

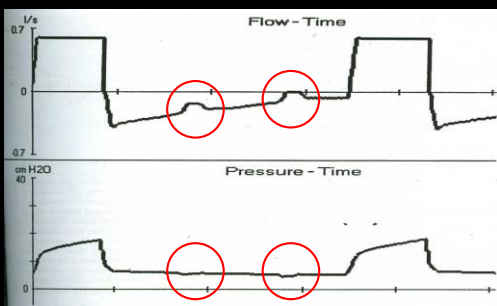
Shortness of breath during mechanical ventilation

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Ramathibodi hospital

Case I

Male COPD
Acute exacerbation
On MV
Mode VCV
T_v 480 ml.
Flow 60 L/min → decelerate flow
Preset RR 14
PEEP 5
Measured patient's RR = 30
Measured actual MV RR = 20

Wave form



Auto-PEEP in airway diseases

Expiratory phase

Normal



Severe airway obstruction
Expiratory port opened



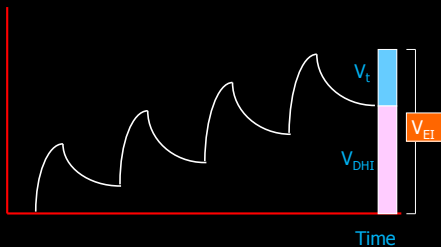
Severe airway obstruction
Expiratory port occluded



Martini JJ. Occult positive end expiratory pressure in mechanical ventilate patients with airflow obstruction. Am Rev Respi Dis 126:166,1982

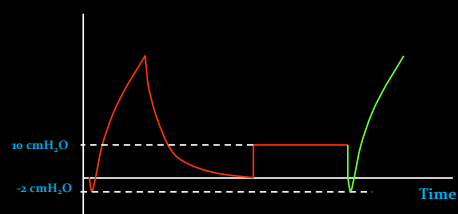
Dynamic hyperinflation

Lung volume

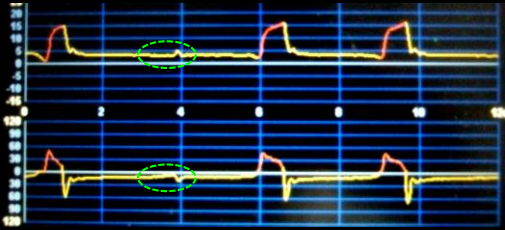


Difficult to trigger and auto-PEEP

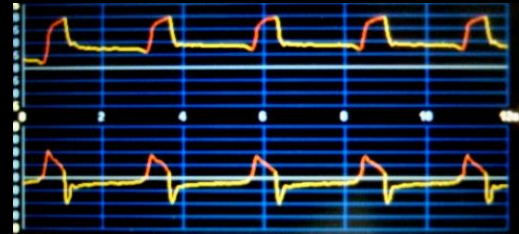
Pressure



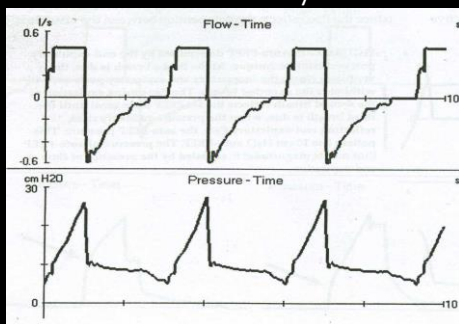
Difficult to trigger from PEEPi



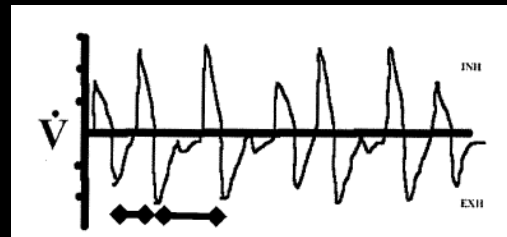
Waveform after applied PEEP



Time delay



Ineffective triggering in large TV



Case II

COPD exacerbation

On MV

Mode VCV

Tv 480 ml.

