Comparison of Ventilation/Perfusion Obtained by Polarized Gas MRI with Multiple Inert Gas Elimination Technique

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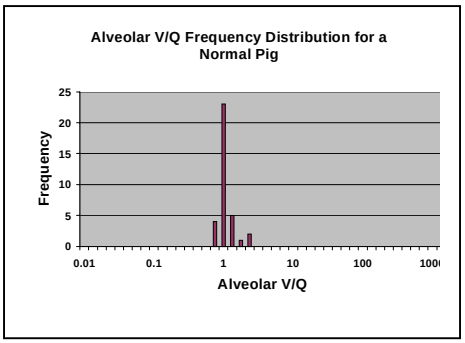
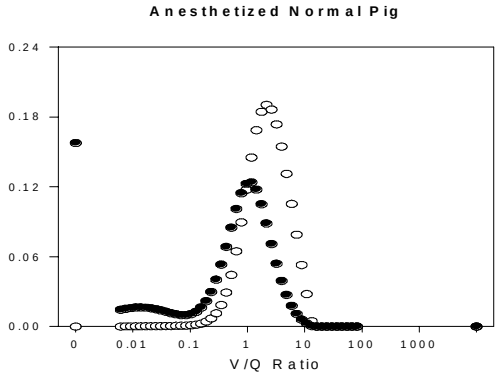
Introduction: The ability to accurately measure the V_A/Q ratio is of great importance in assessing lung function. Although frequency distribution measurements of said ratio are indeed a valuable tool, of greater clinical worth would be a technique capable of also localizing a particular V_A/Q ratio. The multiple inert gas elimination technique (MIGET) has been accepted as the gold standard for global V_A/Q measurement (1). Recently the use of hyperpolarized (HP) ^{3}He MRI has produced results that illustrates the technique possesses potential value for assessing regional V_A/Q. However, to fully substantiate merit to the HP ^{3}He MRI technique comparison must be made to the gold standard. The aim of this study is to compare the frequency distributions of regional V_A/Q ratios obtained using HP ^{3}He MRI with those obtained using the MIGET.

Methods: Yorkshire pigs (25 kg) were anesthetized, intubated, paralyzed, and maintained under anesthesia using intravenously administered pentobarbital. MIGET was performed using methods already established (1, 2). Swan–Ganz and arterial catheters were inserted to facilitate the sampling of mixed venous and arterial blood, respectively. Six inert gases were infused into the pig,, and expiratory gases were collected after equilibration. Upon completion of the MIGET data collection the animal was transferred supine to a 1.5 T imaging unit with a birdcage coil double tuned to ^{3}He and proton frequencies for image acquisition. Two sets of images were acquired using identical imaging parameter with the exception of the interscan time that was changed from 1 s to 6 s between series. Using previously described methods (3), regional pO_2 was calculated for 26 regions of interest (ROIs; 14 x 14 pixels) from the HP ^{3}He MRI images. In turn, the pO_2 values were used to calculate V_A/Q ratios using a method described elsewhere.



Data from **HP ^{3}He MRI** (left) and **MIGET** (right). Note that the MIGET data is displayed on a logarithmic scale.



Results and Discussion: The data above, illustrating the frequency distribution of V_A/Q ratios, correlates with the expected unimodal distribution, centered around 0.8 to 1, for a MIGET performed on a healthy animal. The animal used for HP ^{3}He MRI data collection had a perfusion defect in the right lower lobe. This area, with a V_A/Q ratio close to infinity, was excluded from data analysis to allow for V_A/Q comparison to be made with a normal animal. However, it appears that the V_A/Q ratio approximately centered on 0.65 rather than a normal value of 0.8. This observation was most likely due to the perfusion obstruction slightly altering the hemodynamics of the remainder of the lung. Nonetheless, as expected, the normal lung regions portrayed unimodal value distributions comparable to those obtained with the MIGET. Further comparison of specimens with normal and abnormal V_A/Q ratios would provide stronger insight about the validity of assessing regional V_A/Q ratios using HP ^{3}He MRI.

Conclusion: This study demonstrated that regional V_A/Q assessment using HP ^{3}He MRI yields results comparable to those acquired using the MIGET. Furthermore, HP ^{3}He MRI offers regional data, which may allow for the localization of potential V_A/Q abnormalities.

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