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Research Article

Analysis of Difference of Double Lung Ultrasound in Patients with Single Lung Ventilation

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ABSTRACT

Objective: To retrospectively analyse the lung ultrasound images of 60 patients undergoing thoracoscopic partial pneumonectomy and compare the difference of bilateral lung ultrasound images.
Results: B3 lines were predominant in ventilating side lung, B7 lines and atelectasis were predominant in operative side lung.
Conclusion: Short-term lung injury after one-lung ventilation is mainly on the ventilation side, and the main manifestation is pulmonary edema.

Introduction

One-lung ventilation is a commonly used ventilation method in thoracic surgery at present, but many studies have found that one-lung ventilation can cause certain lung injuries. The mechanism of lung injury was different on both sides. Mechanical barotrauma was the main injury on ventilation side, and mechanical stimulation induced inflammatory response. On the collapsed side, local inflammatory reaction and reperfusion injury were mainly caused by surgical operation [1-3]. Whether there is a difference in ultrasound images of the two lungs has not been reported. Pulmonary ultrasound can accurately identify common pulmonary complications during the perioperative period, such as pulmonary edema, pneumothorax and atelectasis. The author conducted a study on ultrasound images of the two lungs in the department of chest, and the report is as follows.

Materials and Methods

I Data and Methods

Sixty patients aged 35-78 years after thoracic surgery in the Second Affiliated Hospital of Dalian Medical University from December 2020 to July 2021 were retrospectively analysed. The patients had no history of respiratory and circulatory failure or abnormal liver and kidney function. They all woke up in the post-anaesthesia care unit, resumed spontaneous breathing and had tracheal tube removed.

II Instruments and Methods

Use of Philips SPARQ colour ultrasonic instrument, convex array probe.

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i BLUE Protocol

The operator compared the size of the patient's hands and placed them together on the patient's anterior chest wall and placed the hypothenar of the left hand on the patient's subclavicular margin. Check the position of the blue dot: the third and fourth metacarpophalangeal joint of the left hand; Lower blue dot: right palm.

ii Diaphragm Point

Level with right hand hypothenar.

iii PLAPS Point

The point at which the lower blue point intersects the posterior axillary line vertically backward.

iv Lung Ultrasound Image Line A

Echo line parallel to pleural line, equidistant, repeated and gradually decaying.

v B3 Line

Appears from pleura line, points to the far end of the screen without attenuation of radium rays, and moves with breathing high-echo line, spacing between adjacent echo lines is 3mm.

vi B7 Line

The property is the same as B3 line, adjacent echo line spacing 7mm.

vii Fragmentary Sign

Solid tissue with fragmentary irregular strong echoes at the deep and aerated lung boundaries.

viii FATE Protocol

Parasternal long-axis ultrasound images were selected for collection, and cardiac dysfunction such as left ventricular systolic dysfunction was excluded.

Results

The characteristics of lung ultrasound images were 3.3% in ventilated side A, 50% in B3 line, 45% in B7 line and 1.7% in fragment sign. On the collapsed side, 33.3% of the patients were in A, 15% in B3 line, 40% in B7 line, and 11.7% in fragmentation sign. The relationship between operation time and line B: within 2 hours of operation, 30% of ventilator-lung B3 line, 60% of ventilator-lung B7 line, 5% of surgically side lung B3 line, 25% of lung B7 line; After operation for more than 2 hours, 65% of ventilated lungs were at B3 line, 25% at B7 line, and 25% at B3 line and 55% at B7 line.

Table 1: Ultrasonic imaging of two lungs.

	Ventilated lung	Collapsed lung
Upper blue point	B3 line, A	B7 line, A
Lower blue point	B7 line	Fragment sign, B3 line
PLAPS point	B7 line, B3 line	B7 line, A
Diaphragm point	B3 line, B7 line	B3 line

Transthoracic echocardiography showed no abnormal cardiac function. Left ventricular ejection fraction was > 50%, the diameter of inferior vena cava was 2-2.5cm, and the variation rate of inferior vena cava was 10-20% (Table 1, Figures 1 & 2).

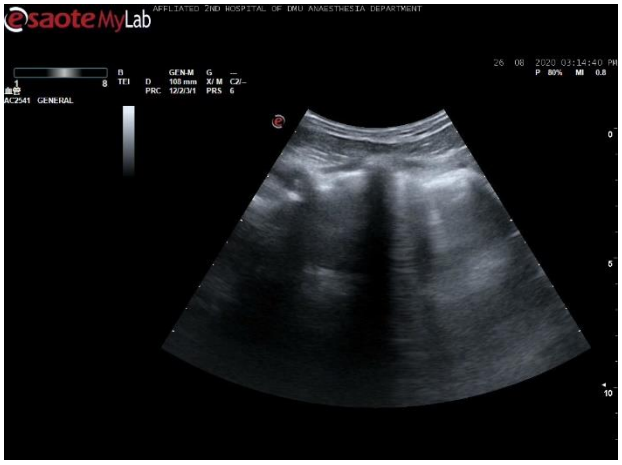

Figure 1: B7 line.

