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The Lung Point Sign; not pathognomonic for pneumothorax

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Corresponding Author:	Edmundo Rubio, MD Central Agricultural Research Institutelion Clinic Roanoke, VA UNITED STATES
First Author:	Sameh Aziz, MD, FCCP, FACP
Order of Authors:	Sameh Aziz, MD, FCCP, FACP
	Brijesh B Patel, M.D.
	Susanti Ie, MD
	Edmundo R Rubio, MD
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Ultrasound Quarterly
1891 Preston White Drive
Reston, VA 20191
Phone: 703-858-9210

Dear Publisher:

Please find attached a manuscript entitled: "The Lung Point Sign: not pathognomonic of a pneumothorax" which I am submitting for exclusive consideration of publication as an article in Ultrasound Quarterly.

The paper demonstrates importance of both clinical correlation and understanding of using ultrasound in diagnosing pneumothorax and pitfall of underlying bulla. As such this paper should be of interest to a broad readership including those interested in education in Ultrasound,

Thank you for your consideration of our work! Please address all correspondence concerning this manuscript to me at Virginia Tech Carilion School of Medicine and feel free to correspond with me by e-mail: errubio@carilionclinic.org

Sincerely,

Edmundo Rubio, MD

Section Chief

Pulmonary, Critical Care and Sleep Medicine

We have changed the wording of the "entirely accurate" to "yet such finding may be present in patients with bullous lung disease without a pneumothorax" as per reviewer 2 comment.

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Title Page with Authors' Information

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Sameh G Aziz, MD, FCCP, FACP

Assistant Professor of Medicine

Pulmonary, Critical Care and Sleep Medicine

Virginia Tech Carilion School of Medicine

sgaziz@carilionclinic.org

Brijesh B Patel, MD

Fellow, PGY-4

Pulmonary, Critical Care and Sleep Medicine

Virginia Tech Carilion School of Medicine

bbpatel@cariionclinic.org

Susanti R Ie, MD

Assistant Professor of Medicine

Pulmonary, Critical Care and Sleep Medicine

Virginia Tech Carilion School of Medicine

srie@carilionclinic.org

Edmundo R Rubio, MD

Section Chief

Pulmonary, Critical Care and Sleep Medicine

Virginia Tech Carilion School of Medicine

errubio@carilionclinic.org

Corresponding Author

Edmundo R Rubio, MD

Section Chief

Pulmonary, Critical Care and Sleep Medicine

Virginia Tech Carilion School of Medicine

errubio@carilionclinic.org

Institution Name

Virginia Tech Carilion School of Medicine and Research Institute

1906 Belleview Ave,

Roanoke, VA 24014

Phone number: 540-597-5291

Fax number: 540-983-1133

Address for reprints

Carilion Clinic, 1906 Belleview Ave, Suite 320, Roanoke, VA 24014

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Abstract

Since the development of portable ultrasonography equipment, this technology has provided clinicians the ability to evaluate a variety of lung pathology at the bedside, but we are still learning how to accurately interpret the acquired images. Adequate interpretation and recognition of certain signs is crucial to diagnosing pathological processes. Additionally, such signs must be adequately correlated with the patient's medical condition. For instance the "lung point sign" has been traditionally considered to be pathognomonic for the presence of a pneumothorax, yet such finding may be present in patients with bullous lung disease without a pneumothorax.

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To our knowledge this is the first case reported demonstrating that the "lung point sign" is not always indicative of a pneumothorax. We discuss the importance of both clinical correlation and understanding of the underlying pathophysiology when reviewing ultrasound images, in order to accurately interpret ultrasound findings.

