VENTILATION

MECHANICAL VENTILATION(MV)

INVASIVE VENTILATION

NON-INVASIVE VENTILATION(NIV)

BY

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- Controlled mandatory ventilation(CMV)

the ventilator delivers

► preset tidal volume (or pressure) at a time triggered (preset) respiratory rate.

► As the ventilator controls both tidal volume (pressure) and respiratory rate, the ventilator "controls" the patients minute volume

Controlled mandatory ventilation(CMV)

- Patient can not breath spontaneously
- Patient can not change the ventilator respiratory rate
- Suitable only when patient has no breathing efforts

  - Disease or
  - Under heavy sedation and muscle relaxants

- Controlled mandatory ventilation (CMV)

►Asynchrony and increased work of breathing.
► Not suitable for patient who is awake or has own respiratory efforts
► Can not be used during weaning

- In this mode preset the following parameters:

-Fio2 (fractional inspired 02)
-Vt (tidal volume)
-RR (respiratoy rate)
-I:E ratio (inspired to expired ratio)

VCV mode gives a guarantee that preset Vt can be delivered to the patient, but there is a risk of barotrauma due to excessive volume that reach the lungs

ASST-CONTROL MANDATORY VENTILATION (ACV)

- The ventilator provides the patient with a pre-set tidal volume at a pre-set rate.
- The patient may initiate a breath on his own, but the ventilator assists by delivering a specified tidal volume to the patient.
- Client can breathe at a higher rate than the preset number of breaths/minute

Cont..

- The total respiratory rate is determined by the number of spontaneous inspiration initiated by the patient plus the number of breaths set on the ventilator.

- If the patient want to breathe faster, he or she can trigger the ventilator and receive a full-volume breath.

- Often used as initial mode of ventilation When the patient is too weak to perform the work of breathing (e.g. when emerging from anesthesia)

Cont...

- The preset RR ensures that the patient receives adequate ventilation, regardless of spontaneous efforts.

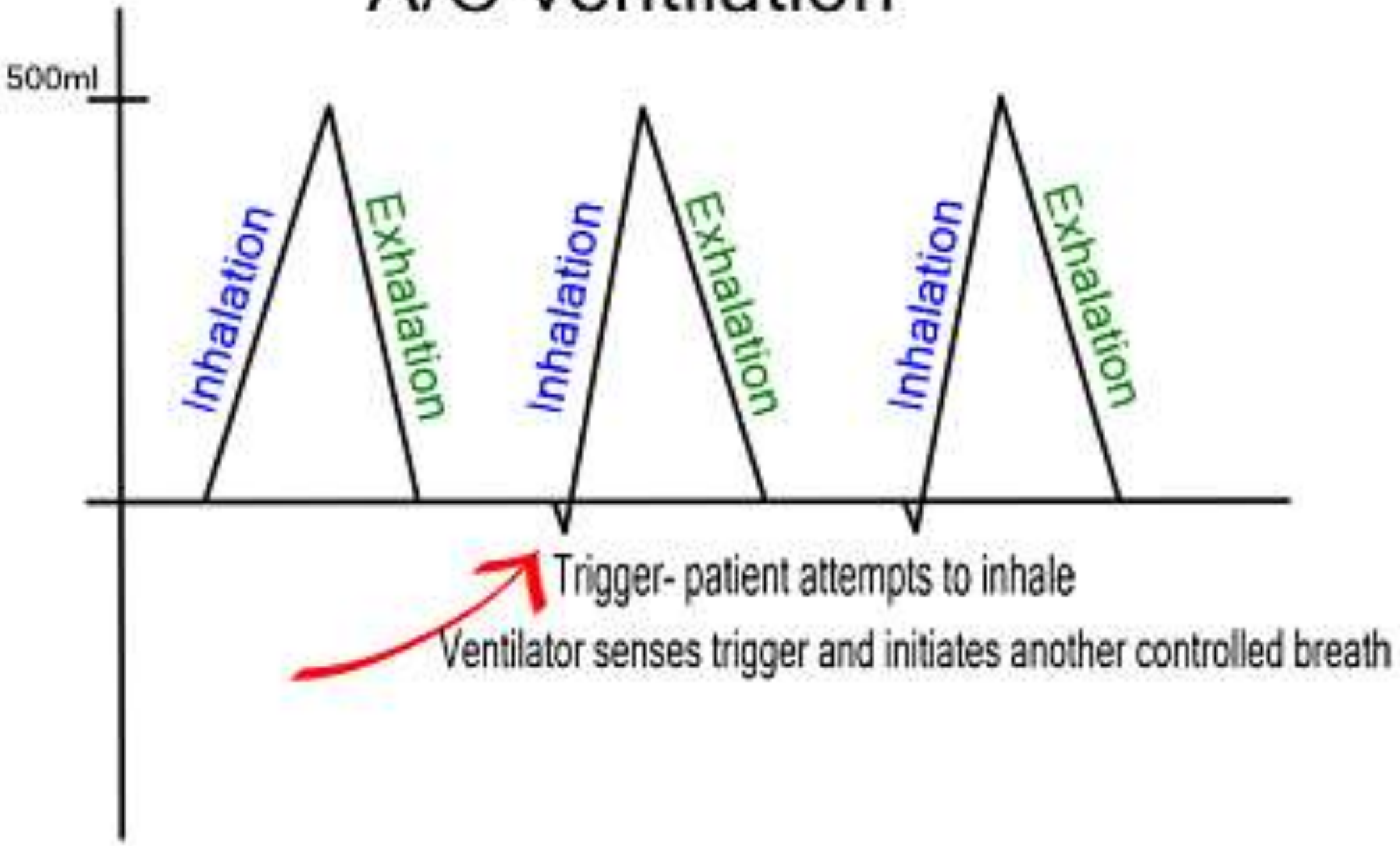
- The patient can breath faster than the preset rate but not slower
- Patient can control RR but not V_T or P_{aw}