Flow 40 l/min → decelerate flow

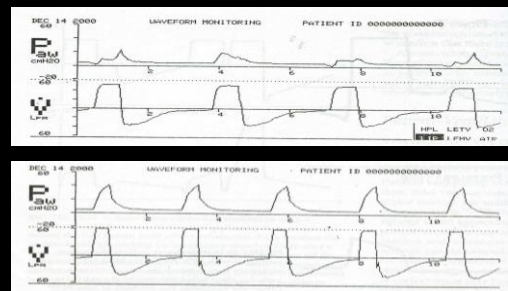
Preset RR 14

PEEP 5

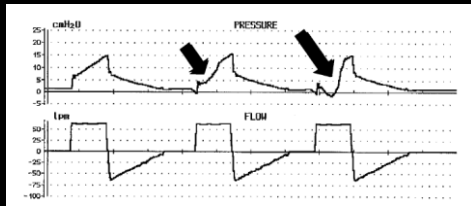
Measured patient's RR = 30

Measured actual MV RR = 30

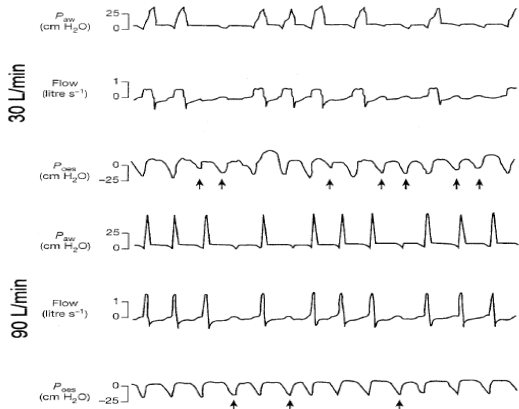
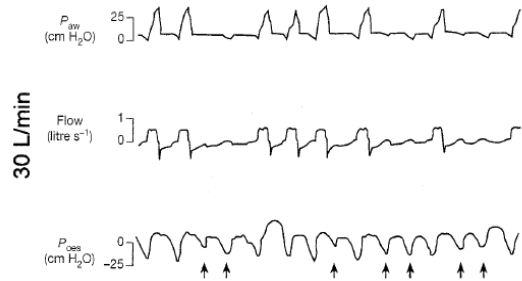
Wave form



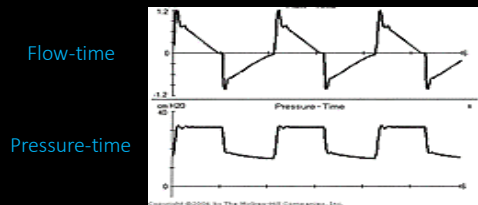
Wave form of flow starvation



Flow starvation and ineffective trigger



PCV unlimited flow



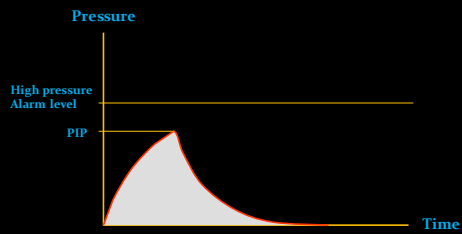
Case III

COPD acute exacerbation
 On mechanical entilation
 Mode: VCV
 Tidal volume 450 ml.
 Flow: Decelerate flow 55 L/min
 FIO2 0.5
 PEEP 8 cmH2O

