Patient-Ventilator Interactions

Newer Approaches

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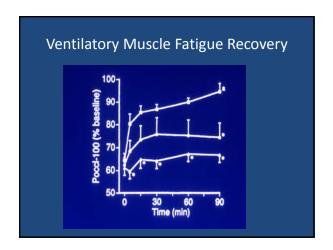
Durham NC, USA

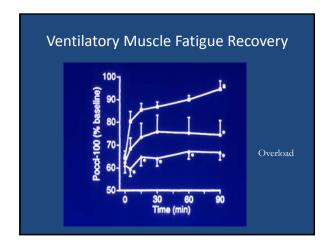
Patient Ventilator Interactions

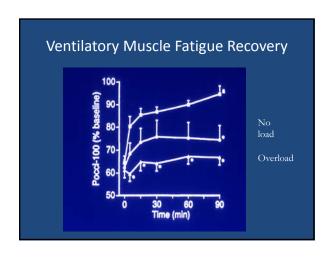
- Assisted vs controlled mechanical ventilation
- Interactions during conventional assisted mechanical ventilation: properly loading respiratory muscles
 - Trigger, flow delivery, cycling
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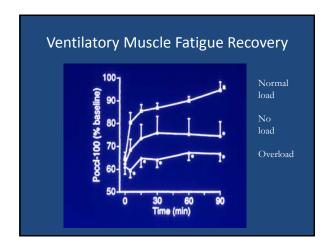
Assisted vs Controlled MV

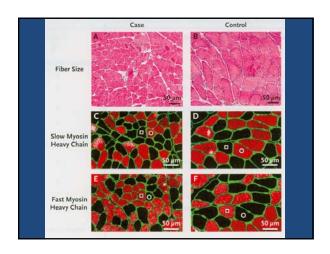
- Controlled machine determined rate and VT
 - Patient does no work
 - ? Useful in florid resp failure with fatigued muscles
 - Risk of VIDD, need for excessive NMBs
- Assisted pt. triggers and interacts with the breath
 - Load depends on effort and applied support
 - ? Useful in recovering respiratory failure
 - Risk of fatigue, dys-synchrony/"fighting"

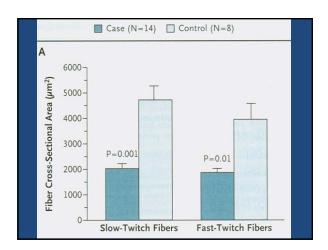












Assisted vs Controlled MV

- Clinically, assisted offers opportunity to avoid NMBs, maintain muscle function (ie avoid VIDD)
 - Shorter length of mechanical ventilation
 - Less long term myopathy
 AJRCCM 2004;169:336, NEJM 2008;358:1527, CCM 1997;25:1187

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 AJRCCM 2004;169:336, NEJM 2008;358:1527, CCM
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- Recent study: survival with 48hrs of NMB
 - Less "fighting" the ventilator? Lower PTX?
 - BUT, control group had: higher "rescue" NMB use than ARDSnet (56% vs 10%) and higher PTX than 3 large RCTs studying PEEP (12% vs 7%)

NEIM 2010: 363:110

Assisted vs Controlled MV

- General consensus is to use assisted modes as soon as clinically possible
- However, assisted modes require patients and ventilators to interact
 - These interactions must be synchronous and comfortable
 - Dys-synchrony and discomfort leads to unnecessary sedation needs and muscle overload

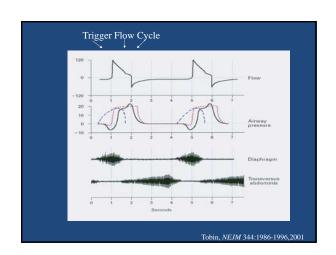
Table 4 Comparison of the outcome between patients with and without a high prevalence of asynchronies (<i>IQR</i> interquartile range)		Asynchrony index < 10% (n = 47)	Asynchrony index ≥ 10% (n = 15)	p
	Duration of mechanical ventilation (days; IQR)	7 (3-20)	25 (9-42)	0.005
	Duration of mechanical ventilation ≥ 7 days	23 (49%)	13 (87%)	0.01
	Tracheostomy	2 (4%)	5 (33%)	0.007
	Mortality	15 (32%)	7 (47%)	0.36