- Advantages:
  - Very small WOB, if correct trigger sensitivity is set.
  - Allows patient to control MV (through RR) to normalise $PaCO_2$

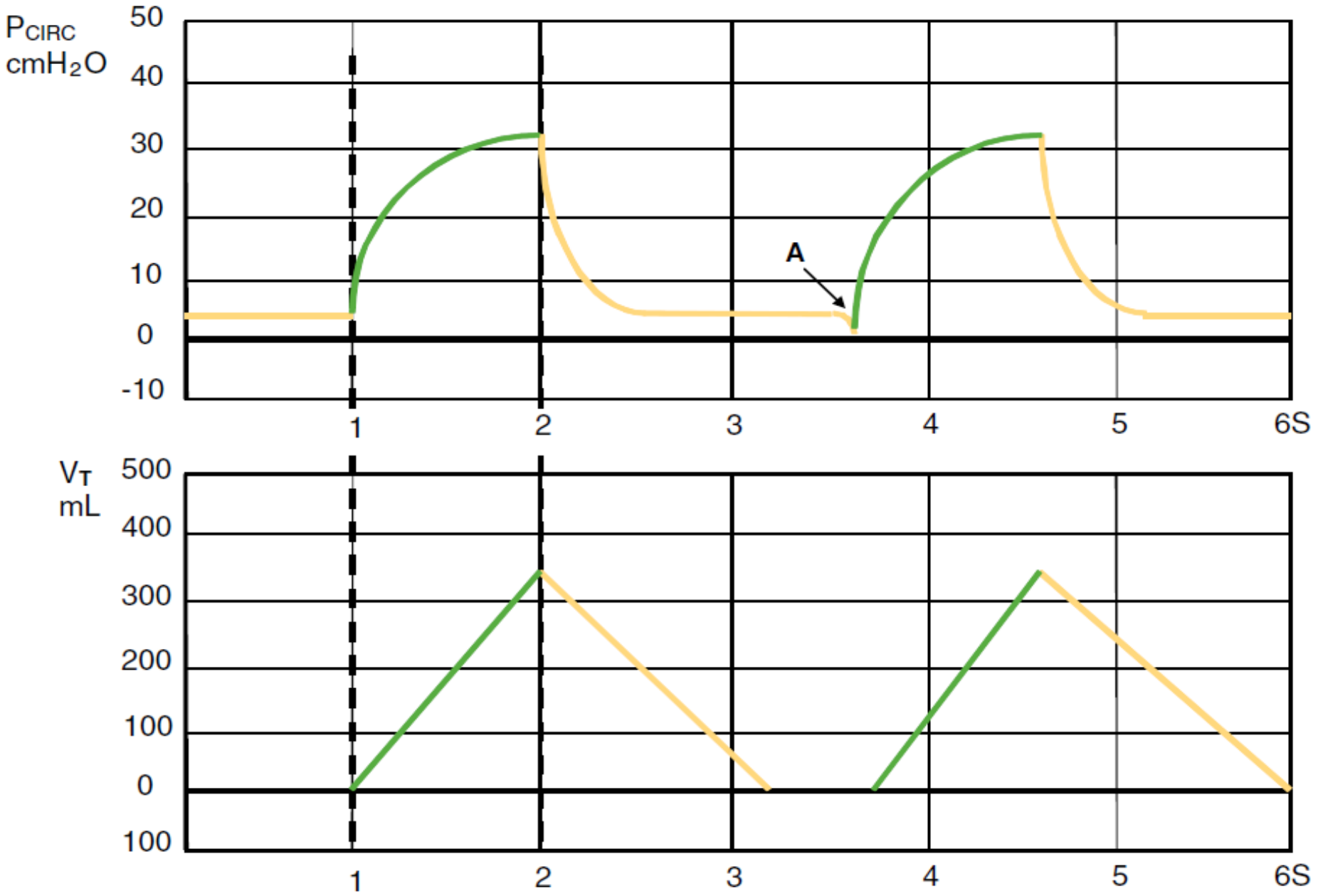
- Disadvantages:
  - Alveolar hyperventilation
  - Respiratory alkalosis
  - Higher pH and lower $PaCO_2$ compared to IMV [1]

- Contraindications:
  - Irregular RR
  - Cheyne – Stokes respiration
  - Hiccoughs
  - Brainstem injury

