

Mechanical Ventilation in the Emergency Department

서울아산병원
최승준

Mechanical Ventilation

ICU

ER



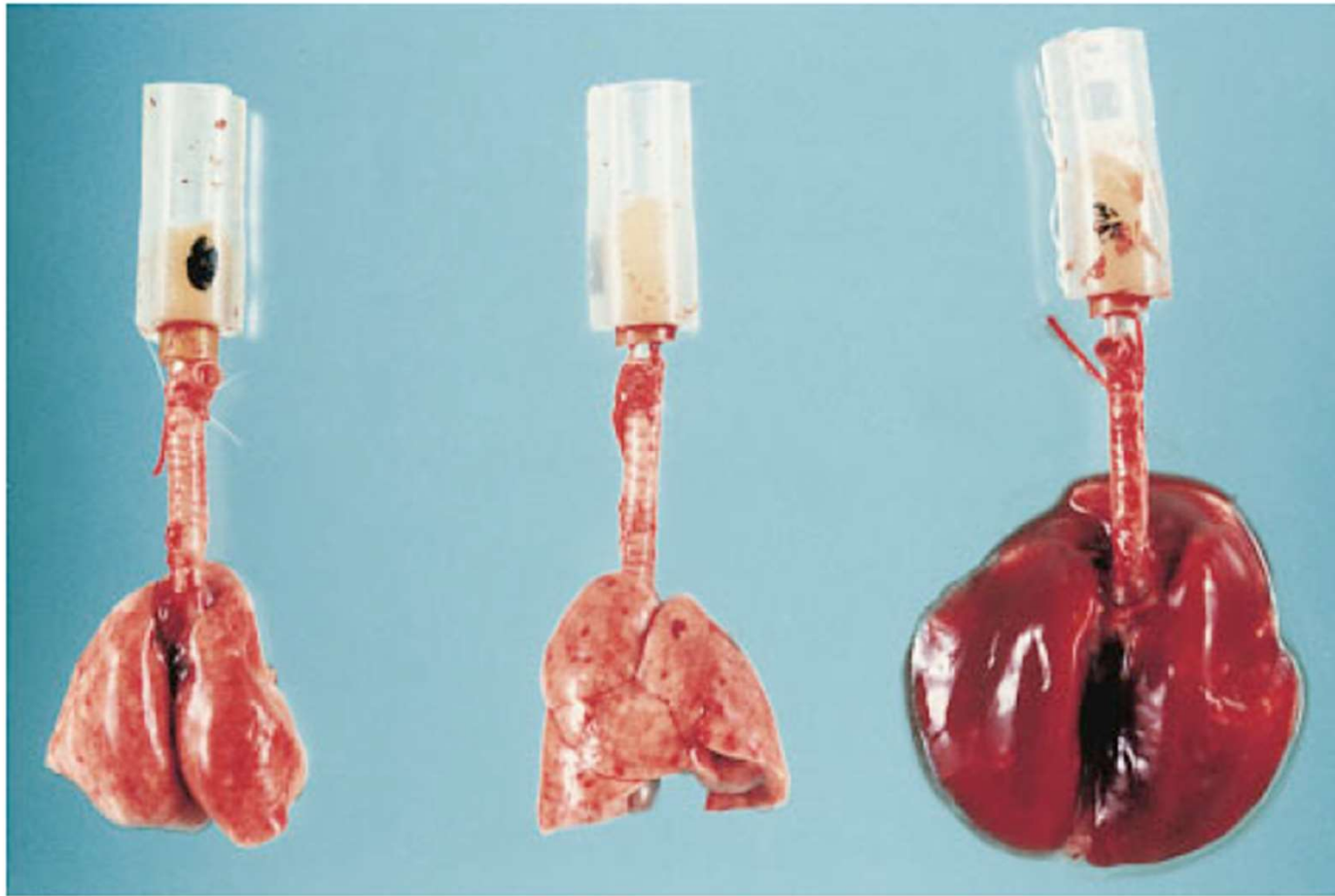
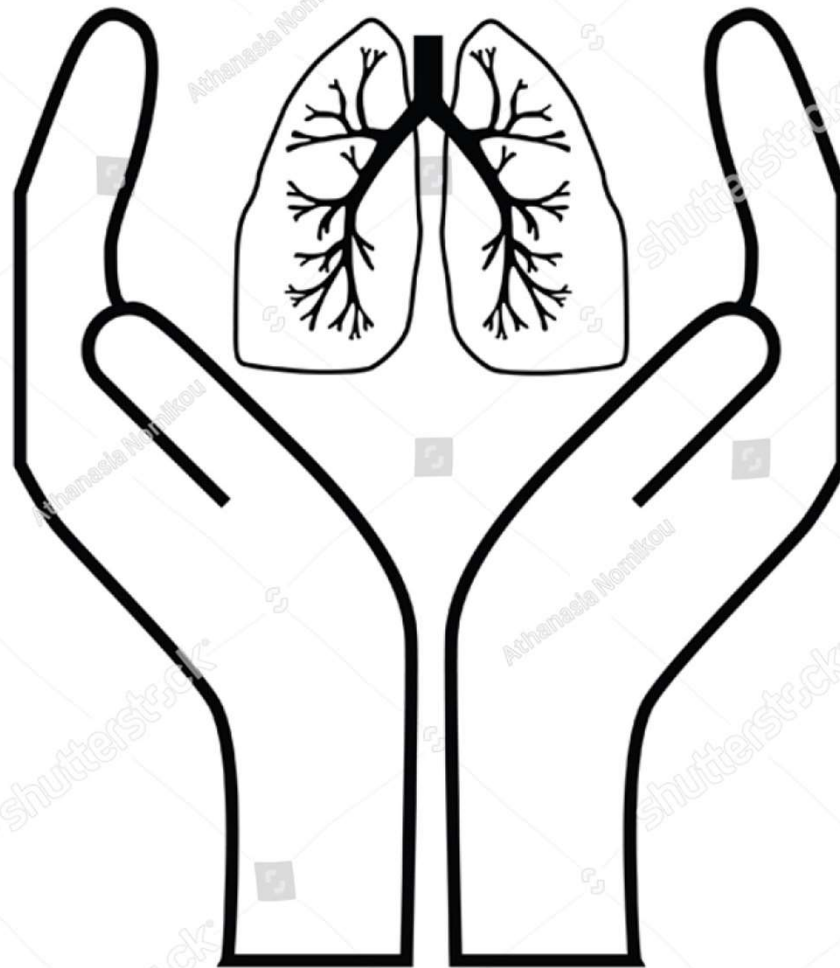


Figure 5. Macroscopic aspect of rat lungs after mechanical ventilation at 45 cm H₂O peak airway pressure. *Left:* normal lungs; *middle:* after 5 min of high airway pressure mechanical ventilation. Note the focal zones of atelectasis (in particular at the left lung apex); *right:* after 20 min, the lungs were markedly enlarged and congestive; edema fluid fills the tracheal cannula.

