Liver blood flow measurement with ^{85}krypton clearance by portal venous and hepatic arterial routes of injection

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Using inert gas clearance for measurement of liver blood flow (LBF), workers in the past have concluded that there is incomplete mixing of blood from the portal vein and hepatic artery in the liver sinusoids (Hollenberg & Dougherty, 1966; Birtch, Casey & Zakheim, 1967). This was based on the finding that clearance of the gas was about 30% slower after injection into the hepatic artery than that after portal vein injection. It contradicts established anatomical views of the hepatic microcirculation and also throws doubt on the suitability of the inert gas clearance method for measurement of LBF.

This problem has been studied in the anaesthetized dog, using an ^{85}Kr clearance technique for measuring LBF. Following its injection into the portal vein or hepatic artery, the beta emissions of the isotope were recorded using a Geiger-Müller tube positioned over the surface of the liver.

Variation seen in the anatomy of the hepatic artery suggested the possibility that standard hepatic arterial injection through the gastroduodenal artery might result in extrahepatic shunting of isotope to the portal vein, reduce the apparent clearance rate from the liver, and thus underestimate the true LBF. After hepatic arterial bolus injection of ^{85}Kr, sequential samples of portal venous blood were analysed for radioactivity in 3 animals. In each case, significant activity was found in the portal vein 20 s later and remained for at least 3 minutes.

A dissection was designed which isolated the liver from local recirculation by arterial collaterals via the foregut to the portal vein. Following this, radioactivity was no longer found in portal venous blood after gastroduodenal artery injection, indicating that there had indeed been an extrahepatic shunt of ^{85}Kr from the hepatic artery to the portal vein.

To determine the influence of such a shunt on LBF values obtained from clearance curves recorded after hepatic artery injection, clearances were performed in pairs by injection of ^{85}Kr alternately into the portal vein and hepatic artery. Two groups of dogs were studied: Group A (9 dogs) had standard cannulations, while Group B (6 dogs) had similar cannulations plus the additional dissection described above.

The hepatic artery clearance in Group A was significantly slower than portal vein clearance ($P < 0.001$), the mean ratio LBF–hepatic artery route/LBF–portal vein route being 0.69 ± 0.24 (s.d.) in 42 pairs. In Group B, however, hepatic artery clearance was no longer significantly different from portal vein clearance ($P > 0.05$), with the mean ratio LBF–hepatic artery route/LBF–portal vein route 0.98 ± 0.15 (s.d.) in 37 pairs. There was a highly significant difference between the ratios of the two groups ($P < 0.001$).

These results show that when ^{85}Kr reaches the liver through the hepatic artery with no extrahepatic shunt to the portal vein (Group B), it clears from the liver at the same rate as after injection by the portal venous route, thus confirming that hepatic arterial and portal venous blood mix completely in a common flow bed in the liver.

References

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