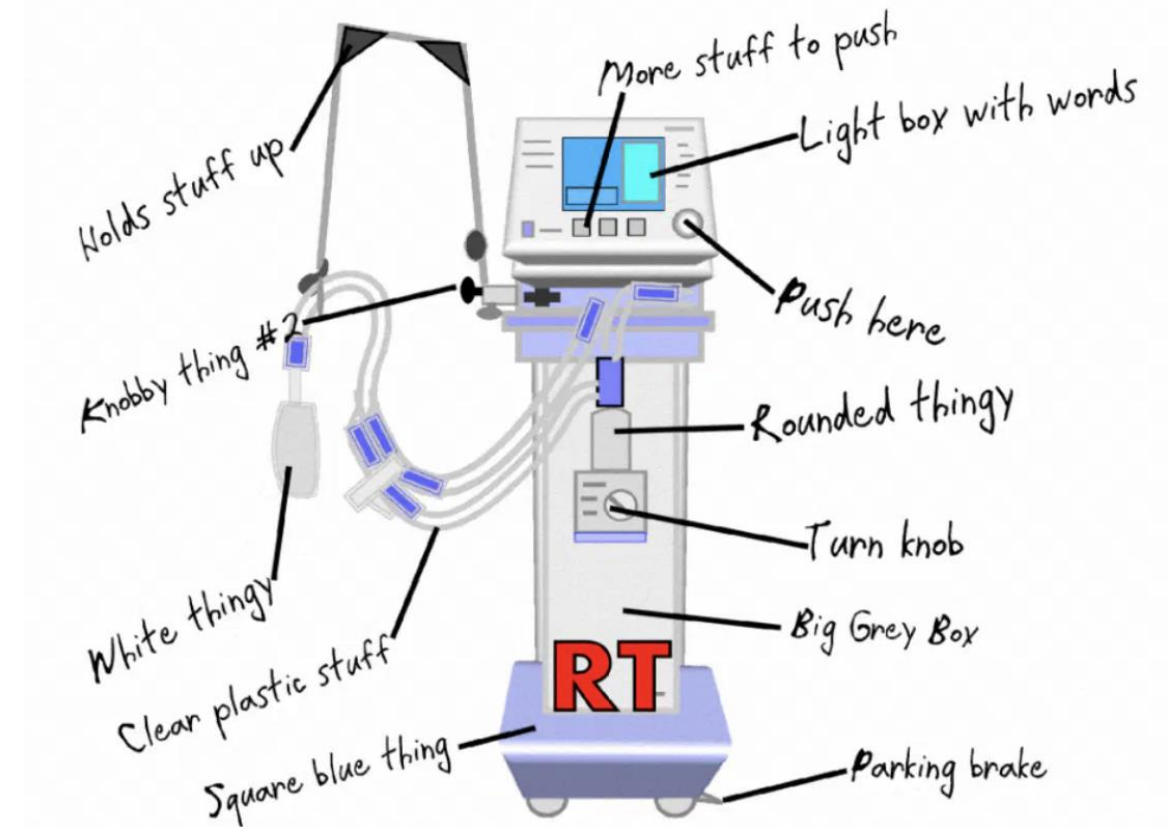


Ventilators

- ▶ Danielle Guyer MD
- ▶ ICU Fellow 2025-2026
- ▶ Core conference May 2026



What is the ventilators/your job?

Get Oxygen in

Get Carbon dioxide out (ventilation)

Create Harmony

Other situations

- GCS <8 /agitation/protecting the airway
- Severe acidosis

Types of ventilating

- ▶ Controlled: Breath size and minimum RR set (pCMV (A/C PC), APVcmv (PRVC), APRV, A/C VC)
- ▶ Spontaneous: Breath size and rate set by patient (PS, SIMV)
- ▶ Ventilation variable:
 - RR and Tidal volume
- ▶ Oxygenation variables:
 - FiO₂ and PEEP

Scenerio: Post-intubation

56 yo male with HTN presented with SOB found to have new onset CHF and CHF exacerbation that is not improving with BiPAP and diuresis. RR is 35 and he is using accessory muscles to breath.

Decision is made to intubate

Post -intubation what mode and vent settings do you ask for?

What do you set on a ventilator

- ▶ Mode
 - ▶ Volume (RR and tidal volume)
 - ▶ Pressure (RR and inspiratory pressure)
- ▶ PEEP
- ▶ FiO₂

What other
information
do you want
first?

