

Connecting a Global Community
in Clinical Chest Medicine

PAP Modalities

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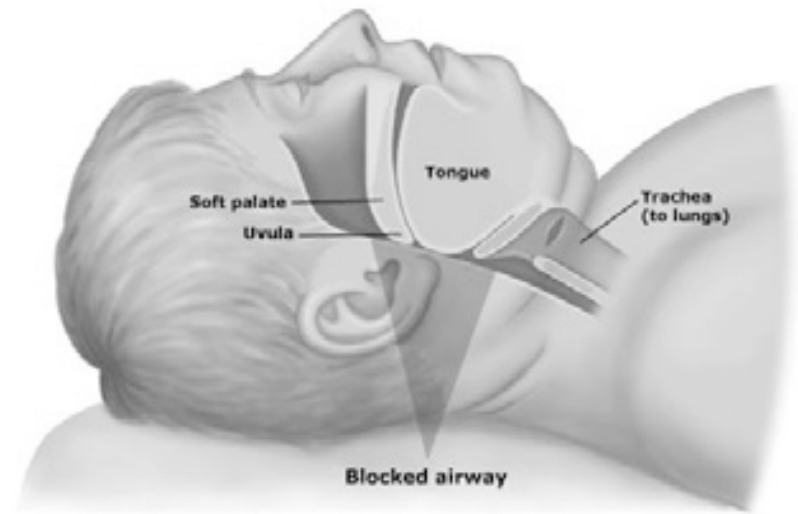
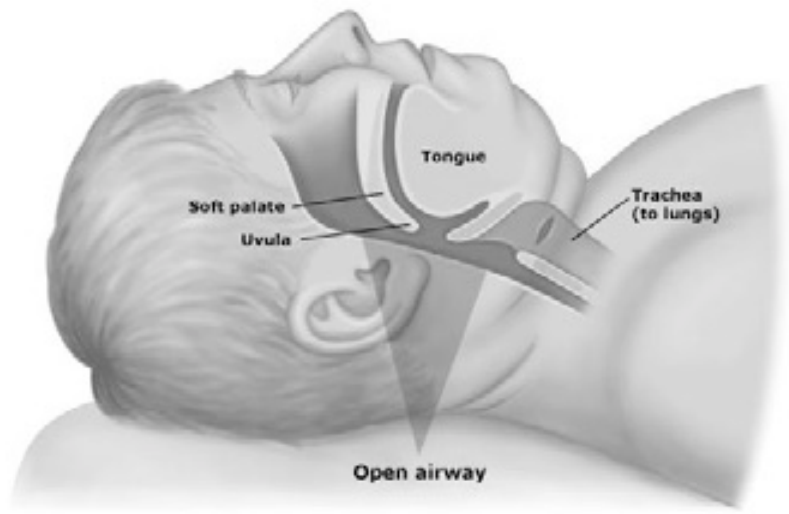
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Positive Airway Pressure (PAP) Modalities

- CPAP
- APAP
- Bilevel
- Advanced bilevel modalities
 - Bilevel ST, Adaptive Servo Ventilation, Volume Assured Pressure Support

CPAP

- Continuous Positive Airway Pressure
- CPAP delivers pressurized air at a constant pressure through a mask to keep the airway open during inhalation.



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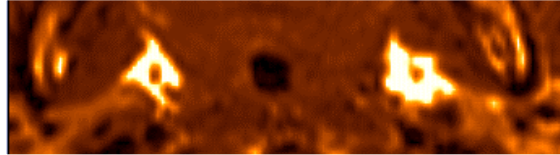
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CPAP Acts as an Airway Stent

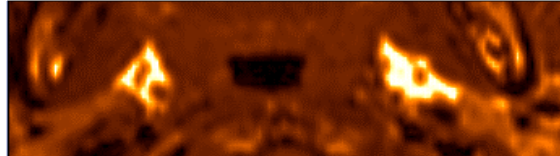
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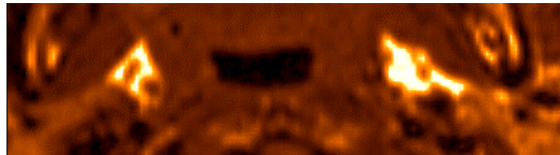
0 cm H₂O