Key Words

Ultrasound; pneumothorax; bulla; lung point sign

Introduction

Over the last 20 years there has been increasing interest in the use of ultrasonography for lung evaluation. Currently, bedside ultrasonography is used routinely to diagnose pleural effusions, lung consolidations and pneumothoraces. The use of ultrasound has a reportedsensitivity of 85-100% in diagnosing pneumothoraces, making it superior than chest roentgenograms in diagnosing this abnormality. Ultrasound is also more readily accessible in intensive care units than computed tomography (CT) of the chest.[1]

The presence of "lung point" is a dynamic ultrasound sign commonly viewed as pathognomonic of a pneumothorax. This sign is a sudden change at the precise location between normal pleura with underlying lung tissue and the pneumothorax (visible both on M-mode and 2-D mode images). Of course, this is true provided such finding is not mistaken with the normal anatomic interface of the lung with the heart and diaphragm. Additionally, such sign may also be viewed in the presence of bullous disease, in the absence of a pneumothorax. This observation has not been clearly made in the literature. We present a case with illustrative images demonstrating that the "lung point" should not be considered pathognomonic of a pneumothorax, particularly in patients with known bullous lung pathology.

Case Report

An 83 year old white man with chronic obstructive lung disease (COPD) presented to our emergency room with progressive dyspnea. On examination, he had labored breathing with bilateral expiratory wheezes. Oxygen saturation on 2 liters of supplemental oxygen was 84%. Arterial blood gas showed a pH of 7.16, PCO_2 of 66 and P_aO_2 of 57 mmHg on room air. Due to his acute hypercapneic respiratory failure, he was placed on bi-level positive airway pressure (BIPAP) therapy. A chest roentgenogram (CXR) suggested air-space disease in the left pleural effusion. Also, bedside lung

ultrasonography was done for further evaluation, demonstrating additionally a “lung point sign” on the interface signaled by the arrow in Figure 1, suggesting a possible pneumothorax, which is also seen in the attached movie file (Movie 1). This was a surprising finding, as the CXR did not suggest a pneumothorax and the patient’s symptoms were slowly improving on BIPAP, with no hemodynamic instability or pulsus paradoxus. For further investigation, a CT of the chest was obtained, as it is considered the gold standard for diagnosis a pneumothorax. This demonstrated emphysema with a large right middle lobe bulla in the same location where the “lung point sign” was noted, but no pneumothorax. (Figure 2)

Discussion

The lung is one of the most voluminous organs of the body, hence leading to high acoustic impedance at the level of the visceral pleura. The latter translated for many years in an underutilization of ultrasound to evaluate lung pathology.

Lung evaluation using ultrasound depends mainly on visualization of the pleural membranes and the ultrasound beam reflection at the level of the interface between visceral pleural and alveolar wall. Its utility has significantly expanded as we understand better how to interpret images and correlate these to known pathological processes.[2]

For varied reasons, the interest in lung ultrasonography has recently been on the rise. Firstly, ultrasound machines are portable and easily accessible not only in the Intensive Care Units, but also in Medical/Surgical floors. Secondly, ultrasound evaluation is usually fast and can be repeated in order to evaluate the response to treatment or progression of the disease. Lastly, the test is relatively inexpensive and does not utilize ionizing radiation.[3]

Normal lung ultrasound relies on artifacts caused by the reverberation of the ultrasound beam at the level of visceral pleura, which are mainly 'A lines' representing a reflection of the pleural line and 'B lines' (comet-tail artifact) (Figure 3) caused by reverberations of the ultrasound beam. Lung sliding is the movement of the visceral pleura sliding against the parietal pleura during respiration.[4]

Evaluation begins by identifying the pleural line using a high frequency ultrasound probe. The pleural line is usually about 5 mm deep to the rib cortex. Identification of the parietal and visceral pleura is possible by adjusting the depth on the ultrasound machine. Lung movement during respiration is recognized by the lung sliding sign or the shimmering sign at the level of the visceral pleura, with the amplitude being greater at the base when compared at the apex. By increasing the depth setting on the machine, a normally aerated lung will show an A-line pattern; and one may be able to identify B-lines which move with respiration and extend to the bottom of the ultrasound screen (Figure 2). Using the M-mode, the lung movement correlates with the appearance of the seashore sign, which is the interface produced by the horizontal lines representing the motionless parietal layers and a granular pattern generated by the sliding lung (Figure 4).

