Society of Anesthesia and Sleep Medicine (SASM)
8th Annual Meeting: *Perioperative Care and Sleep Medicine: Controversies, Challenges and Special Populations*
October 12, 2018
W San Francisco • San Francisco, CA

Choosing the Appropriate Mode of PAP Therapy in the Perioperative Setting

Lisa F. Wolfe MD
Northwestern University
Chicago, Illinois

Choosing the Appropriate Mode of PAP Therapy in the Perioperative Setting

- Thoughts on OSA
  - Does CPAP work?
  - Does Auto CPAP work?
- Thoughts on Obesity
  - Does Lung Volume Recruitment work?
- Thoughts on Obesity related hypoventilation
  - Does NIV work?
  - Does VAPS work?
- Thoughts on Opiod related hypoventilation
  - Does ASV work?

Thoughts on OSA……

Who are these patients?

- Straight forward obstructive sleep apnea
- Defined by a sleep study
- No other significant medical issues that impact control of breathing
- Good established PAP compliance

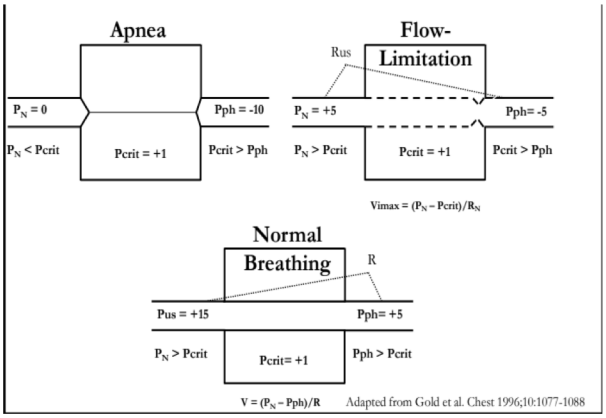
What do we know about their treatment?

- Fixed Pressure CPAP is best in this group
- Good pre – op CPAP users do well with CPAP post op
- These well established patients appear to benefit the most from CPAP use in the post – operative period

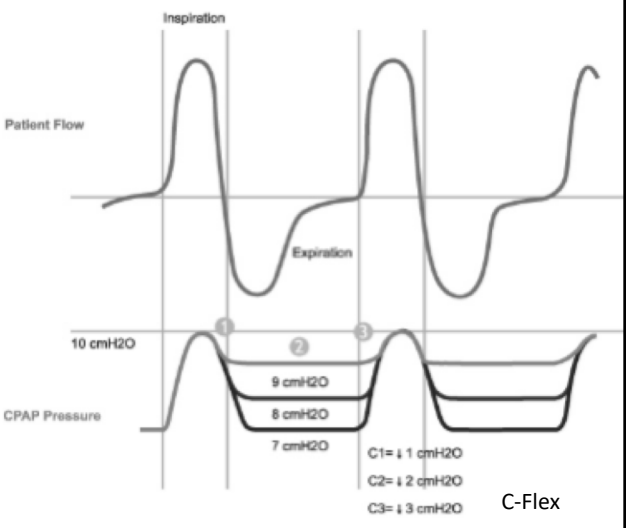
Martin Roesslein and Frances Chung Eur J Anaesthesiol 2018; 35:245–255

Thoughts on OSA……

Establish Critical Opening Pressure



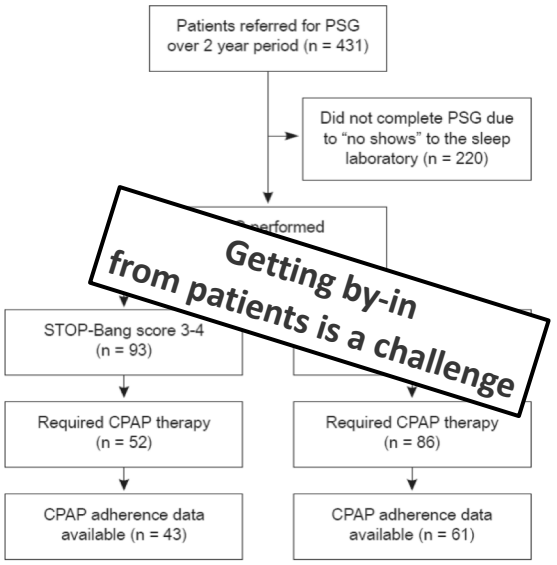
Types of CPAP



C-Flex

Thoughts on OSA……What if they are new users?