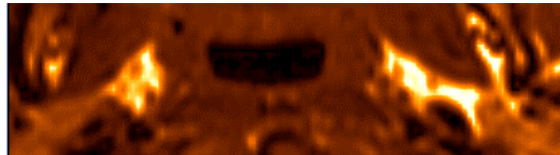
5 cm H₂O



10 cm H₂O



15 cm H₂O

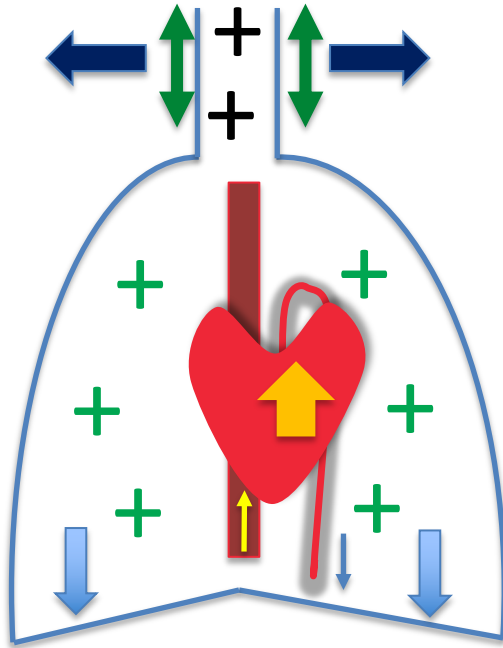


Richard Schwab, M.D. UPENN

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Effects of PAP



- +
 - +
 - ↕
 - ➡
 - ↓
 - ↑
 - ↓
 - ↑
- Positive airway pressure
- Positive intrathoracic pressure
- Traction on airway
- Splinting of airway
- Increased lung volume
- Decreased venous return
- Decreased afterload
- Increased cardiac output

Adherence With CPAP

- Definition of adherence
 - > 4 hours/night on 70% of nights
- Adherence probably about 50 - 60%
 - Patients overestimate nightly use.
- Adherence patterns are determined early
- Few clear predictors of adherence:
 - Daytime sleepiness
 - More severe disease

CPAP: Complications

- Rhinorrhea
- Nasal congestion or dryness
- Epistaxis
- Skin abrasions/rashes
- Chest discomfort
- Claustrophobia
- Air swallowing
- Inconvenient
- “Not sexy”

Examples of Common CPAP Devices

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Respironics
Dreamstation



DeVilbiss
IntelliPaP



Resmed
Airsense

Fisher &
Paykel



Common CPAP Interfaces: Masks

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Nasal



Nasal Pillows



Full Face



APAP

- Auto Positive Airway Pressure
- (autotitrating positive airway pressure)
- APAP works similarly to CPAP but the pressure can adjust within a range of pressures to maintain an open airway

APAP Download

Auto-CPAP Summary

Auto-CPAP Mean Pressure	8.7 cmH2O
Auto-CPAP Peak Average Pressure	11.1 cmH2O
Average Device Pressure <= 90% of Time	11.3 cmH2O
Average Time in Large Leak Per Day	0 secs.
Average AHI	5.3

Device Settings as of 1/17/2019

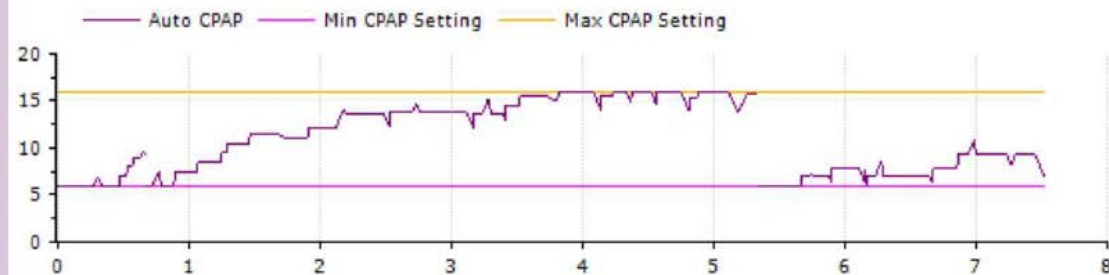
Device Mode AutoCPAP - A-Flex

Device Settings

Parameter	Value
Min Pressure	6 cmH2O
Max Pressure	16 cmH2O

Pressure (cmH2O)