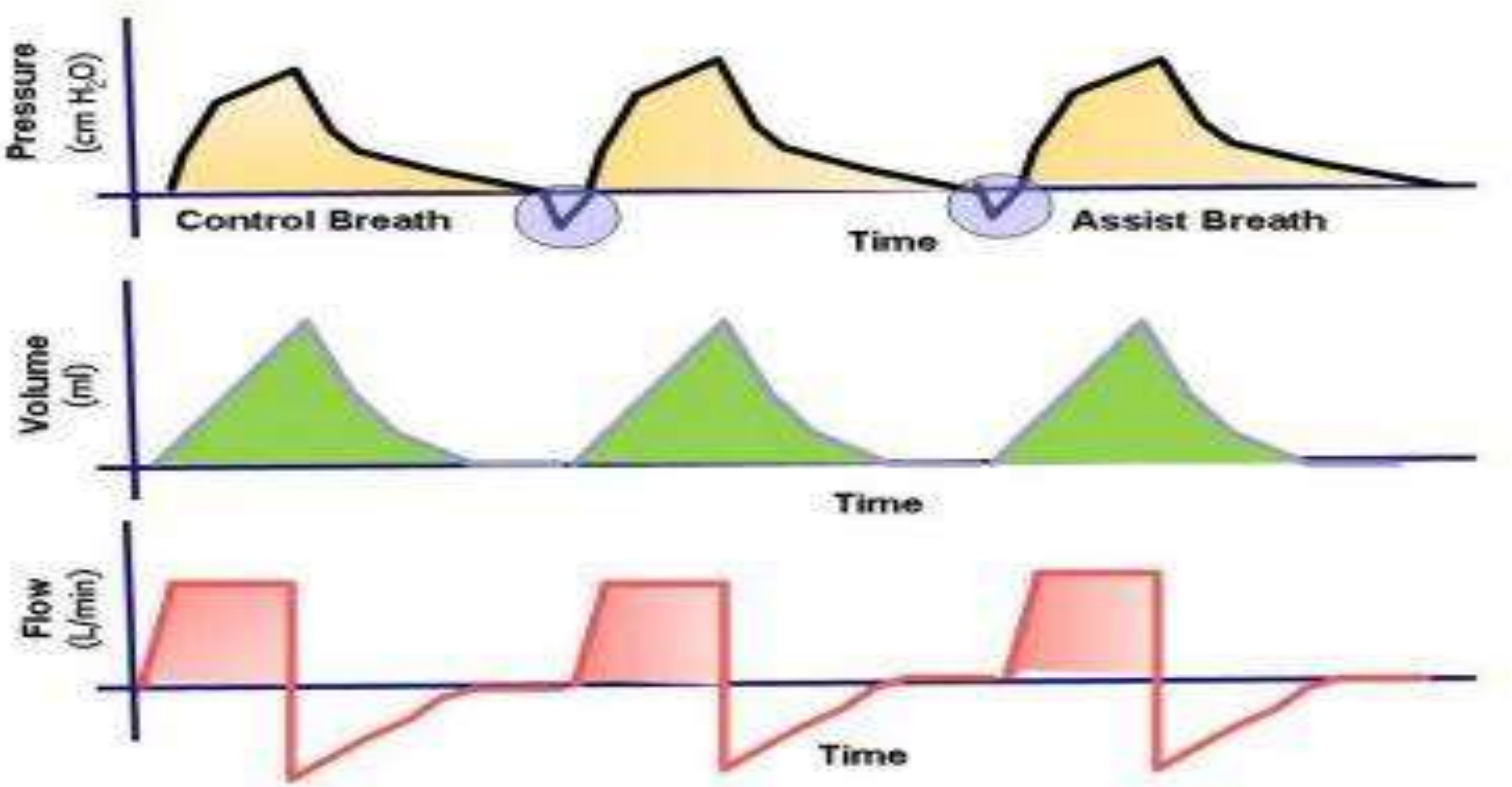
A/C ventilation



Assist Control



Assisted Mode
(Volume-Targeted Ventilation)



Synchronized Intermittent Mandatory Ventilation (SIMV)

