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Influence of Pulmonary Surfactant Protein Mimics on Model Lung Surfactant

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Introduction to Pulmonary Surfactants

Components and Compositions

Surface-active materials lining up at the air-alveolar fluid interface in mammalian lungs or pulmonary surfactants (PS) play an important role in vital physiological processes, such as respiratory movement. First, at the interface, PS reduces surface tension to minimize the work of breathing and to prevent alveolar collapse in expiratory movements (Schürch et al., 1976). Second, PS rapidly adsorbs on and spreads to the interface (Bastacky et al., 1995). PS is synthesized by type II pneumocytes and then stored in characteristic lamellar body organelles in the cytoplasm prior to secretion into the alveolar hypophase. It exists in the alveolar hypophase in the form of heterogeneous phospholipid-rich aggregates, including tubular myelin, which is associated with rapid adsorption to the air-water interface (Magoon et al., 1983; Notter et al., 1986; Putman et al., 1996). Then, it adsorbs from these aggregates to form a film at the air-water interface. PS is a mixture of lipids (≈90 wt%) and proteins (≈10 wt%). The material consists mainly of phosphatidylcholines (especially dipalmitoylphosphatidylcholine, DPPC; disaturated phospholipid, ≈50 wt%) and smaller but significant amounts of phosphatidylglycerol (PG), palmitic acid (PA), and four proteins (surfactant proteins: SP-A, -B, -C, and -D) (Veldhuizen et al., 1998; Postle et al., 2001; Krüger et al., 2002; Yu & Possmayer, 2003). DPPC is not common in cell membranes and has been recognized as an important surfactant component soon after the discovery that surface active agents are present in the lungs (Brown, 1964). SP-A, -B, and -C have crucial biophysical significance in PS function. SP-A comprises ≈5% of lavaged PS on a weight basis and can be isolated as a material closely associated with surfactant lipids during centrifugation. SP-B and SP-C together make up ≈1.5% by weight of typical lavaged surfactant isolates and