

Effect of Ventilation on Lung Liquid Clearance at Birth Visualised with Synchrotron X-ray Imaging

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Aeration of the lung and the transition to air-breathing at birth is fundamental to mammalian life and initiates major changes in cardiopulmonary physiology. However, the dynamics of this process and the factors involved are largely unknown, because it has not been possible to observe or measure lung aeration on a breath-by-breath basis.

We have used the high contrast and spatial resolution of synchrotron based phase contrast X-ray imaging to study lung aeration at birth in neonatal rabbits. As the liquid-filled fetal lungs provide little absorption or phase contrast, they are not visible and only become visible as they aerate, allowing a detailed examination of this process. Several imaging protocols were employed which allowed the imaging live from birth and several ventilation strategies.

We have been able to determine the timing and spatial pattern of lung aeration and relative levels of lung aeration. We report the first detailed observations and measurements of lung aeration, demonstrating its dependence upon inspiratory activity and body position; dependent regions aerated at much slower rates. The air/liquid interface moved towards the distal airways only during inspiration, with little proximal movement during expiration, indicating that trans-pulmonary pressures play an important role in airway liquid clearance at birth. Studies of ventilation included determining the effect of a positive end expiratory pressure which was found to have a major impact upon lung aeration. Using these imaging techniques, the dynamics of lung aeration and the critical role it plays in regulating the physiological.

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