



Plateau and driving pressure in the presence of spontaneous breathing

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Driving pressure (ΔP), i.e. plateau pressure (P_{plat}) minus positive end-expiratory pressure, is increasingly a target for limiting inspiratory lung stretch, since it represents the pressure distending the respiratory system.

It is commonly thought that estimation of P_{plat} (and hence ΔP) is unreliable during spontaneous effort because a stable inspiratory “hold” cannot be achieved. Moreover, the contribution of spontaneous effort is ignored if reading airway pressure without esophageal manometry (P_{es}). Thus, it is thought that P_{plat} and ΔP are accurately measurable only during paralysis. However, both of these limitations can be easily overcome.

First, a brief inspiratory hold during pressure support ventilation (if allowed by the specific ventilator in use, Supplemental Table 1) results in a satisfactory P_{plat} as

shown in previous publications from our group. Second, inspiratory effort (negative P_{es} deflection) is not apparent from the airway pressure waveform, but is reflected in it when inspiration is interrupted.

An inspiratory hold during a positive pressure breath without spontaneous effort results in a slight decrease in the inspiratory pressure as the flow ceases yielding the P_{plat} ; this is the pressure generated by that static lung volume. An inspiratory hold during a positive pressure breath with spontaneous effort (Fig. 1 and supplemental video) results in an increase in the airway pressure, which is again the P_{plat} . It is important to realize that this is a true P_{plat} that reflects the size of the V_T and the additional (hidden) contribution of the spontaneous effort.

In conclusion, an inspiratory hold during assisted ventilation allows measurement of the total distending

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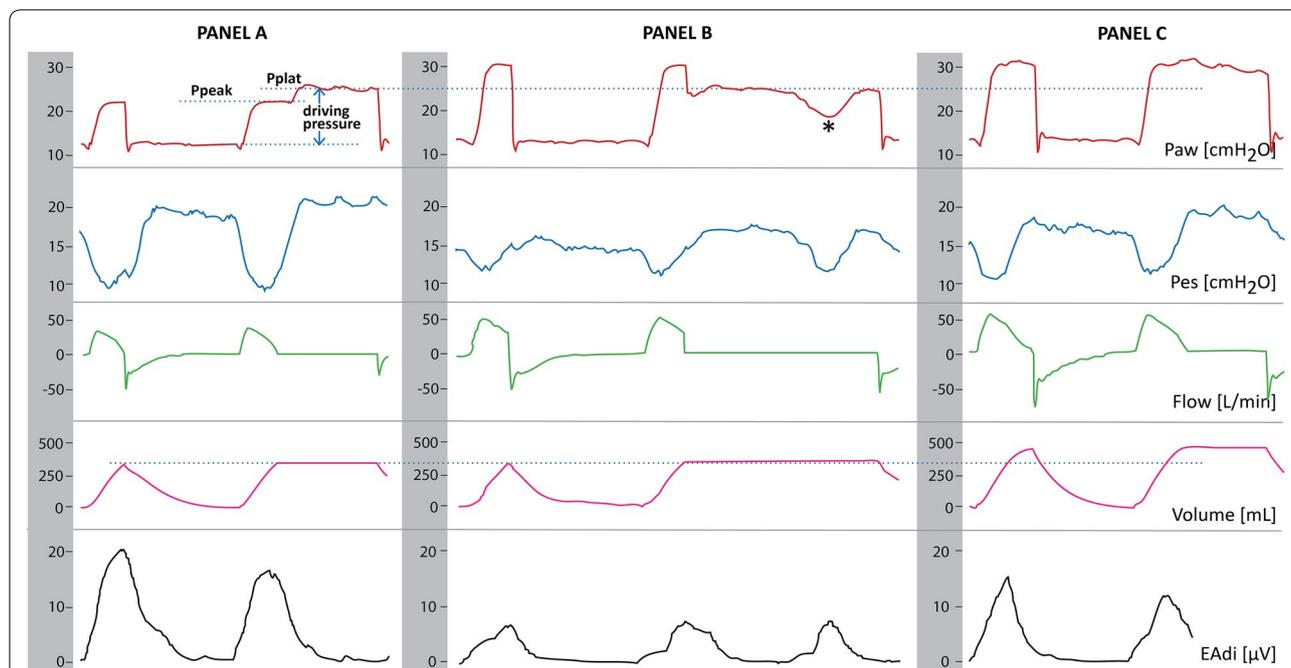


Fig. 1 The figure shows three inspiratory holds obtained under different conditions during pressure support ventilation. In panel B a baseline condition is depicted. A tidal volume (V_T) generated by pressure support plus spontaneous effort results from combined deflections in positive airway pressure (visible on standard monitors) and negative pleural pressure (visible only by esophageal manometry). An inspiratory hold stops airflow, and once the spontaneous effort ceases, the pressure generated by that V_T will also be P_{plat} . If a patient's effort occurs, this temporarily disturbs the P_{plat} reading, but it is easily recognized (*). In panel A, the level of pressure support (and hence peak inspiratory pressure) is decreased, but the patient's effort increases (as seen by the greater swings in esophageal pressure and electrical diaphragm activity), so that tidal volume is unchanged. Because negative P_{es} and positive P_{aw} contributed, the V_T will be greater than if it was generated solely by the positive pressure; thus, the static pressure corresponding to that larger V_T means that airway pressure will increase (not decrease) to P_{plat} when an inspiratory hold is applied. It can be noticed that P_{plat} obtained by an inspiratory hold is the same between these two conditions, reflecting an equal pressure distending the respiratory system and the greater the effort relative to the level of PS, the greater will be the rise of inspiratory pressure to P_{plat} . Panel C shows the effect of an increased breathing effort, with the same level of assistance (in comparison with panel B), leading to an increased P_{plat} (and ΔP)

pressure (P_{plat}) and derivation of compliance and ΔP , which may allow for better protective ventilation.

Electronic supplementary material

The online version of this article (<https://doi.org/10.1007/s00134-018-5311-9>) contains supplementary material, which is available to authorized users.

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Compliance with ethical standards

Conflicts of interest

The authors have no conflict of interest to declare.

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