Pneumothorax is usually identified by the absence of lung sliding on 2-D view, leading to the presence of the bar code sign that is seen as multiple horizontal lines. By evaluating additional lung fields, a lung point sign can be identified with the presence of lung and air in the same view, representing the sudden transition from normal lung to pneumothorax. On the M-mode this is seen as parallel lines on one side of the screen with an abrupt change to a granular pattern on the other side of the screen – this is the "lung point sign." The probe must be held motionless in once location to elicit this sign.[5]

While traditionally a "lung point" is considered pathognomonic of the presence of a pneumothorax, in our case this sign was produced by the same pathophysiology as that of a

pneumothorax, but in the absence of the latter. The “lung point” was present in our patient with bullous emphysema due to the presence of normal lung tissue adjacent to an area of trapped air related to a large pulmonary bulla. To our knowledge this is the first reported case of a “lung point” identified in a patient without a pneumothorax.[6]

This is an important finding given the ever increasing utilization of ultrasound in daily pulmonary and critical care medicine practices. As mentioned earlier, when performing a lung ultrasound, it is important to know the location of the lung in relation to other organs of the body, such as the heart and the diaphragm. It is also necessary to perform the ultrasound examination before and after completing a planned procedure. For instance, if our patient had a central line placed on the same side of the lung with bullous emphysema, an ultrasound performed after the line insertion may have led the physician to strongly misinterpret the findings as representative of an acute iatrogenic pneumothorax. This could have led to the unnecessary placement of a chest tube and the possible rupture of the bulla with a potential secondary bronchopulmonary fistula formation. Such circumstances further emphasize the need to be able to clearly evaluate ultrasound findings before implementing therapy based on these results.

Therefore, bedside ultrasonography is still an evolving technology which requires adequate training in image acquisition or interpretation and logical correlation with known pathophysiological processes. It should be used as a complement to physical examination and other radiological modalities. Knowing what structures surround the lungs and the morphological changes of lung disorders is also crucial when interpreting the ultrasound images.