- ▶ Height 170 cm
 - ▶ IBW male= $50 + 0.91(\text{height in cm} - 152.4)$;
female= $45.5 + 0.91(\text{height in cm} - 152.4)$
- ▶ RR before intubation 35
- ▶ SpO₂ 88%
- ▶ Blood gas 7.50/30/55/24
- ▶ Any other lung/cardiac pathology

Tidal volume for ideal body weight

Height		6 ml/kg Tidal Volume		Height		6 ml/kg Tidal Volume	
Inches	CM	Male	Female	Inches	CM	Male	Female
48	122	130	110	64	163	360	330
49	124	150	120	65	165	370	340
50	127	160	140	66	168	380	360
51	130	180	150	67	170	400	370
52	132	190	160	68	173	410	380
53	135	200	180	69	175	420	400
54	137	220	190	70	178	440	410
55	140	230	200	71	180	450	420
56	142	240	220	72	183	470	440
57	145	260	230	73	185	480	450
58	147	270	250	74	188	490	470
59	150	290	260	75	191	510	480
60	152	300	270	76	193	520	490
61	155	310	290	77	196	530	510
62	157	330	300	78	198	550	520
63	160	340	310	79	201	560	540

Initial vent settings



CMV, APVCMV, APRV



TIDAL VOLUME : 6-8ML/KG OF IBW (IF YOU CHOOSE A VOLUME CONTROLLED MODE)*



RR (CAN START WITH RR PRIOR TO INTUBATION BUT OFTEN WANT TO ADJUST BASED ON BLOOD GAS)



PEEP: CAN START AT 5 AND TITRATE UP



SET INSPIRATORY PRESSURE 15-20 ABOVE PEEP IF USING PCMV



FIO2: 100% AND RAPIDLY TITRATE DOWN TO <60% TO AVOID OXYGEN TOXICITY

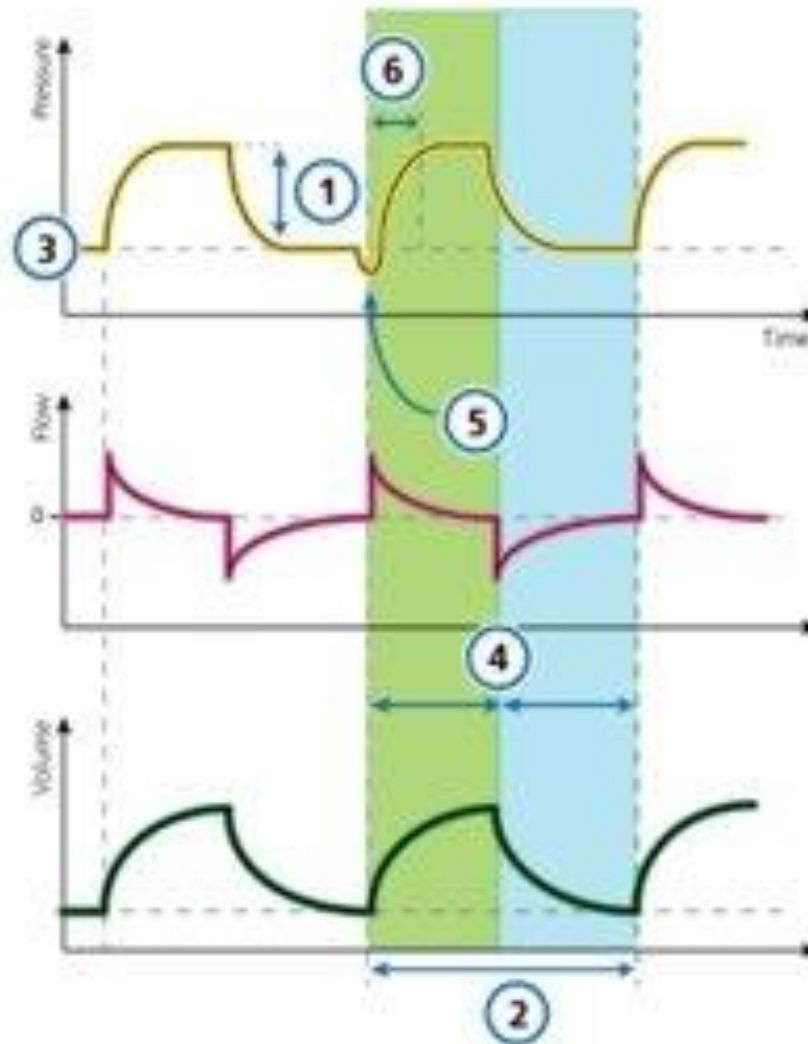
pCMV (A/C PC)

- ▶ Every breath delivered or triggered by patient is at a set pressure for a set time
- ▶ Good for limiting pressures
- ▶ Monitor volumes (volutrauma or hypoventilation)
- ▶ Monitor Volumes

PCV+ or P-CMV

Pressure-controlled ventilation

PCV+ or P-CMV / A/C-PC



CO2 elimination

- 1 Pcontrol*
- 2 Rate
Sigh (not shown)

Oxygenation

- 3 PEEP
- 4 I:E**
Oxygen (not shown)

Patient synchronization

- 5 Trigger
- 6 P-ramp

* On some devices, ΔP control.

