Purpose: Diffraction enhanced imaging (DEI) generates image contrast in a fundamentally different way than absorption x-ray imaging—the refraction and extinction of x-rays yield unique contrast. The purpose of this study was to measure the apparent absorption coefficient of the lung tissue in normal rats and to quantify the difference in contrast between DEI's peak image and radiography.
Methods: Chest radiographs and DEI peak images (analyzer crystal aligned to the Bragg peak) were acquired of anesthetized and paralyzed Sprague Dawley rats (n=14) at Beamline X15A of the National Synchrotron Light Source at an x-ray energy of 60 keV. The images were acquired in the anteroposterior (AP) direction. Intensity measurements were used to calculate an approximate apparent absorption coefficient of rat lung tissue. Measurements of the transmitted intensity of both the radiograph and DEI peak images were then used to calculate contrast within the lung.
Results: The measured apparent absorption coefficient for the inflated lungs was 0.86 +/- 0.15 cm^-1. To put this in context, the absorption coefficient of air, water and bone at 60 keV are 0.0002 cm^-1, 0.21 cm^-1 and 0.50 cm^-1, respectively. Thus, the DEI contrast generated by the lung is about two times that generated by the same thickness of bone. DEI showed a significant gain in contrast over radiography (C_DEI/C_Rad) of 1.7 +/- 0.6.
Conclusions: DEI generates 70% greater lung contrast than radiography at 60 keV. The large difference in the apparent absorption coefficient of DEI and the absorption coefficient of conventional radiography shows that DEI can be used to either enhance lung contrast for the same radiation dose, or could be used to substantially reduce the required radiation dose for a chest x-ray while maintaining the same contrast-to-noise ratio.

Funding Support, Disclosures, and Conflict of Interest:

Drs. Connor, Parham, Pisano and Zhong are equity holders in NextRay, Inc. Dr. Pisano is on the Board of Directors at NextRay, Inc. Drs. Connor, Parham and Zhong are consultants to NextRay, Inc.