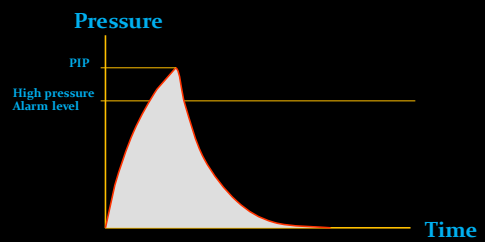
During mechanical ventilation



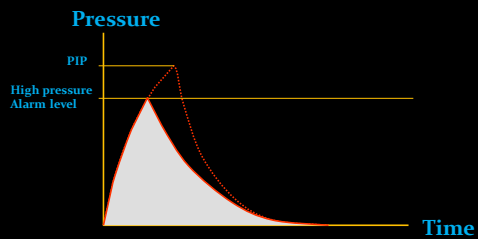
Adverse effect of high pressure alarm



Adverse effect of high pressure alarm



Adverse effect of high pressure alarm



Additional physical examination

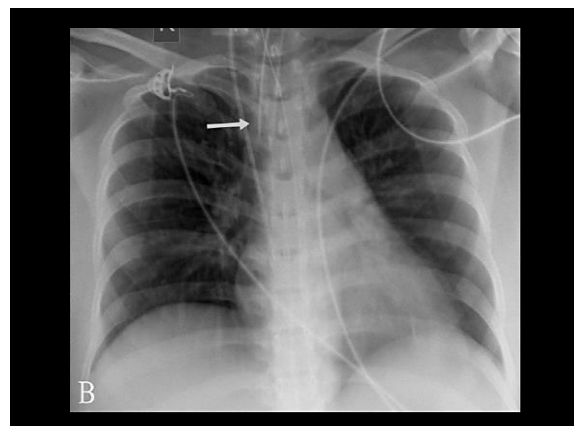
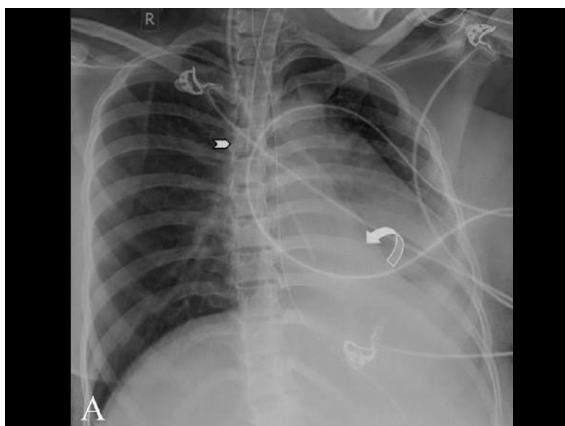
Decrease breath sound at left lung

D/Dx- Pneumothorax

On ICD

No air leak

???



Causes of high PIP

1. High airway resistance
 1. Broncho spasm
 2. Tube obstruction
 3. Circuit obstruction
 4. Over inspiratory flow rate
 5. Very small endotracheal tube
2. Lower lung compliance
 1. Pneumothorax
 2. One lung intubation
 3. Intrinsic PEEP (Air-trapping)
 4. Pulmonary fibrosis
 5. ARDS

Case IV

Pneumonia in Male 40 YO

BW 90 kg.

On mechanical ventilation

Mode: PCV

IP 20

Exhaled Tidal volume 500 ml.

I:E - 1:2

RR 16

PEEP 8 cmH₂O

FIO₂ 0.5

Case IV



Early terminate from MV



Causes of early termination

In VCV

Too low tidal volume

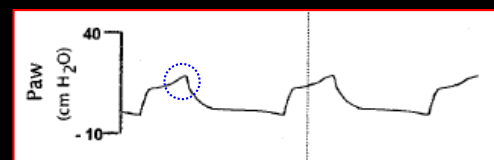
Too high flow

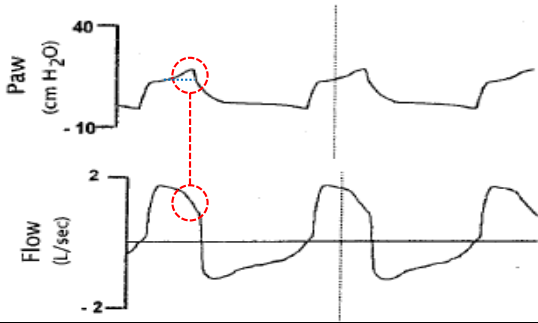
In PCV

Too short Ti

Case V

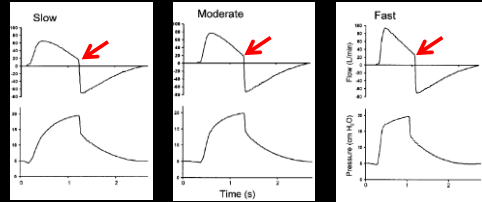
ผู้ป่วยอาการดีขึ้น ได้รับการ wean ด้วย PSV



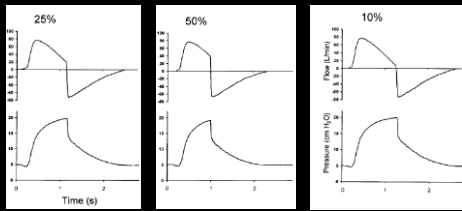


Delay inspiratory termination

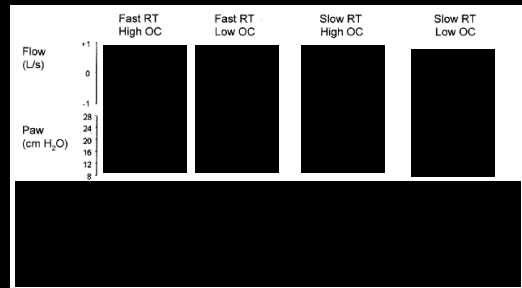
Rise time in PSV



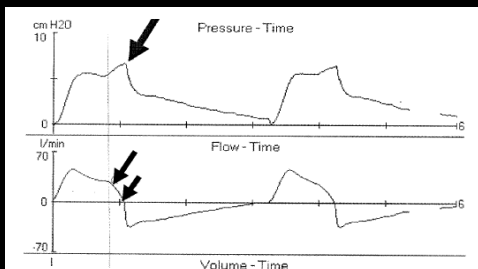
E-sense and inspiratory termination in PSV



