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LETTER TO THE EDITOR

Letter to the Editor: The Effect of Ventilation Strategy on Arterial and Cerebral Oxygenation During Laparoscopic Bariatric Surgery

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To the Editor: We read with great interest the article by Jo et al. [1] which has been recently published in your journal. Upon close reading, this study triggered several questions since both common factors, namely worldwide increased prevalence of obese population and intensively applied endoscopic technology with implication of CO_2-pneumoperitoneum, made the ventilator management for obese individuals during laparoscopic surgery an important multidisciplinary topic of research and practical view. Moreover, according to a recent systematic review by Shah et al. [2] "The ideal ventilatory plan for obese patients is indeterminate," therefore, the authors [2] suggested that "A multimodal preoxygenation and intraoperative ventilation plan is helpful in obese patients to reduce perioperative respiratory complications. More studies are needed to identify the role of low tidal volume, positive end-expiratory pressure, and recruitment maneuvers in obese patients undergoing general anesthesia." Under this point of view and according to the aim of this study [1], we expected to find answers concerning changes in lung mechanics and respiratory function as well as cerebral oxygenation depending on the mode of ventilation during laparoscopic bariatric surgery, taking into account high intraperitoneal pressure of CO_2-pneumoperitoneum (14–15 mmHg).

Briefly, the study [1] was designed as repeated measures with over time assessment of inspiratory/expiratory (*I*/*E*) ventilation ratios of 1:2, 1:1, and 2:1, in consecutive order, with a 20-min duration for each ventilation mode, subsequently defined as conventional, equal, and inverse ventilations with the same CO_2-pneumoperitoneum insufflation pressure and body positioning. Data from 28 patients were analyzed. Lung mechanics, respiratory, cardiovascular, and hemodynamic parameters were continuously monitored considering the following events as the main time points: anesthesia induction, CO_2-pneumoperitoneum, three sequential ventilation modes, and the end of surgery.

Although end-tidal CO_2 concentration ($P_{ET}CO_2$) increased significantly in all three ventilation modes in comparison with those samples from anesthesia induction time, the values of the regional sO_2 were remaining stable over time [1].

Parameters of lung mechanics, such as peak/mean airway pressures and dynamic compliance, were significantly increased with both equal and inverse ventilation (1:1 and 2:1) in comparison with that of conventional ventilation (1:2). The arterial pCO_2 value was higher and alveolar arterial oxygen tension gradient was lower after inverse ventilation (2:1) than those of conventional ventilation (1:2).

However, all these parameters were remaining within the physiological ranges suitable to the ventilation mode with a 5-cmH_2O positive end-expiratory pressure (PEEP) to ensure a tidal volume of 8 ml/kg of ideal body weight +45.5 for women/+50 for men and adjusted respiratory rate to maintain $P_{ET}CO_2$ between 35 and 40 mmHg. Intra-abdominal pressure of CO_2-pneumoperitoneum was limited to 14–15 mmHg, and the patient was placed in 40° reverse Trendelenburg position [1].

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In general, some findings of this study [1] are in accord with those of other studies [3–5]. It was clearly shown that CO_2-pneumoperitoneum markedly decreases a lung compliance during laparoscopic gastric banding [3, 4] and robotic-assisted surgery [5], and it significantly increases other parameters of lung mechanics, such as peak inspiratory pressure [4] and plateau airway pressure [5]. Further, an increased $P_{ET}CO_2$ value [4, 5] decreased both pH and bicarbonate values, which were negatively correlated with the total exhaled CO_2 per minute [4] and were demonstrated during CO_2-pneumoperitoneum.

In addition to highlighted limitations of this study by the authors themselves [1], the changes in respiratory and blood gas variables were analyzed only within ventilation modes without including samples taken at anesthesia induction time, insufflation of CO_2-pneumoperitoneum, and at the end of surgery. Subsequently, we can see only fragments of their results and it makes it difficult to judge whether changes are related to the lung mechanics and respiratory and blood gas parameters upon the whole perioperative period, since ventilation is the only part of the observation. In our opinion, logically, these values should be studied and analyzed with the same design by means of the ANOVA repeated measures, as other parameters such as a mean arterial pressure, heart rate, and regional cerebral oxygen saturation [1]. A repeated measurement design was applied in many analogous studies, when intraoperative respiratory parameters were monitored continuously [3–5].

It is well known that intraperitoneal insufflation of CO_2 during laparoscopic surgery initiates a direct raise in peritoneal tissue pCO_2 with subsequent pCO_2 gradients between peritoneal tissue-to-venous blood, followed by venous-to-arterial blood shift with an overall increase of CO_2 in the body which reacts with water and forms carbonic acid. The latter disintegrates into bicarbonate and hydrogen ions with decreased pH and acid base alterations. Therefore, ventilation strategy for laparoscopic surgery is adjusted to keep $P_{ET}CO_2$ at the physiologic ranges in order to eliminate an excess amount of CO_2 by increasing minute ventilation. Subsequently, lung ventilation for laparoscopic surgery is programmed in the anesthesia ventilators to control volume and/or pressure, as well as inspiration and expiration variables, which was clearly shown in this study [1] as well as by demonstration of raising minute ventilation and increased respiratory rate [5]. However, in such kind of study design, it should be taken into account that a gas exchange in the human body depends on many physiological factors, including sex, age, BMI, general health condition, as well as meteorological parameters (altitude and humidity) [6–8]. Subsequently, mixed gender populations (male and female individuals) with diseases such as diabetes mellitus and hypertension in this study [1] might mislead the results. Therefore, prior to such kind of studies with sophisticated physiological variables, a plan should be precisely designed with strict patient selection criteria, in order to limit an impact of biasing factors in their outcomes.

Independently of the abovementioned shortcomings, this study [1] attracted our interest and should be equally for other *Obes Surg* readers since it aimed to cast a light into lung physiology and arterial and cerebral oxygenation during laparoscopic bariatric surgery depending on anesthesia ventilation strategy. Intrasurgical anesthesia ventilation is an important and underestimated multidisciplinary topic involving respiratory physiology, anesthesiology, and minimally invasive surgery, and further studies are called with involving anesthesiologists, surgeons, and experts from intensive care, respiratory, and cardiovascular physiology fields.

Compliance with Ethical Standards

Conflict of Interest All authors declare that they have no conflict of interest.

A Statement of Informed Consent Informed consent is not required for this study.

A Statement of Human and Animal Rights A statement of human and animal rights is not required for this study.

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