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Editorial

Lung Ultrasound in Thoracic Anesthesia: Which Uses?

To the Editor:

The authors have read with great interest the recent article by Shiqing et al.[1] This is a remarkable article concerning the use of ultrasound in thoracic anesthesia. Most thoracic surgery procedures require lung exclusion. One-lung ventilation (OLV) most frequently is achieved through the insertion of a double-lumen endotracheal tube (DLT).[2] The advent of video-assisted thoracoscopic surgery has increased the number of cases requiring OLV.[3]

The most common complications in the use of DLTs are malpositioning and direct trauma of the airways, but numerous other complications are reported in the literature and known from daily clinical experience.[2] An Italian multicenter prospective observational study which took into account 2,127 patients undergoing OLV during thoracic surgery, showed a malpositioning rate of DLTs of 14%, with a consequent significant increase in the incidence of intraoperative desaturation episodes.[4] They also were correlated positively with the increase in the size of DLTs used. On the contrary, the control of the DLT with a fiberoptic bronchoscope (FOB) was able to reduce the risk of desaturation. However, this study showed that FOB was used to control DLT only in 54% of cases.

DLT malpositioning during OLV can lead to serious complications, such as hypoventilation and hypoxemia; lack of lung protection from blood, pus, and secretions; alteration of the regional distribution ventilation; suboptimal collapse of the operated lung, with impediment to the surgical procedure and increased risk of postoperative air leak; occlusion of the left upper bronchus (often misunderstood due to objectivity), with intraoperative lobar atelectasis and increased risk of postoperative infections; and distal dislocation of the DLT with lesion of the trachea and/or main bronchi.[5]

The incidence of DLT injuries is 0.5 to 2 in every 1,000 intubations.[2] More often this is mild and causes laryngitis or tracheal irritation, but, although more rarely, this can lead to rupture of the airways, with a variable incidence in the literature between 0.19% and 0.26%.[6,7] In a recent review that considered 187 cases of airway rupture, this occurred more frequently at the level of the trachea (52%), especially in the membranous part without cartilage support, or in the left main bronchus (37%).[8] The most frequent causes include incorrect use of the stylet, overdistention of the bronchial cuff resulting in mucosal ischemia, multiple repositioning attempts, difficult intubation, and the use of an oversized DLT. Other risk factors include chronic obstructive pulmonary disease, history of radiotherapy, and prolonged steroid therapy resulting in inherent weakness of the tracheobronchial wall. In most patients, the cause is due to more than 1 factor. According to previous reviews, airway rupture occurred more frequently in female patients. This predominance can be explained by the fact that the membrane part in women is weaker and that the diameter of the airways is smaller, with a greater risk of receiving an oversized DLT. The event had a fatal outcome in 8.8% of patients.[8]

Both malpositioning and direct injuries very often are related to the choice of an incorrectly sized DLT.[2] Various techniques have been used to determine what the correct measure of DLT is for a given patient, but in the literature the question still remains debated. Theoretically, the optimal size DLT is the tube that passes smoothly through the upper airways, advances into the trachea without difficulty, and enters without encountering excessive resistance through the main bronchus, having a slight air leak with a deflated bronchial cuff. In daily practice, many thoracic anesthesiologists still choose the size of this device based on parameters, such as height and sex, and based on their own clinical experience. Previous studies showed that this approach often leads to the choice of a DLT of incorrect size, frequently oversized, especially in female patients.[9] It is now established that a correct choice of the size of the DLT cannot be made without the knowledge of the anatomy of the patient that can be studied directly with the radiologic investigations, mainly computed tomography (CT) scans.[10] However, the CT may not always be available, for example, in an emergency, or the tracheobronchial tree measurements may be missing and CTs also have high costs. In addition, even what measurements correlate more accurately with the optimal tube measurement is not yet entirely clear. For example, the use of the bronchial diameter alone to estimate the correct measurement of the DLT to be used seems to present limits: in a very recent randomized controlled trial it has been shown that, in Asian women, the use of the diameter

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of the left main bronchus measured at the CT scan was not sufficiently accurate in predicting the correct measurement of the DLT.[1] In this study, the cricoid diameter associated with the diameter of the left main bronchus increased the overall accuracy from 60% to 87.5%, with a lower incidence of sore throat in the group of patients in whom the combined measurement was performed.

Ultrasound over the past 15 years has made an important contribution to the assessment and management of the airway.[11] Ultrasound technology can be of great help in predicting any difficulties in managing the airway, verifying the correct positioning and insertion depth of the tracheal tube and laryngeal mask airway, guiding the execution of percutaneous tracheotomies and cricotomies, and identifying diseases in the upper airways. Ultrasound also has been very useful in predicting the correct measurement of DLT to be used by measuring the external diameter of the trachea or, as in the case of the authors' study, of the cricoid.[12,13] In addition to being used routinely in emergency medicine and in intensive care for the diagnosis of pneumothorax, pleural effusion, and lung parenchyma diseases and to guide respiratory weaning, lung ultrasound (LUS) also has been proposed recently as a method of verifying the correct positioning of the left DLT.[14] In a randomized prospective trial, in which the effectiveness in predicting the correct position of the left DLT of the clinical method alone was compared to the clinical method associated with LUS, it emerged that the addition of a fast ultrasound scan was able to increase sensitivity (75% *v* 88%), specificity (18% *v* 75%) and diagnostic accuracy (57% *v* 85%) significantly. The ultrasound quickly and effectively can show the diaphragm and pleura range, qualitative and quantitative indicators of lung expansion.

Although fibrobronchoscopy remains the gold standard to check the correct position of the DLT under thoracic anesthesia, and often is essential as a guide to its repositioning, it is known that not always can it be executed (emergency surgery or bleeding) and it presents high management costs and long learning curves and is an invasive maneuver not free from serious complications. Furthermore, it does not offer any advantage in the choice of the DLT measure to be used. On the contrary, LUS is a fast technique, easy to perform bedside, noninvasive, and could be a valuable aid in choosing the measurement and controlling the correct positioning of the DLT. Related to this, the authors are waiting for the first results of their multicenter study, "Comparison Between Diagnostic Performances of Auscultation and Ultrasonography Against Fiberoptic Bronchoscopy in the Valuation of Positioning of Endotracheal Double-lumen Tube in Elective Thoracic Surgery. Auscultation, LUS, FOB in OLV: ALFIO" (NCT 03912311).

However, although the literature seems to provide more and more evidence of the use of ultrasound in thoracic anesthesia, it is always necessary to take into account the limitations of the method, including it being an operator-dependent technique and that the ultrasound is not able to provide useful data on the anatomy of the bronchial tree. In addition, most studies provide information on selected subgroups, such as the study in which the sample was represented only by Asian women; further studies are needed before this method can be proposed as a new gold standard.

In conclusion, ultrasonography can be considered an attractive alternative to the routine use of FOB as a first-line diagnostic tool in thoracic anesthesia; specifically, ultrasound of the cricoid diameter can be considered a new powerful tool that can guide the anesthesiologist in choosing the correct measurement of the DLT.

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