- In one model pre-op pt's at high risk based on the STOP BANG
- High drop outs
- CPAP need in 65%
- Adherence:
  - Median=2.5 h/nt
  - Predictors= Race(AA), male, and depression

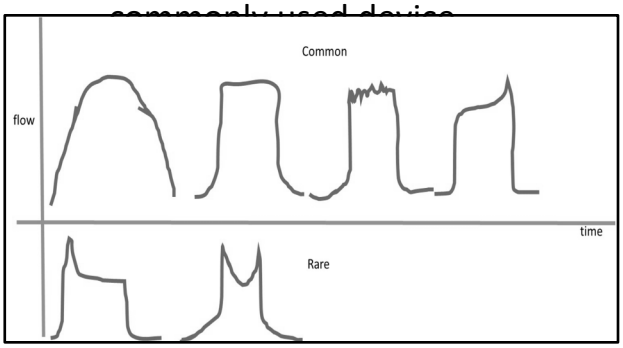


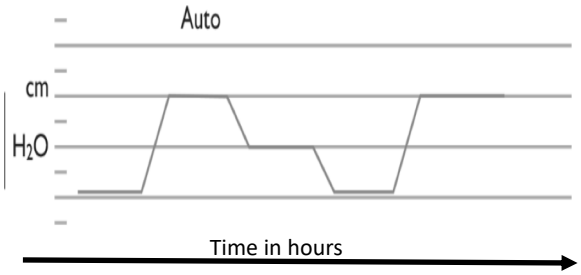
Guralnick AS; *J Clin Sleep Med 2012;8(5):501-506.*

Thoughts on OSA……What if they are new users?

Auto CPAP

- If the patient does not have a device AutoCPAP is the most commonly used device

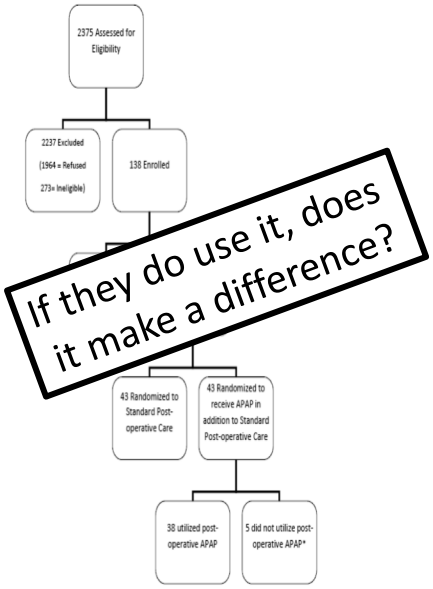




Hillman and Auckley Respir Care 2018;63(4):479–487.

Thoughts on OSA……What if they are new users?

- RTC of APAP post-op
  - Naïve pt's
  - Randomized based on Flemmons scores (PSG done after for analysis purposes)
- Subjects more:
  - Male , obese (33 BMI), elderly (61 yoa), and with more co-morbdities
- Compliance : 6 hours a night
- No difference: LOS, ICU transfers, delirium, atalectaisis



S. M.O'Gorman, P.C.Gay, and T.I.Morgenthaler, Chest. 2013 Jan 3. doi: 10.1378/chest.12-0989.

Thoughts on OSA……What if they are new users?

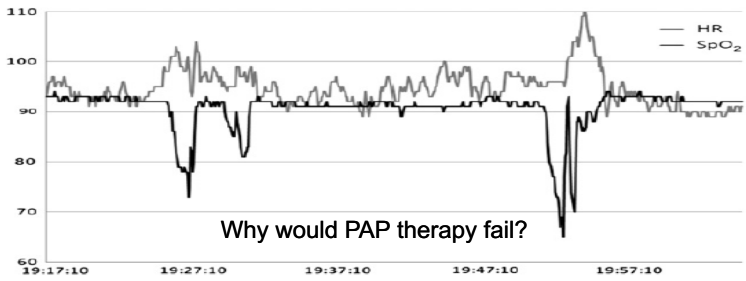
Why is there no difference?

	AHI ≥ 15	AHI < 15
High risk	47	23
Low risk	19	26

- Many patients listed as high risk had low AHI.
  - Over treatment??
- Auto's are not as affective as needed
  - Increased physician awareness may have impacted equipoise/ recruiting.
  - Average CPAP press= 5
  - Average persistent AHI = 13.2
  - Auto's cant address central apnea or hypoventilation

Susan M. O'Gorman Chest. 2013 Jan 3.. [Epub ahead of print]

Thoughts on Obesity - Why would PAP therapy fail?



