**Name of Journal:** *World Journal of Clinical Cases*

**Manuscript NO:** 88120

**Manuscript Type:** CASE REPORT

**Lung ultrasound for the early diagnosis of acute lung injury: A case report**

Zheng X *et al*. LUS for the early diagnosis of ALI

Xin Zheng, Na Liu

**Xin Zheng, Na Liu,** Department of Anesthesiology, The Second Hospital of Dalian Medical University, Dalian 116027, Liaoning Province, China

**Author contributions:** Zheng X performed the data collection and drafted the article; Liu N revised the article.

**Corresponding author: Na Liu, MD, Doctor,** Department of Anesthesiology, The Second Hospital of Dalian Medical University, No. 467 Zhongshan Road, Dalian 116027, Liaoning Province, China. 18640964469@163.com

**Received:** September 11, 2023

**Revised:** October 4, 2023

**Accepted:** November 3, 2023

**Published online:**

**Abstract**

BACKGROUND

The extensive availability of ultrasound (US) technology has increased its use for point-of-care applications in many health care settings. During anaesthesia and surgery, acute respiratory failure or pulmonary oedema are common life-threatening events that, if not recognized and treated appropriately, result in a high mortality rate.

CASE SUMMARY

We report a patient under anaesthesia whose lung US examination showed multiple vertical artefacts (B-lines) in the lung tissue, indicating pulmonary oedema. The respiratory state improved with the resolution of the pulmonary oedema after our treatment.

CONCLUSION

We believe that US of the lungs may be a useful tool for dynamic respiratory monitoring at the bedside during anaesthesia.

**Key Words:** Lung ultrasound; Acute respiratory failure; Ultrasound; Lung; Case report

Zheng X, Liu N. Lung ultrasound for the early diagnosis of acute lung injury: A case report. *World J Clin Cases* 2023; In press

**Core Tip:** The extensive availability of ultrasound (US) technology has increased its use for points of care applications in many health care settings. During anesthesia and surgery, acute respiratory failure or pulmonary edema are common life-threatening events that, if not recognized and treated appropriately, result in a high mortality rate. We report on a patient under anesthesia whose lung US examination showed multiple vertical artifacts (B-lines) in the lung tissue, indicating pulmonary edema. The respiratory state was improved with the resolution of pulmonary edema after our treatment. We believe that US of the lungs may be a useful tool for dynamic respiratory monitoring at the bedside during anesthesia.

**INTRODUCTION**

Lung ultrasound (US) (LUS) is now a standard tool for the diagnosis of acute lung injury (ALI), which refers to a clinical syndrome characterized by bilateral lung injury, severe diffuse failure of the lung, and even hypoxemia[1]. Perioperative lung injury is the main cause of excess health care use, avoidable mortality, and postoperative morbidity[2]. If not recognized and treated appropriately, cases of mild pulmonary injury with nonspecific signs and symptoms would increase the morbidity and mortality rate[3]. Focused US (point-of-care US) is defined as an ultrasonic evaluation at the bedside, where an ultrasonic evaluation is conducted in real time[4]. These images are collected by the anaesthesiologist perioperatively, and they can immediately be integrated into the medical decision-making process. The reported case shows the importance of performing LUS to evaluate respiratory function in the operating room.

**CASE PRESENTATION**

***Chief complaints***

On arrival at the operating room, the patient presented with increased respiratory effort.

***History of present illness***

An 89-year-old man diagnosed with acute intestinal obstruction was scheduled to undergo laparoscopic exploration.

***History of past illness***

No basic past illness.

***Personal and family history***

His personal history shows no abnormalities.

***Physical examination***

His heart rate was 103 beats per minute, his blood pressure was 120/74 mmHg, and his respiratory rate was 22 breaths per minute.

***Laboratory examinations***

An arterial blood gas analysis was taken immediately, which showed a PH value of 7.25, partial oxygen pressure of 59 mmHg, partial carbon dioxide pressure of 48 mmHg.

***Imaging examinations***

His chest X-ray on the first day of admission showed no abnormal findings except for mild right pleural effusion (Figure 1). Bedside ultrasonography was performed and displayed the disappearance of lung sliding and the presence of multiple B-lines in both lungs (Figure 2).

**FINAL DIAGNOSIS**

We diagnosed pulmonary oedema using sonography.

