

THE INFLUENCE OF POSITIVE PRESSURE VENTILATION ON ELECTROCARDIOGRAM AMPLITUDE: A CONFIRMATORY STUDY

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It is well-known that arterial pulse pressure variation can be induced by positive pressure ventilation. Arguing that positive pressure ventilation would likely also influence the electrocardiogram (ECG) through variations in thoracic blood volume and thus thoracic electrical conductivity, like Cannesson's team [1], we hypothesized that a similar effect might be obtained with the electrocardiogram. We set about to test this hypothesis using a custom data acquisition system to collect intraoperative data at 600 samples per second per channel in patients with an arterial line in situ undergoing general anesthesia and positive pressure ventilation. Airway pressure was obtained by connecting a clinical pressure transducer to the patient breathing circuit. The figure below shows a sample result including a period of apnea.

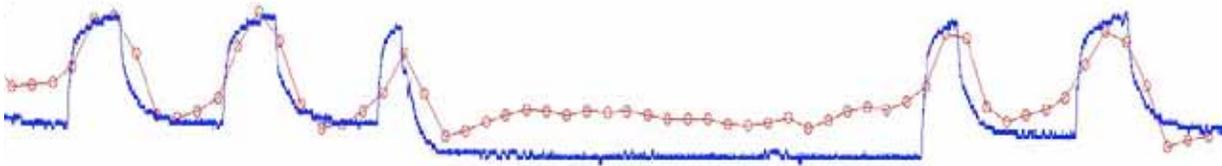


Figure: A plot of electrocardiogram (ECG) amplitude and airway pressure against time. Note how the regular respiratory variation in ECG amplitude vanishes with apnea.

The presented data clearly confirms the findings of Cannesson et al. that the amplitude of the electrocardiogram does vary with positive pressure variation. We hypothesize that the amplitude of the electrocardiogram increases as the volume of blood in the thorax decreases as a result of positive pressure ventilation. Note also how this variation vanishes under apneic conditions.

This hypothesis is also supported by the work of Madias and Guglin [2], who investigated the effect of fluid removal by ultrafiltration (UF) pump on the on the ECG amplitude in patients in heart failure (CHF). They concluded that “augmentation of the amplitude of QRS complexes correlates well with net fluid loss in response to UF in patients with CHF, and can be employed as an index of effectiveness of therapy.”

References

1. Cannesson M, Keller G, Desebbe O, Lehot JJ. Relations between respiratory changes in R-wave amplitude and arterial pulse pressure in mechanically ventilated patients. *J Clin Monit Comput.* 2010;24:203-7.
2. Madias JE, Guglin ME. Augmentation of ECG QRS complexes after fluid removal via a mechanical ultrafiltration pump in patients with congestive heart failure. *Ann Noninvasive Electrocardiol.* 2007; 12:291-7.