Mode: Auto CPAP with A-Flex



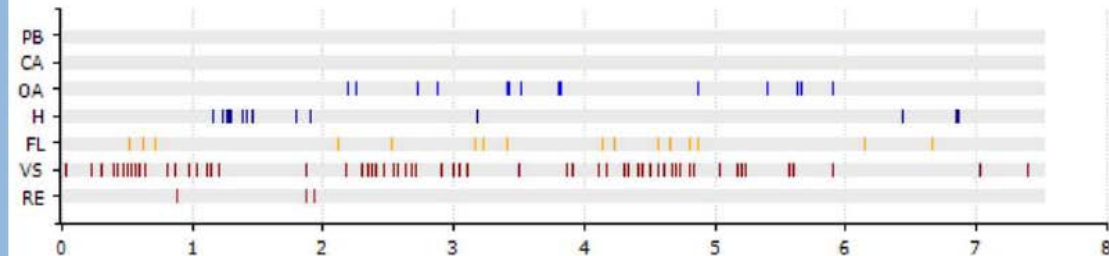
90% Pressure

13.3

Average CPAP

11.0

Sleep Therapy Flags



Indices

0.0 % of Night in PB

CA: 0.0

OA: 2.1

H: 2.1

FL: 2.1

VS: 13.3

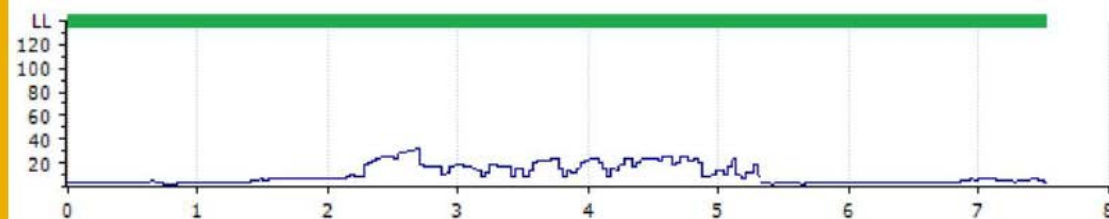
RE: 0.4

AHI: 4.2

FL - Flow Limitation, VS - Vibratory Snore, PB - Periodic Breathing, CA - Clear Airway Apnea, RE - RERA, H - Hypopnea, OA - Obstructed Airway Apnea, AHI - Apnea/Hypopnea Index

Unintentional Leak (LPM)

■ Normal Mask Fit ■ Breathing not detected ■ Large Leak (LL) — Unintentional Leak



Min in Large Leak

0.0 mins.