** Depending on the selected breath timing philosophy (I:E, TI, or other supported option, if available).

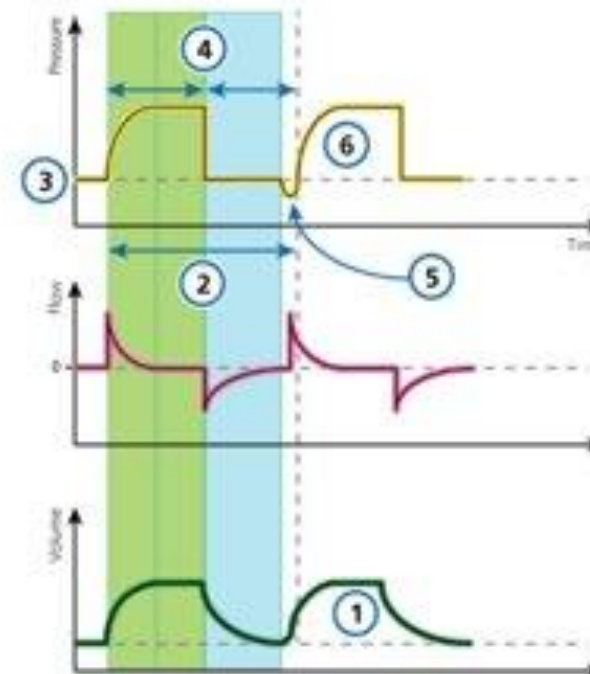
APVcmv (PRVC)

- ▶ Hybrid PC mode with dynamic changes to inspiratory pressure to deliver desired volume
- ▶ Vt guaranteed and pressure controlled breath
- ▶ Monitor pressure and volumes

APVcmv or (S)CMV+

Adaptive pressure ventilation with controlled mandatory ventilation or synchronized controlled mandatory ventilation

APVcmv or (S)CMV+ / A/C-vtPC



CO2 elimination

- 1 Vt
- 2 Rate
- Sigh (not shown)

Oxygenation

- 3 PEEP/CPAP
- 4 I:E^{*}
- Oxygen (not shown)

Patient synchronization

- 5 Trigger
- 6 P-ramp

^{*} Depending on the selected breath timing philosophy (I:E, Tl, or other supported option, if available).

^{**} On some devices, Vtarget.

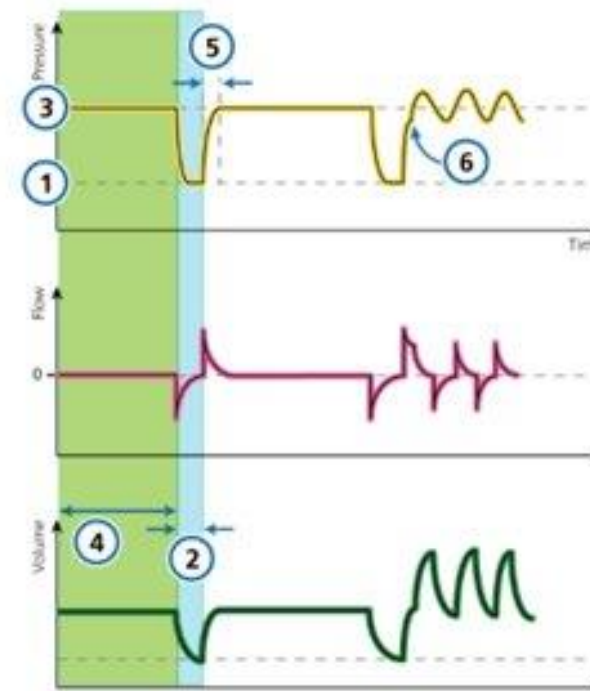
APRV

- ▶ Inverse ratio ventilation allows pt to breathe spontaneously
- ▶ Great for ARDS (may improve comfort and oxygenation)
- ▶ Risk of ventilator induced injury if settings are incorrect
- ▶ Monitor Volume, gas exchange pCO₂/etCO₂

APRV

Airway pressure release ventilation

APRV / IMV-PC



CO₂ elimination

- 1 P low
- 2 T low

Oxygenation

- 3 P high*
- 4 T high

Oxygen (not shown)

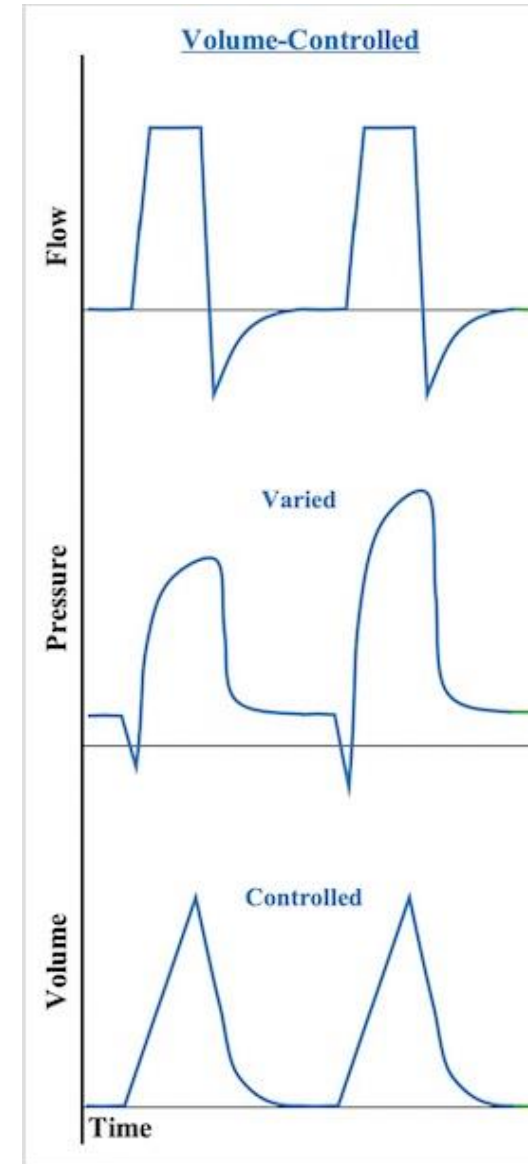
Patient synchronization

- 5 P-ramp (to P high)
- 6 Trigger

* With prolonged T high settings and short T low settings, the P high setting in effect becomes the PEEP level.