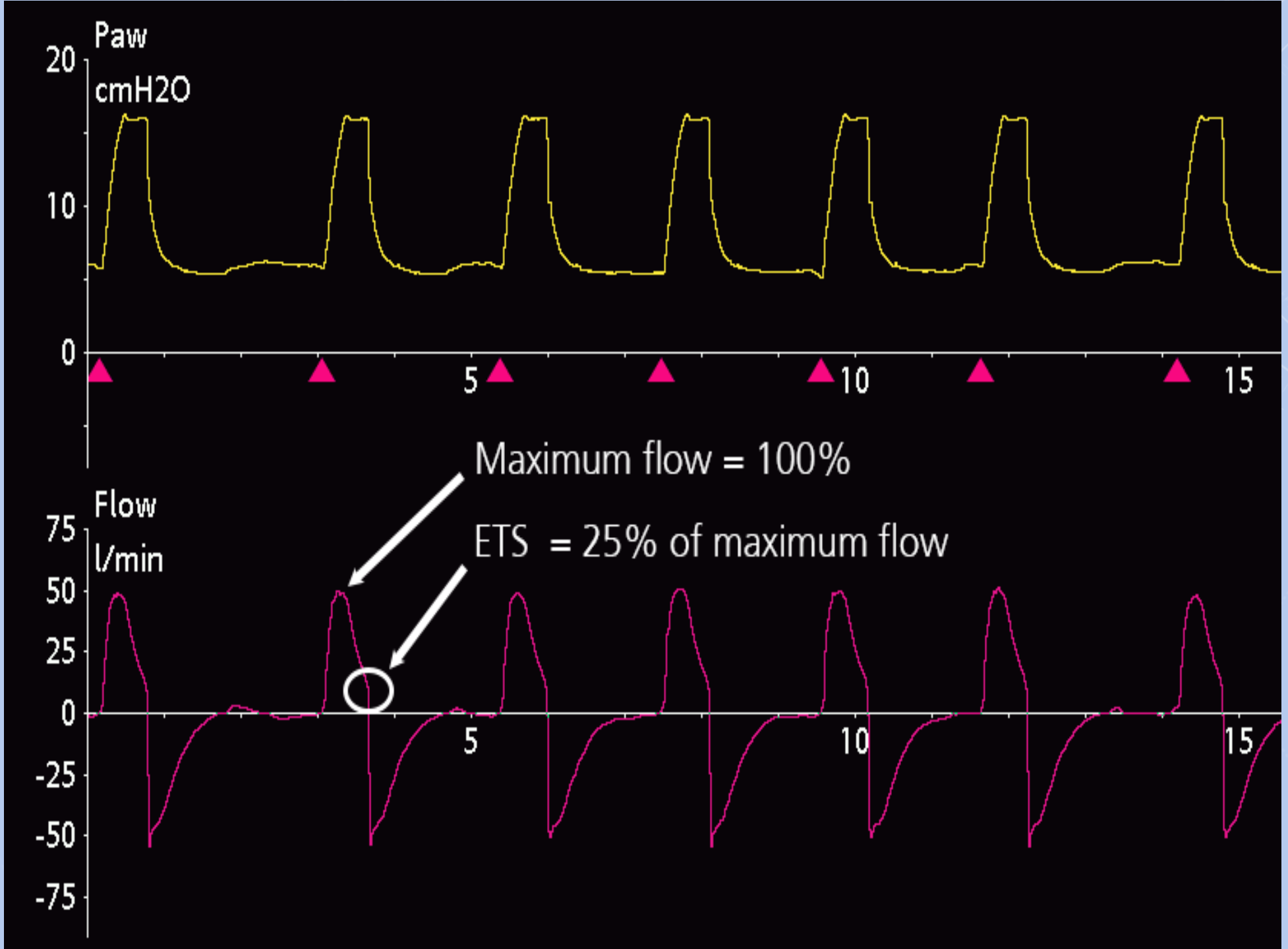
- Breaths are given are given at a set minimal rate, however if the patient chooses to breath over the set rate no additional support is given
- One advantage of SIMV is that it allows patients to assume a portion of their ventilatory drive
- SIMV is usually associated with greater work of breathing than AC ventilation and therefore is less frequently used as the initial ventilator mode
- Like AC, SIMV can deliver set tidal volumes (volume control) or a set pressure and time (pressure control)
- Negative inspiratory pressure generated by spontaneous breathing leads to increased venous return, which theoretically may help cardiac output and function

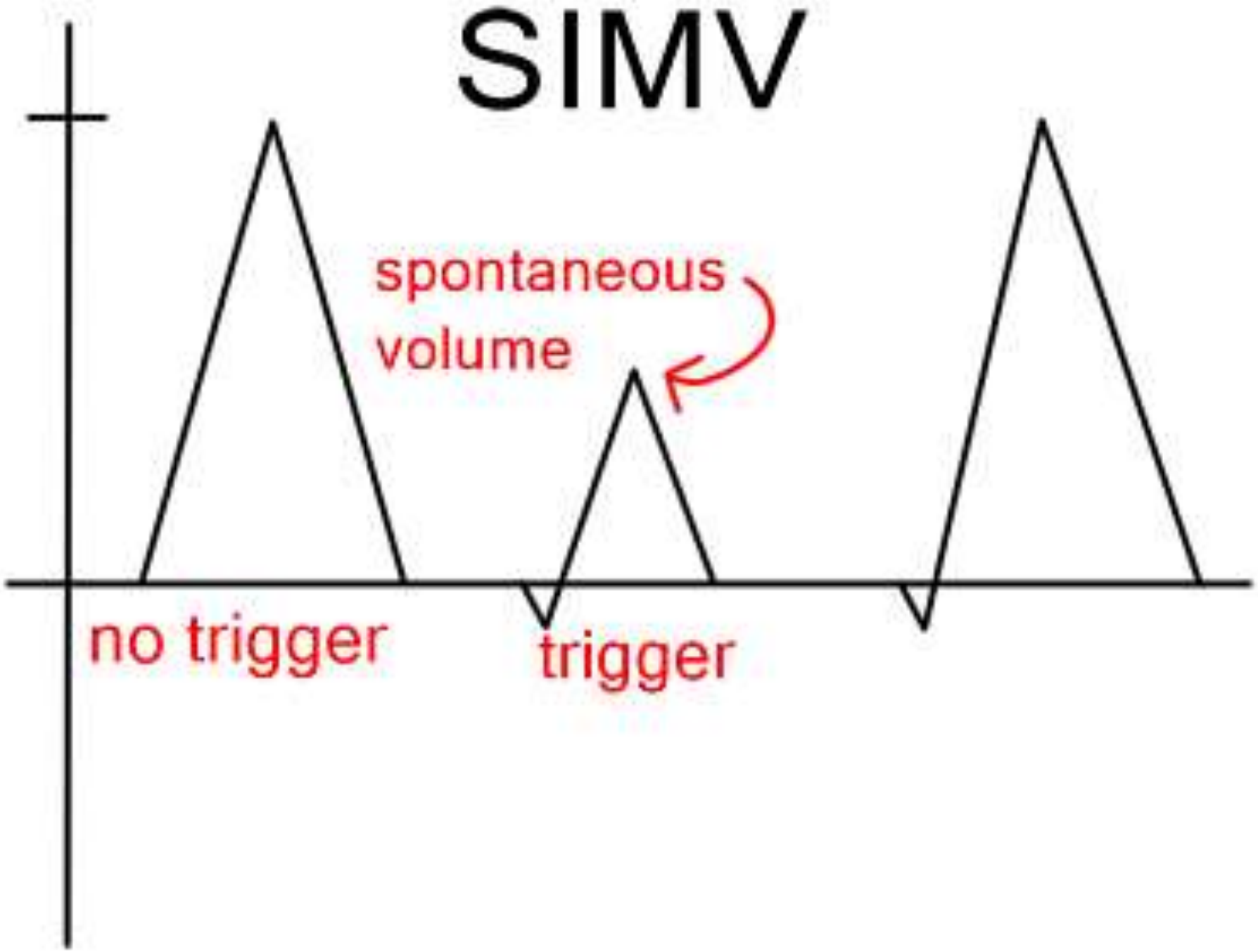
- The problem of ‘breath stacking’ and dys-synchrony was addressed by SIMV.
- But, problems of WOB and R_{aw} during spontaneous breath persisted.
- This is tackled with use of **Pressure Support** as adjunct.
- Breath is terminated once patients inspiratory flow declines below a set limit.
- Thus, patient triggered, pressure limited, flow cycled assisted ventilation.
- SIMV and spontaneous mode always used with PSV in modern practice.