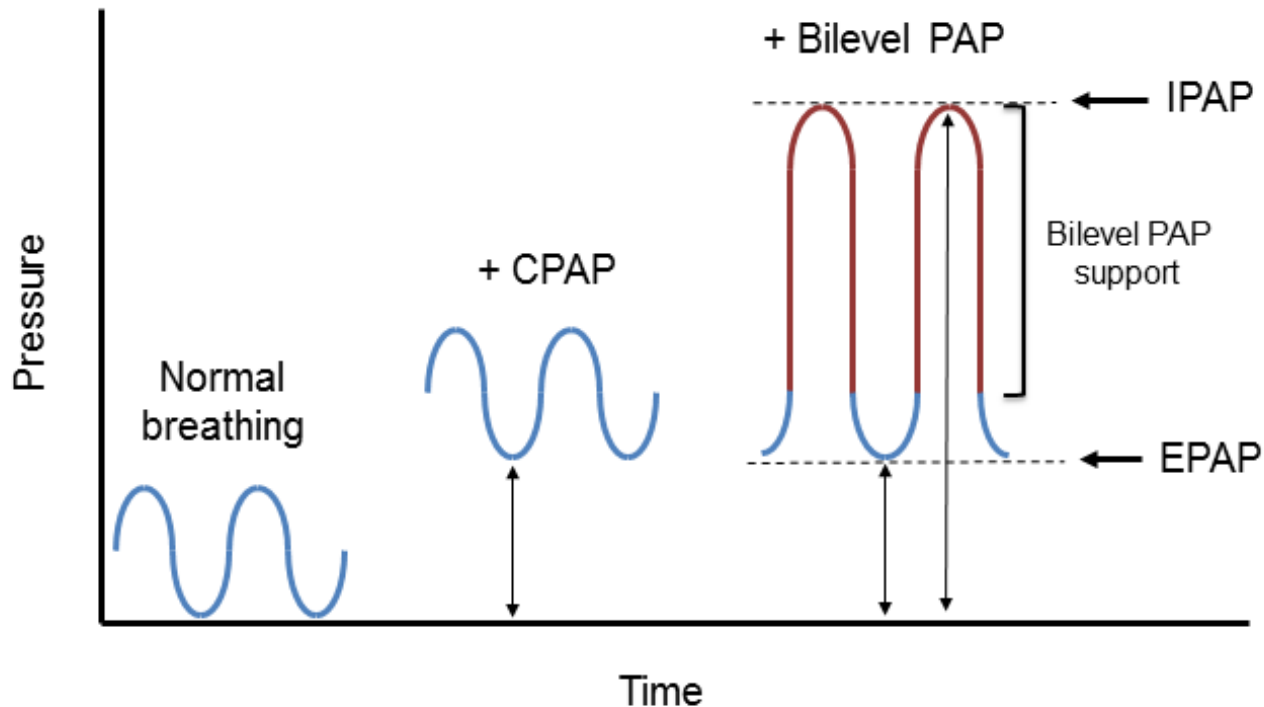
% of Night in Large Leak

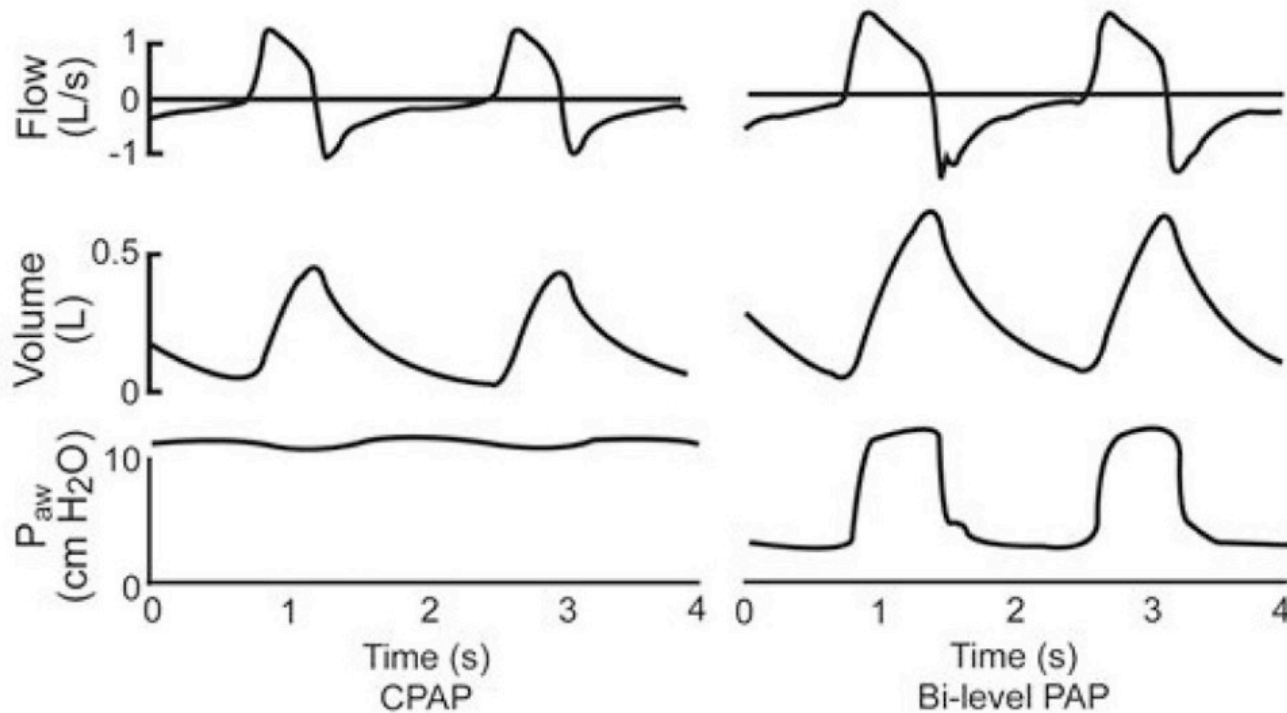
0 % of Night

Average Unintentional Leak

10.0

Bilevel





Antonescu-Turcu et al. Respir Care. 2010 Sep; 55(9): 1216–1229.

