Calculation of Respiratory Mechanics

Introduction:

Respiratory mechanics refers to the expression of lung function through measures of pressure and flow. They are very useful to know the status of the lungs of ventilated patients. Below is the screen shot of Hamilton Medical ventilator monitoring menu. This document will try to calculate as much as possible parameters from this menu, using data input from our flow meter and pressure sensor. This should be noted that this is a developing document and will be updated periodically

1) Alveolar Pressure:

For volume control setup like ours it's calculated by

$P_{alv} = VT/C_{RS} + PEEP.$

VT <= set by us

PEEP<=set by us

$C_{RS=}$ calculated by Equation 6

2) Plateau Pressure

There are two methods to calculated it,

1) one is by holding the breath after inspiration for 0.5-1 second and measuring the pressure at inspiratory limb. This will be difficult in our setup of multiple patient.

2) The second method is using below equation and no hold breath maneuver is needed.

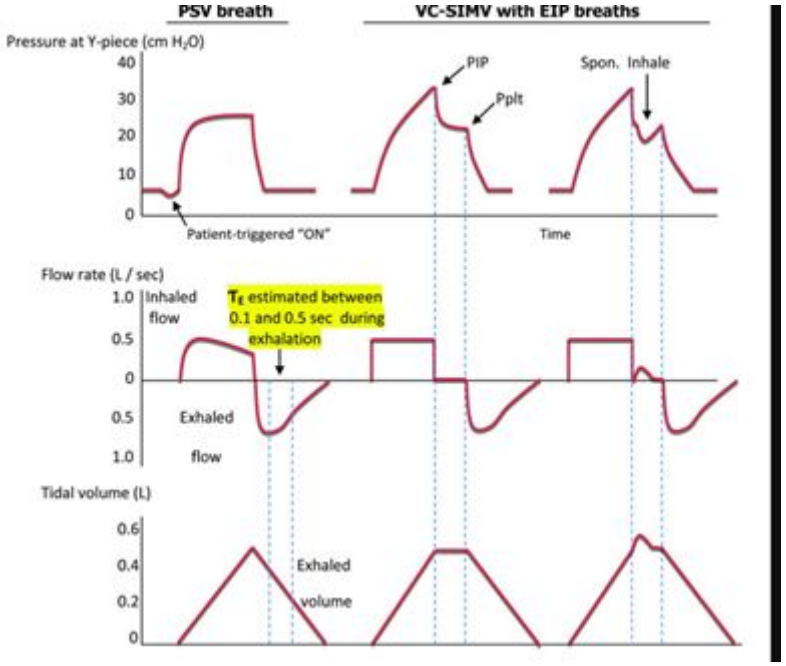
$$P_{plat} = \frac{(V_T \times PIP) - (V_T \times PEEP)}{V_T + (\tau_E \times \dot{FLOWi})}$$

VT=tidal volume, set by us

PIP=peak inspiratory pressure , given by our pressure senor

PEEP=set by us

Time constant T_E is calculated by slope of expiratory flow curve between 0.1-0.5 seconds as shown below



3) Auto-PEEP or iPEEP

Once again it can be calculated by two methods

a) Holding a breath after expiration and waiting for 0.5-1 second and measure pressing at proximal airway is Auto-PEEP, probably not applied in our case

b) It can also be calculated by mathematical equation

$$\text{auto-PEEP} = V_T/(C_{RS} \times (e^{Kx \times T_E} - 1),$$

VT=tidal volume

C_{RS} as calculated by equation-6

$Kx=1/T_{E,}$ and for TE see equation 2

4) Mean Airway Pressure

Calculated using following equation

$$P_{aw} = 0.5 \times (PIP - PEEP) \times (T_I/T_{tot}) + PEEP.$$

PIP is peak inspiratory pressure

PEEP is known

$\mathbf{T_I}$ is time taken by respiration (SET BY US)

$\mathbf{T_{tot}}$ total breathing cycle time

5) Respiratory System Compliance:

Defined in change in volume of respiratory system per unit of pressure

$$C_{RS} = \Delta V/\Delta P = V_T/(P_{plat} - PEEP),$$

V_T=tidal volume

P_{plat} = See equation 2

PEEP=set by us