A/C VC

- ▶ Every breath delivered or triggered by patient is at a set volume for a set time
- ▶ Good for limiting volutrauma
- ▶ Monitor pressures (barotrauma)
- ▶ Monitor pressures



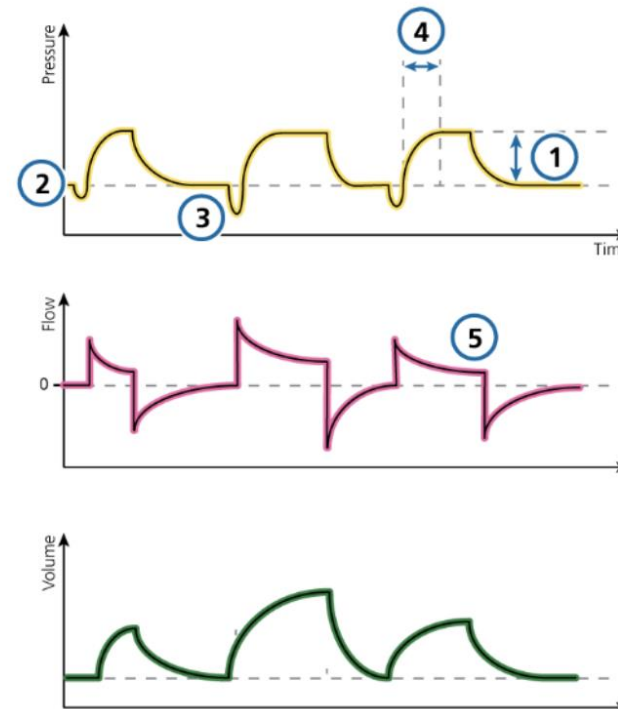
Spontaneous mode

- ▶ ALL breaths triggered by patient
- ▶ Great weaning mode
- ▶ Monitor volumes

SPONT

Spontaneous mode

SPONT / CSV-PS



CO₂ elimination

- 1 P_{support}*
Sigh (*not shown*)

Oxygenation

- 2 PEEP/CPAP
Oxygen (*not shown*)

Patient synchronization

- 3 Trigger
- 4 P-ramp
- 5 ETS

* On some devices, $\Delta P_{support}$.

Adjusting vents

What do you change if a patient is hypoxemic

Increase
 FiO_2

Increase
PEEP

What do you change if you need to adjust CO₂?



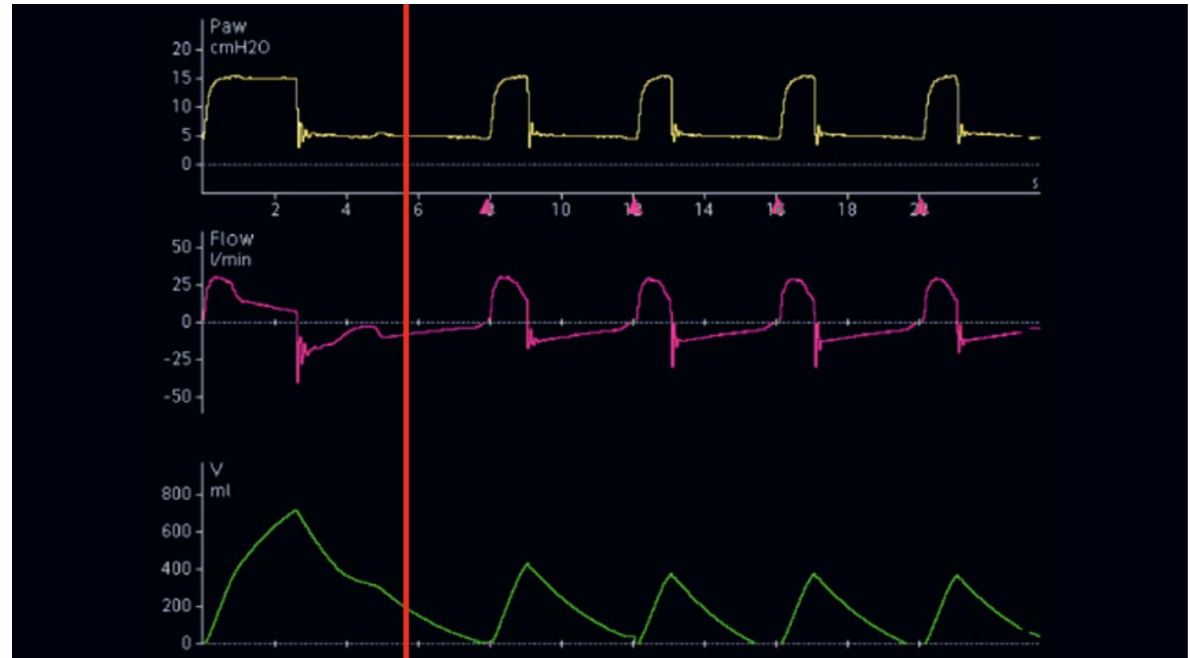
RR



Tidal
volume

Feedback from the vent

- ▶ The actual RR and tidal volume of a patient
- ▶ Pressure
 - ▶ Peak Pressure
 - ▶ Plateau pressure (you'll need to obtain this from the vent- ask RT for help)