Abbreviations

1. CT – Computed Tomography
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Figure 1. (Top) 2D view of lung point sign. (Bottom) M-mode showing lung point and sea shore sign
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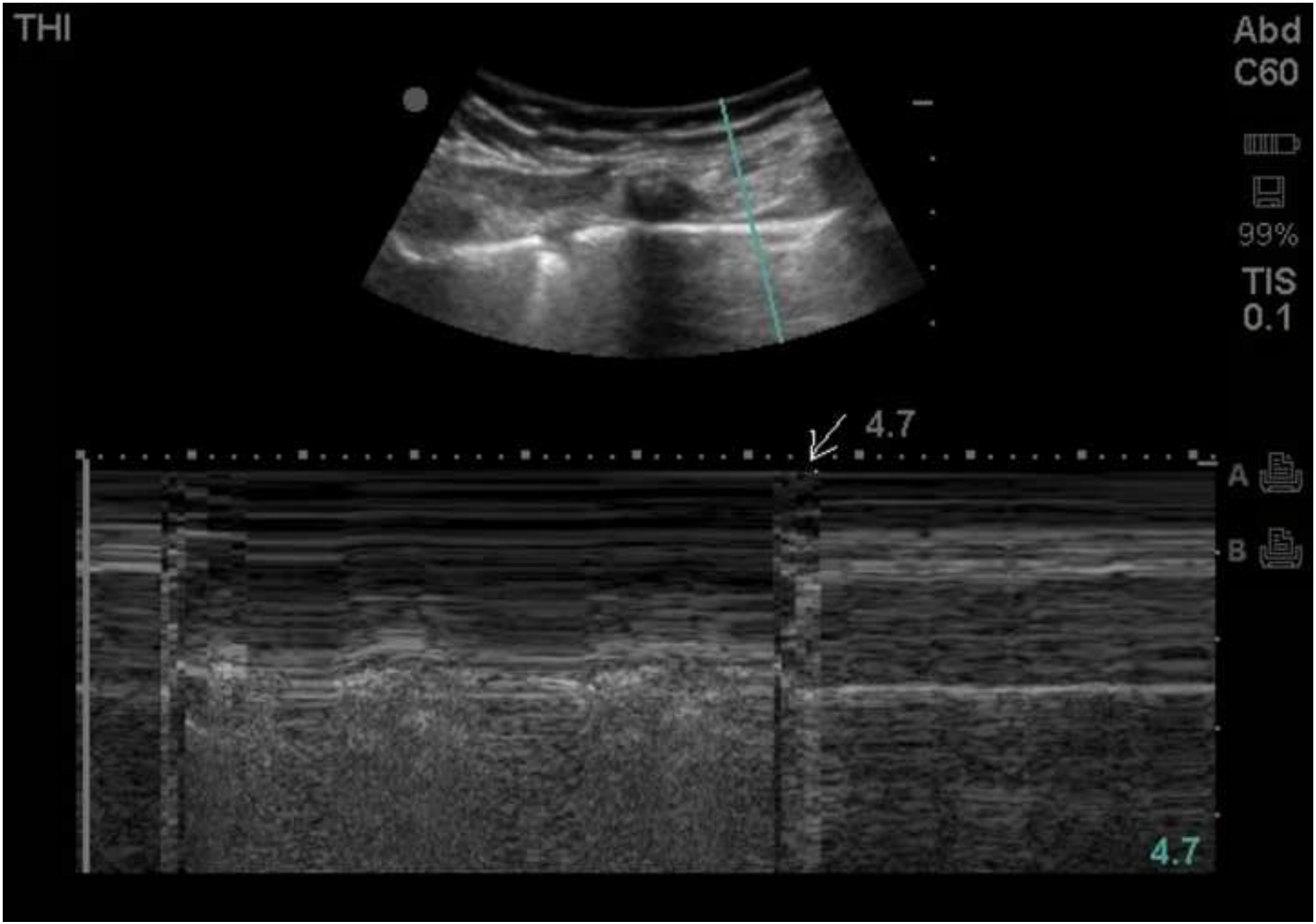