FIRST,
DO NO
HARM



Lung Protective Ventilation



Indications for Mechanical Ventilation

- Inadequate oxygenation
- Inadequate ventilation
- Inability to protect the airway

Indications for Mechanical Ventilation

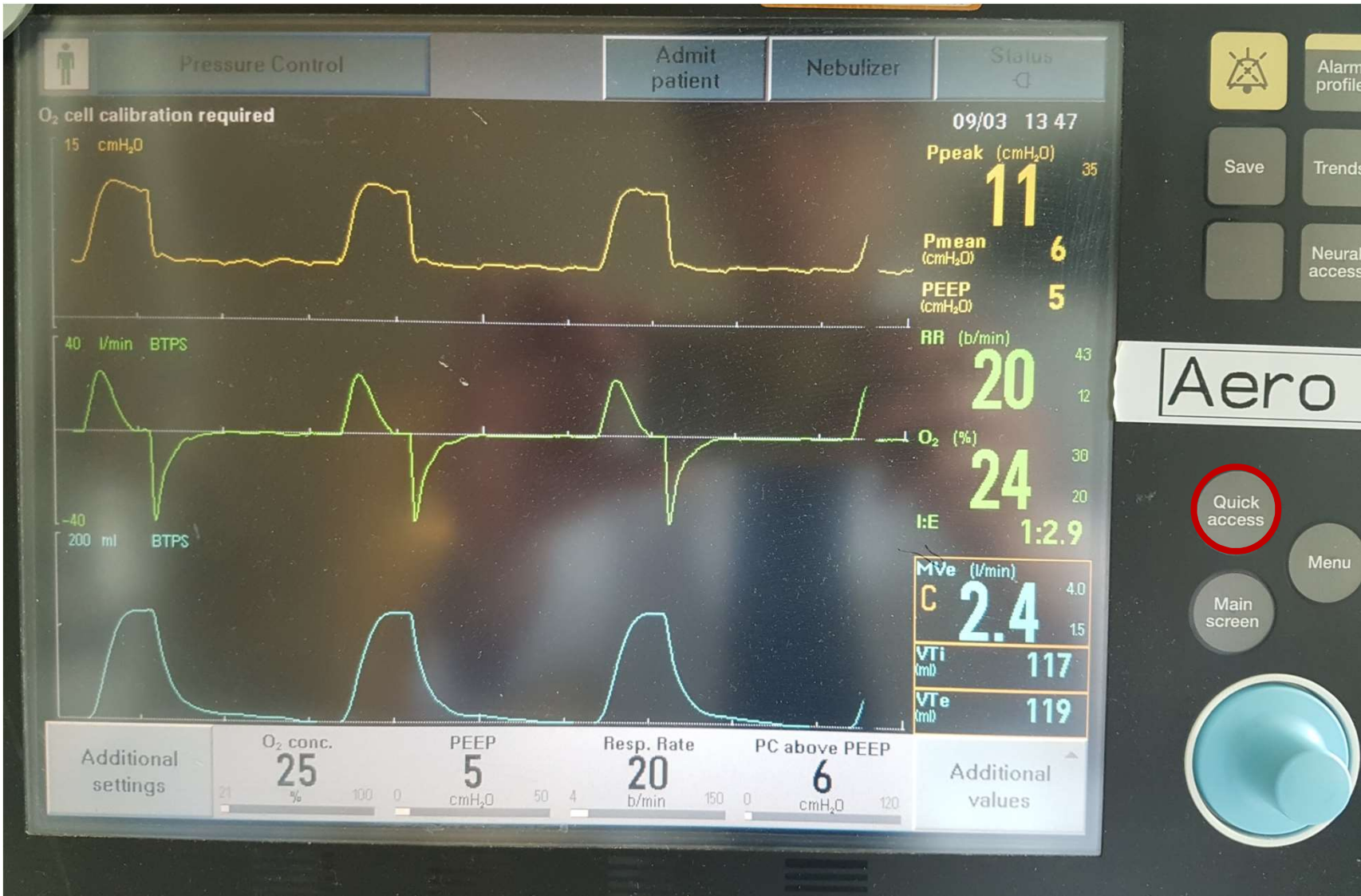
Table II. Indications for mechanical ventilation

Failure to breathe (normal lungs)

- CNS pathology, e.g. severe head injury or decreased cerebral perfusion due to shock
- Drugs and poisons, e.g. heroin overdose
- Neuromuscular disease, e.g. myasthenia gravis or Guillain Barré syndrome

Poor gas exchange (sick lungs)

- Localised or diffuse lung infiltrates, e.g. acute respiratory distress syndrome (ARDS), severe cardiogenic pulmonary oedema, pneumonia and aspiration
- Severe airflow obstruction, e.g. asthma/chronic obstructive pulmonary disease (COPD)





Pressure Control

Admit
patient

Nebulizer

Status
G

O₂ cell calibration required

09/03 13 47

Volume - Pressure



Flow - Volume



15 cmH₂O



P_{peak} (cmH₂O)

11

35

P_{mean} (cmH₂O)

6

PEEP (cmH₂O)

5

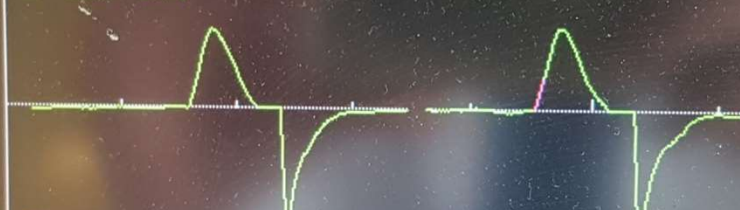
RR (b/min)

21

43

12

40 l/min BTPS



O₂ (%)

24

30

20

-40 200 ml BTPS



I:E

1:2.8

MVe (l/min)

C

2.5

4.0

15

VTi (ml)

118

VT_e (ml)

123



Close

Additional
settings

O₂ conc.

25

%

PEEP

5

cmH₂O

Resp. Rate

20

b/min

PC above PEEP

6

cmH₂O

Additional
values



O₂ cell calibration required

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Set Ventilation Mode

Pressure Control ▼

Ti 0.78 s (26%)

Basic

I:E

Trigger

PC above PEEP

6

cmH₂O

Resp. Rate

20

b/min

PEEP

5

cmH₂O

O₂ conc.

25

%

I:E

1:2.9

1:10.0 4.0:1

T insp. rise

5

%

Trigg. Flow

6

-20 0

Ppeak (cmH₂O)

11

35

Pmean (cmH₂O)

6

PEEP (cmH₂O)

5

RR (b/min)

20

43

12

O₂ (%)

24

30

20

I:E

1:2.8

MVe (l/min)

2.4

4.0

15

VTi (ml)

124

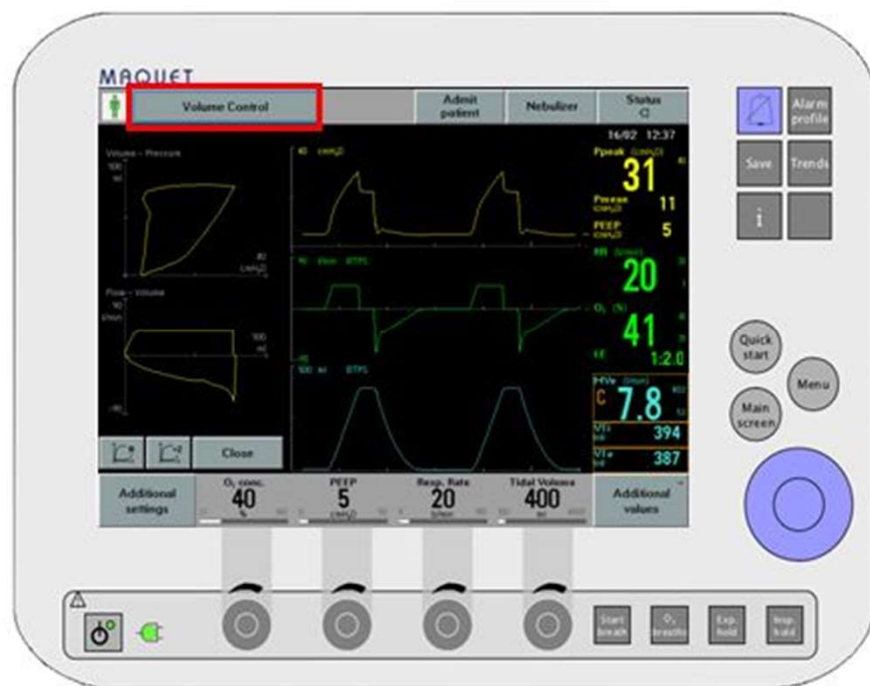
VTe (ml)

