

3.17 Changes in Liver Lobe Function After Portal Vein Ligation Determined by Selective Biliary Drainage

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Introduction: Portal vein ligation (PVL) and embolization (PVE) are techniques used before extended hepatic resections to prevent posthepatectomy liver failure. These therapies redirect portal blood to liver lobes that will remain after surgery resulting in hypertrophy, while the portal deprived lobes undergo atrophy. Although, the effect of PVL on liver volume is well-documented, the parallel alterations in lobar liver function are still the subject of controversy. Therefore, the aim of the present study was to evaluate the morphological, hemodynamic and functional alterations caused by the selective occlusion of the portal vein in a well-established rat model.

Methods: Male Wistar rats (n=84) underwent PVL by the ligation of the portal veins feeding the median, left lateral and caudate lobes (approximately 80% of total liver mass). Before PVL, as well as 24-, 48-, 72-, 120-, 168 hours after PVL, liver morphology (liver weight; mitotic activity; necrotic-, apoptotic cell death and lobular area), hepatic microcirculation (laser Doppler flowmetry), global liver function (laboratory blood test; total hepatic bile flow; plasma disappearance rate of indocyanine-green (PDR); the percentage of biliary ICG excretion to the administered ICG during the first 20 minutes (ICG%_{20min})) as well as hepatic lobar function (lobar bile flow and lobar biliary ICG excretion) were examined.

Results: PVL induced atrophy of ligated lobes (from 0.35 ± 0.037 to 0.09 ± 0.018 g/BWkg) and hypertrophy of non-ligated lobes (from 0.1 ± 0.102 to 0.31 ± 0.019 g/BWkg), while the total liver weight remained unchanged. The microcirculation of ligated lobes impaired, while the microcirculatory blood flow of non-ligated lobes significantly increased with the peak response at 48th postoperative hours. Serum albumin-, total bilirubin levels and total hepatic bile flow did not changed significantly throughout the entire experiment. PDR and ICG%_{20min} significantly decreased after PVL, with the lowest value at postoperative 48th hours and returned near to the baseline at 168 hours after the operation. The bile flow and biliary ICG excretion of ligated lobes decreased significantly after PVL (from 81.99 ± 8.6 to 17.62 ± 3.9 g/BWkg and from 1.16 ± 0.03 to 0.1 ± 0.03 g/BWkg, respectively), while bile flow and biliary ICG excretion of non-ligated lobes showed a significant increase (from 23.65 ± 2.75 to 88.8 ± 4.67 g/BWkg and from 0.34 ± 0.03 to 1.4 ± 0.03 g/BWkg, respectively).

Conclusion: PVL induced a temporary impairment in global liver function, followed by a rapid recovery mainly caused by the increase in the function of non-ligated liver lobes. In the non-ligated lobes, the functional increase was more pronounced than suggested by the degree of hypertrophy. Consequently, the functional capacity of the liver was shifted towards the regenerating lobes in a greater extent than would be expected according to the volumetric alterations.