Figure 2. CT Chest showing Large Lung Bulla
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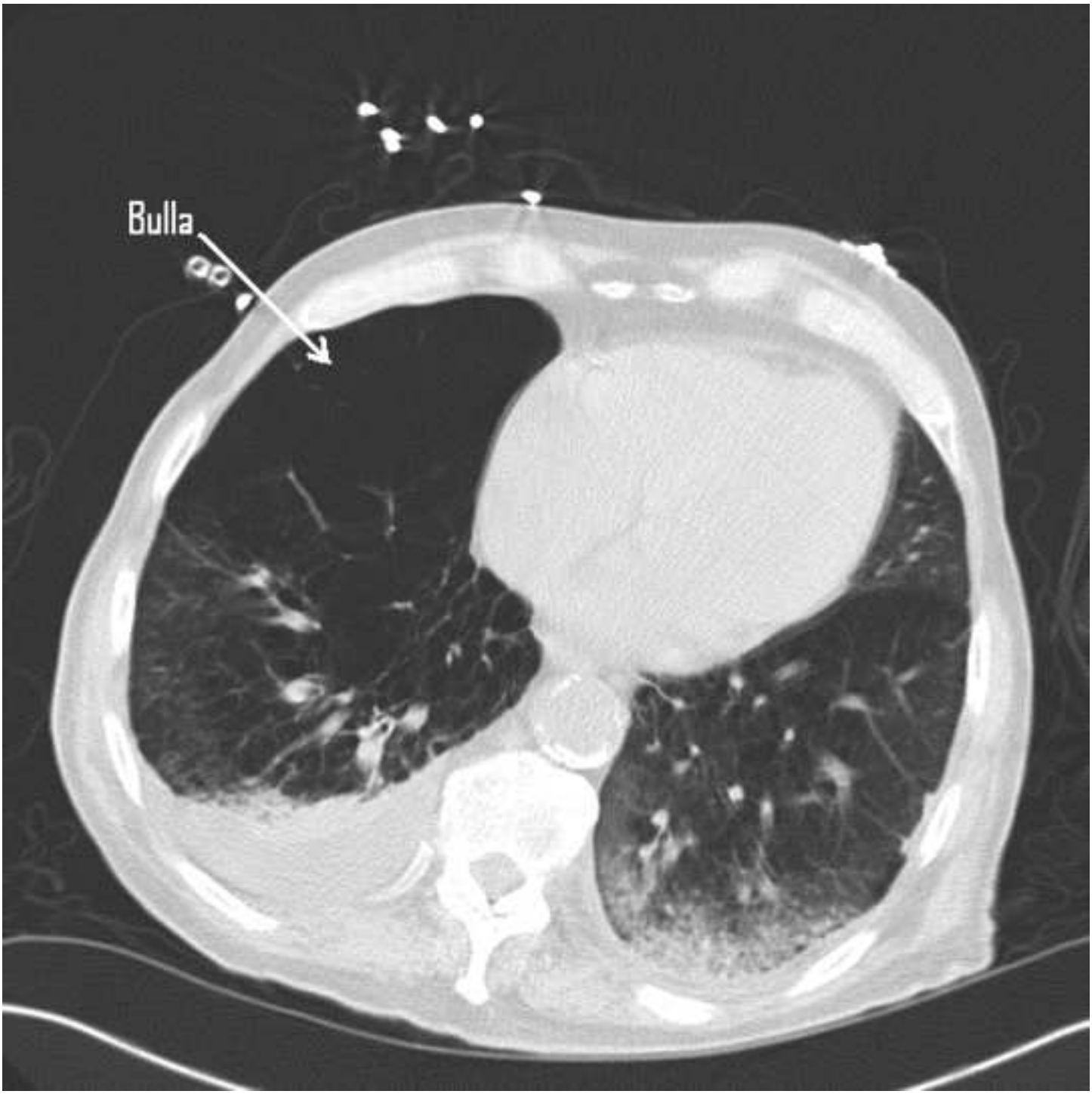

Figure 3 B-line representing reverberation artifact in normal lung
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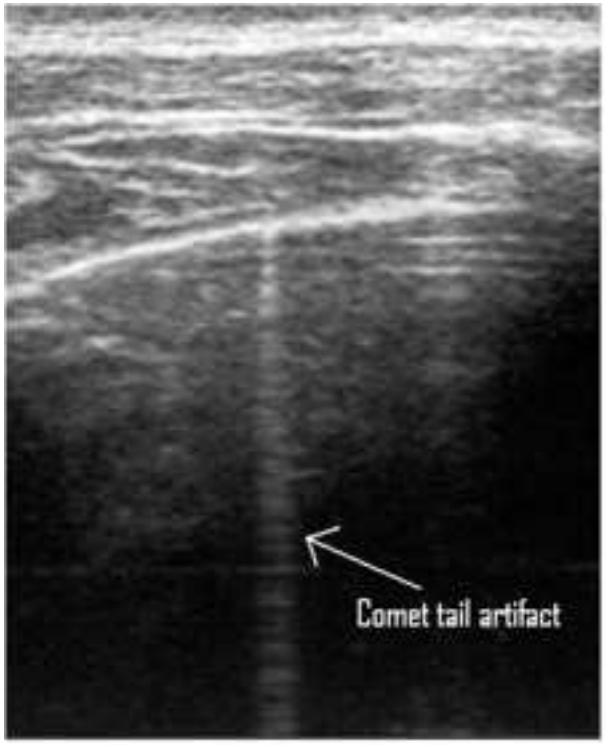

