

LUNG PRESERVATION WITH NEWLY-DEVELOPED SOLUTIONS

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BACKGROUND Most clinical lung transplantation programs have preserved donor lungs with prostaglandin (PGE1 or PGI2) pretreatment followed with Euro-Collins solution (EC). The limit of the safe ischemic time of this method is considered to be approximately 9 hours. Better methods of lung preservation would increase the quantity and quality of available lung grafts, improve lung function after transplantation and permit elective surgery in clinical lung transplantation. Trehalose (C₁₂H₂₂O₁₁) is a non-reducing disaccharide and consists of two D-glucose moieties connected by a 1,1-linkage. Trehalose has been shown to protect cell membrane structures under various environmental stresses, such as desiccation, freezing and high temperatures. We investigated the effect of trehalose on the canine lung preservation, and developed new types of solutions containing trehalose; Extracellular and Intracellular Trehalose-Kyoto solutions (ET-K and IT-K). The composition of these solutions is identical except for the electrolyte content. The efficacy of ET-K and IT-K for 20-hour lung preservation was examined in canine lung allotransplantation.

MATERIALS and METHODS: Experiment 1 (Exp.1) Canine lungs were perfused and preserved with a EC in which 3.5% trehalose (group 1) or 7% trehalose (group 2) replaced glucose. In group 3, lungs were perfused and preserved with standard EC. After 12-hour cold storage, left lung was transplanted and evaluated. Experiment 2 (Exp.2) Canine lungs were perfused and preserved with ET-K (group 1), IT-K (group 2), or EC (group 3 and 4). In group 3, PGE1 pretreatment was employed before pulmonary arterial flush. Left lung was transplanted and evaluated after 20-hour storage.

RESULTS: Exp.1 The PaO₂ levels in groups 1 and 2 after reperfusion were 264.9 and 257.5 mm Hg, respectively (FiO₂ = 0.5), and significantly higher than the corresponding level in group 3 (114.8 mmHg). All the transplanted lungs in groups 1 and 2 had normal structures on histologic examination, whereas lungs in group 3 showed pulmonary edema. Exp.2 The PaO₂ level in group 1 was uniformly excellent after reperfusion (292.3 mmHg; FiO₂ = 0.5), and significantly higher than those in group 2 (151.1 mmHg), group 3 (125.2 mmHg) and group 4 (80.5 mmHg). The other parameters such as peak inspiratory airway pressure, pulmonary vascular resistance, wet to dry weight ratio and histologic examination showed better preservation in group 1.

CONCLUSIONS: Trehalose is effective in 12-hour canine lung preservation. ET-K provides reliable 20-hour lung preservation in dogs, even without PGE1 and is superior to EC with PGE1 pretreatment which is the most widely used method of clinical lung preservation. The comparison of ET-K and IT-K suggests that a low-potassium extracellular solution has a more beneficial effect on lung preservation. It is expected that ET-K may be of clinical use and may help in achieving the goal of elective lung transplantation.