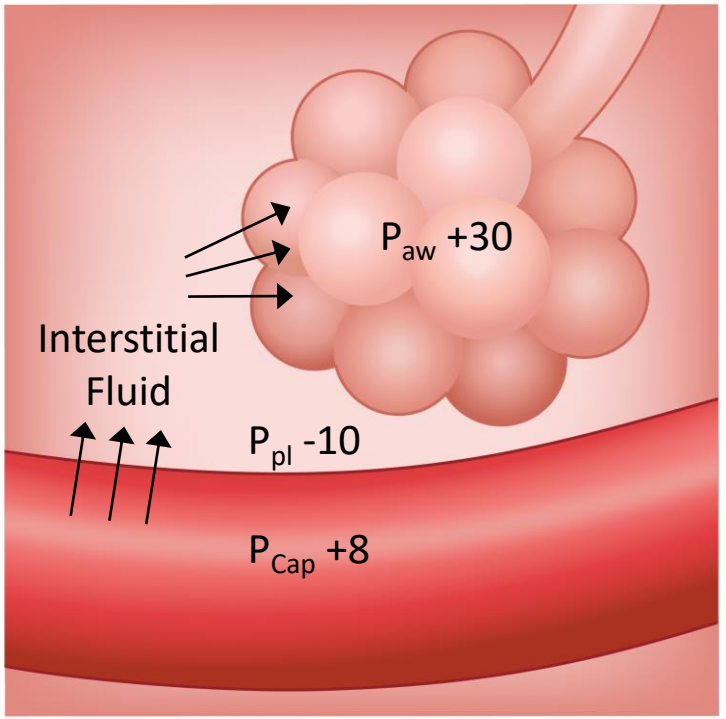
Yoshida T, et al. Am J Resp Crit Care Med 2017; 195:985–992.

Why is it bad?

$P_L = P_{AW} - P_{Pl}$

$P_{TC} = P_{Cap} - P_{Pl}$

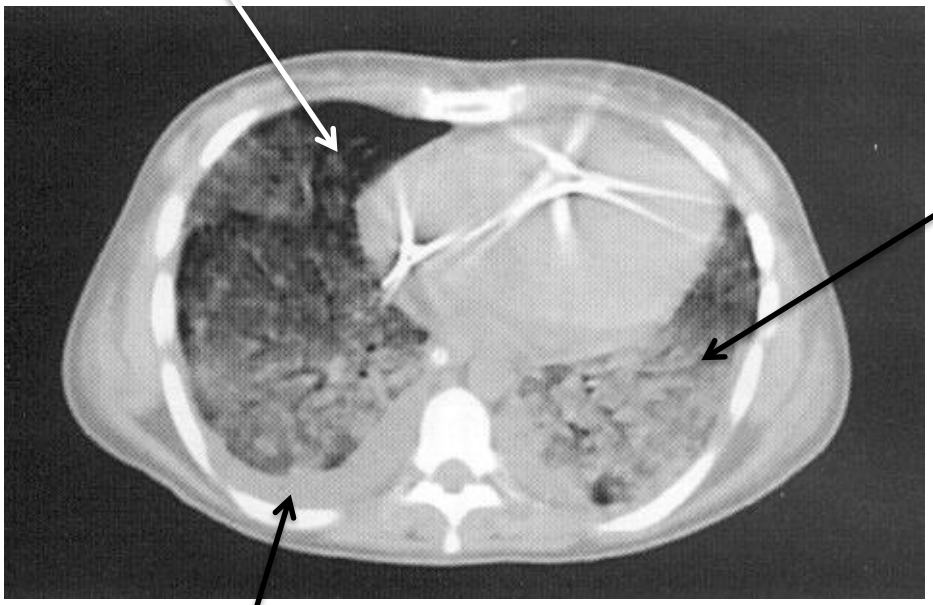




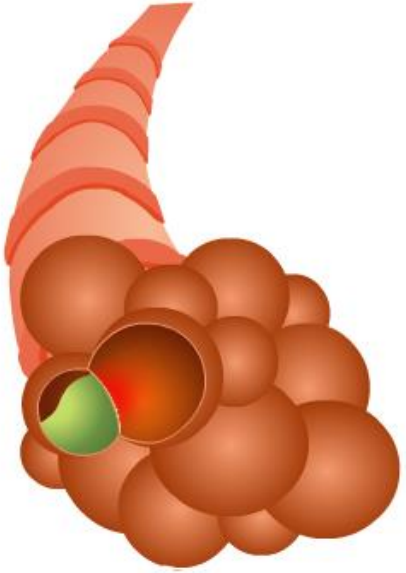
Yoshida T, et al. Am J Resp Crit Care Med 2017; 195:985–992.