Figure 4. M-mode showing sea shore sign

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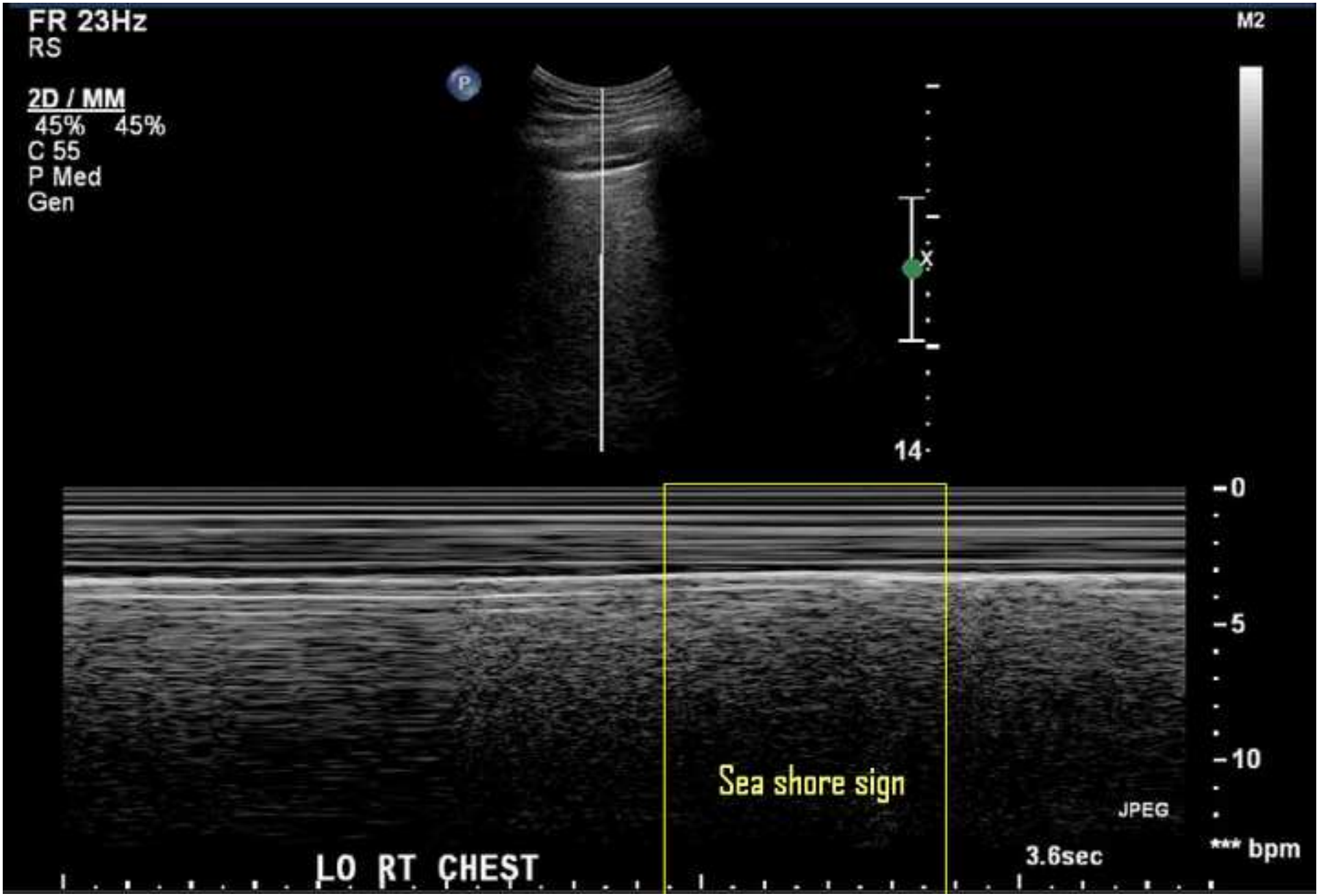

Supplemental Video File

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