- In this study post op gastric bypass patients were monitored with pulse oximetry.
- Even the use of CPAP therapy did not completely resolve desaturation events

- Three episodes of nocturnal desaturation
- Episodes of hypoxemia were a consistent finding, despite aggressive preoperative diagnosis and treatment of OSA (CPAP/ Bipap).
- No patient exhibited arterial PaCO2 evidence of hypoventilation.
- No patient experienced cardiopulmonary arrest/instability.

Gallagher et al JOURNAL OF SURGICAL RESEARCH: VOL. 159, NO. 2, APRIL 2010

Thoughts on Obesity - Why would PAP therapy fail?

Table 3. Postoperative Oximetry Outcomes

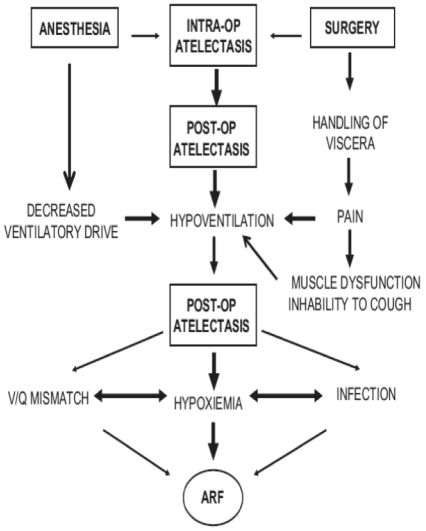
	OSA	Non-OSA	*P*
Median Spo_2 with supplemental oxygen during first 24 h postoperatively	97.0 (96.1–97.6)	97.3 (95.4–98.3)	0.97
Percent of time <90% sat	0.2 (0.06–0.7)	0.6 (0–1.6)	0.48
Gastric bypass	0.20 (0.06–0.85)	0.75 (0.4–6.5)	0.17
Gastric banding	0.10 (0.0–0.70)	0 (0–0.8)	0.59
Oxygen desaturation index <4% of sleep study baseline	1.2 (0.8–3.4)	2.9 (0.6–6.0)	0.44
Gastric bypass	1.3 (0.8–4.0)	4.5 (0.5–7.8)	0.43
Gastric banding	1.1 (0.7–2.0)	2.0 (0.8–2.9)	0.40

- Key finding – desaturations were also seen in the non-OSA group

Gallagher et al JOURNAL OF SURGICAL RESEARCH: VOL. 159, NO. 2, APRIL 2010

Thoughts on Obesity - Why would PAP therapy fail?

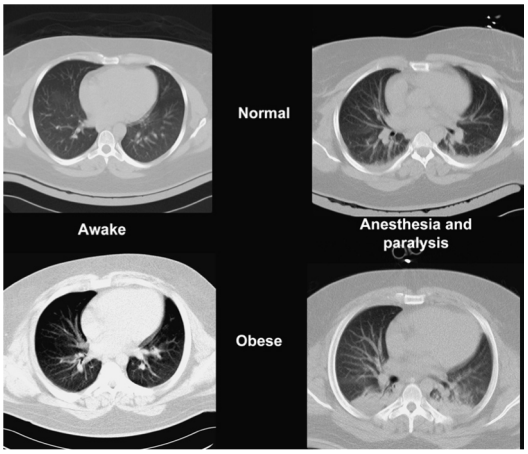
- Hypoxemia in the setting of obesity may be due to factors other then OSA:
  - Hypoventilation
  - V/Q mismatch
  - Atelectasis



Paolo Pelosi, Best Practice & Research Clinical Anaesthesiology 24 (2010) 211–225

Thoughts on Obesity - Why would PAP therapy fail?

- The fixes:
  - Recruitment maneuver (35– 55 cmH2O for 6s) intraoperatively – just before extubation
  - followed by the application of CPAP= 10cmH2O.