Scene

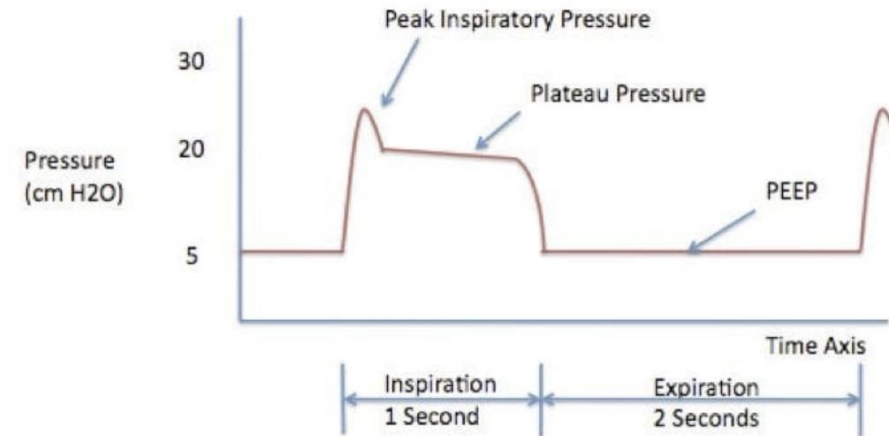
You are on phone rounds and the RT comes by and says "the vent in room 5 has been alarming- for high peak pressures, just thought I would let you know"

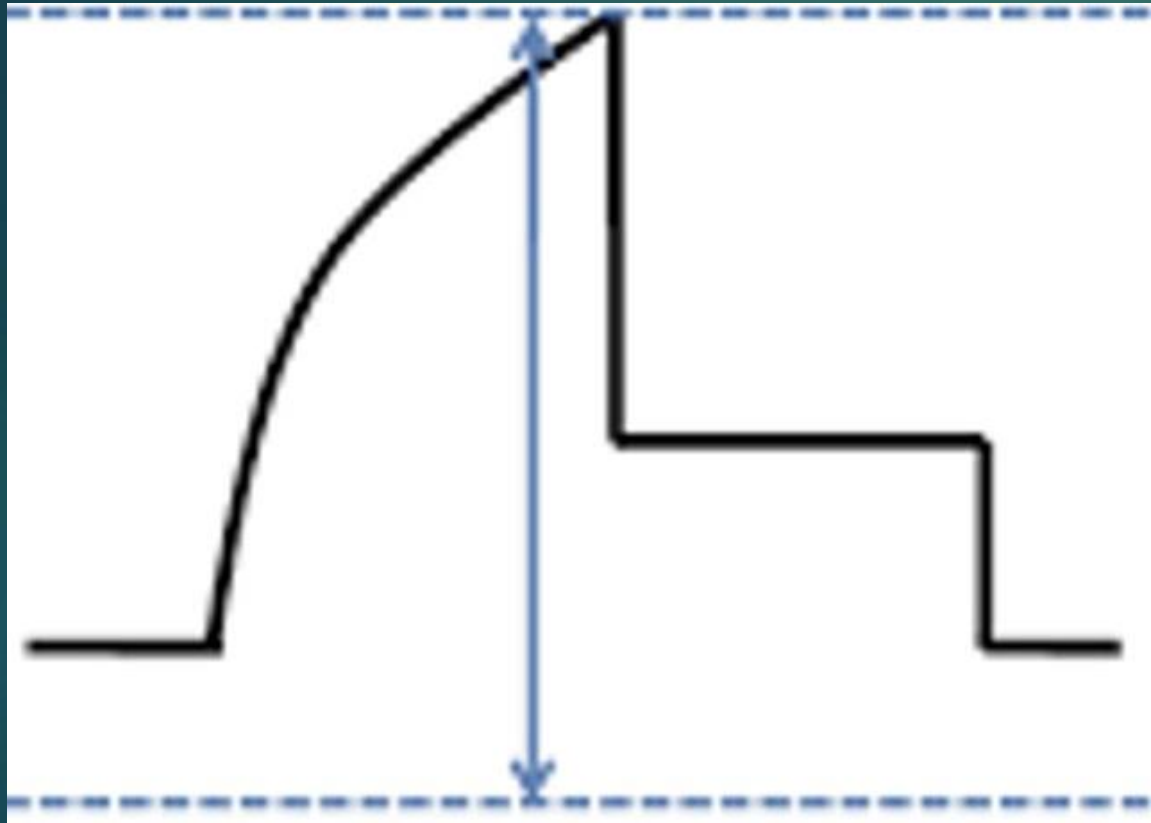
- ▶ What is Peak pressure?
- ▶ What is normal?
- ▶ What is your next question?