Can bilevel in spontaneous mode treat central sleep apnea?

A. Yes

B. No

Can bilevel in spontaneous mode treat central sleep apnea?

A. Yes

B. No

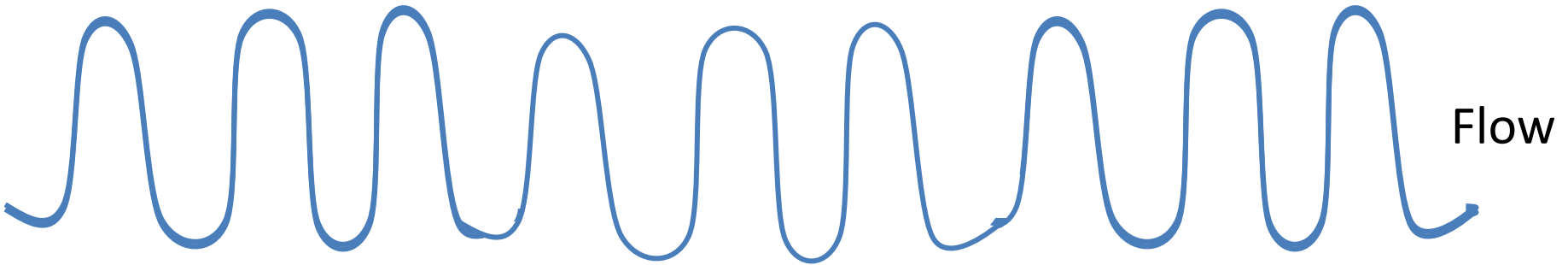
Bilevel Spontaneous vs Spontaneous Timed

Central Apnea



Bilevel Spontaneous vs Spontaneous Timed

Central Apnea



Which of the following PAP modalities should be avoided in patients with hypoventilation?

- A. Bilevel ST
- B. Volume Assured Pressure Support (VAPS)
- C. Bilevel S
- D. Adaptive Servo Ventilation (ASV)

Which of the following PAP modalities should be avoided in patients with hypoventilation?

A. Bilevel ST

B. Volume Assured Pressure Support (VAPS)

C. Bilevel S

D. Adaptive Servo Ventilation (ASV)

	Hypoventilation	Central Sleep Apnea with Periodic Breathing	Central Sleep Apnea with Hypoventilation
Bilevel S	YES	NO	NO
Bilevel ST	YES	YES	YES
Adaptive Servo Ventilator (ASV)	NO	YES	NO
Volume Assured Pressure Support (VAPS)	YES	NO	YES

Adaptive Servo Ventilation (ASV)

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Maintains a the patient's recent flow/ventilation by adjusting the pressure support, and providing a backup rate

Theory of Operation

Breath by breath, the algorithm adjusts pressure support if....

1. Peak Flow/Minute Ventilation is at target → No additional* IPAP is given
2. Peak Flow/Minute Ventilation is reduced below target → IPAP is increased
3. Peak Flow/Minute Ventilation is increased → IPAP is decreased