- Settings:

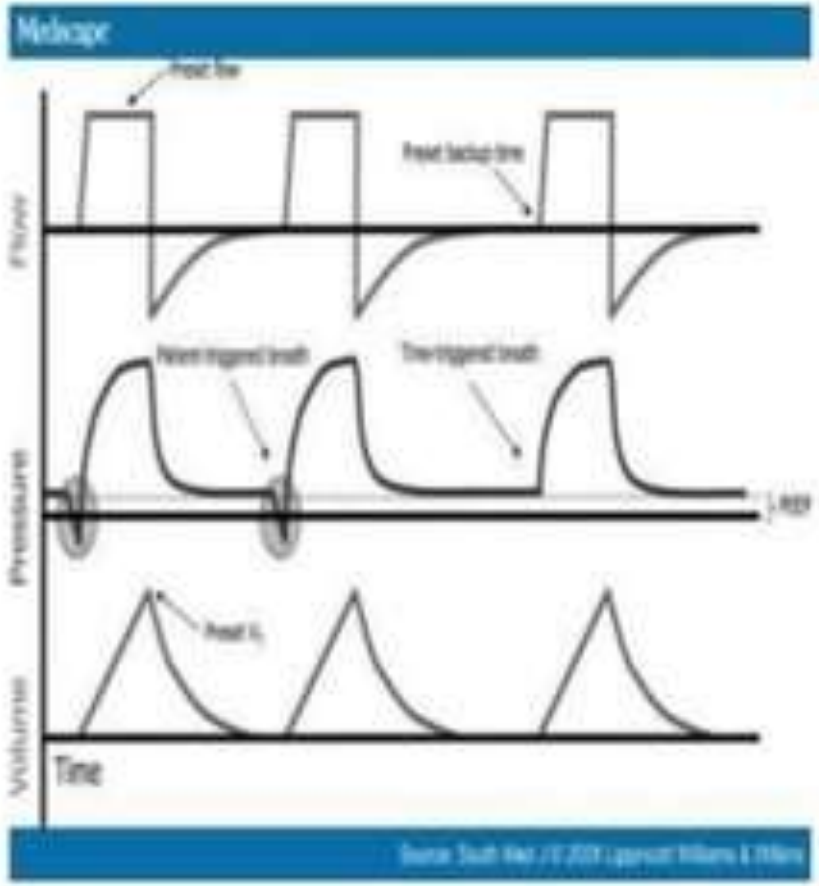
1. SIMV + PS – VCV
   - V_T - 6-12 ml/kg IBW
   - RR – 10 – 15 bpm
   - I:E – 1:2 – 1:4
   - FiO2 – titrated to PaO2
   - PS: PIP – P_{plat} (min 5 cm H2O
   - High pressure alarm
   - Low pressure/ vol alarm
1. SIMV + PS – PCV
   - Pressure - < 30 cm H2O
   - Low pressure alarm
   - Low volume alarm

Advantages	Disadvantages
Maintains respiratory muscle strength/ avoids atrophy	May provide false sense of improvement of lung function
Reduces V/Q mismatch	Desire to wean too early and failed weaning.
Decreases mean airway pressure	
Facilitates weaning	
P.S: Increases V_T , decreases patients' RR, decreases WOB	