Paolo Pelosi, Best Practice & Research Clinical Anaesthesiology 24 (2010) 211–225

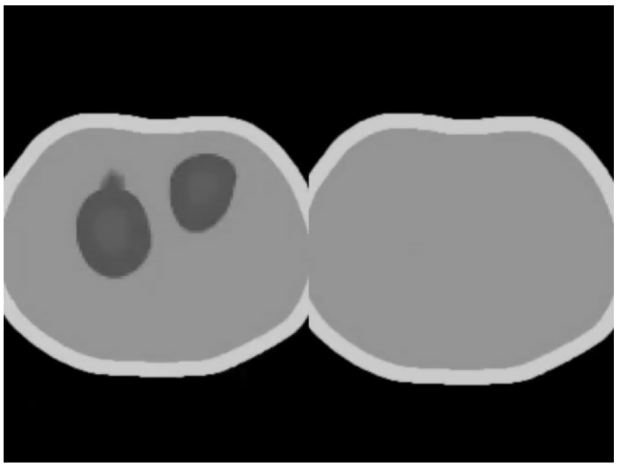
Thoughts on Obesity - Why would PAP therapy fail?

Am J of R & CCM Vol(198) 4 - August 15 2018

Pendelluft = a pronounced diaphragmatic contraction resulting in concentration of force within dependent areas of the lung.

When PEEP is increased to 16 cm H2O, a more homogeneous distribution of ventilation is observed with a significantly reduced pendelluft.

Improved Ventilation



electrical impedance tomography

Thoughts on Obesity related hypoventilation

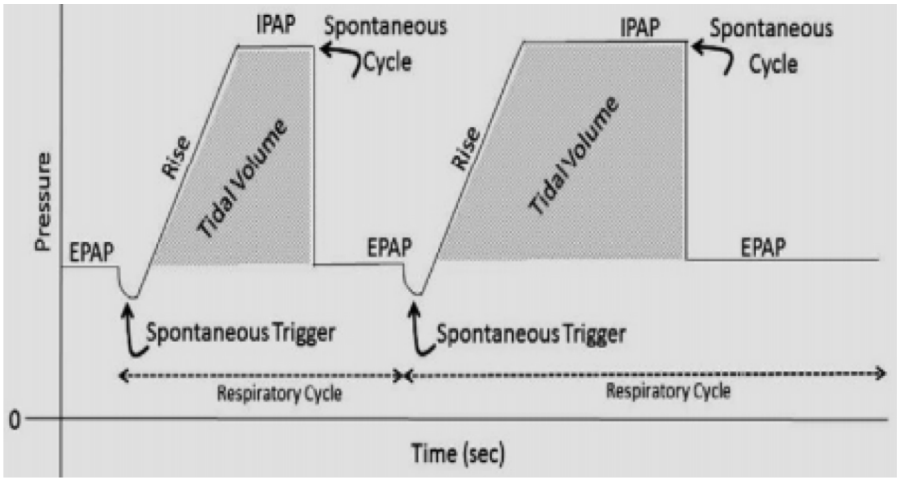
High AHI	Low AHI

• ~60% of the pt's are effectively treated with CPAP
• Another significant portion of pt's who need NIV in the ICU can be transitioned to CPAP over time.
• If initiated in the hospital on VAPS mode it is appropriate to assess in the sleep lab after d/c to try and downshift to CPAP therapy
	• These pt's are a unique, poorly under stood phenotype
	• These patients should continue to receive full NIV
	• They may need LSMV over the long term
	• Goal of removing supplemental O2 is likely of great benefit
	  • Sign of adequate ventilation
	  • Sign of better cardiac resilience

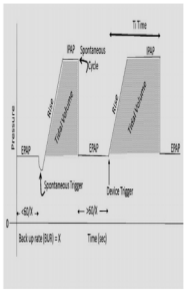
Masa Et al AJRCCM Vol 192, Iss 1, pp 86–95, Jul 1, 2015	Masa JF, Corral J, Caballero C, et al. Thorax 2016;71:899–906.