Plateau pressure

- ▶ Inspiratory pause
- ▶ Pressure felt by the lungs determined by tidal volume and lung compliance
- ▶ Best representation of the pressure in the aveloli
- ▶ Goal <30

Normal Pressure Time Curve



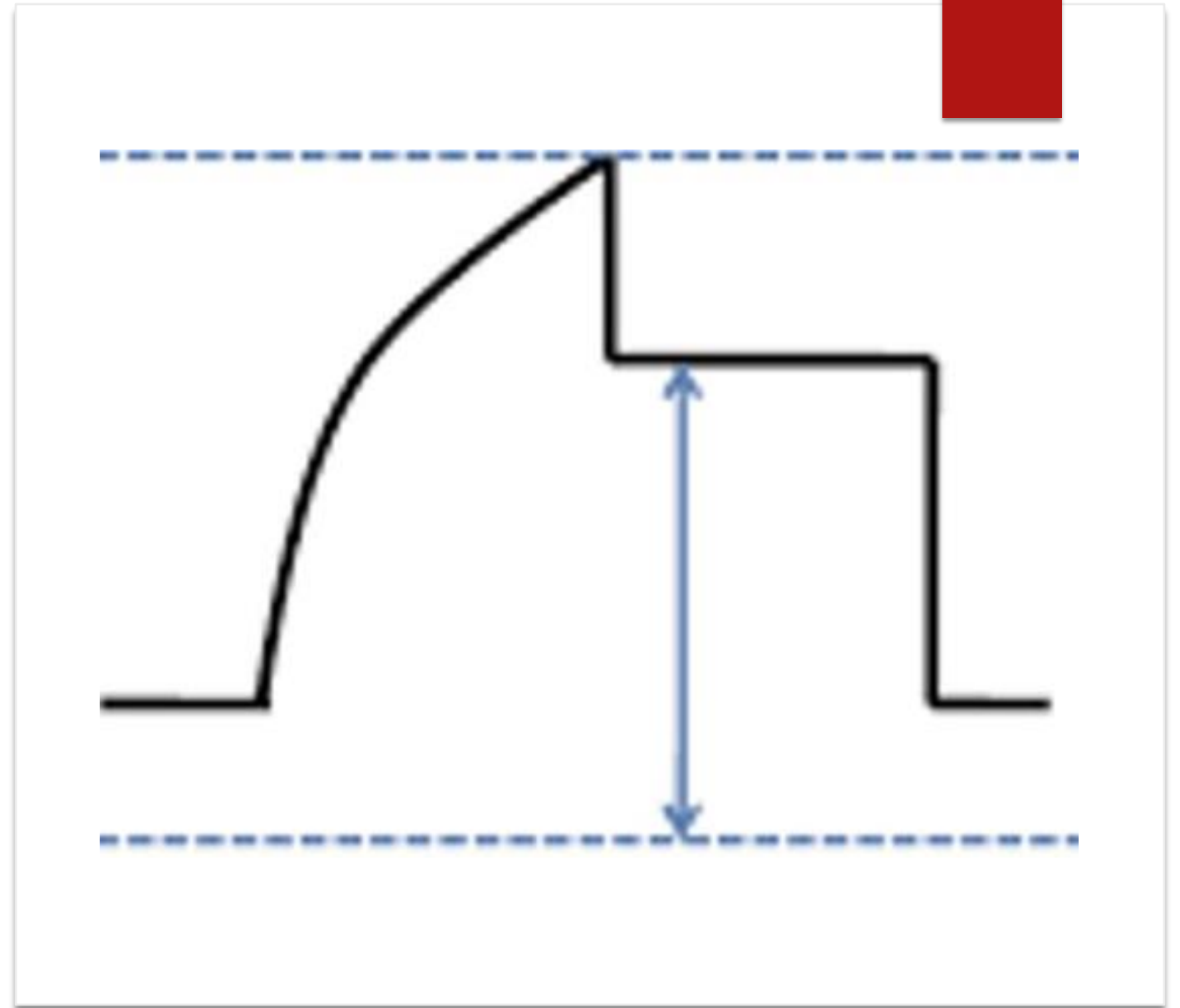


This is what
you see on
the vent....