118

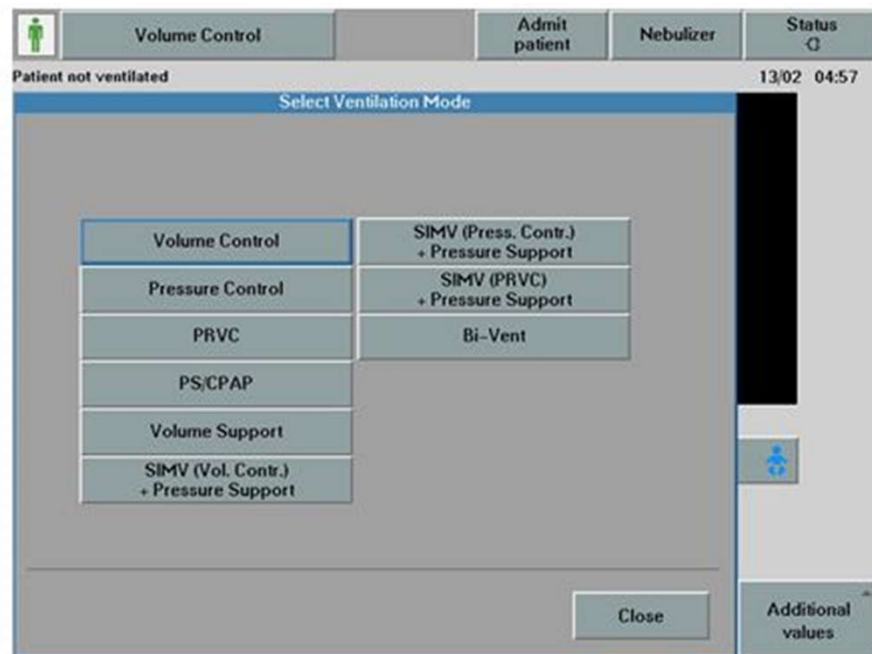
Additional values

Cancel

Accept



Ventilation mode



Ventilation mode window

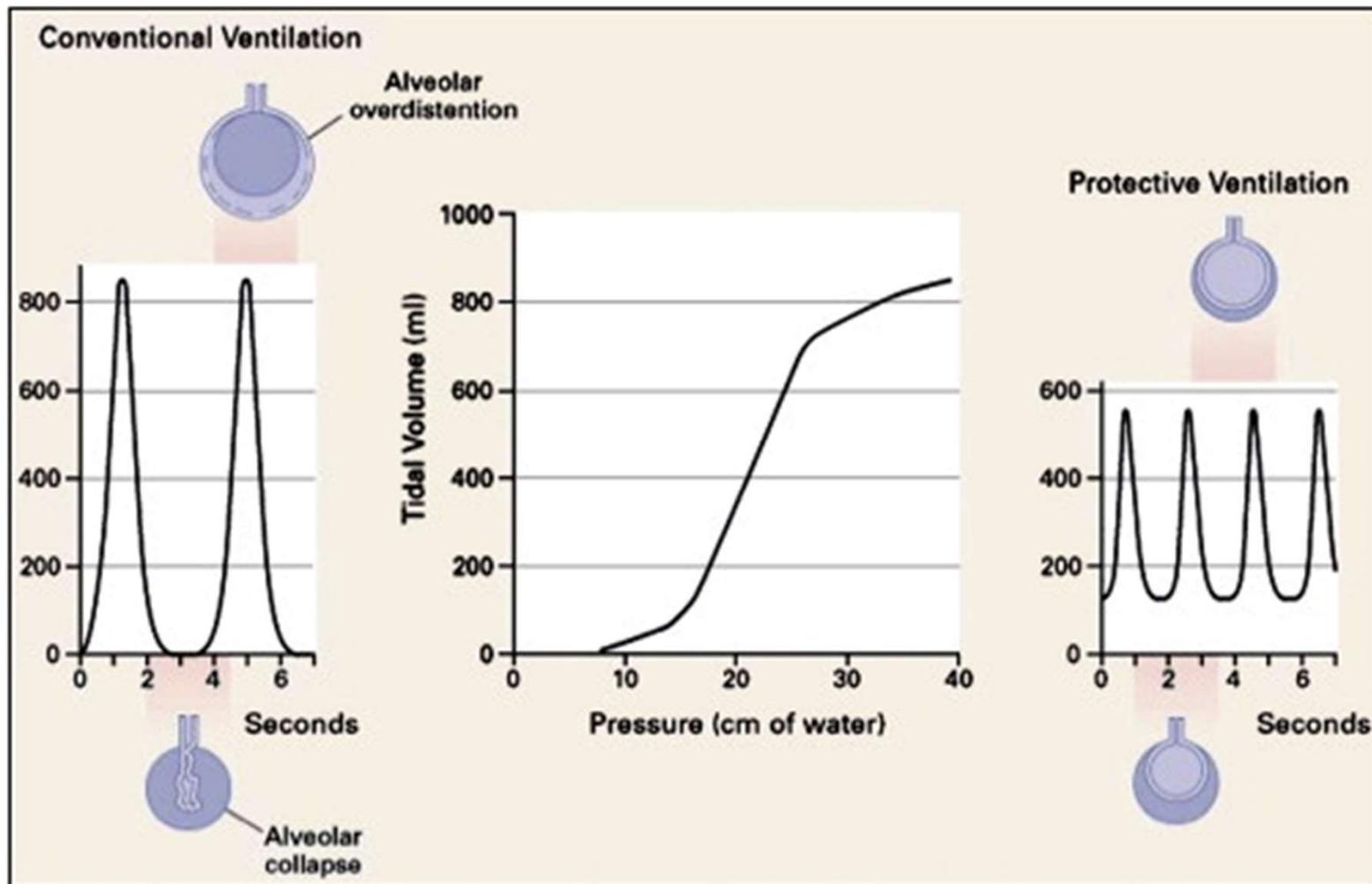
Respiratory Rate

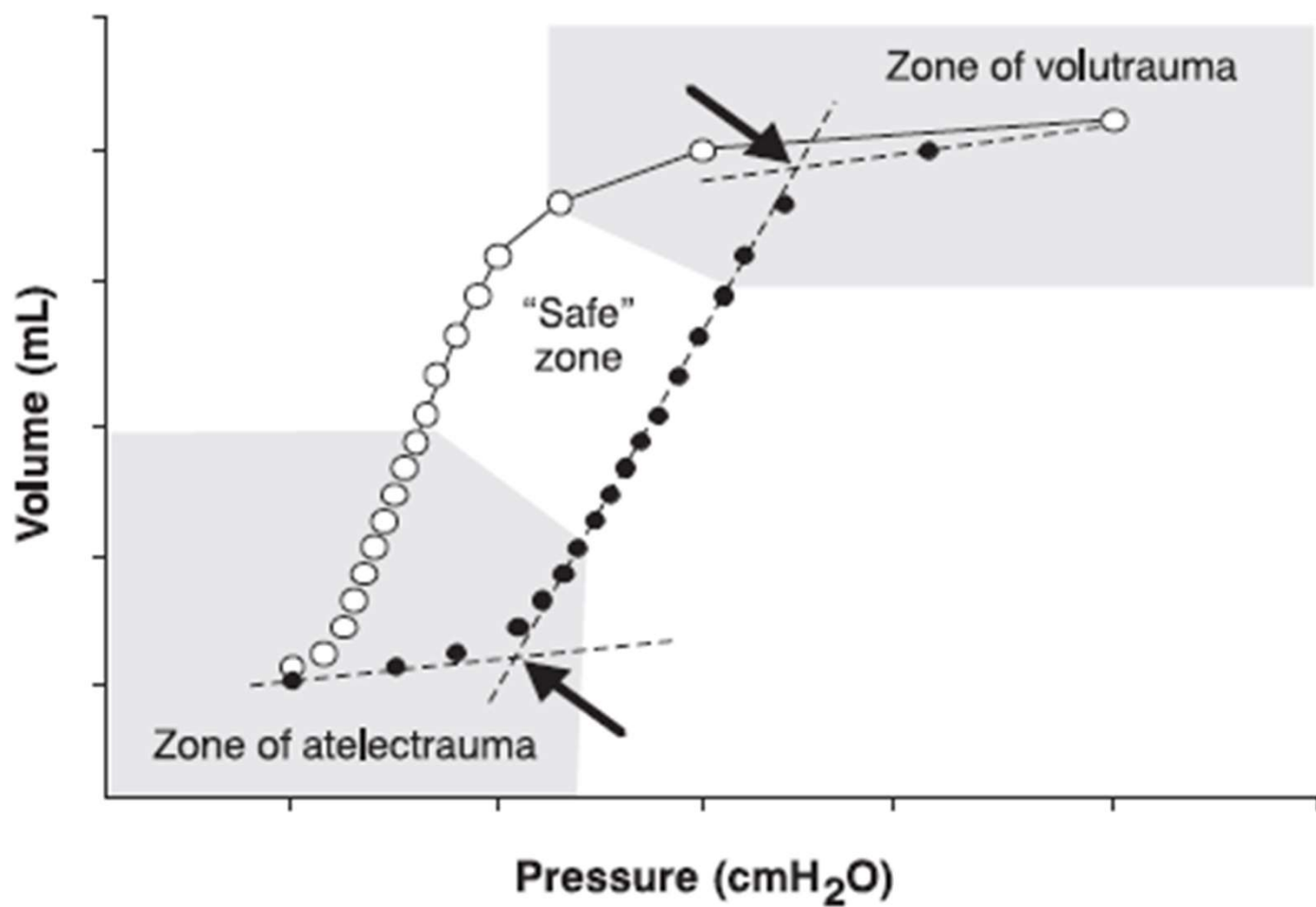
General Vital Signs and Guidelines

Age	Heart Rate (beats/min)	Blood Pressure (mmHg)	Respiratory Rate (breaths/min)
Premature	110-170	SBP 55-75 DBP 35-45	40-70
0-3 months	110-160	SBP 65-85 DBP 45-55	35-55
3-6 months	110-160	SBP 70-90 DBP 50-65	30-45
6-12 months	90-160	SBP 80-100 DBP 55-65	22-38
1-3 years	80-150	SBP 90-105 DBP 55-70	22-30
3-6 years	70-120	SBP 95-110 DBP 60-75	20-24
6-12 years	60-110	SBP 100-120 DBP 60-75	16-22
> 12 years	60-100	SBP 110-135 DBP 65-85	12-20