Severe ARDS

Baby Lung



⇧Capillary permeability



⇧Tidal recruitment

SB in early severe ARDS

- Often vigorous efforts
- High tidal volumes (over distention and barotrauma)
- Tidal recruitment of collapsed alveoli (shear stress and pulmonary inflammation)
- Increased interstitial and alveolar fluid content

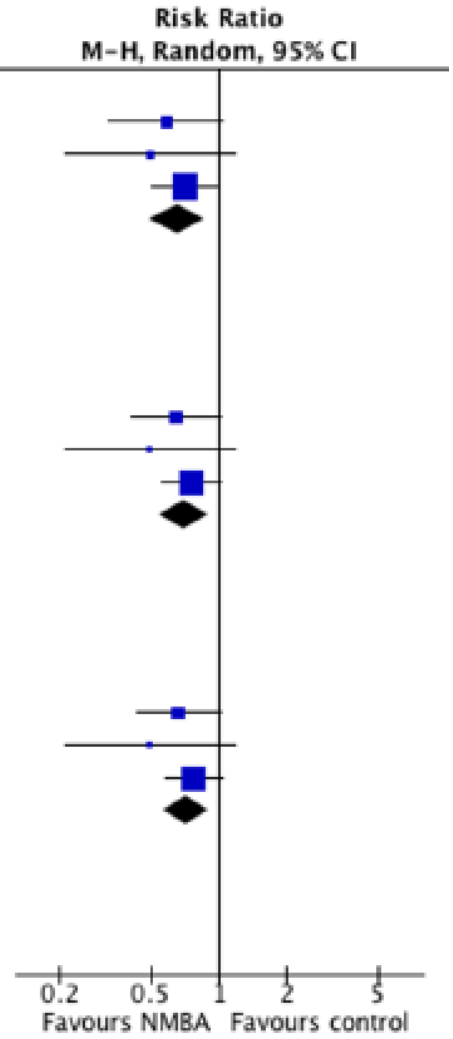
Poor outcomes

Evidence?

- Human studies in early, severe ARDS
  - Randomized trials indirectly support the concept
    - Neuromuscular blockade (prevents spontaneous effort)
      - Improved lung function
      - Reduced barotrauma (especially pneumothorax)
      - Increased survival

Gainnier M, et al. Crit Care Med 2004;32:113–119.
Forel JM, et al. Crit Care Med 2006;34: 2749–2757.
Papazian L, et al. N Engl J Med 2010;363:1107–1116.

Study or Subgroup	NMBA Events	NMBA Total	Control Events	Control Total	Weight	Risk Ratio M-H, Random, 95% CI	Year
1.21.1 Mortality at 28 days							
Gainnier 2004	10	28	17	28	23.1%	0.59 [0.33, 1.05]	2004
Forel 2006	5	18	10	18	10.7%	0.50 [0.21, 1.17]	2006
Papazian 2010	42	177	54	162	66.2%	0.71 [0.51, 1.00]	2010
Subtotal (95% CI)		**223**		**208**	**100.0%**	**0.66 [0.50, 0.87]**	
Total events	57		81				
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 0.75$, df = 2 (P = 0.69); $I^2 = 0\%$							
Test for overall effect: Z = 2.97 (P = 0.003)							
1.21.2 ICU mortality							
Gainnier 2004	13	28	20	28	27.2%	0.65 [0.41, 1.03]	2004
Forel 2006	5	18	10	18	8.0%	0.50 [0.21, 1.17]	2006
Papazian 2010	52	177	63	162	64.8%	0.76 [0.56, 1.02]	2010
Subtotal (95% CI)		**223**		**208**	**100.0%**	**0.70 [0.55, 0.89]**	
Total events	70		93				
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 0.95$, df = 2 (P = 0.62); $I^2 = 0\%$							
Test for overall effect: Z = 2.88 (P = 0.004)							
1.21.3 Hospital mortality (truncated at 90 days)							
Gainnier 2004	14	28	21	28	28.1%	0.67 [0.43, 1.02]	2004
Forel 2006	5	18	10	18	7.1%	0.50 [0.21, 1.17]	2006
Papazian 2010	57	177	67	162	64.8%	0.78 [0.59, 1.03]	2010
Subtotal (95% CI)		**223**		**208**	**100.0%**	**0.72 [0.58, 0.91]**	
Total events	76		98				
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 1.13$, df = 2 (P = 0.57); $I^2 = 0\%$							
Test for overall effect: Z = 2.81 (P = 0.005)							



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Ahazzani W et al. Crit Care 2013; 17:R43

Evidence?

