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Letter to Editor Open Access

Value of Lung Sonography to Control Right-Sided Double Lumen Endotracheal Tube Location

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Editor,

Lung isolation is mandatory during Lung surgery [1]. The most useful device to achieve Lung isolation is the use of double lumen endotracheal tube (DLT). The Gold Standard to assess DLT position remains fibroscopy because pulmonary auscultation alone isn't accurate enough to ensure correct DLT correct position. Fibroscopic verification of blind insertion of DLT shows malposition of 78% left-sided DLT and 83% of right-sided DLT [2]. Moreover fibroscopic checking is mandatory whenever a right-sided DLT is used, to prevent right upper lobe (RUL) isolation [3]. Right-sided DLT is usually required during left pneumonectomy, but also for lobectomy each time the surgeon plans left lung may be incomplete. The use of fibrocopy may be time-consuming and requires specific small sized fibroscopes whose optical fibers may be broken during the passage through the tracheal tube.

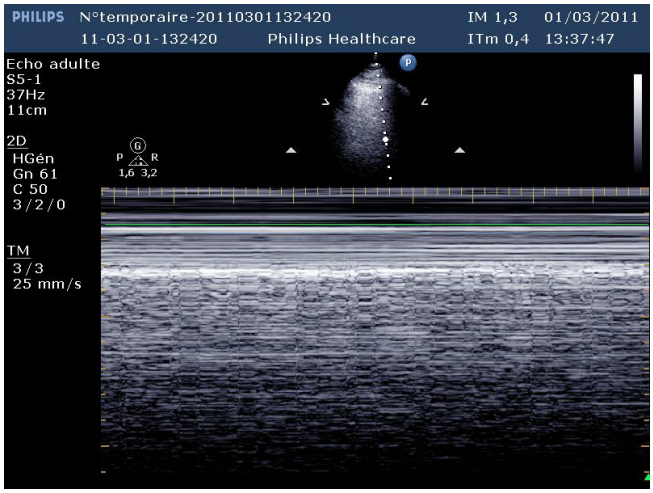

Figure 1: Lung sliding in motion mode.

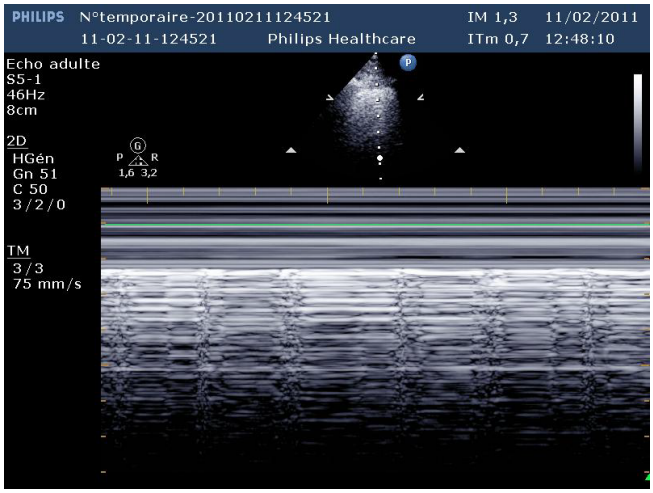

Figure 2: Lung pulse in motion mode.

Lung sonography may be an alternative for proper lung isolation checking [4]. Two dynamic ulrasound signs are required for this diagnosis. The first one is the abolition of lung sliding. Lung sliding corresponds to alveolar surface movements while breathing. In motion mode (M) this sonographic artifact appears like slush, separated from the motionless chest wall by the hyperechogenic pleural line (Figure 1). When the lung sliding disappears, differential diagnoses are pneumothorax and lung isolation, often named early stage atelectasis. The second dynamic sonographic sign required for diagnosis of lung isolation is the lung pulse, a usual lung sonographic sign (Figure 2). This latter is usually concealed by the lung sliding (Figure 3). The lung pulse corresponds to heart movements transmitted by lung parenchyma along the pleural line, as. An algorithm for lung isolation assessment is now available when these two dynamic sonographic signs are combined (Figure 4).

Ethical approval for this study (Ethical Committee 56-2011-02) was provided by the Ethical Committee of Limoges University hospital center (Limoges, France) on February 2011. In this prospective, monocentric study, all consecutive patients scheduled for thoracic tumor surgery with right-sided DTL (Broncocath™, Mallinckrodt corporation © Tyco Healthcare), were included. After left lung isolation, the DLT was connected to the ventilator (Primus Dräger Medical AG & Co) by an Opti-port™ (Mallinckrodt corporation © Tyco Healthcare) and all the patients were placed under mechanical ventilation with a tidal volume of 5 ml/kg of ideal weight and a positive end-expiratory pressure between 4 and 10 mmHg. A right bronchus aspiration was performed in the bronchial lumen before sonographic evaluation. Sonography (probe S5-1 for Philips CX50) was used to assess correct Bronchocath® position by placing the probe perpendicularly under the right clavicle to evaluate at First right upper lobe isolation, then by moving the probe on the left anterior axillary line, just beside the nipple, to check left lung isolation. Thereafter, two questions were asked to the anesthesiologist: 1) is left lung correctly isolated? And 2) is RUL ventilated? Lung sliding and lung pulse were assessed with M mode. Thereafter, regardless of sonographic imaging, Bronchocath placing