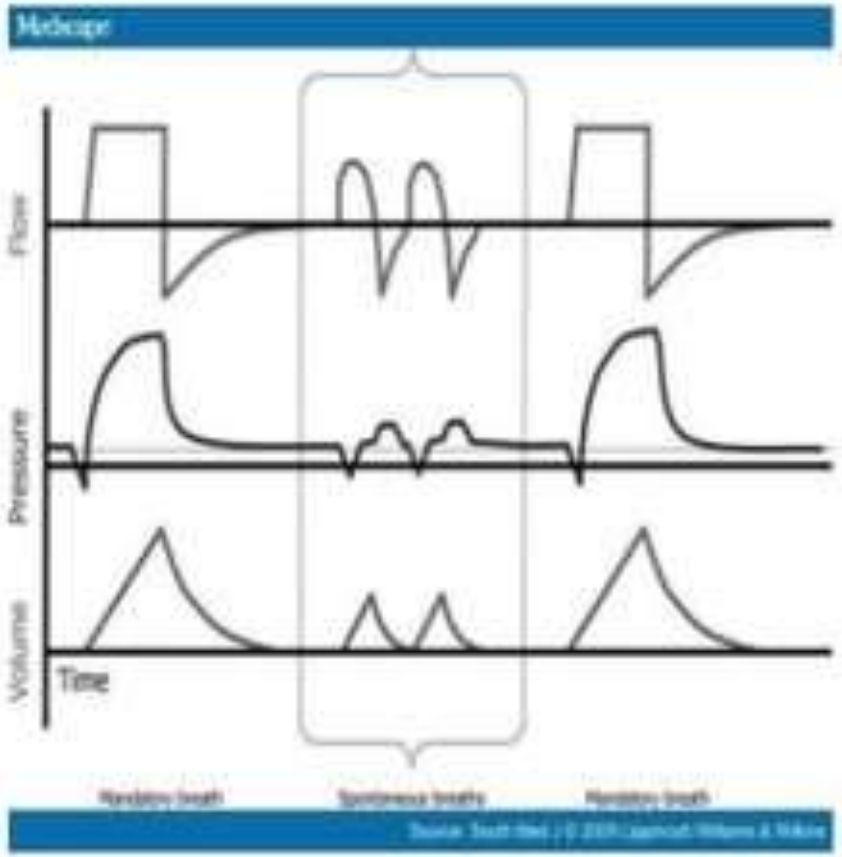

Paw
cmH2O
20
10
0
5
10
15
Maximum flow = 100%
ETS = 25% of maximum flow
Flow
l/min
75
50
25
0
-25
-50
-75
5
10
15