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Patient-ventilator interactions

- During assisted/supported breaths, patients must:
 - trigger the breath
 - synchronize inspiratory effort with the delivered flow
 - synchronize effort termination with machine breath termination
- Dys-synchrony during any of these phases results in high pressure loads on the muscles

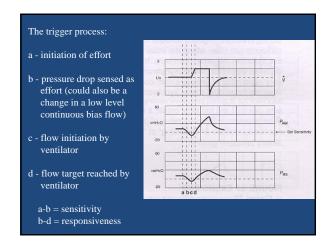


Recognizing dys-synchrony

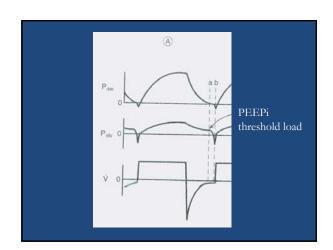
- Clinical signs:
 - excessive breathing effort during the trigger or flow delivery phase
 - inspiratory or expiratory efforts during the cycle phase
- · Graphical displays
 - triggering loads in the Paw or Pes tracings
 - airway pressure being "pulled" down
 - airway pressures not at baseline during cycling

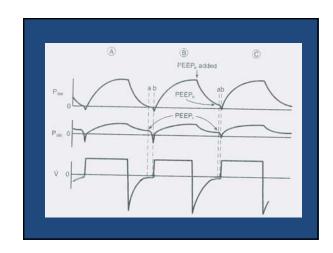
Synchrony issues

- Current approaches:
 - Triggers
 - Flow vs pressure
 - Missed triggers role of PEEP in OAD
 - Extra triggers
 - Flow
 - Flow vs. pressure target
 - Cycle
 - Time, volume, flow criteria



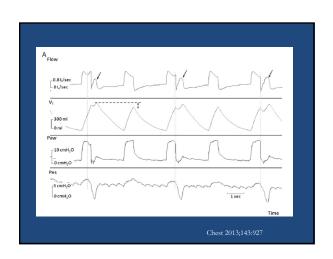
Assisted breath triggering • Pressure trigger - effort produces pressure drop in vent circuit • sensitivity determined by set pressure drop • Flow trigger - effort draws gas out of a continuous flow through the vent circuit • sensitivity determined by amount of flow taken by patient * some vents have both and trigger off the first detected

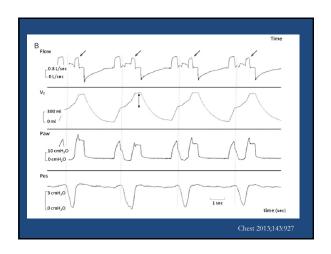




Extra triggers ("Double triggers")

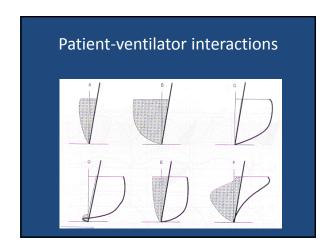
- Cycle criteria to short persistent effort triggers breath
- Entrainment during controlled breaths