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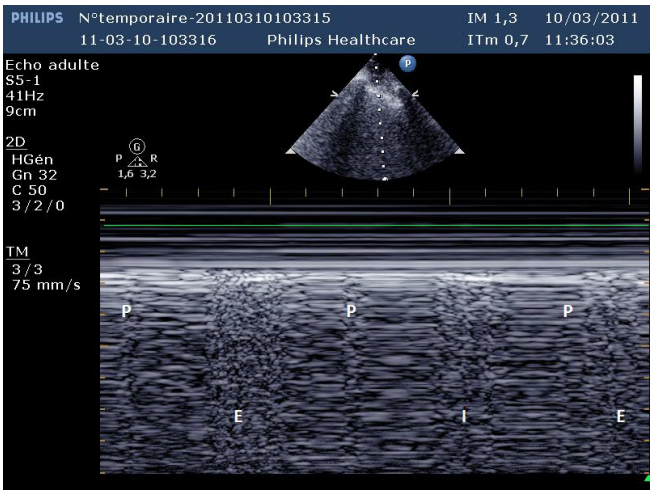

Figure 3: Lung pulse (P) during mechanical ventilation between inspiratory (I) and expiratory (E) phase.

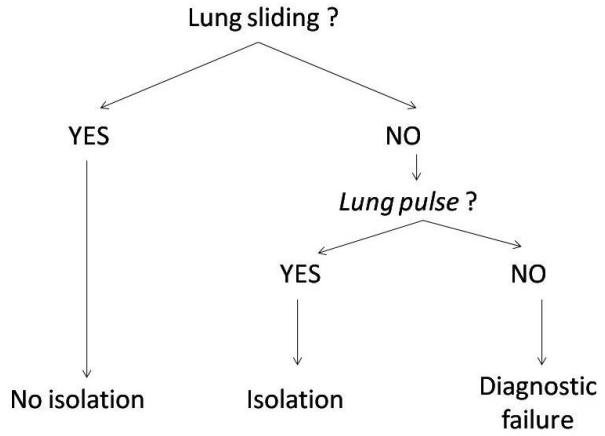

Figure 4: Algorithm for lung isolation assessment.

was verified by another operator with a fiberscope (Pentax® FB-10V), and answered to the same questions. The DLT was then repositioned if necessary under fiberoptic control. Contingency tables were obtained for statistical analyzes and sensibility, specificity, negative and positive predictive values were calculated.

From February 2011 to august 2012, six left pneumonectomy and 64 left thoracotomy were performed in our hospital. Twenty four patients were included in the study, 19 for partial left lung resection and 4 for left pneumonectomy. The last patient underwent a pleuroscopy, and was not considered for analysis because right DLT placement wasn't mandatory, and sonographic analysis wasn't possible (no lung pulse and no lung sliding observed). For the 23 remaining patients, sex ratio was 1.44, age 64 ± 13 years, and body mass index 24.82 ± 4.36 kg/m². According to the American Society of Anesthesiology score (ASA): nine were ASA 2, twelve ASA 3 and three ASA 4. All left lung were correctly isolated according to fiberoptic exam. For diagnosis of left lung isolation, sensibility, specificity, negative and positive predictive values of sonography were 100%. In 12 cases, the RUL was accidentally isolated. Sensibility of sonographic diagnosis of RUL isolation was 91.67%, specificity 100%, negative predictive value 91.67% and positive predictive value 100%. Fiberoptic repositioning was successfully performed in all cases.

Sonography had already been used in DLT location assessment [5] with a relevant clinical performance (accurate for 88% of cases), but with a low specificity (50%) and a low positive predictive value (86%). But in this previous study, lung sliding and diaphragmatic excursion were the only studied parameters. In Lichtenstein's study [4], lung sonography's sensibility in complete lung isolation diagnosis was 97%. In our study, the sensibility was 100%. This difference can be explained in part because the device Lichtenstein used for lung isolation wasn't a DLT but a simple lumen endotracheal tube, which voluntary was pulled through the right bronchus. In the other hand, the Gold Standard used for lung isolation diagnosis wasn't fiberscopy but chest X-rays. For RUL isolation, sensibility and negative predictive value were lower. Lung sliding and lung pulse are more difficult to observe on the anterior thoracic area. The tidal volume chosen is recommended by the French Society of Anesthesiology and Intensive Care. Increasing the tidal volume to improve the lung sliding visualization wasn't considered ethical by our team and wasn't clinically relevant: if the RUL is isolated, the increase in tidal volume will affect the two other lobes. A lung sliding could then be observed on this isolated RUL, this latter being the perception of RUL repression by the hyperinflation of the two other lobes, instead of a normal breathing movement.

Lung sonography can it be proposed for left DLT location assessment. Furthermore, it may be useful in accidental lung isolation diagnosis in operative wards or intensive care units, beause sonography is more and more easily available in these areas. On the other hand, sonography isn't so relevant in right DLT positioning. Despite these promising results, Fiberoptic control can't yet be abandoned for the benefit of sonography. However, when no fiberoptic is available, a lung sonography could assess left lung isolation and RUL bronchus ventilation as sonography is more and more easily available in these areas [6].

Conflict of interest

S. P: Occasional intervention: survey report for Drager Medical SAS.

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