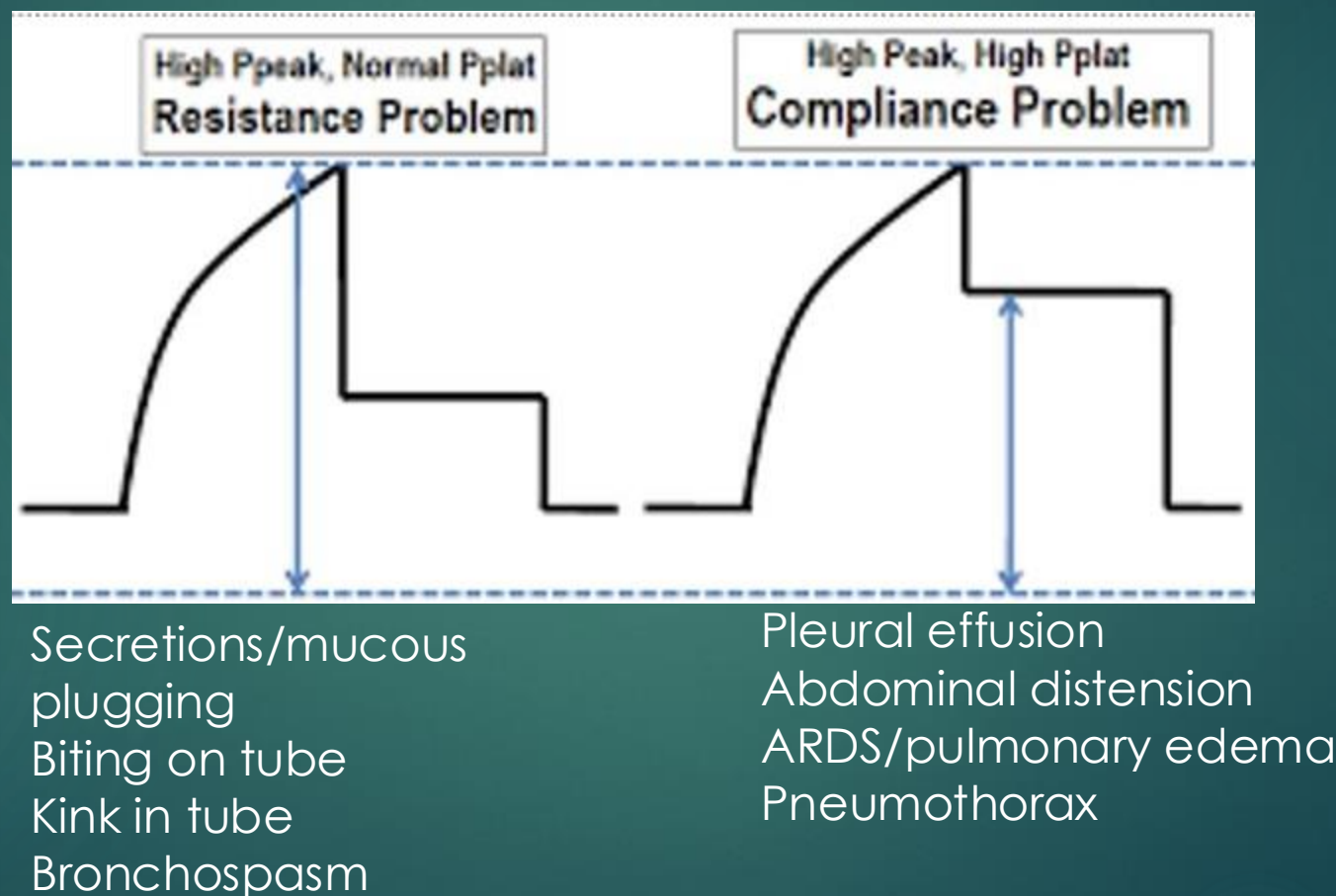
THE DIFERENCE BETWEEN THE PEAK
AND PLATEAU IS 20

Oh man-now room 6 has high peak pressure but this time RT brings you this picture....now what

