The Use of a Respiratory Volume Monitor to Assess Ventilation Before and After Airway Maneuvers

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Introduction

Over 20 million gastrointestinal endoscopies are performed each year in the United States.1 The use of propofol is becoming increasingly popular. However, propofol-induced deep sedation may increase the incidence of respiratory depression and provide insufficient ventilation.2 The use of a respiratory volume monitor (RVM) can provide continuous, real-time measurements of ventilation (MV), tidal volume (TV) and respiratory rate (RR).

Methods

A bio-impedance based RVM (ExSpiromatic, Respiratory Motion, Waltham, MA) was used to collect digital respiratory traces from an electrode PadSet placed on the thorax. A recommended electrode placement and calibration algorithms, strong correlations (r >0.96) between RVM and spirometric measurements have been previously demonstrated.2 Nineteen patients (age 54 ± 5 years, BMI: 28 ± 2 kg/m²) were evaluated. Procedures included: 15 EGD (1 with colonoscopy, 1 with EFRP, 1 with manometry), 8 ERCP, 4 EUS, and 2 gastroscopies. Four of the patients undergoing ERCP were intubated prior to the procedure and were excluded from the analysis. MV, TV, and RR were calculated from 30-second segments over the entire stay. Average MV, TV, and RR were calculated from a 2-minute period of quiet breathing prior to the procedure, this was defined as the period before any pre- or endoscopic procedure and RVM calculation was based on the estimated body surface area (BSA). Average MV, TV, and RR were calculated one minute prior to each airway maneuver and then again during the maneuver at the peak ventilation. Examples of the MV response to airway maneuvers are shown in Figure 2.

Airway maneuvers were performed in 19 of the 25 patients studied. A total of 45 airway maneuvers were performed. Of these 45 maneuvers, 19 occurred during the insertion or removal of the endoscope or during ERCP. Of these, 21 maneuvers required ≥ 1 minute of jaw thrusting, and 7 occurred immediately following another maneuver and were excluded from this analysis. In the 23 maneuvers analyzed, the bulk were either chin lifts (n = 6) or jaw thrust (n = 17). During these 23 maneuvers, all respiratory parameters increased relative to pre-maneuver levels. MV increased on average by ± 4 ± 5 (mean ± SEM), relative to pre-maneuver, TV increased by ± 2 ± 7 L and RR increased by ± 1 ± 6. The effectiveness of airway maneuvers was evident across all patients studied, as both jaw thrusts and chin lifts were effective in restoring airway patency (Figure 3). Jaw thrusts improved MV, from 6.1 ± 0.7 L/min to 6.9 ± 0.5 L/min (23 ± 6%, range: -12 to 62%) and chin lifts improved MV from 5.0 ± 0.1 to 8.8 ± 0.1 L/min (72 ± 10%, range: -12 to 623%). Both improvements were significant (paired t-tests, *p<0.01 and **p<0.05 respectively).

Results

Airway maneuvers were performed in 19 of the 25 patients studied. A total of 45 airway maneuvers were performed. Of these 45 maneuvers, 19 occurred during the insertion or removal of the endoscope or during ERCP. Of these, 21 maneuvers required ≥ 1 minute of jaw thrusting, and 7 occurred immediately following another maneuver and were excluded from this analysis. In the 23 maneuvers analyzed, the bulk were either chin lifts (n = 6) or jaw thrust (n = 17). During these 23 maneuvers, all respiratory parameters increased relative to pre-maneuver levels. MV increased on average by ± 4 ± 5 (mean ± SEM), relative to pre-maneuver, TV increased by ± 2 ± 7 L and RR increased by ± 1 ± 6. The effectiveness of airway maneuvers was evident across all patients studied, as both jaw thrusts and chin lifts were effective in restoring airway patency (Figure 3). Jaw thrusts improved MV, from 6.1 ± 0.7 L/min to 6.9 ± 0.5 L/min (23 ± 6%, range: -12 to 62%) and chin lifts improved MV from 5.0 ± 0.1 to 8.8 ± 0.1 L/min (72 ± 10%, range: -12 to 623%). Both improvements were significant (paired t-tests, *p<0.01 and **p<0.05 respectively).

Discussion

RVM provides continuous non-invasive measurements of MV, TV and RR in non-intubated patients.

RVM provides respiratory data previously unavailable during endoscopic procedures.

RVM provides quantification of the effectiveness of various airway maneuvers in restoring upper airway patency during endoscopic procedures. RVM allows providers to better assess the need for airway maneuvers and the effectiveness of the maneuver, minimizing reductions in minute ventilation and potentially reducing adverse outcomes.

RVM has the potential to improve ventilatory monitoring and ventilation during endoscopic procedures to help optimize patient safety.

References:

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