Thoughts on Obesity related hypoventilation

High AHI



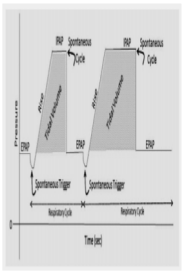
Low AHI



Selim, Coleman, Wolfe
Chest 2018

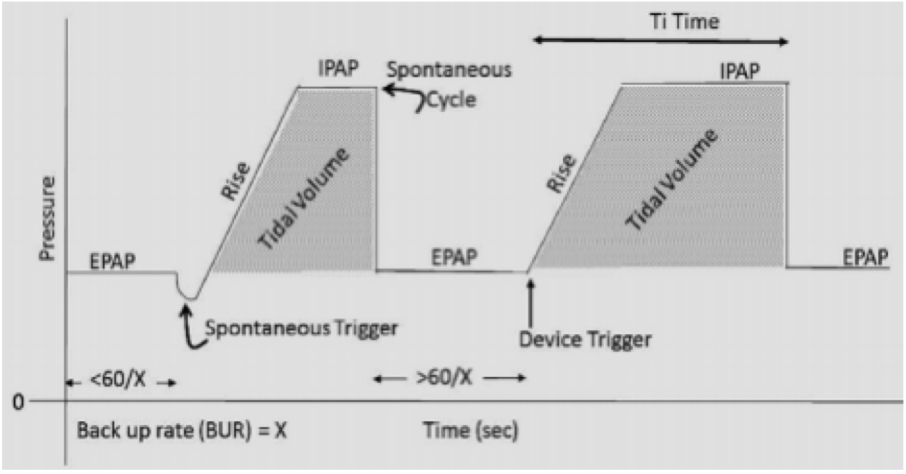
Thoughts on Obesity related hypoventilation

High AHI



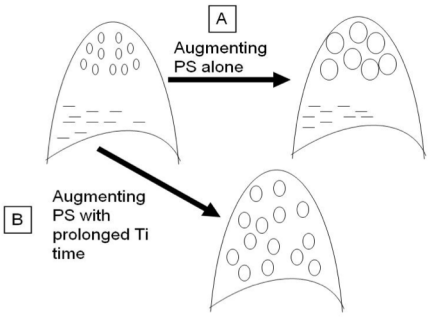
Selim, Coleman, Wolfe
Chest 2018

Low AHI



Thoughts on Obesity related hypoventilation

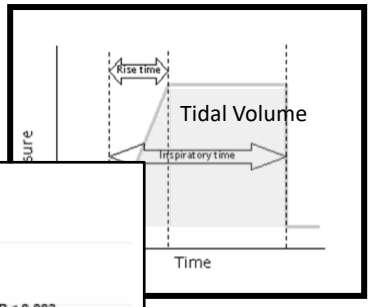
Adjustment of IPAP, EPAP, and PS Settings

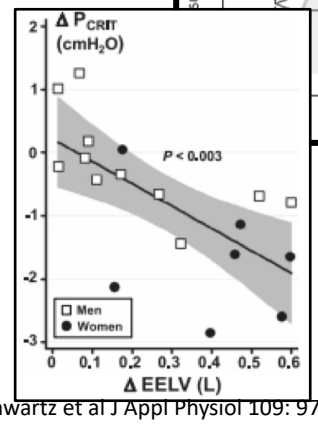


This picture (A) highlights the impact of pressure support alone which would tend to over distend areas with of low resistance (upper lobes) and would fail to recruit areas of high resistance (basilar atelectasis).

This picture (B) highlights the impact of prolonged Ti time which would allow for improved recruitment of high resistance atelactatic basilar segments, and thereby improve V/Q relationships.

$$V_t \alpha \frac{(I-E)}{R} \times T_i$$





Pcrit 1/ α FVC

Alan Schwartz et al J Appl Physiol 109: 977–985, 2010

Thoughts on Obesity related hypoventilation

Awaiting results however the theory is that those with OHV need to accurately assure BOTH

- **Vt & PEEP**

Protective intraoperative ventilation with higher versus lower levels of positive endexpiratory pressure in obese patients (PROBESE)