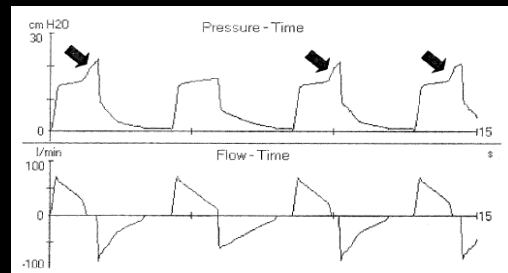
Different RS and OC in PSV



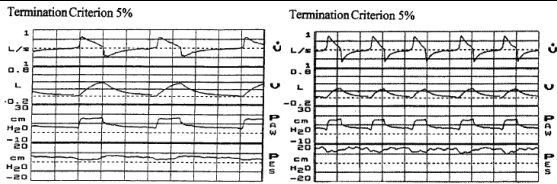
Delay termination



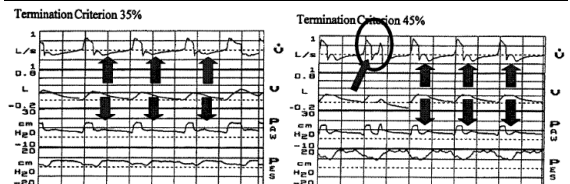
Delay termination in PCV



Normal respiratory pattern in PSV



Early termination in PSV



Case V

Case Pneumonia

On MV

Mode: VCV

Tidal volume: 500 ml.

Decelerate flow 40 L/min

PEEP 5

FIO2 0.4

Case VI

Low tidal volume alarm

Inspired Tv = 500 ml.

Expired Tv = 300 ml.

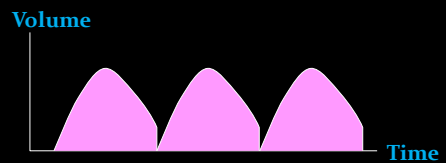
Causes of exhaled Tv < preset Tv

Leak

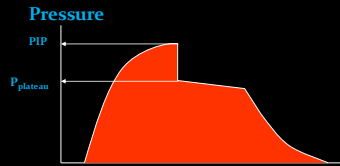
Air trapping

Machine malfunction

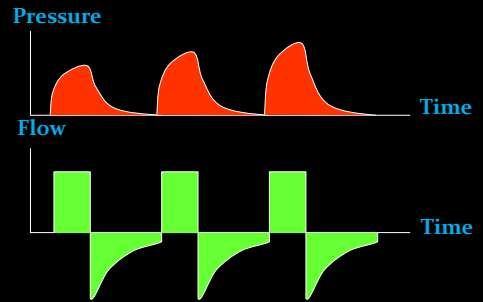
Volume-time



Leakage



Auto-PEEP



Case VII

Pneumonia

On Mechanical ventilator

Mode: VCV

Tidal volume 480 ml.

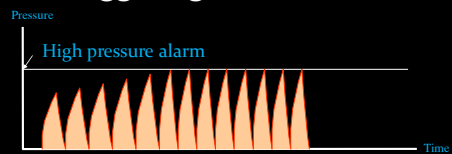
RR 14

Decelerate flow 50 L/min

PEEP 5

FIO₂ 0.6

Autotriggering



Autotriggering causes worsening effect to patient.

Increase PEEP,

Increase WOB from high auto-PEEP

Cause hypotension from high auto-PEEP

Cause worsening hypoxemia from V/Q mismatch

occurred by auto-PEEP.

