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Inhalation of hydrogen gas reduces liver injury during major hepatectomy in swine

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Abstract

Aim: To study the effect of H₂ gas on liver injury in massive hepatectomy using the intermittent Pringle maneuver in swine.

Methods: Male Bama pigs (n = 14) treated with ketamine hydrochloride and Sumianxin II as induction drugs followed by inhalation anesthesia with 2% isoflurane, underwent 70% hepatectomy with loss of bleeding less than 50 mL, and with hepatic pedicle occlusion for 20 min, were divided into two groups: Hydrogen-group (n = 7), the pigs with inhalation of 2% hydrogen by the tracheal intubation during major hepatectomy; contrast-group (n = 7), underwent 70% hepatectomy without inhalation of hydrogen. Hemodynamic changes and plasma concentrations of alanine aminotransferase (ALT), aspartate aminotransferase (AST), hyaluronic acid (HA), tumor necrosis factor- α (TNF- α), interleukin-6 (IL-6), and malondialdehyde (MDA) in liver tissue were measured at pre-operation, post-hepatectomy (PH) 1 h and 3 h. The apoptosis and proliferating cell nuclear antigen (PCNA) expression in liver remnant were evaluated at PH 3 h. Then we compared the two groups by these marks to evaluate the effect of the hydrogen in the liver injury during major hepatectomy with the Pringle Maneuver in the swine.

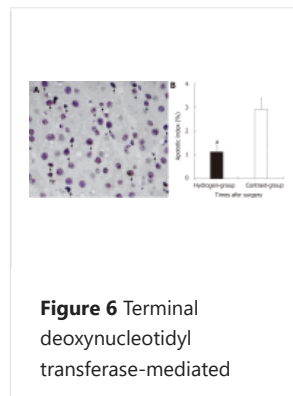
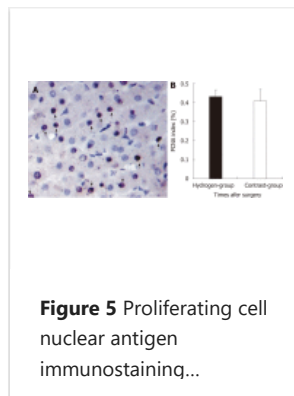
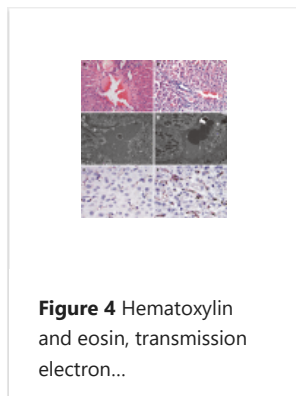
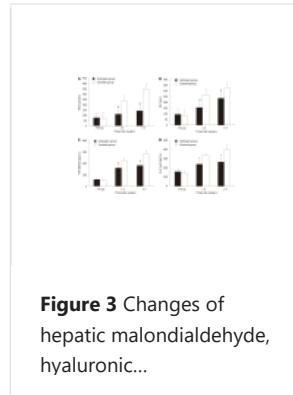
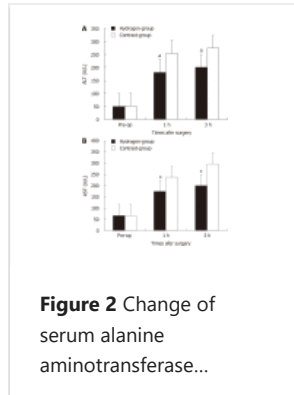
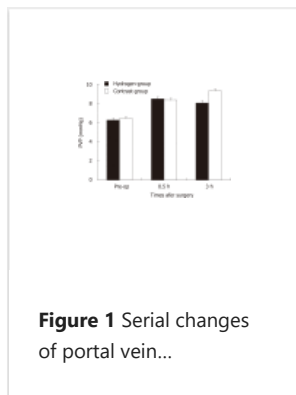
Results: There were no significant differences in body weight, blood loss and removal liver weight between the two groups. There was no significant difference in changes of portal vein pressure between two groups at pre-operation, PH 30 min, but in hydrogen gas treated-group it slightly decrease and lower than its in contrast-group at PH 3 h, although there were no significant difference (P = 0.655). ALT and AST in Hydrogen-group was significantly lower comparing to contrast-group (P = 0.036, P = 0.011, vs. P = 0.032, P = 0.013) at PH 1 h and 3 h, although the two groups all increased. The MDA level increased between the two group at PH 1 h and 3 h. In the hydrogen gas treated-group, the MDA level was not significantly significant at pre-operation and significantly low at PH 1 h and 3 h comparing to Contrast-group (P = 0.0005, P = 0.0004). In Hydrogen-group, the HA level was also significantly low to contrast-group (P = 0.0005, P = 0.0005) although the two groups all increased at PH 1 h and 3 h. The expression of cluster of differentiation molecule 31 molecules Hydrogen-group was low to Contrast-group. However, PCNA index (%) was not statistically significant between the two groups (P = 0.802). Microphotometric evaluation of apoptotic index (AI) in terminal deoxynucleotidyl transferase-mediated dUTP-biotin nick end labeling-stained tissue after hepatectomy for 3h, the AI% level in the hydrogen was significantly low to contrast-group (P = 0.012). There were no significant difference between Hydrogen-group and contrast-group at pre-operation (P = 0.653, P = 0.423), but after massive hepatectomy, the TNF- α and IL-6 levels increase, and its in Hydrogen-

group was significantly low compared with contrast-group ($P = 0.022$, $P = 0.013$, vs. $P = 0.016$, $P = 0.012$), respectively. Hydrogen-gas inhalation reduce levels of these markers and relieved morphological liver injury and apoptosis.

Conclusion: H₂ gas attenuates markedly ischemia and portal hyperperfusion injury in pigs with massive hepatotectomy, possibly by the reduction of inflammation and oxidative stress, maybe a potential agent for treatment in clinic.

Keywords: Anti-oxidant; Hydrogen gas; Hyperperfusion; Malondialdehyde; Massive hepatotectomy; Oxidative stress.

Figures



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