Bluth et al. Trials (2017) 18:202

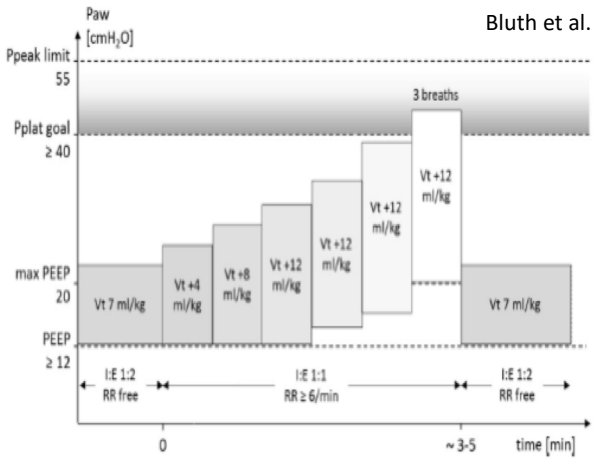
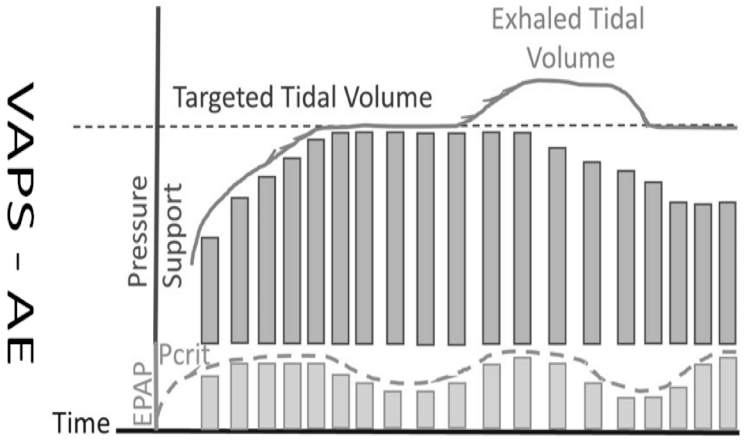


Fig. 2 Lung recruitment maneuver protocol. *Ppeak* Peak airway pressure, *Pplat* Plateau airway pressure, *PEEP* Positive end-expiratory pressure, *Vt* Tidal volume normalized for predicted body weight, *RR* Respiratory rate, *I:E* Ratio between inspiratory and expiratory time

Thoughts on Obesity related hypoventilation

Volume Assured Pressure Support

- No data in the peri-operative period
- Dual treatment
  - Pcrit assessment target best EPAP
  - Exhale Vt assessment to target best IPAP

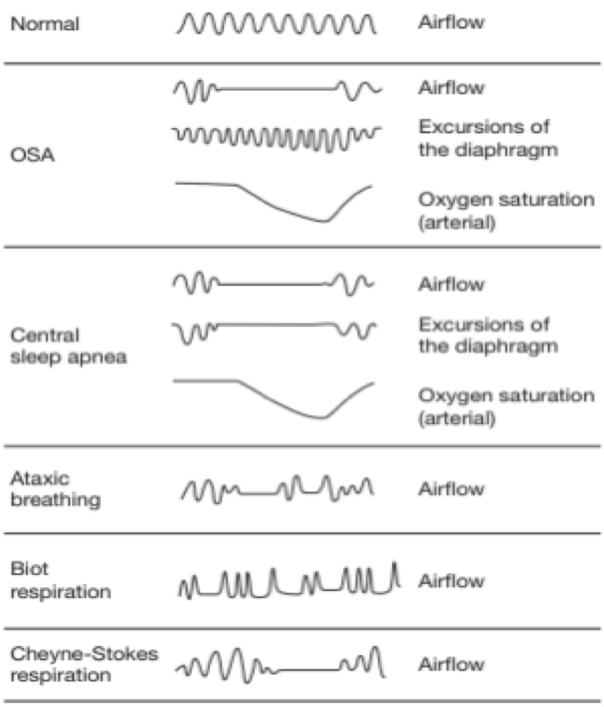


Thoughts on Opiod related hypoventilation

When CPAP isn't enough

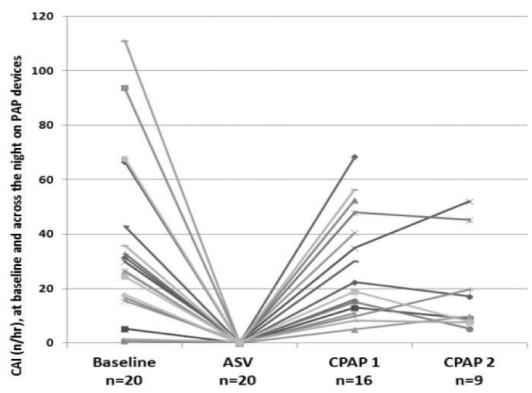
- Use of opiod medications increases *central apnea* in those with no breathing issues
- In the setting of OSA – *obstructive events* became worse in the setting of Narcotic use.
- Thirty percent of pt exposed to narcotics have CSA
- Amount of drug alone does not predict risk
- Lower daytime PaCO2 is a risk

