USE OF WAVEFORMS IN SETTING VENTILATORY PARAMETERS

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With the advent of new technology ventilators in the intensive care units have become very sophisticated with a lot of clinical material depicted in the form of graphics. The present day intensivist needs to have a very good understanding of these parameters if the patient is to benefit.

Waveforms are graphical representations of data collected by the ventilator either integrated with changes in time (as in Pressure-time, Flow-Time or Volume-Time curves) or with one another (as in pressure-Volume of Flow-Volume loops).

Waveforms offer the user a "window" to visualize what is happening in the patient's lungs in real-time in the form of pictures. The digital values generated and displayed by the ventilator generally lag by at least one breath and in some case 4 to 8 breaths.

Waveforms analysis can also help the clinician detect circuit and airway leaks, estimate imposed ventilatory work, and aid in assessing the efficacy of bronchodilator therapy.

The two common modes of ventilation are

1. Volume control and
2. Pressure control

Pressure-Time curve (Volume control)

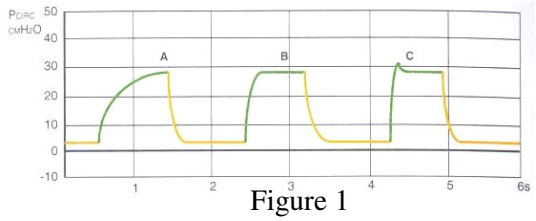

Figure 1

There is gradual rise in pressure (Figure 1, A). If breath is held in inspiration the drop in peak pressure indicate plateau pressure, which indicate alveolar pressure. (Figure 2)

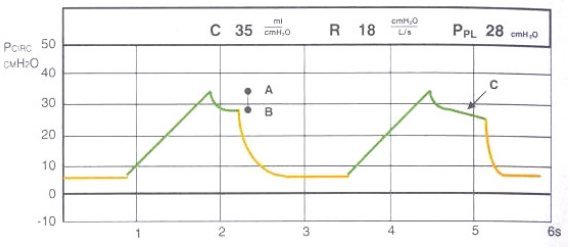

Figure 2

If breath is held in expiration the PEEP rise above the set level will indicate auto PEEP (Figure 3).

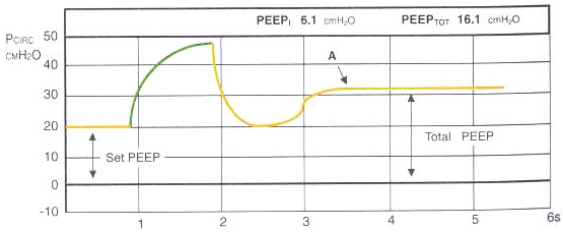

Figure 3

Pressure-Time curve (Pressure control)

Sudden rise in pressure and maintains it throughout inspiration. Therefore alveolar recruitment is better. However tidal volume will vary with compliance of the lung (Figure 1, B).

Flow-Time curve (Volume control)
Constant flow through out inspiration
(Figure 4).

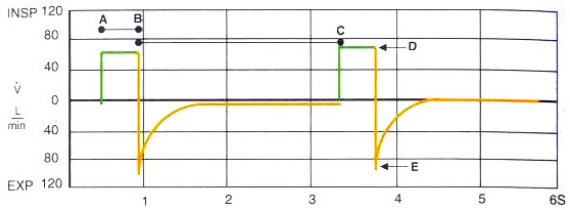

Figure 4

Flow-Time curve (Pressure control)

Exponential drop in flow (Figure 5, B).

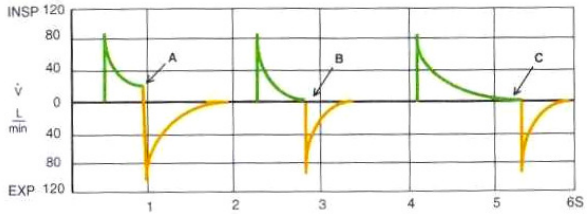

Figure 5

Premature termination of inspiration (Figure 5, A). One can change the I : E ratio to increase the inspiratory time (Figure 5, C).

Premature termination of expiration (Figure 6). This may result in air trapping. One can change the I : E ratio to increase the expiratory time.

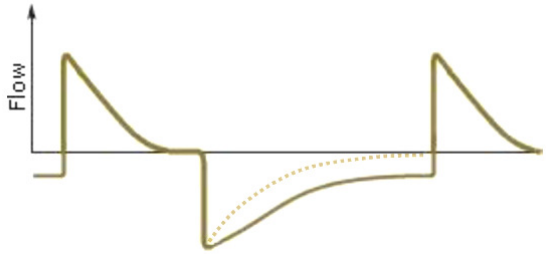

Figure 6

Volume-Time curve

The curve is the same for both volume and pressure control ventilation (Figure 7).

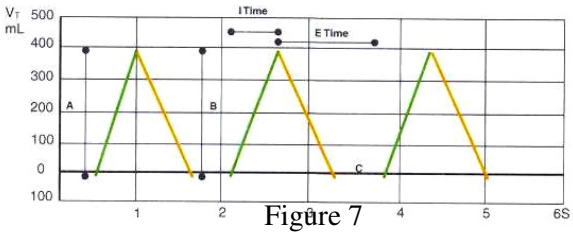

Figure 7

Loss of volume in expiration indicates air leak of air trapping (Figure 8).