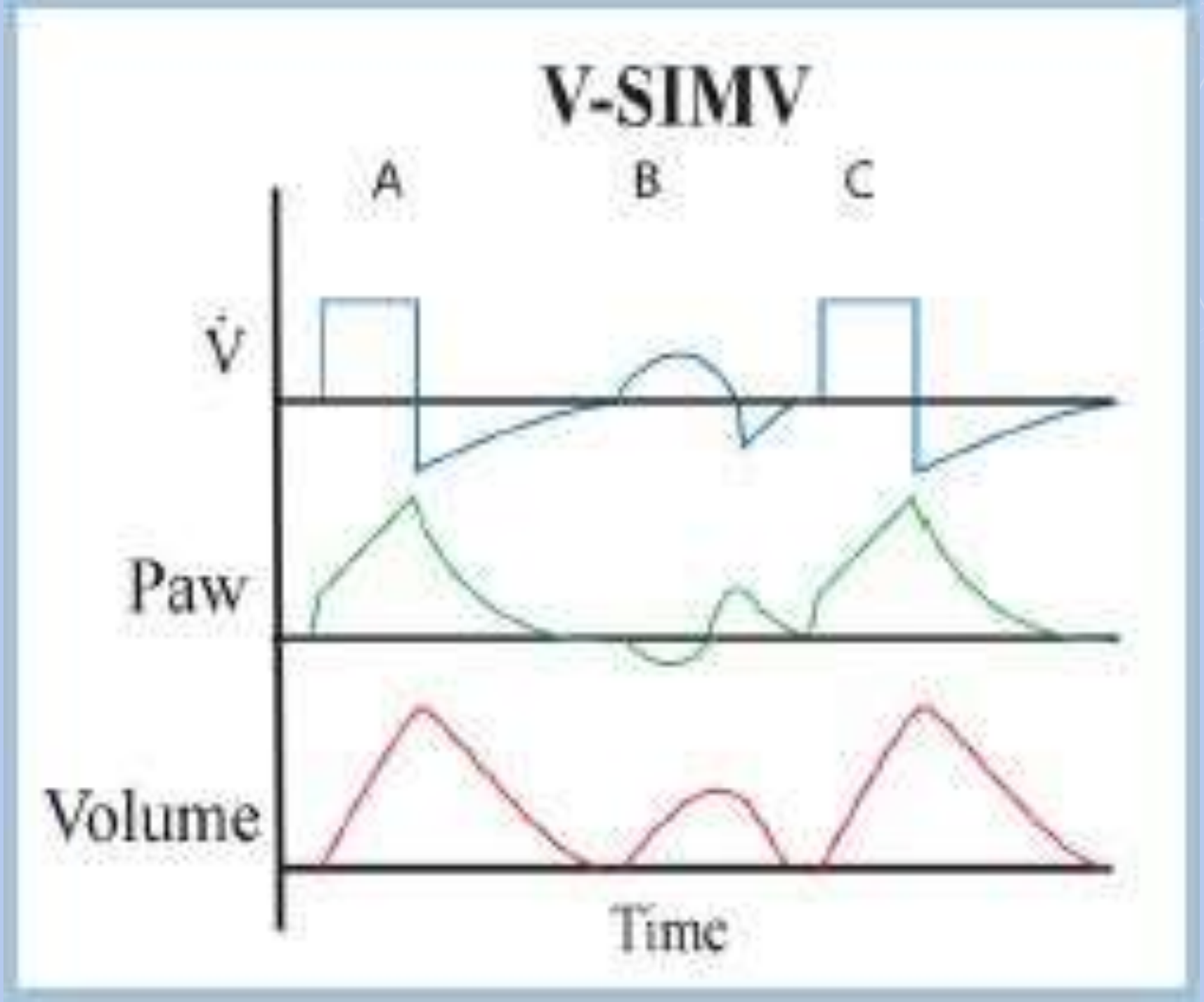

SIMV
spontaneous
volume
no trigger
trigger

Assist Control



SIMV



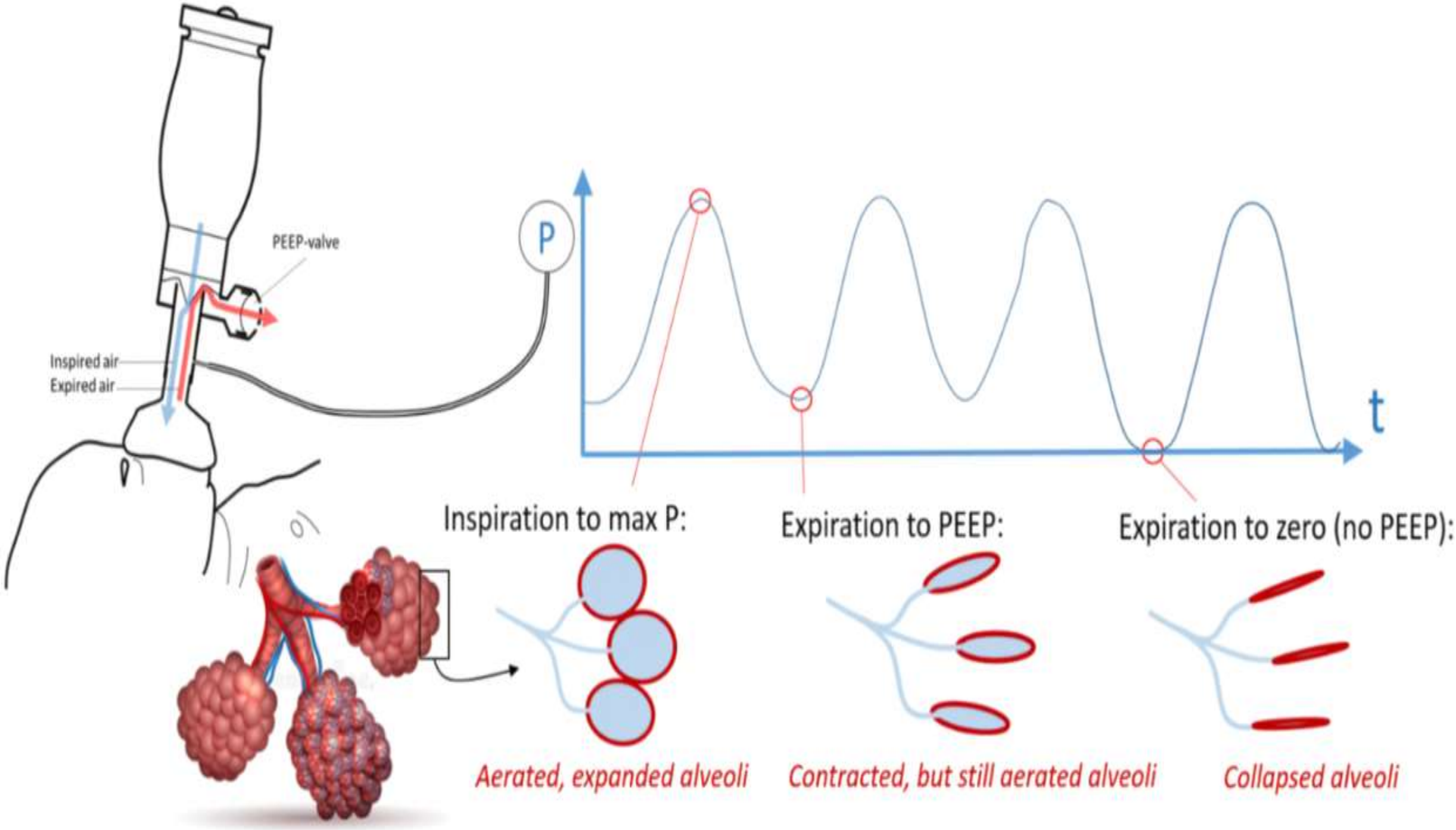

V-SIMV
A
B
C
V̇
Paw
Volume
Time

Pressure Support Ventilation (PSV)

- The patient must initiate all pressure support breaths.
- During weaning using the PSV mode the level of pressure support is gradually decreased based on the patient maintaining an adequate tidal volume (8 to 12 mL/kg) and a respirator y rate of less than 25 breaths/minute.
- PSV weaning is indicated for :
  - Difficult to wean patients
  - Small spontaneous tidal volume

Positive End-expiratory Pressure PEEP

- The amount of positive pressure that is maintained at end-expiration.
- " Typical settings for PEEP are 5 to 20 cm H2O
- PEEP increases oxygenation by preventing collapse of small airways
- It increases the functional residual capacity of the lungs
- A typical initial applied PEEP is 5 cmH20. However, up to 20 cmH20 may be used in patients undergoing low tidal volume ventilation for acute respiratory distress syndrome (ARDS)


PEEP-valve
Inspired air
Expired air
P
t
Inspiration to max P:
Expiration to PEEP:
Expiration to zero (no PEEP):
Aerated, expanded alveoli
Contracted, but still aerated alveoli
Collapsed alveoli

CPAP (Continuous Positive Airway Pressure)

- CPAP is positive pressure applied throughout the respiratory cycle to the spontaneously breathing patient.
- A continuous level of elevated pressure is provided through the patient circuit to maintain adequate oxygenation, decrease the work of breathing.
- CPAP may be used invasively through an endotracheal tube or tracheostomy or noninvasively with a face mask or nasal prongs

Cont...