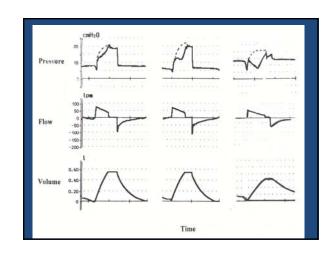


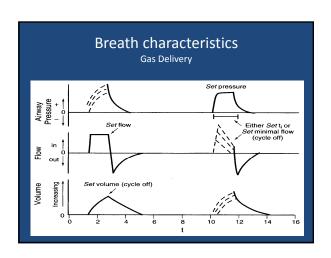


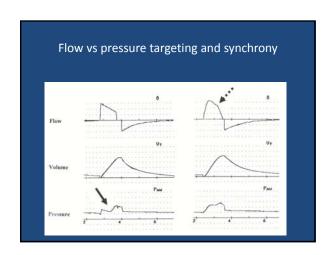
Synchrony issues Current approaches: Triggers Flow vs pressure Missed triggers - role of PEEP in OAD Extra triggers Flow Flow vs. pressure target Cycle

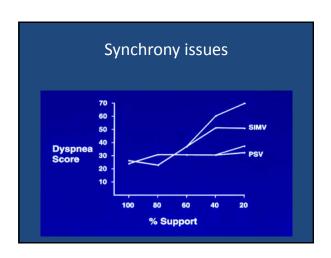
• Time, volume, flow criteria

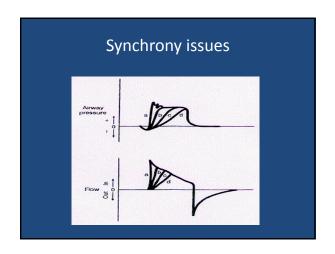


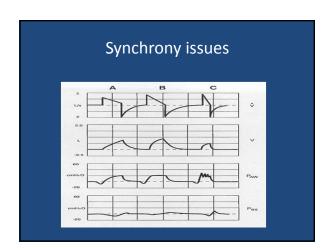


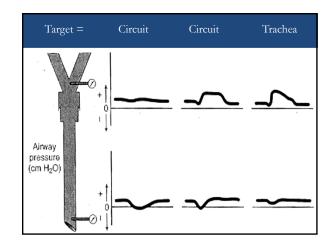


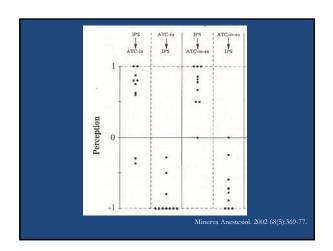


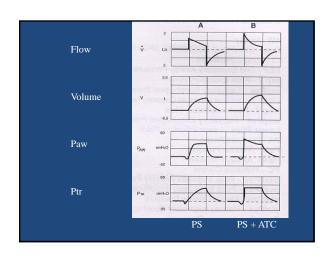






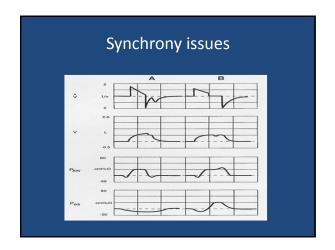


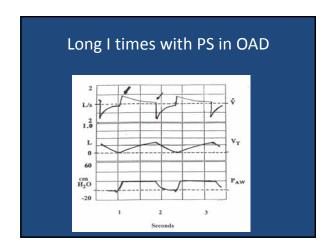


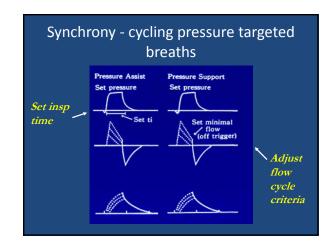


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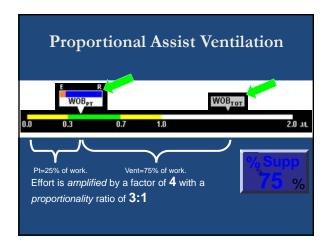
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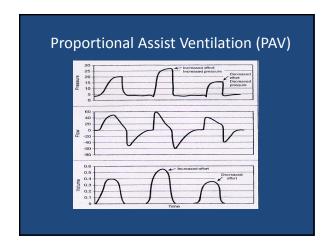
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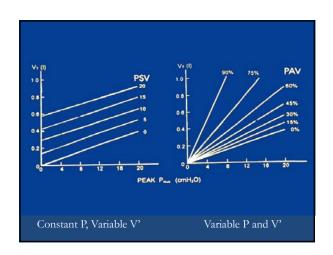
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 - Proportional assist ventilation
 - Neurally adjusted ventilatory support