**TREATMENT**

Intubation and ventilation were initiated immediately. Controlled ventilation was chosen using FiO2 100% oxygen and 10-15 cm H2O positive end-expiratory pressure (PEEP). While the patient was undergoing the lung recruitment manoeuvre with US, we observed that the area of collapsed alveoli reaerated as the PEEP reached 15 cm H2O. Dobutamine and epinephrine were given after the valve preload, and his haemodynamics gradually stabilized.

**OUTCOME AND FOLLOW-UP**

After surgery, the patient was sent to the intensive care unit. His respiratory symptoms resolved on the second day (Figure 3), and 100% oxygen was gradually removed. The patient was successfully extubated and discharged after 12 d of hospitalization.

**DISCUSSION**

The current observational case showed that LUS is an important tool to monitor lung involvement in many different situations. Perioperative lung injury complicates postoperative recovery for many patients. The rate of postoperative pulmonary complications is between 11% and 59%, which has led to a significant increase in mortality and morbidity and an increase in the use of hospital resources[5].Perioperative lung injury includes respiratory insufficiency, gas exchange disorders and pneumonia. Mild lung injury is generally not a threat to life; however, a delayed diagnosis may be harmful because it is associated with compromised circulation and respiration in unstable patients[6].

LUS can be performed at the bedside by an anaesthesiologist in the operating room and can provide accurate images of the lung state with diagnostic and therapeutic relevance[7]. A high sensitivity and specificity of LUS were shown in the diagnosis of pneumothorax and interstitial syndrome[4,8]. Although chest computed tomography (CT) is the gold standard to assess lung involvement[9], it necessitates the transfer of a ventilated patient out of the operating room. CT cannot always be performed promptly. Any delay in the provision of radiological evidence may be deleterious in some instances. LUS examination may be a valid alternative to CT scans[10]. It is not intrusive and is easily repeatable at the bedside, enabling the assessment of lung recruitment following PEEP or any other manoeuvres requiring direct visualization of the lungs.

Lung ultrasonography is useful for the diagnosis and estimation of lung recruitment by PEEP[11]. Several randomised controlled trials reported that patients undergoing laparoscopic surgery receiving 5 cm of H2O PEEP experienced significantly better oxygenation and less postoperative atelectasis than patients with zero PEEP[2]. Tsubo *et al*[12] used transoesophageal ultrasonography to evaluate the reaeration induced by PEEP of a hyperdense left lower lobe. Researchers noticed that the ultrasonic densities “disappeared” using 15 cm H2O PEEP for ALI patients. LUS examinations can be used to monitor the responsiveness of each 3- to 4-cm H2O increase in PEEP until moderate or severe aeration loss becomes normal.

**CONCLUSION**

As shown by this case report, lung ultrasonography may be a valuable tool to evaluate lung recruitment in real time at the bedside. Intraoperative point-of-care US performed by the anaesthesiologist provides the possibility of assessing lung reaeration in surgical patients. LUS may be an important alternative to chest CT scans in the perioperative setting.

**REFERENCES**

1 **Abraham E**, Matthay MA, Dinarello CA, Vincent JL, Cohen J, Opal SM, Glauser M, Parsons P, Fisher CJ Jr, Repine JE. Consensus conference definitions for sepsis, septic shock, acute lung injury, and acute respiratory distress syndrome: time for a reevaluation. *Crit Care Med* 2000; **28**: 232-235 [PMID: 10667529 DOI: 10.1097/00003246-200001000-00039]

2 **O'Gara B**, Talmor D. Perioperative lung protective ventilation. *BMJ* 2018; **362**: k3030 [PMID: 30201797 DOI: 10.1136/bmj.k3030]

3 **Fernandez-Bustamante A**, Frendl G, Sprung J, Kor DJ, Subramaniam B, Martinez Ruiz R, Lee JW, Henderson WG, Moss A, Mehdiratta N, Colwell MM, Bartels K, Kolodzie K, Giquel J, Vidal Melo MF. Postoperative Pulmonary Complications, Early Mortality, and Hospital Stay Following Noncardiothoracic Surgery: A Multicenter Study by the Perioperative Research Network Investigators. *JAMA Surg* 2017; **152**: 157-166 [PMID: 27829093 DOI: 10.1001/jamasurg.2016.4065]

4 **Shrestha GS**, Weeratunga D, Baker K. Point-of-Care Lung Ultrasound in Critically ill Patients. *Rev Recent Clin Trials* 2018; **13**: 15-26 [PMID: 28901850 DOI: 10.2174/1574887112666170911125750]