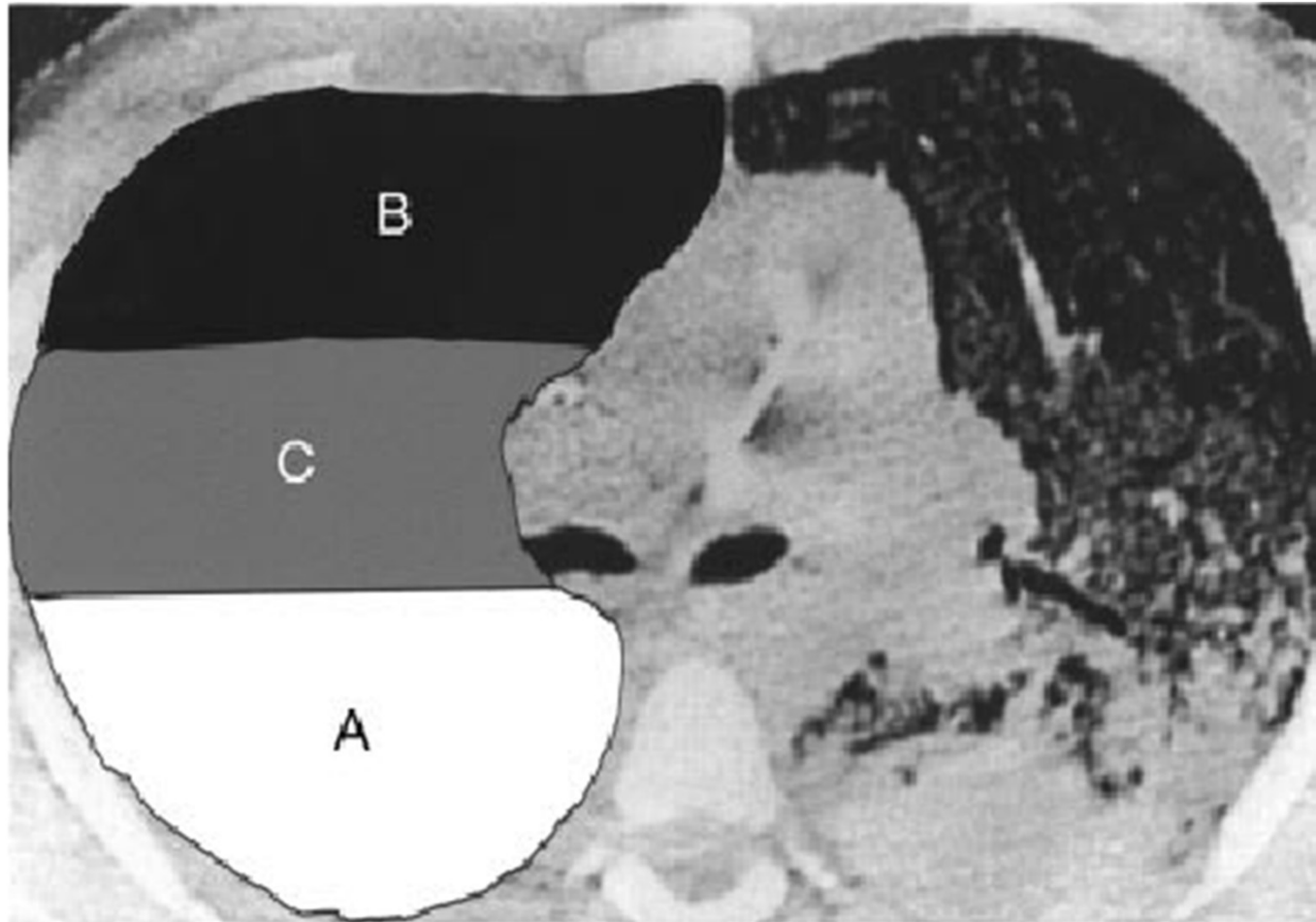
PALS Guidelines

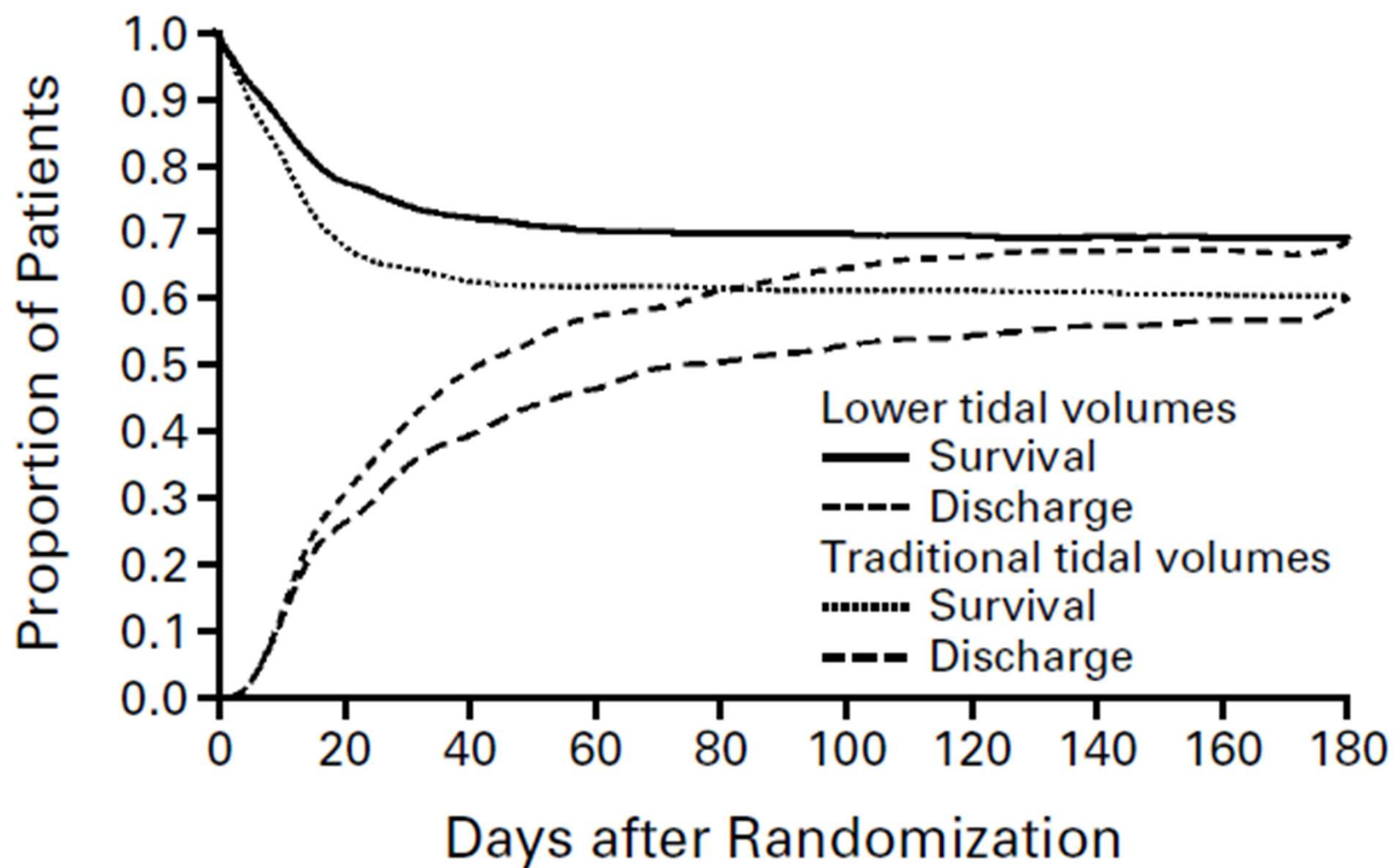
