APNEA DETECTION DURING SEDATION USING TRACHEAL SOUNDS ENTROPY
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Introduction: Undetected apnea can lead to hypoxic encephalopathy, bradycardia and even cardiac arrest. Tracheal sounds entropy has been proved to be a robust method for estimating respiratory flow(1) thus maybe a more reliable way to detect apnea. Our study hypothesis is that changes in the entropy of tracheal sounds will provide an early warning of the onset of apnea in sedated patients, especially when the patients receive supplemental oxygen.

Method: After obtaining IRB approval, 24 volunteers received propofol and remifentinal in graded steps until they became unresponsive to the insertion of a bougie into the trachea (simulating an endoscope). At each step, respiratory flow rate and tracheal sounds were recorded using a pneumotachometer (CO2SMO, Novametrix, Louisville, KY) and a microphone (WM-56A103 Panasonic) placed in a precordial stethoscope. The logarithm of the tracheal sound Shannon entropy (Log-E) was calculated to estimate flow rate. An adaptive Log-E threshold was used to distinguish between the presence of normal breath sounds and apnea. Apnea detected from breath sounds was compared to the apnea detected from respiratory flow rate, Fig 1.

Result: Apnea occurred 322 times during the 12.9 hr study. Table 1 shows that the volunteers did not breathing for 15 sec or longer (apnea) for a total of 148 min, as detected from both the tracheal sounds and the respiratory flow meter. Periods of apnea were not detected by the tracheal sounds for a total of 7 min. Tracheal sounds misclassified periods of normal breathing as apnea for a total of 54 min. The acoustic method detected apnea in sedated volunteers with a sensitivity of 95% and a specificity of 91%.

Discussion: We found the entropy of the acoustic signal from a microphone placed over the trachea may reliably provide an early warning of the onset of apnea in volunteers receiving propofol and remifentanil.

References

Abstract 27