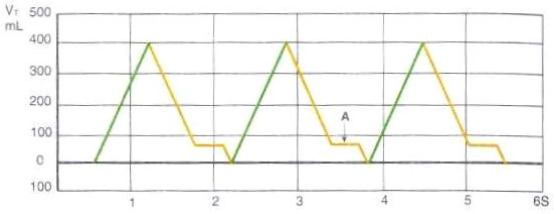

Figure 8

Pressure Volume loop

A left shift indicate increased resistance to expiration and a right shift indicate resistance to inspiration (Figure 9).

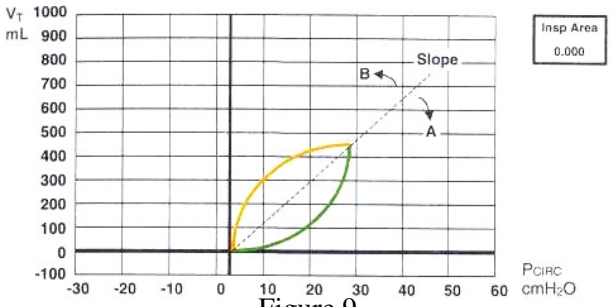

Figure 9

A pressure increase without an increase in volume indicates over distention. This might result in barotrauma. One needs to reduce the tidal volume (Figure 10).

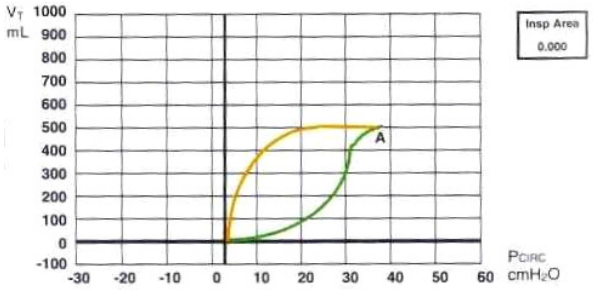

Figure 10

Expiration not returning to base line indicates an air leak or air trapping (Figure 11).

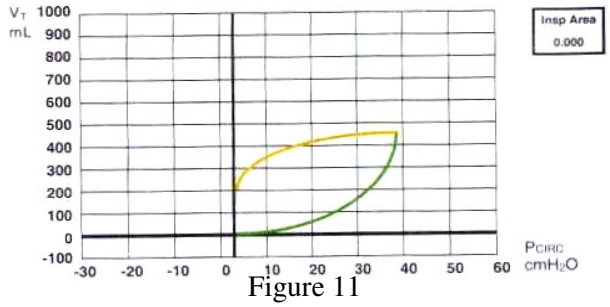

Figure 11

Negative pressure in the pressure axis denotes spontaneous breathing. Higher the area on this side, higher the work needs to be done to trigger the ventilator (Figure 12).

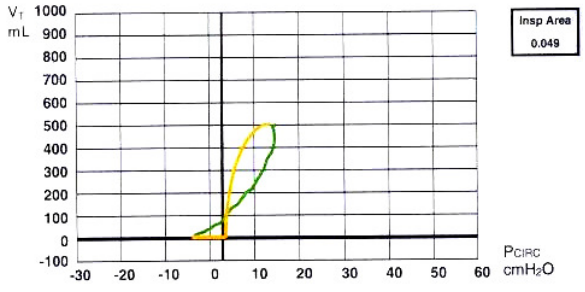

Figure 12

Flow volume loop

Normal flow volume loop (Figure 13). Scooping indicates increased air way resistance (Figure 14).

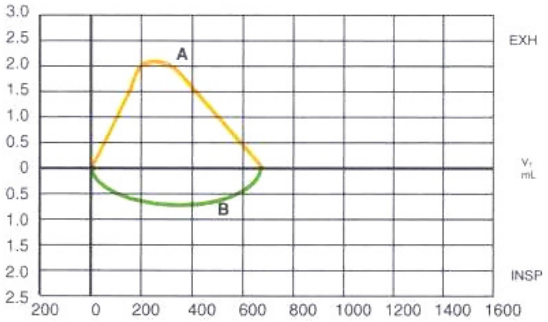

Figure 13

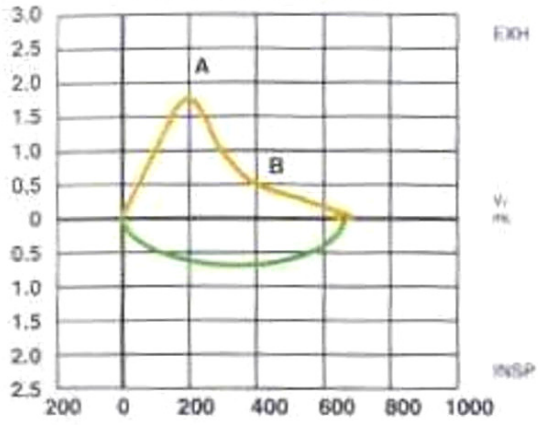

Figure 14

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