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Abstract

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State of the art EM techniques for quantitative assessment of lung structure

In order to understand how the mammalian lung functions as a gas exchanger, one has to do two things: looking inside the lung and measuring its structure. Both aspects require adaequate methodology. Regarding the first aspect, the cellular details of the barrier separating air and blood can only be resolved by electron microscopy. Regarding the second aspect, the gold standard for obtaining quantitative (morphometric) data on lung structure in microscopy is stereology. This research field was pioneered by Ewald Weibel (1929–2019). Meanwhile, stereology as the method of choice for quantitative assessment of lung structure is endorsed by an official research policy statement of the American Thoracic Society and the European Respiratory Society (Hsia, Hyde, Ochs, Weibel: Am J Respir Crit Care Med 2010;181:394–418).

A new dimension to electron microscopy of the lung was added by 3D techniques. They comprise a broad spectrum of recent developments and advances in instrumentation and specimen preparation and include serial block face scanning electron microscopy (SBF-SEM), focused ion beam scanning electron microscopy (FIB-SEM), and electron tomography (ET). These methods are complementary regarding sample size and resolution. They provide 3D datasets of the lung much more efficiently and at higher quality than conventional serial section transmission electron microscopy (Ochs, Knudsen, Hegermann, Wrede, Grothausmann, Mühlfeld: Histochem Cell Biol 2016;146:695–707).

In this presentation, I will review the history of lung microscopy and stereology, and provide an overview on current 3D EM techniques, their application to the study of lung micro-structure, and their potential for stereological studies.