Nick Antic CHEST 2016; 150(4):934-944



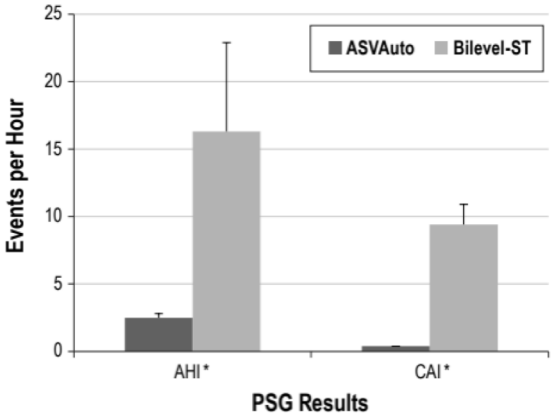
Thoughts on Opiod related hypoventilation

In the setting of Narcotic use
Impact of ASV on AHI



Javaheri J Clin Sleep Med 2014;10(6):637-643

ASV in auto mode is more effective in narcotic patients



Cao, M.et al JCSM , Vol. 10, No. 8, 2014

Thoughts on Opiod related hypoventilation

Servo- Ventilation:

The term correctly applies only to systems where the *feedback or error-correction signals* help control mechanical position, speed or other parameters.

- Designed to address Cheyne-Stokes Respiration
- REM to NREM differences in central apnea of CSR
- Night to night changes:
  - Alkalosis
  - Hypervolemia
  - Body position
  - Narcotics

Volume Targeted Ventilation:

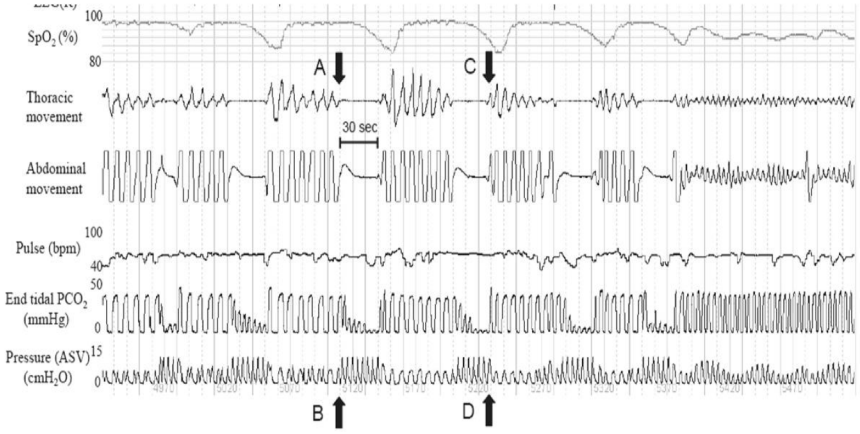
The term refers to systems that use optimization in delivered pressure support *reach a goal / average exhaled tidal volume*.

- Designed to address hypoventilatory central apnea
- REM to NREM differences in ventilation
- Night to night changes:
  - Progressive muscle loss
  - Alcohol/ benzodiazepines
  - Body position

http://en.wikipedia.org/wiki/Servomechanism

Thoughts on Opiod related hypoventilation:
Servo Ventilation

- Servo Ventilation: How does it work?



Banno *et al.*, *J Clin Sleep Med* 2006;2(2):181-186.

Thoughts on Opiod related hypoventilation:
Servo Ventilation - Settings

ResMed:
Adapt Servo Ventilation in auto mode

- **EPAP min** (4-15)
- **EPAP max** (4-15)
- **PS** set from min (3) to max (16)
  - Total pressure can't go above 25.
- **Back up rate** is auto
  - Does not need to be set

Respironics:
BiPAP Auto SV advanced

- **EPAP min** (4-15)
- **EPAP max** (4-15)
- **PS min** (0-20)
- **PS max** (0-20)
- **Max pressure** (25)
- **Rise** (1-3)
  - Only an option when flex is off
- **Biflex**(1,2,3)
  - Only when rise is off

- **Rate** (4-30, auto, off)
  - Ti (0.5-2.0)
    - Only an option when the rate is set (4-30)

Circ Heart Fail 2010;3:140-148
Therapeutic Advances in Respiratory Disease. 4(6):341-51, 2010 Dec.

Take home messages

- CPAP settings from a pre – op PSG is best
- Auto CPAP is the standard of care but may not be the best choice
- Obesity patients need lung volume recruitment
- OHV patients will often need NIV rather then CPAP
  - VAPS devices may be an option when baseline NIV settings have not been pre-determined
- Narcotics may induce central apnea and auto titration with ASVauto may be best