Vibration Response Imaging (VRI): a new modality for evaluation of Pleural Effusion

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Background

Pleural effusion produces relatively distinct physical findings, but imaging is essential for confirmation, especially prior to taping. Chest X-ray (CXR) cannot be done effectively at bedside and, moreover, it involves radiation.
The VRI device provides a radiation-free approach to detect pleural effusion.

Objective

To evaluate this novel technology in the diagnosis and monitoring of pleural effusion compared to conventional CXR.

Description of Device

The VRI system constructs a dynamic lung image from vibrations produced by airflow. The vibrations, hence the image, are altered by the airway and parenchymal abnormalities. The vibration energy from 40 sensors, attached to the back, is processed during breathing cycles and creates a dynamic image.
The presence of fluid as well as the compression and displacement of the lungs by pleural effusion are easily detected by this method.

Figure 1: The lung VRI (Vibration Response Imaging) system

Method

Sixteen patients (avg. 70.6 yrs) were enrolled in the study at the Pulmonary Institute. Study population included men and women, between the ages of 18 to 85 years, who were admitted to the medical center and treated for a confirmed diagnosis of pleural effusion. Patients with a pacemaker or implantable defibrillator or a history of tuberculosis were not included in the study. Clinical symptoms were reported, a medical history was taken (including past lung function testing), and a physical exam and chest x-ray were performed. The presence of PE was confirmed by a standard CXR; one case of large PE (> 2 Lit.), 7 with moderate PE (1–2 Lit.) and 8 with small PE (< 1 Lit.). Patients were recorded with the VRI prior to treatment and following drainage [4 of the 16 cases].

Results

The VRI dynamic and static images showed characteristic features in the regions corresponding to the pleural effusion (as determined by the chest X-ray). The areas of pleural effusion were easily identified due to an absence of vibration energy in the image and adjacent attenuation of the image, as well as a cross-segmental, meniscus-shape in the region of pleural fluid. The absence of vibration response was correlated to the region of pleural effusion, as determined by the CXR in 14/16 (87.5%) patients. Following treatment, VRI images showed increased vibration response in the area of pleural effusion in all 4 cases, which corresponded with CXR.

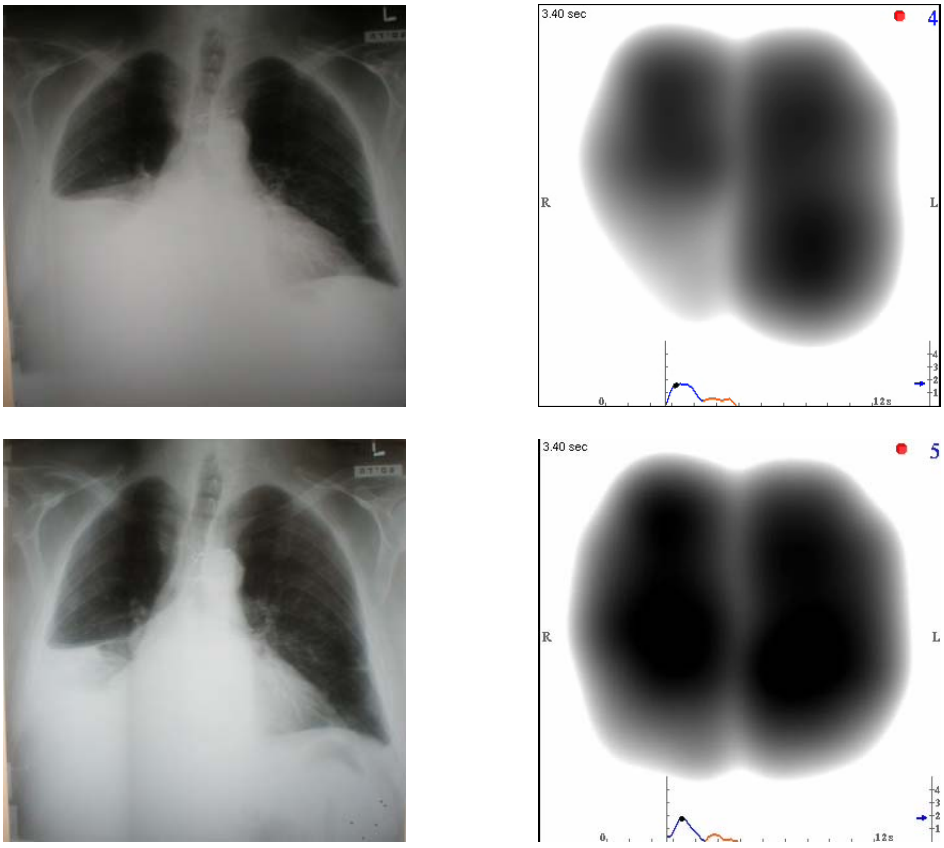

Figure 2(a, b,& c): Chest x-ray (2a) and VRI still image during maximum inspiration (2b) from a 75 year old male with pleural effusion in the left lung prior to drainage; (2c) VRI image after drainage. Note the increased vibration response in the left lung.

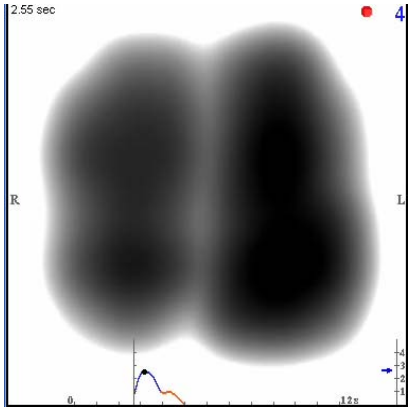

Figure 3: VRI still image during maximum inspiration of a 53 year old healthy male. Note that there is a vibration response in all areas of the lungs, as opposed to the absence of vibration response in the lower region of the left lung in Figure 2b.

Conclusion

The VRI provides a simple, bedside, radiation-free approach to detect the presence of pleural effusion and to follow its course; thereby, improving the cost effectiveness of bedside evaluation with suspected or documented pleural effusion.

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