Conventional vs Protective



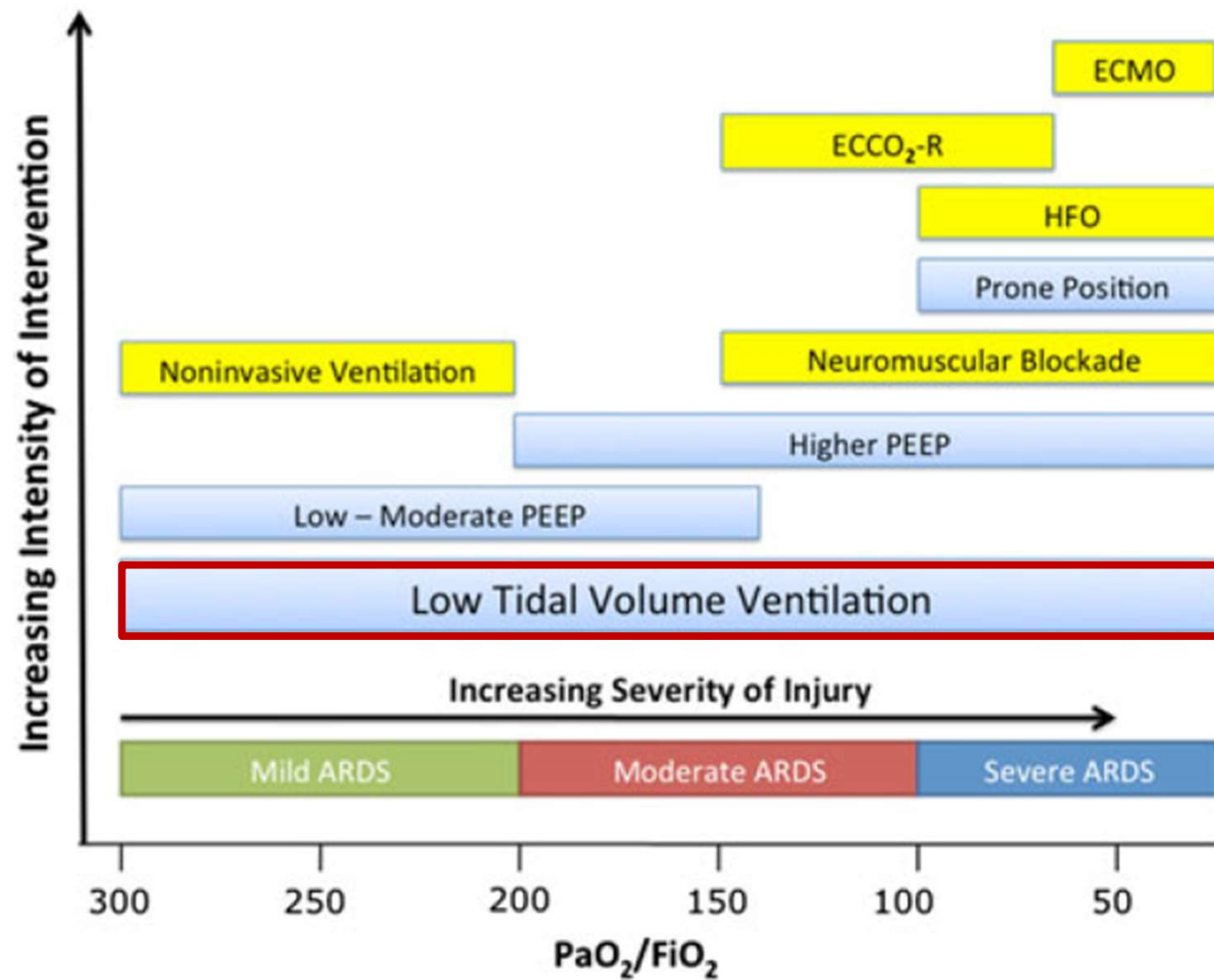


Baby Lung





N Engl J Med 2000;342:1301-8.