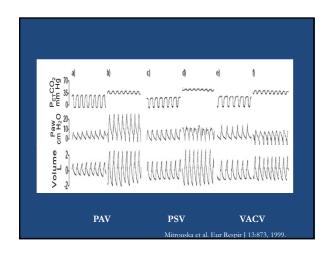
Proportional Assist Ventilation (PAV)

- Calculates R and C
- Monitors inspiratory flow demand
 - Calculates work of breathing (ie pressure requirements for desired flow and volume)
- Applies set "proportion" of required pressure
 - Also terminates (cycles) when effort ceases
- Like power steering on an automobile
 - Driver selects distance to turn wheel, system supplies pressure to reduce effort
 - Like automobile driver patient must be reliable!

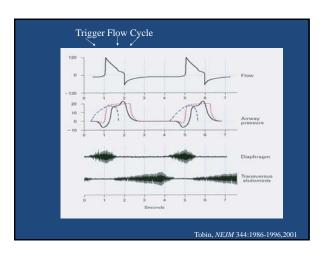


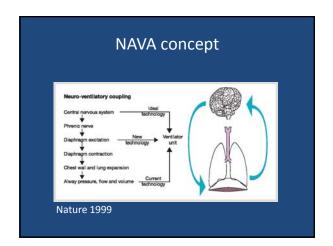


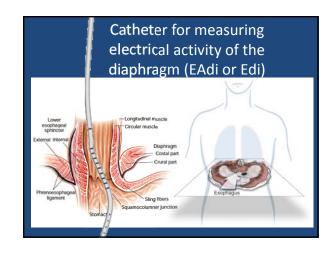


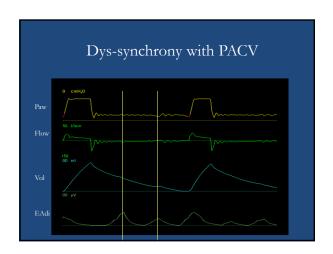


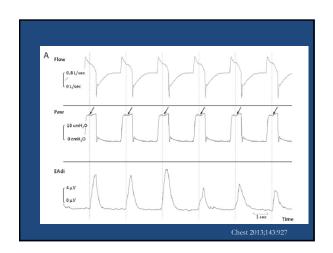
PAV — Clinical Application • Performs as designed - gives comfortable support - Int Care Med 2008 on line - Thorax 2002:57:79 - J Appl Physiol 1996;81:429 - Am J Resp Crit Care Med 1996;153:1005 • No good outcomes trials to date • Reasonable to use in pts with flow or cycle dyssynchrony - Will still have triggering (incl PEEPi) issues - Will require monitors/alarms for low, unstable drive

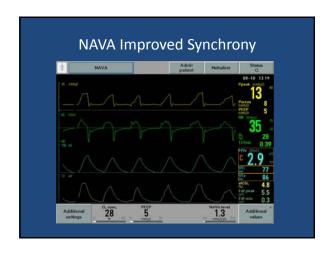


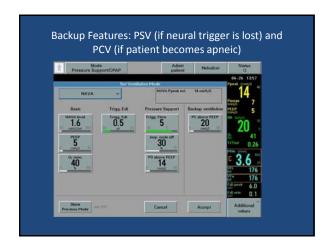












NAVA – Clinical Application

- Performs as designed
 - Intensive Care Med. 2010 Sep 25.
 - Anesthesiology. 2010;113:925
 - Crit Care Med. 2010;38:518
- No good outcomes trials to date
- Theoretically attractive BUT:
 - Catheters expensive and invasive
 - Needs dedicated control system (also expensive)
 - Like PAV< will require monitors/alarms for low unstable drive

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