

## Assessing regional lung function in emphysema using a new, Vibration Response Imaging (VRI\*) technology

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### Background

Assessment of regional contribution of different areas of the lung to its integrated function is often required, such as prior to lung resection in the presence of tumor or emphysema. This assessment is derived from the proportion of zonal radionuclear perfusion or ventilation. We hypothesized that lung VRI may provide an alternative approach to assess regional lung function.



**Figure 1:** Lung VRI (Vibration Response Imaging) system

### Objective

To compare the regional lung vibration energy, as measured by the VRI system, with regional lung function, as assessed by standard perfusion and ventilation radionuclear scans.

### Description of Device

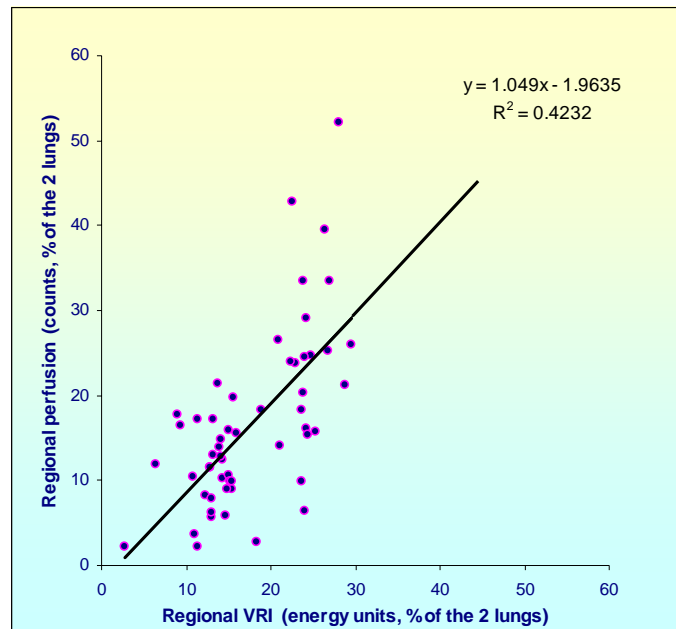
The VRI system creates a dynamic image of the lung from the vibrations produced by air flow. These vibrations are integrated over time and converted to energy units. The regional vibrations are altered by structural lung changes such as in emphysema. The energy can be quantified for any area, by integration over the matching sensors.

### Patients

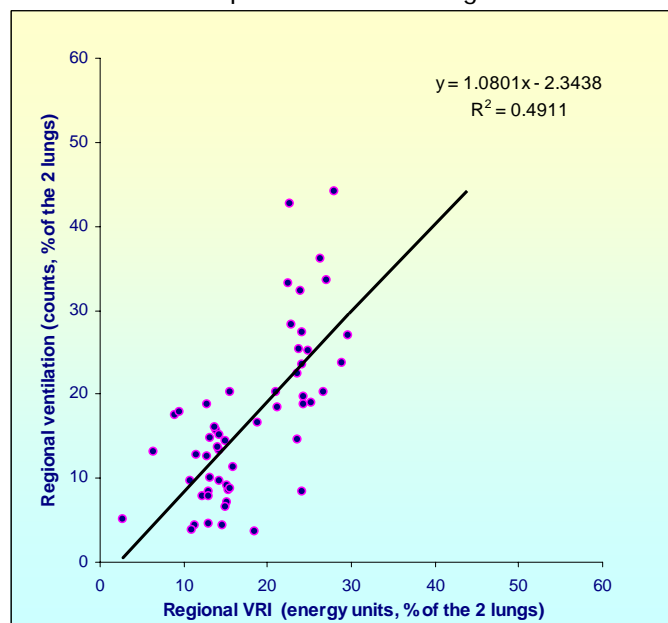
Eleven subjects (3 females) with severe emphysema and a mean age of  $67 \pm 13$  yrs;  $FEV_1$   $41 \pm 19\%$ ;  $DL_{CO}$   $43 \pm 14\%$  and RV of  $217 \pm 35\%$  of predicted, were prospectively and blindly evaluated. Each patient underwent standard radionuclide perfusion and ventilation (Technegas®) scans and VRI testing during tidal breathing. The lung fields were subdivided into 6 zones; 3 on each side. The long axis of each lung, as defined by the borders of the VRI or nuclear image, was divided to 3 equal parts. The corresponding regional counts on scans (fraction of the total radioactivity and fraction of the total VRI energy) were integrated, digitalized and compared.

