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The effects of hydrogen gas inhalation during ex vivo lung perfusion on donor lungs obtained after cardiac death

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Abstract

Objectives: Lung transplantation is a well-established treatment of end-stage lung disease; however, it is limited by a shortage of donor lungs. To overcome this problem, donation after cardiac death (DCD) and ex vivo lung perfusion (EVLP) are being widely investigated. In this study, the effect of hydrogen gas, a known antioxidant, was investigated on a DCD lung model during EVLP.

Methods: Ten pigs were randomized into either a control (n = 5) or a hydrogen group (n = 5). After fibrillation by electric shock, no further treatment was administered in order to induce warm ischaemic injury for 1 h. The lungs were then procured, followed by 4 h of EVLP. During EVLP, the lungs were ventilated with room air in the control group, and with 2% hydrogen gas in the hydrogen group. Oxygen capacity (OC), pulmonary vascular resistance (PVR) and peak airway pressure (PAP) were measured every hour, and the expressions of interleukin-1 beta (IL-1β), IL-6 (IL-6), IL-8 (IL-8) and tumour necrosis factor-alpha (TNF-α) were evaluated in lung tissue after EVLP. Pathological evaluations were performed using lung injury severity (LIS) scores and the wet/dry ratio was also measured.

Results: The OC in the hydrogen group was higher than in the control group, but the difference was not statistically significant (P = 0.0862). PVR (P = 0.0111) and PAP (P = 0.0189) were statistically significantly lower in the hydrogen group. Compared with the control group, the hydrogen group had a statistically significantly lower expression of IL-1β (P = 0.0317), IL-6 (P = 0.0159), IL-8 (P = 0.0195) and TNF-α (P = 0.0159). The LIS scores (P = 0.0358) and wet/dry ratios (P = 0.040) were also significantly lower in the hydrogen group.

Conclusions: Hydrogen gas inhalation during EVLP improved the function of DCD lungs, which may increase the utilization of DCD lungs.

Keywords: Donation after cardiac death; Ex vivo lung perfusion; Hydrogen; Warm ischaemic injury.

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