- Severe ARDS (PaO_2/FiO_2 < 120mmHg)
  - RCT 340 patients
  - Early (48h) neuromuscular blockade
    - Reduced barotrauma (4 vs. 11.7%)
    - Decreased 90 day mortality (30.8 vs. 44.6%)

Papazian L, et al. N Engl J Med 2010;363:1107–1116

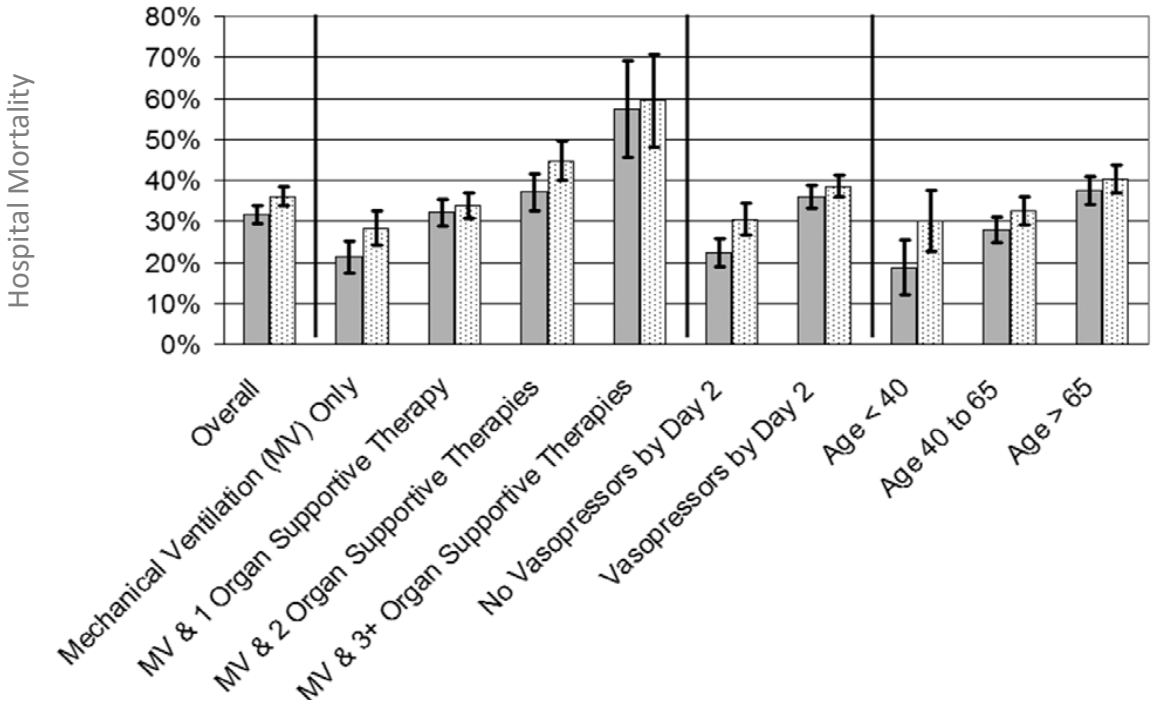
Evidence?

- Epidemiologic cohort study (39 US hospitals)
- Severe Sepsis and MV
  - 7 864 patients (1 818 patients with NMB by D2)
  - Propensity score matching and sensitivity analysis to adjust for confounders

Steingrub JS, et al. Crit Care Med 2014;42:90–96.

Evidence?

- Severe Sepsis and MV



Steingrub JS, et al. Crit Care Med 2014;42:90–96.

Conclusion

- Most likely important to avoid spontaneous breathing in early, severe ARDS
  - NMB with full “controlled MV” for 48h after intubation of severe ARDS

“Intubated MV and ARDS Day 1 - 30% breathe spontaneously regardless of severity”

Bellani G, et al. JAMA 2016;315:788-800

Conclusion

- Spontaneous breathing during MV can be bad for you
- Early, severe ARDS (up to 48h)
  - Recommend NMB
- No evidence for increase in diaphragmatic weakness and PMN critically ill if use is limited to 48h