Intensive Care Med (2012) 38:1573–1582

PEEP

Lower PEEP/higher FiO₂

FiO₂	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7
PEEP	5	5	8	8	10	10	10	12

FiO₂	0.7	0.8	0.9	0.9	0.9	1.0
PEEP	14	14	14	16	18	18-24

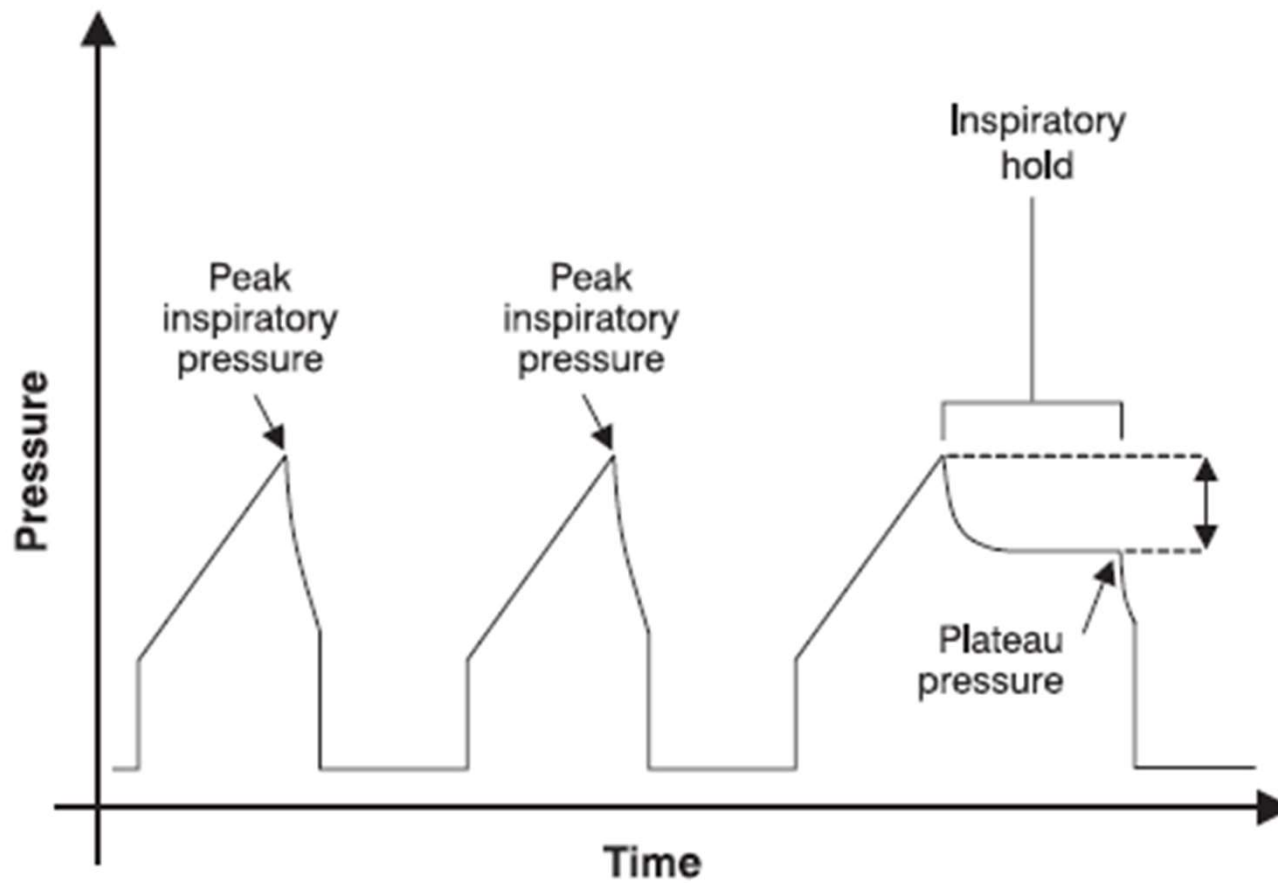
Higher PEEP/lower FiO₂

FiO₂	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.5
PEEP	5	8	10	12	14	14	16	16