5 **Shander A**, Fleisher LA, Barie PS, Bigatello LM, Sladen RN, Watson CB. Clinical and economic burden of postoperative pulmonary complications: patient safety summit on definition, risk-reducing interventions, and preventive strategies. *Crit Care Med* 2011; **39**: 2163-2172 [PMID: 21572323 DOI: 10.1097/CCM.0b013e31821f0522]

6 **Ding W**, Shen Y, Yang J, He X, Zhang M. Diagnosis of pneumothorax by radiography and ultrasonography: a meta-analysis. *Chest* 2011; **140**: 859-866 [PMID: 21546439 DOI: 10.1378/chest.10-2946]

7 **Soldati G**, Sher S. Bedside lung ultrasound in critical care practice. *Minerva Anestesiol* 2009; **75**: 509-517 [PMID: 19644435]

8 **Volpicelli G**, Elbarbary M, Blaivas M, Lichtenstein DA, Mathis G, Kirkpatrick AW, Melniker L, Gargani L, Noble VE, Via G, Dean A, Tsung JW, Soldati G, Copetti R, Bouhemad B, Reissig A, Agricola E, Rouby JJ, Arbelot C, Liteplo A, Sargsyan A, Silva F, Hoppmann R, Breitkreutz R, Seibel A, Neri L, Storti E, Petrovic T; International Liaison Committee on Lung Ultrasound (ILC-LUS) for International Consensus Conference on Lung Ultrasound (ICC-LUS). International evidence-based recommendations for point-of-care lung ultrasound. *Intensive Care Med* 2012; **38**: 577-591 [PMID: 22392031 DOI: 10.1007/s00134-012-2513-4]

9 **Lichtenstein D**, Goldstein I, Mourgeon E, Cluzel P, Grenier P, Rouby JJ. Comparative diagnostic performances of auscultation, chest radiography, and lung ultrasonography in acute respiratory distress syndrome. *Anesthesiology* 2004; **100**: 9-15 [PMID: 14695718 DOI: 10.1097/00000542-200401000-00006]

10 **Llamas-Álvarez AM**, Tenza-Lozano EM, Latour-Pérez J. Accuracy of Lung Ultrasonography in the Diagnosis of Pneumonia in Adults: Systematic Review and Meta-Analysis. *Chest* 2017; **151**: 374-382 [PMID: 27818332 DOI: 10.1016/j.chest.2016.10.039]

11 **Stefanidis K**, Dimopoulos S, Tripodaki ES, Vitzilaios K, Politis P, Piperopoulos P, Nanas S. Lung sonography and recruitment in patients with early acute respiratory distress syndrome: a pilot study. *Crit Care* 2011; **15**: R185 [PMID: 21816054 DOI: 10.1186/cc10338]

12 **Tsubo T**, Sakai I, Suzuki A, Okawa H, Ishihara H, Matsuki A. Density detection in dependent left lung region using transesophageal echocardiography. *Anesthesiology* 2001; **94**: 793-798 [PMID: 11388530 DOI: 10.1097/00000542-200105000-00017]

**Footnotes**

**Informed consent statement:** Informed written consent was obtained from the patient for publication of this report and any accompanying images.

**Conflict-of-interest statement:** The authors declare that they have no conflict of interest.

**CARE Checklist (2016) statement:** The authors have read the CARE Checklist (2016), and the manuscript was prepared and revised according to the CARE Checklist (2016).

**Open-Access:** This article is an open-access article that was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution NonCommercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: https://creativecommons.org/Licenses/by-nc/4.0/

**Provenance and peer review:** Unsolicited article; Externally peer reviewed.

**Peer-review model:** Single blind

**Peer-review started:** September 11, 2023

**First decision:** September 28, 2023

**Article in press:**

**Specialty type:** Medicine, research and experimental

**Country/Territory of origin:** China

**Peer-review report’s scientific quality classification**

Grade A (Excellent): 0

Grade B (Very good): 0

Grade C (Good): C

Grade D (Fair): 0

Grade E (Poor): 0

**P-Reviewer:** Sunder T, India **S-Editor:** Qu XL **L-Editor: P-Editor:** Qu XL

**Figure Legends**



**Figure 1 Chest X-ray on the first day of admission.**



**Figure 2 Ultrasonography shows the presence of B lines.**



**Figure 3 A chest computed tomography scan shows the minimal presence of pulmonary oedema on the second day of intensive care unit admission.**