- provides pressure at end expiration, which prevents alveolar collapse and improves the functional residual capacity and oxygenation.

- CPAP allows the nurse to observe the ability of the patient to breath spontaneously while still on the ventilator.

- It may used as a Weaning Mode

COMPLICATION

- Hypotension
- Pneumothorax
- Decreased Cardiac Output
- Nosocomial Pneumonia
- Increased Intracranial Pressure (ICP)
- Alarms turned off or nonfunctional
- Sinusitis and nasal injury
- Mucosal lesions Aspiration, GI bleeding, Inappropriate ventilation (respiratory acidosis or alkalosis, Thick secretions, Patient discomfort due to pulling or jarring of ETT or tracheostomy, High PaO2, Low PaO2, Anxiety and fear, Dysrhythmias or vagal reactions during or after suctioning, Incorrect PEEP setting, Inability to tolerate ventilator mode

Weaning from MV

- Every ventilated patient in the ICU should be reviewed daily for readiness criteria for extubation and put him on spontaneous breathing trial to see patient who are ready for unassisted breathing.

Respiratory Criteria:

- ☑ PaO_2/FiO_2 >150–200 mm Hg with FIO_2 ≤50% and PEEP ≤8 cm H_2O.
- ☑ $PaCO_2$ normal or at baseline levels.
- ☑ Patient is able to initiate an inspiratory effort.

Cardiovascular Criteria:

- ☑ No evidence of myocardial ischemia.
- ☑ Heart rate ≤140 beats/minute.
- ☑ Blood presure adequate with minimal or no vasopressors.

Appropriate Mental Status:

- ☑ Patient is arousable, or Glasgow Coma Score ≥13.

Absence of Correctible Comorbid Conditions:

- ☑ No fever.
- ☑ No significant electrolyte abnormalities.

Extubation

- Adequate gag and cough reflex
- Patient should respond to command GCS = 13 or more
- Secretion not copious (suction requirement not more than 2-4 hrs)
- Leak test in suspected cases of laryngeal odema e.g traumatic intubation.
- No radiological or surgical procedure is planned for the near future
- No extubation at end of the day
- After extubation :

- Monitor the patient for signs of respiratory distress and signs of respiratory failure
- Trial of NIV or HFNC for patient with high risk of deterioration

Alarms and Common Causes

High Pressure Limit	Low Pressure	High Respiratory Rate	Low Exhaled Volume
▪Secretions in ETT/airway or condensation in tubing. ▪Kink in vent tubing ▪Patient biting on ETT ▪Patient coughing, ▪gagging, or trying to talk. ▪Increased airway pressure from bronchospasm or pneumothorax	▪Vent. tubing not connected. ▪Displaced ETT or trach tube.	▪Patient anxiety or pain ▪Secretions in ETT/airway ▪Hypoxia ▪Hypercapnia	▪Vent tubing not connected ▪Leak in cuff or inadequate cuff seal ▪Occurrence of another alarm preventing full delivery of breath

mode	trigger	limit	cycle
CMV VC			
CMV PC			
ACMV VC			
ACMV PC			
SIMV VC			
SIMV PC			
PSV			

REMEMBER TWO RULES.....

- An alarm should never be silenced until the cause has been investigated and corrected.

- If the source of the alarm cannot be determined, disconnect the client from the ventilator and use a hand-held resuscitation bag for manual ventilation with 100% oxygen until the problem can be resolved

During mechanical ventilation the oxygenation is determined by the FiO2, PEEP and mean airway pressure and PaCO2 is determined by minute ventilation.

It is important to note that **mechanical ventilation** does **not** heal the patient. Rather, it allows the patient a chance to be stable while the medications and **treatments** help them to recover

Initial ventilator setting

Mode—assist/control (volume or pressure)	
Tidal volume	6–8 mL/Kg ideal body weight (see formula in Appendix B)
Inspiratory time	0.7–1.2 s
Inspiratory flow	Four times minute ventilation (approx)
Rate	12–20 breaths/min
PEEP	4–5 cm H_2O
FiO_2	1.0
Plateau pressure	<30 cm H_2O
Once the patient is stabilized	
FiO_2	To maintain PaO_2 more than 60 mmHg or SpO_2 more than 93–94% in normal lung and 88–92% in hypercapnic respiratory failure
PEEP	Set according to FiO_2 requirements (predetermined according to the degree of hypoxemia)
Plateau pressure	Recheck in an attempt to keep plateau pressure below 30 cm H_2O
Driving pressure (plateau-PEEP)	Keep below 13 cm H_2O

THANK YOU FOR ATTENTION!

Have a nice day!!!