FiO₂	0.5	0.5-0.8	0.8	0.9	1.0	1.0
PEEP	18	20	22	22	22	24

ARDSNet

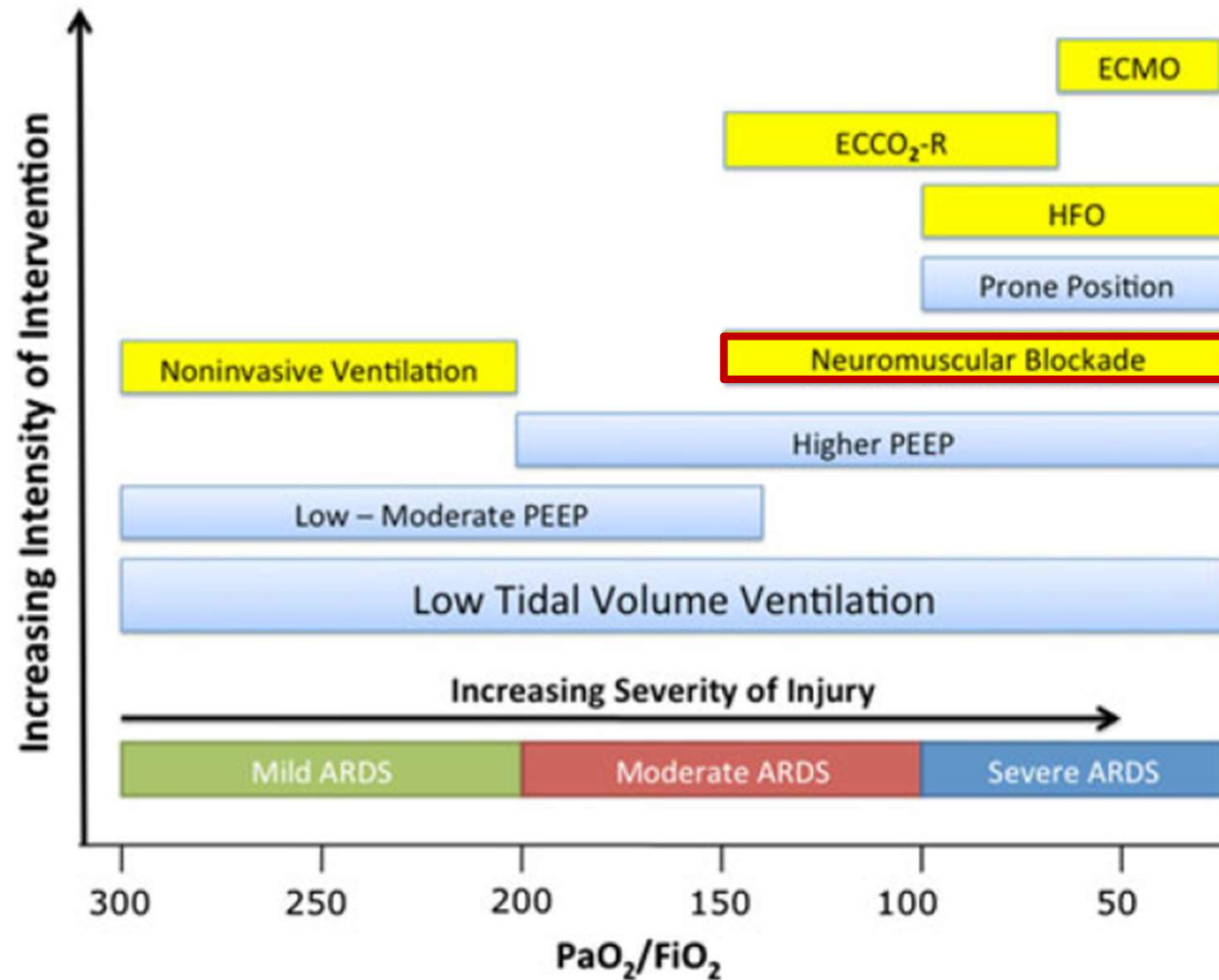
Plateau Pressure

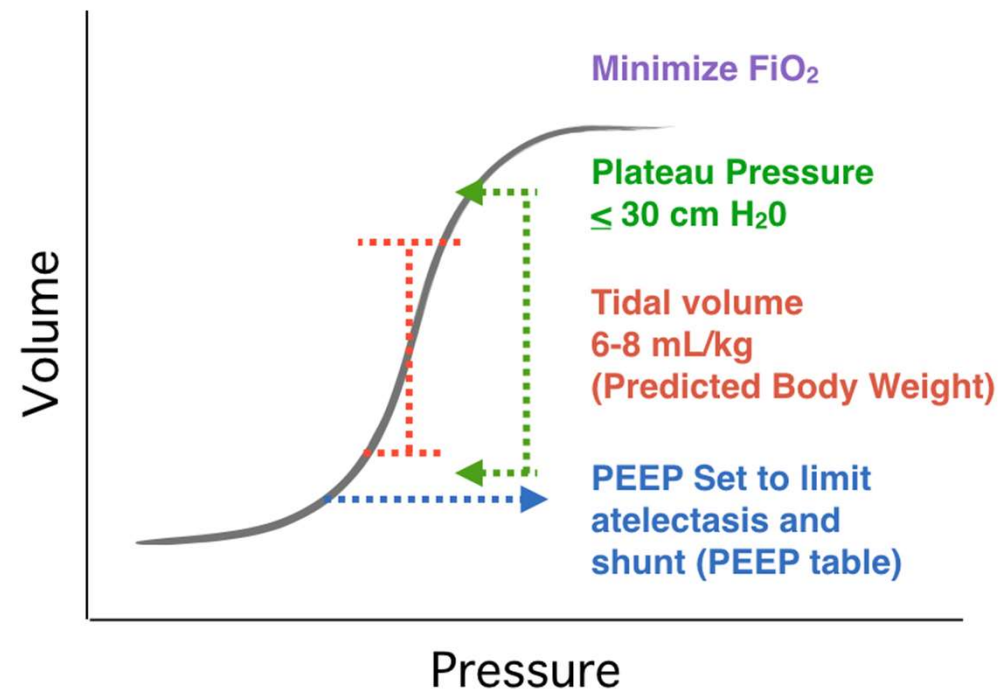


Permissive Hypercapnia

- With tolerable pH, not concern the PaCO₂
- Limit value : PaCO₂ < 80mmHg, pH > 7.20 (?)
- Adverse effects
 - Pulmonary vasoconstriction and pulmonary hypertension
 - Cerebral vasodilation yielding IICP

Neuromuscular Blockade

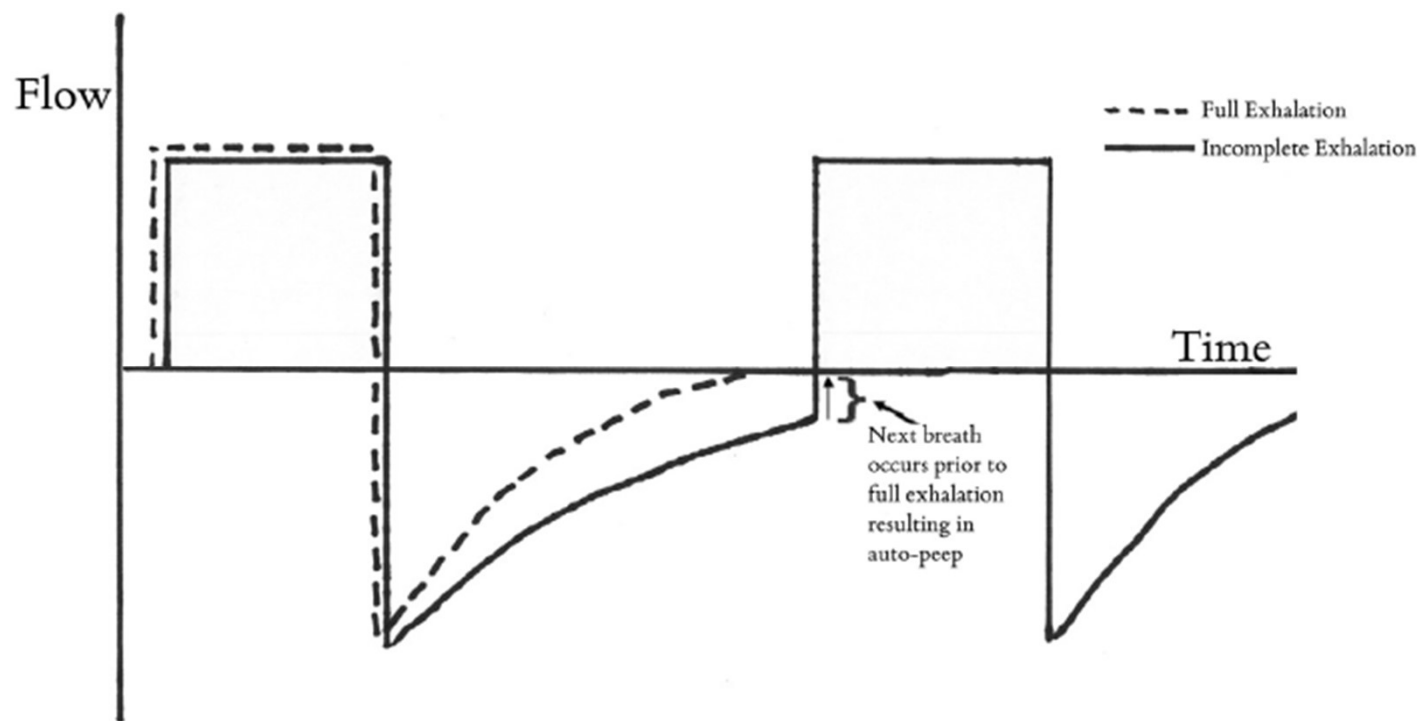




Components of Lung Protective Ventilation to reduce Ventilator-Associated Lung Injury (VALI) and decrease incidence of ARDS