Flow

Pressure

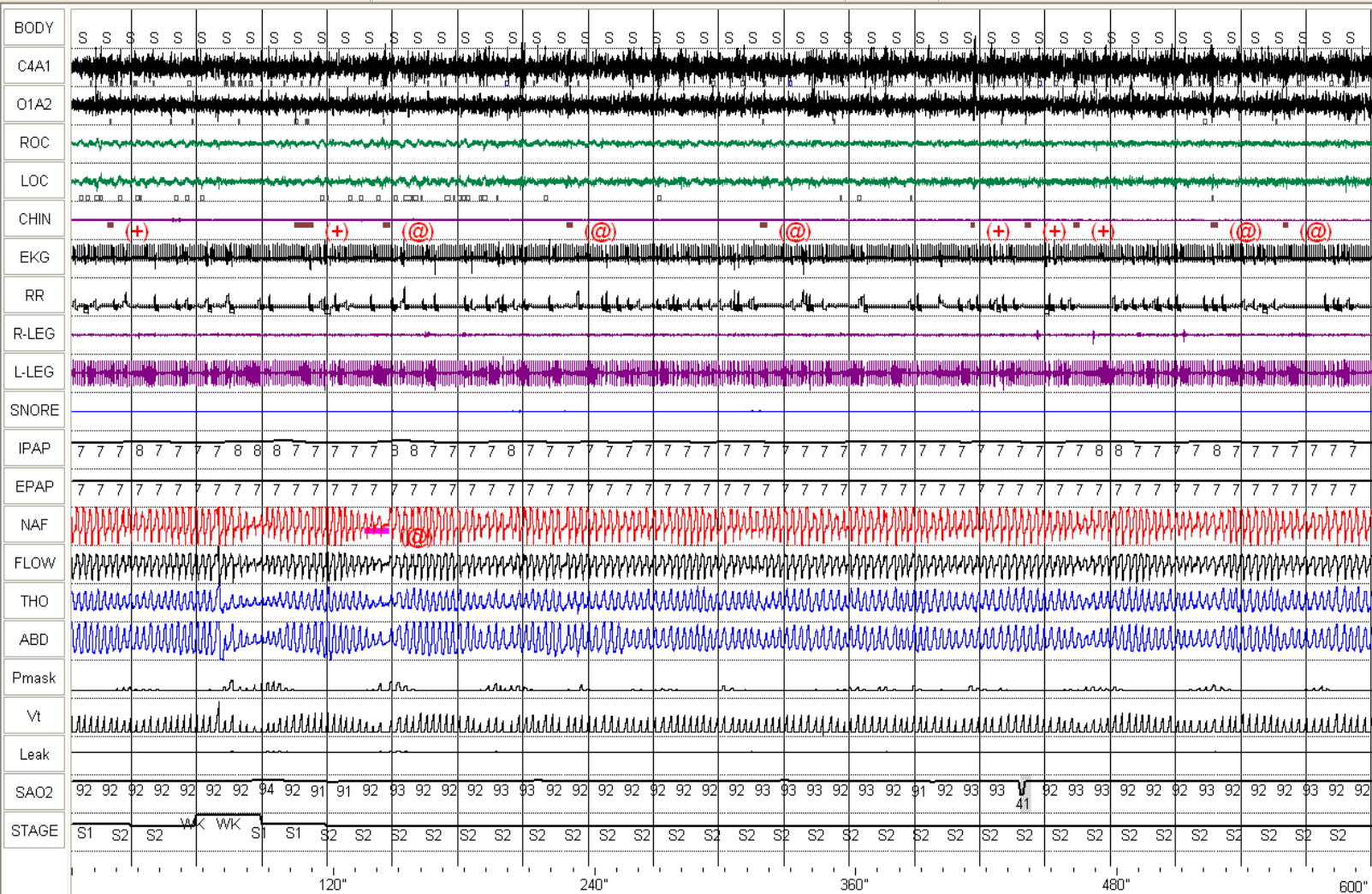


Warning:

ASV is currently contraindicated in patients with predominant central sleep apnea (CSA) and reduced left ventricular ejection fraction (LVEF \leq 45%).