## Results

The regional lung VRI energy correlated with the regional ventilation ( $R=0.70$ ,  $p<0.001$ ) and perfusion ( $R=0.65$ ,  $p<0.001$ ), as shown in Figure 2 and 3. Interestingly, the VRI tended to provide higher readings in the upper-left zones, while the nuclear readings tended to be higher in the lower-right zones; upper-left zones,  $15\pm 2\%$  and  $11\pm 4\%$  of total, for VRI and perfusion; lower-right zones,  $16\pm 5\%$  and  $11\pm 3\%$  of the total, for ventilation and VRI, respectively;  $p<0.05$  (ventilation and perfusion in upper-left zones and perfusion in lower-right zones).

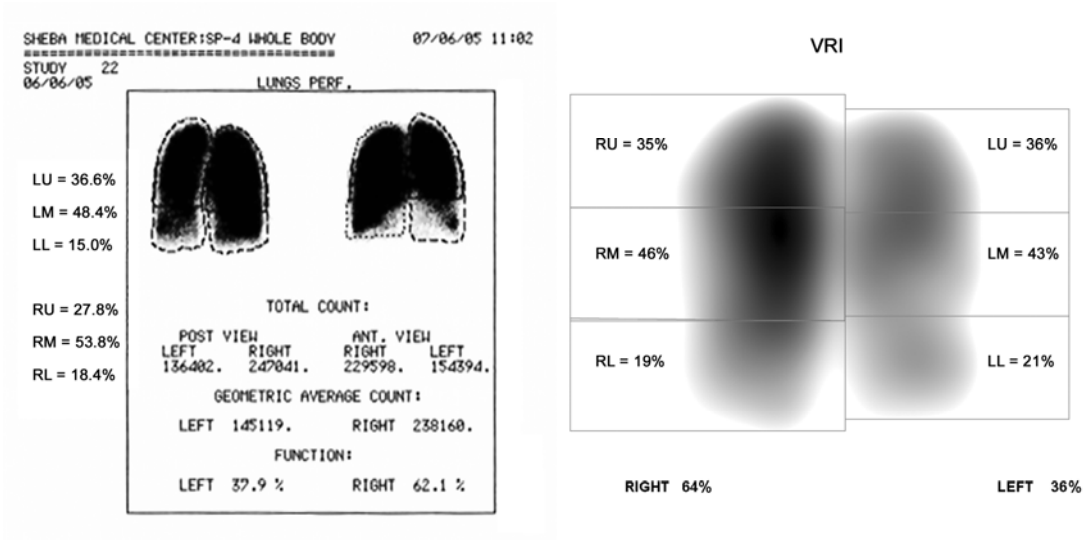


**Figure 2:** Regional VRI Energy Units vs. regional perfusion scan counts; both are presented as percent of the 2 lungs.



**Figure 3:** Regional VRI Energy Units vs. regional Ventilation counts; both are presented as percent of the 2 lungs.

Figure 4 shows an example of PA perfusion scan and maximal VRI image for a 70 year old patient.



**Figure 4:** Maximal VRI image and perfusion scan of a 70 year old male with emphysema. The corresponding regional percentages of the total signal are marked for each zone.

**Conclusion**

These preliminary findings suggest that VRI provides a safe, simple, and radiation-free alternative tool to assess regional lung function in emphysema. The apparent systematic differences in the readings between the upper-left zones and lower-right zones may be inherent to the different methodologies and needs further exploration.