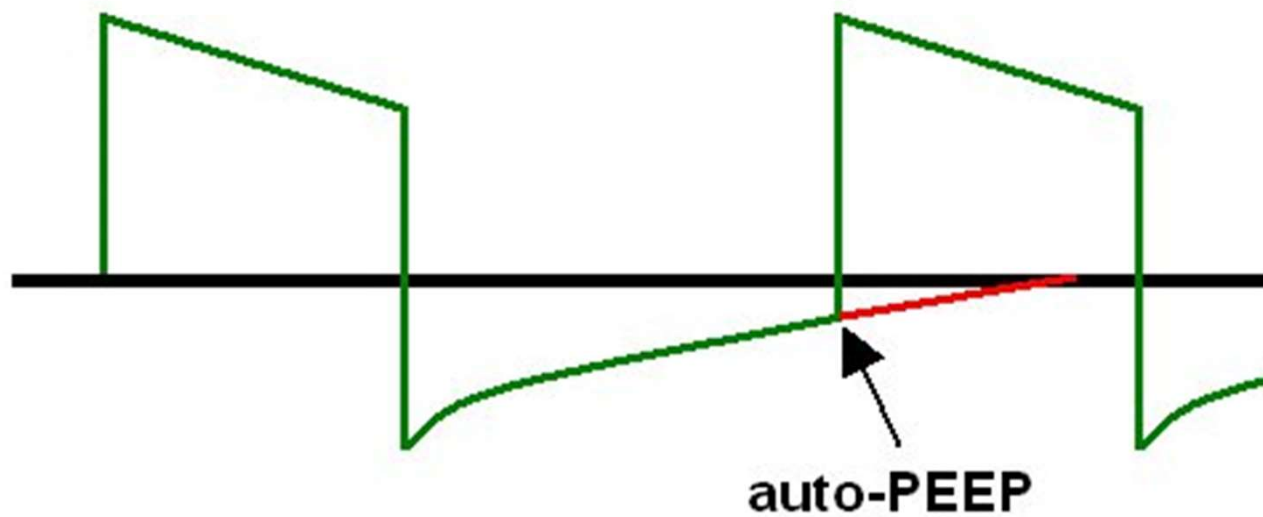
Daniel Kolinsky MD, et al

Obstructive Strategy



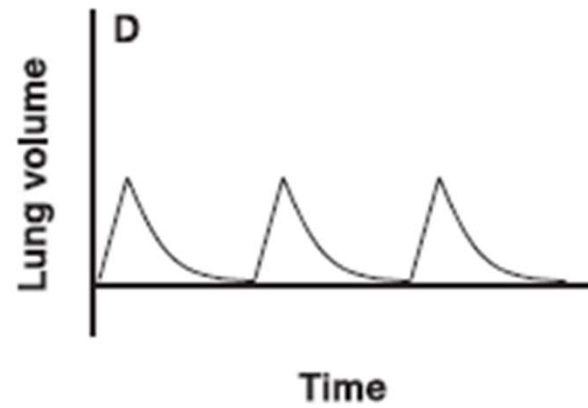
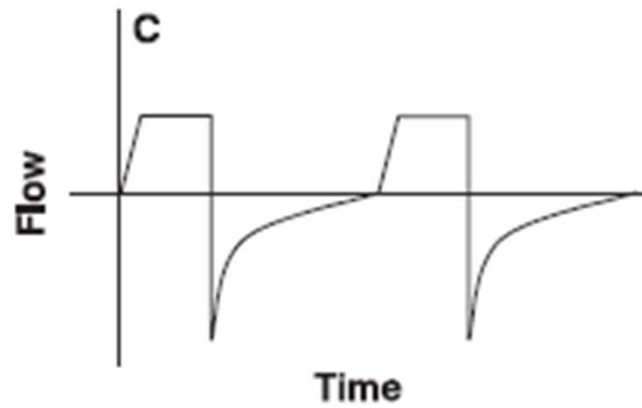
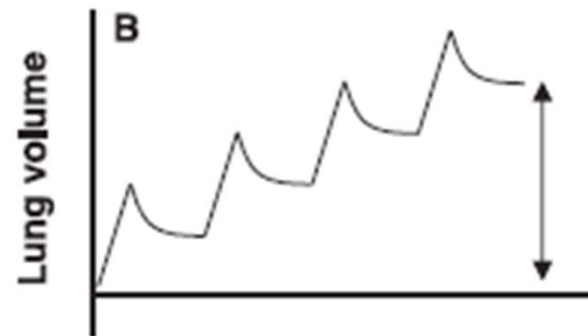
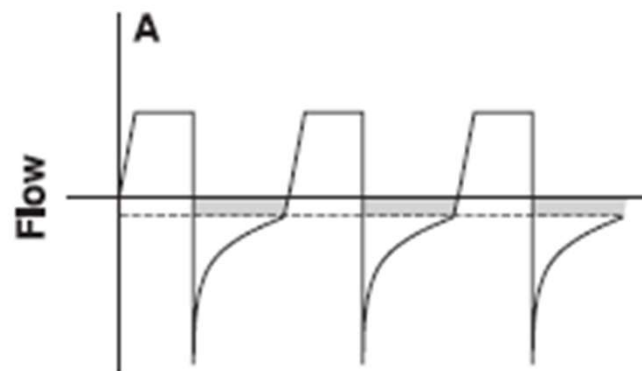
Ann Emerg Med. 2016;68:614-617.

Auto-PEEP



Daniel Arregue

Auto-PEEP





Pressure Control

Admit patient

Nebulizer

Status

O₂ cell calibration required

09/03 13 47

15 cmH₂O

Ppeak (cmH₂O)

11

35

Pmean (cmH₂O)

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PEEP (cmH₂O)

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I:E

1:2.9

MVe (l/min)

2.4

4.0

VTi (ml)

117

VTe (ml)

119

Additional settings

O₂ conc.

25

PEEP

5

Resp. Rate

20

PC above PEEP

6

Additional values



Alarm profile

Save

Trends

Neural access

Aero

Quick access

Menu

Main screen



Sedation & Hydration

- Sedation
 - Ketamine
 - Bronchodilating properties
- Hydration

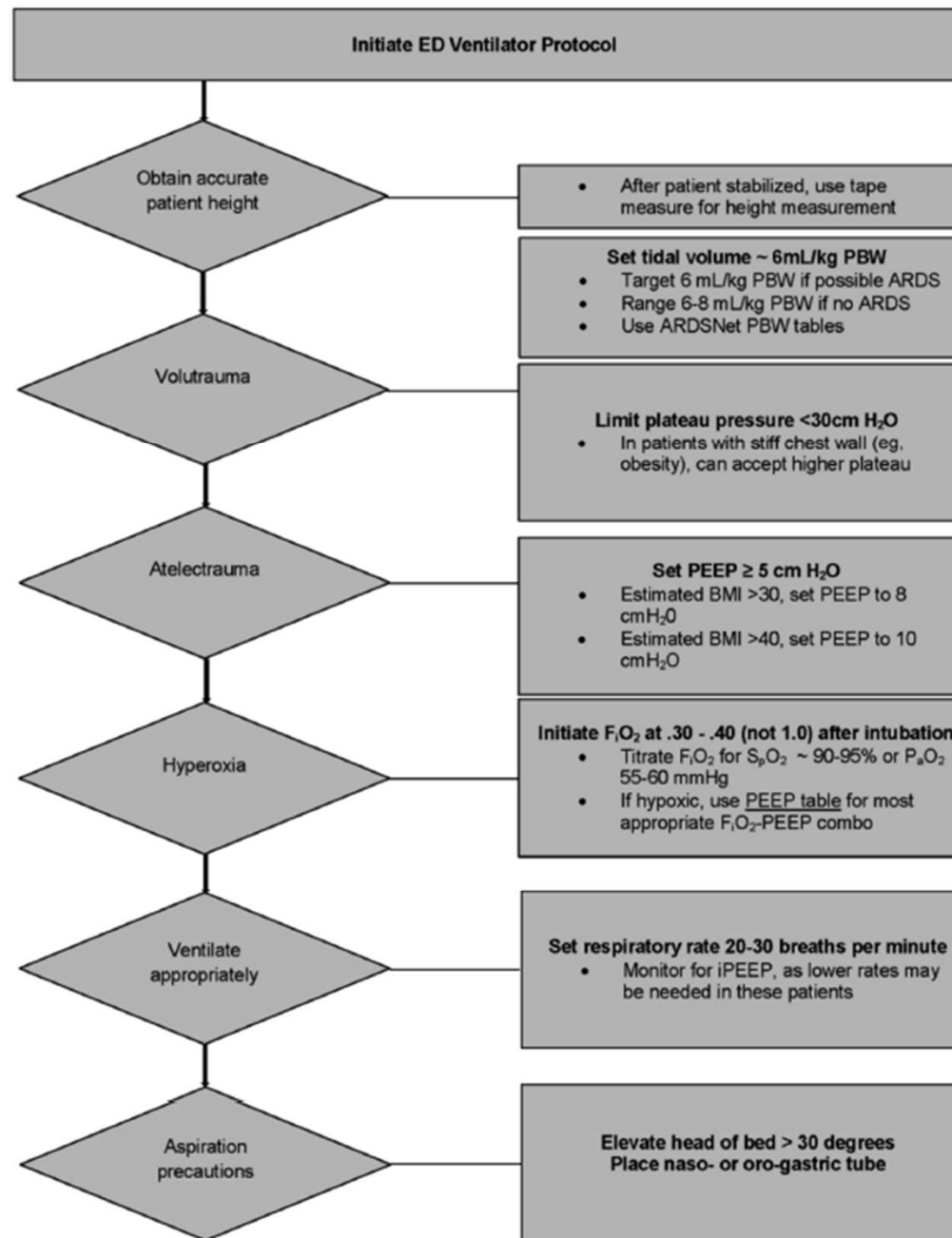


Figure 1. ED ventilator protocol. PBW, Predicted body weight; ARDS, acute respiratory distress syndrome; PEEP, positive end-expiratory pressure.

Summary

- Respiratory rate
- Low tidal volume
- PEEP & FiO₂
- Plateau pressure
- Permissive hypercapnia
- Sedation

Acute Respiratory Failure

Type 1 hypoxic respiratory failure	Type 2 hypercapnic respiratory failure
Lung failure Gas exchange failure ARDS, pneumonia, pulmonary edema	Pump failure Ventilatory failure Asthma, bronchiolitis, COPD