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# Beneficial effects of hydrogen gas on porcine liver reperfusion injury with use of total vascular exclusion and active venous bypass

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## Abstract

**Background:** Liver ischemia/reperfusion (I/R) injury is a high risk factor in liver transplantation and it influences graft survival. One of the major events during I/R injury is the generation of cytotoxic oxygen radicals. Recently, hydrogen gas has been reported to have antioxidant properties and protective effects against organ dysfunction induced by I/R injury. The aim of this study is to investigate effects of hydrogen on porcine liver reperfusion injury.

**Materials and methods:** Six outbred pigs weighing 20 kg were used for the experiment. Under general anesthesia, the venous bypass between the left femoral vein and the splenic vein to the left jugular vein was made using a centrifugal pump. Then, we used a total vascular exclusion clamp (all in- and out-flow to the liver was clamped) for 60 minutes. Hydrogen (5 ppm) saturated with lactate Ringer's solution was prepared. This solution was infused through the portal vein just before reperfusion (hydrogen group).

**Results:** Aspartate aminotransferase levels in the control versus hydrogen group in 30, 60, and 120 minutes after reperfusion were 1560.3, 1925.3, and 2342.5 versus 175.3, 200.7, and 661.00 IU/L, respectively. Lactate dehydrogenase (LDH) levels in the control versus hydrogen groups in 30, 60, and 120 minutes after reperfusion were 23,235.0, 3496.7, and 4793.5 versus 663.3, 802.0, and 983.7 IU/L, respectively. The hydrogen gas level in liver tissue increased to 954.6 ppm immediately after reperfusion; however, it disappeared within 30 minutes.

**Conclusion:** The solution containing hydrogen gas was safe and had remarkably protective effects on the porcine during liver I/R and may be applied in the clinical setting.

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