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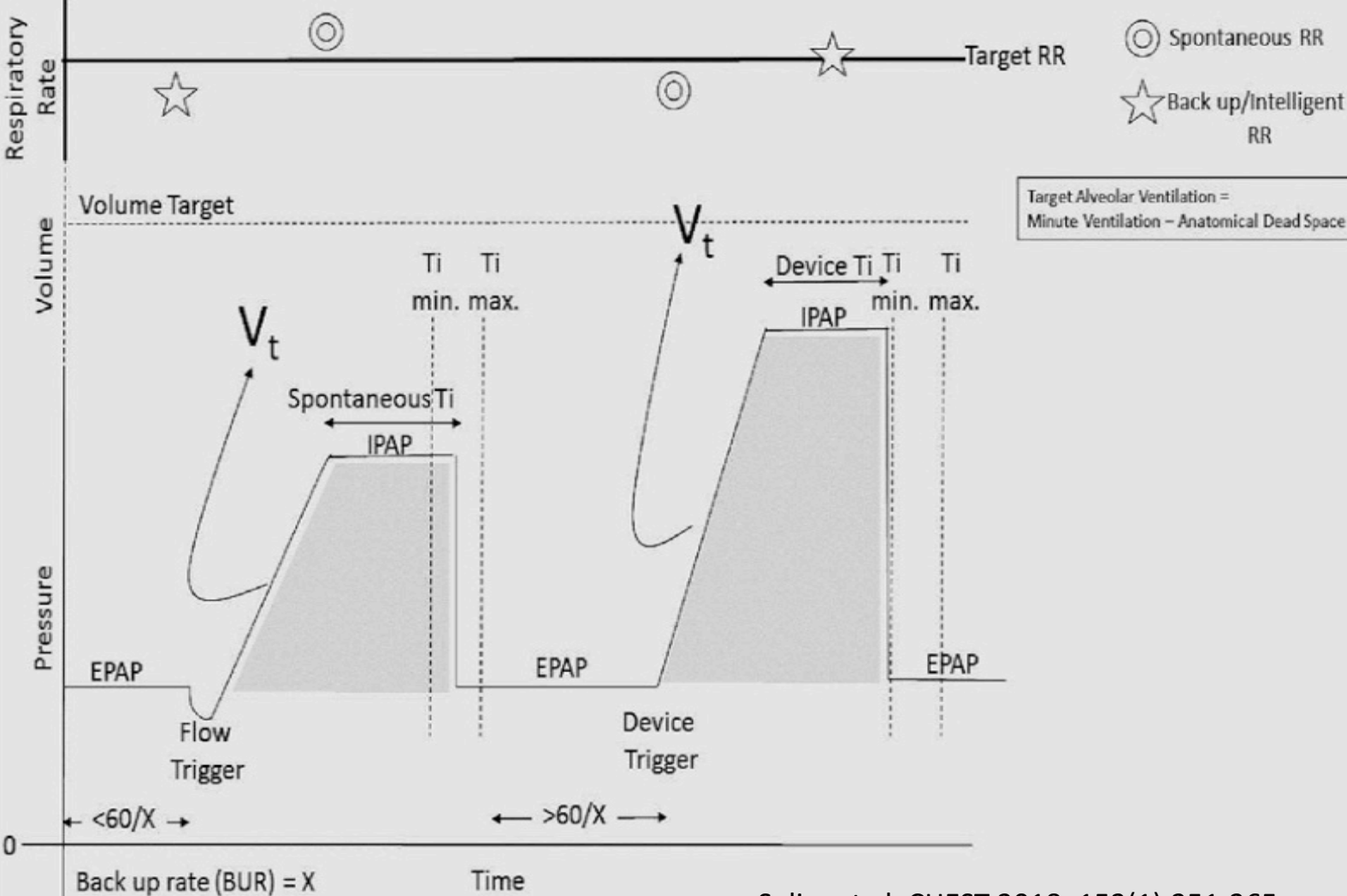


Volume Assured Pressure Support (VAPS)

- Designed to maintain a **preset target ventilation** by monitoring ventilation, adjusting the pressure support, and providing a backup breath automatically
- Non-inferior to Bilevel-ST in management of:
 - obesity hypoventilation syndrome
 - chronic obstructive pulmonary disease
 - neuromuscular disease

Volume Assured Pressure Support (VAPS)

- AVAPS (volume assured pressure support; Respironics)
 - targets expiratory tidal volume
- iVAPS (intelligent volume assured pressure support ResMed)
 - targets alveolar ventilation (minute ventilation minus dead space ventilation)



Device Type	Mechanism	Main Indications
CPAP	Continuous positive pressure to stent open airway	OSA
Bilevel S	Inspiratory and expiratory pressures to augment breaths that are patient initiated	OSA, hypoventilation
Bilevel ST (timed mode)	Inspiratory and expiratory pressures to augment breaths that are patient or device initiated if patient rate falls below set rate	CSA, hypoventilation,
Adaptive Servo Ventilator (ASV)	Maintains a the patient's recent flow/ventilation by adjusting the pressure support, and providing a backup rate	CSA
Volume Assured Pressure Support (VAPS)	Maintains a set target ventilation by adjusting the pressure support, and providing a backup rate	hypoventilation

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