- ▶ The difference between the peak and plateau is 3

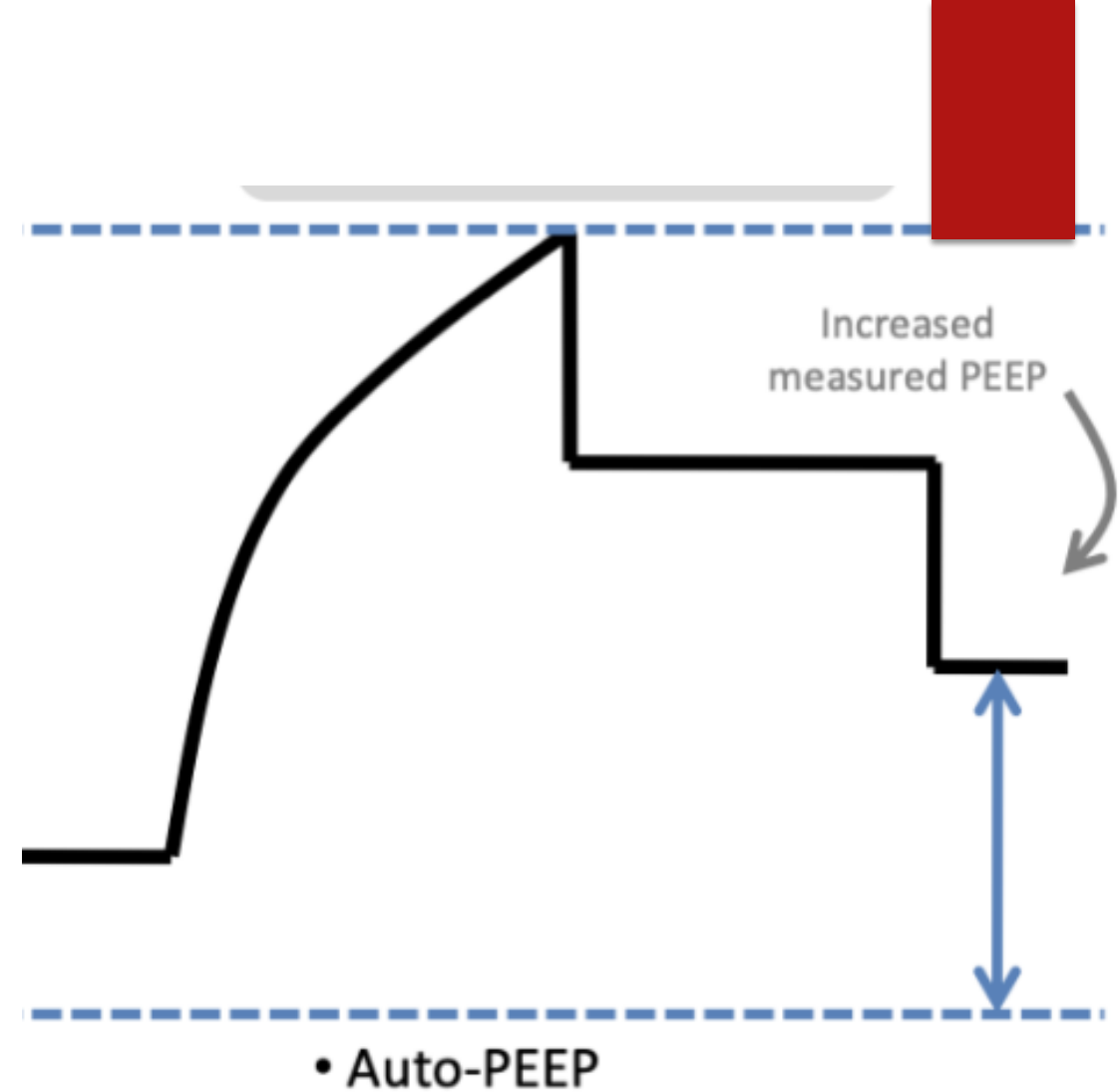


Peak and Pplat



Auto peep

- ▶ Hyperinflation as a result of incomplete emptying before next breath
- ▶ Check when ventilatory flow not at zero at end of expiration and h/o COPD/asthma or work up for low BP
- ▶ decrease I:E ratio, decrease RR, increase inspiratory flow
- ▶ Decrease tidal volume
- ▶ Increase sedation
- ▶ Disconnect the ETT from the vent to allow for exhalation
- ▶ Paralyze



ARDS

▶ Definition

- ▶ Acute onset within 1 week of known insult or new or worsening respiratory symptoms
- ▶ Bilateral opacities on chest radiography or computed tomography not fully explained by effusions, lobar/lung collapse, or nodules
- ▶ Three severity categories defined by $\text{Pa}_{\text{O}_2}:\text{Fi}_{\text{O}_2}$
- ▶ Requirement for invasive or noninvasive mechanical ventilation such that $\text{PEEP} \geq 5 \text{ cm H}_2\text{O}$ is required for all categories of oxygenation severity except mild, which can also be met with $\text{CPAP} \geq 5 \text{ cm H}_2\text{O}$

▶ Lung protective mode of ventilation

Vent equivalent table

Hamilton Medical	Puritan Bennett	Vyaire Medical	Maquet	GE	Philips	Dräger	
HAMILTON-T1	PB 840 / PB 980	Avea	Servo-I /-U	Carestation R860	Esprit/V200	Evita XL	Evita V500
ASV	--	--	--	--	--	--	--
APV _{cmv}	AC-VC+	PRVC-AC / Volume Guarantee (Neo)	PRVC	A/C PRVC	--	CMV with Auto Flow	VC-CMV with Auto Flow PC-VG
APV _{simv}	SIMV-VC+	PRVC-SIMV	SIMV (PRVC)	SIMV PRVC	--	SIMV with Auto Flow	VC-SIMV with Auto Flow/ PC SIMV-VG
P-CMV	A/C-PC	Pressure A/C	Pressure control	A/C PC	(PCV) AC	PCV+Assist	PC-AC
P-SIMV	SIMV-PC	Pressure SIMV	SIMV (Pressure control) + Pressure Support	SIMV-PC	(PCV) SIMV	PCV+PSupp	PC-SIMV
SPONT	SPONT, SPONT-PS	CPAP/PSV	PS/CPAP	CPAP/PSV	CPAP/PSV	CPAP/PSupp	SPN-CPAP/PS SPN-CPAP
APRV	BiLevel	APRV	Bi-vent/APRV	APRV	APRV	APRV	PC-APRV
DuoPAP	BiLevel	BiPhasic	Bi-vent/APRV	BiLevel BiLevel-VG	--	BIPAP	PC-BIPAP
APV _{cmv}	AC-VC	Volume A/C	Volume Control	AC/VG	(VCV) AC	CMV	VC-AC
			SIMV (Volume control) + Pressure Support				
Volume Support	Volume Support	--	Volume Support	VS	--	CMV with Auto Flow	SPN-CPAP/VS
NIV / NIV-ST	Spont - CPAP, PS, VS	--	NIV Pressure Support	NIV	NPPV, SPONT, SPONT/T	NIV	NIV, NIV-ST
nCPAP-PS	Spont - CPAP, PS, VS	Nasal CPAP/IMV	Nasal CPAP	nCPAP	--	PSIMV+	SPN-CPAP PC CMV