Increase dead space

Barotrauma

Causes of auto-trigger

High sensitivity

Retained Water

Cardiac oscillation

Case VIII

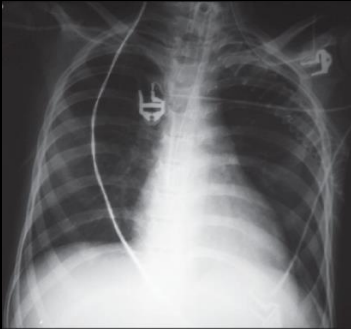
Post-op orthopaedict

On Post-op mechanical ventilation

Day 2 → SpO₂ 85%

Lungs : clear

CXR



ABG

pH 7.46
 pCO₂ 32 mmHg
 pO₂ 70 mmHg
 HCO₃- 23 mmol/L

Causes of hypoxemia

Hypoventilation
 V/Q mismatch
 Shunt

Hypoventilation

Causes
 Obesity
 Severe kyphoscoliosis
 Neuromuscular weakness

ABG:
 pH 7.2
 pCO₂ 60 mmHg
 pO₂ 65 mmHg
 HCO₃- 24 mmol/L



Normal A-a gradient

What is A-a gradient

(A-a) gradient = pAO₂ - paO₂ → Arterial oxygen

↓
 Oxygen in alveoli

(A-a) gradient = [(713 × FIO₂) - (pACO₂/0.8)] - paO₂

(A-a) gradient at room air = 150 - (paCO₂ + paO₂)

Other causes

Pulmonary embolism
 Sepsis
 Metabolic acidosis
 Intra-abdominal pressure

Hypoventilation

Causes

Obesity
Severe kyphoscoliosis
Neuromuscular weakness

ABG:

pH 7.2
pCO₂ 60 mmHg
pO₂ 65 mmHg
HCO₃- 24 mmol/L

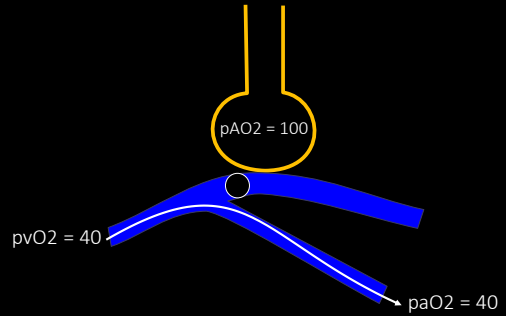


Normal A-a gradient

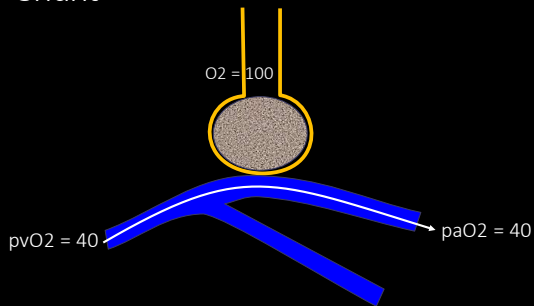
ABG: on cannula 5 L/min

pO₂ 100 mmHg

Shunt



Shunt



Causes

Pulmonary edema

Cardiogenic
Non-cardiogenic → ARDS

V/Q mismatch

Most of hypoxemia caused by V/Q mismatch
Correctable with oxygen

Diseases

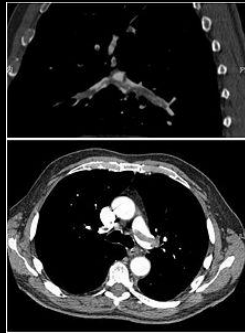
Airway
COPD
Asthma
Parenchyma
Mild pneumonia
Mild congestive heart
Mild interstitial lung
Vascular
Pulmonary embolism

ABG

pH 7.46
pCO₂ 32 mmHg
pO₂ 70 mmHg
HCO₃- 23 mmol/L

Wide A-a gradient
No wheeze
CXR no infiltration

CT scan



Case IX

Cirrhosis with pneumonia

On MV

Mode PCV

IP 20

Exhaled tv = 400

PEEP 5

FiO2 0.5

SpO2 97%

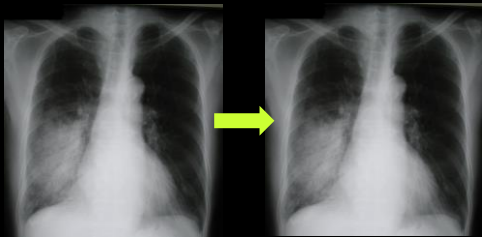


Dyspnea

Exhaled tv = 300

SpO2 94%

Case VIII



No wheezing

Abdominal distention



Thank you for your attention