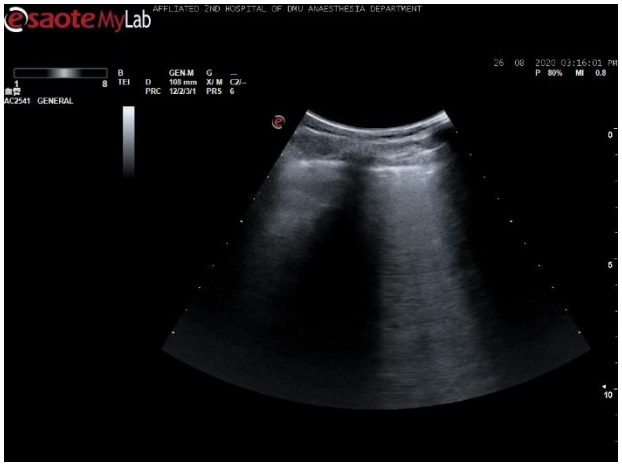

Figure 2: B3 line.

Discussion

Minimally invasive endoscopy is the main method in thoracic surgery, but single-lung ventilation is still the main ventilation method. Mechanical stimulation of single lung ventilation can induce lung injury. Pulmonary injury on the surgical side may be complicated with ischaemia-reperfusion injury due to aggregation of inflammatory factors at the surgical site. Commonly used drugs, such as propofol, sevoflurane and dexmedetomidine, can inhibit lung injury to a certain extent, but lung injury still occurs clinically and affects the rapid recovery of patients [3]. How to diagnose lung injury quickly and conveniently is a big challenge in clinic. Bedside pulmonary ultrasound was first proposed by French scholars, and the BLUE protocol of pulmonary ultrasound for

dyspnea was introduced, which can quickly identify pneumothorax, pulmonary edema, pulmonary consolidation and other life-threatening conditions, and is now widely carried out in emergency and critical disciplines [4, 5]. At the same time, pulmonary ultrasound can quickly identify pulmonary edema before clinical symptoms such as dyspnea and decreased oxygen saturation. It is a powerful tool for rapid diagnosis of pulmonary edema, and its accuracy is comparable to CT.

Point of care ultrasound can quickly identify cardiopulmonary dysfunction in the perioperative period and improve the prognosis of patients. Different procedures are selected to provide rapid diagnosis according to different clinical articles, highlighting the advantages of rapid and real-time [6, 7]. The ultrasound images of lung are mainly pseudo, and there are obvious clinical symptoms when the reality changes and pleural effusion occur. In normal ventilation, line A and pleural sliding were the main features. When there was high echo line from the pleural line, pointing to the far end of the screen without attenuation, moving with respiration, it was line B, indicating increased lung water. More than 3 lines in each intercostal space indicate pulmonary edema, and the number of b-lines is positively correlated with the severity of pulmonary edema. It has been clinically recognized that the severity of pulmonary edema can be assessed by using the score based on the number of b-lines [4, 8, 9]. A large number of studies have confirmed that lung injury is induced by inflammation, resulting in increased lung permeability and pulmonary edema [2, 10, 11]. Severe pulmonary edema resulting in decreased oxygen saturation is usually diagnosed by chest CT. However, the conditions for CT examination in anaesthesia recovery room are not available, and CT examination should not be performed immediately due to the high risk of transport. Point of care ultrasound can be used to quickly detect pulmonary edema.

The author found that pulmonary ultrasound examination after chest surgery could show specific changes in both lungs, while transthoracic cardiac ultrasound examination could exclude pulmonary edema caused by cardiac insufficiency, making it possible to diagnose pulmonary edema in the perioperative period early. Through the study of cases in anaesthesia recovery room, preoperative lung CT of patients was generally normal and pulmonary edema could be excluded. Bedside ultrasound lung scan showed early pulmonary edema on the ventilation side, which was common in lung line B on the ventilation side, while the severity of pulmonary edema was higher than that on the operation side, which was line B3. The pulmonary edema at the operation side appeared late, mainly in the B7 line, with some consolidation of the lung. It is suggested that early postoperative pulmonary edema is mainly on the ventilation side, and early atomization inhalation should be performed around the ventilation side of the lung in the treatment, which is expected to achieve better results and facilitate the rapid recovery of patients.

Without ultrasound images of both lungs 12 hours after surgery, further comparison of differences between the two lungs could not be completed. At the same time, the patients with lung injury can be further integrated by ultrasound with reference to critical care medicine for further improvement in the next step. Perioperative point of care ultrasound has good clinical significance in postoperative and perioperative application. Standardized use of perioperative point of care ultrasound after systematic training can provide visual evidence for perioperative decision-making and is expected to become a basic perioperative skill, with broad application prospects [12].

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