TWENTY-FOUR-HOUR PROFILES OF HEPATIC BLOOD FLOW IN SHEEP

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Introduction

The liver is an important organ for the metabolism of a variety of nutrients in blood. Barnes et al.(1984) reviewed the control of splanchnic blood flow in ruminants. There is little quantitative information concerning the changes in blood flow through the liver in sheep within a day. The purpose of the present study was to observe the pattern of changes in hepatic blood flow rate in sheep over a 24 h period.

Materials and Methods

Three female and two castrated male sheep weighing 42-64 kg were used. They were housed in metabolic cages and were fed lucerne pellets (1000 g) and orchard grass hay (100 g) once daily at 19:00 h. Water was freely available at all times. The animals were fitted with a carotid loop a few months before experiments. In addition, polyvinyl catheters were surgically implanted into the hepatic, portal and mesenteric veins in all sheep by the modified technique of Katz and Bergman (1969a). The catheters were flushed and filled with physiological saline containing heparin (50 units/ml). The animals were not used for observations until at least 14 days after surgery by which time their normal feeding pattern was restored. On the day of an experiment, a catheter was inserted into the carotid loop 5 h before feeding. Para-amino hippuric acid (PAH) was used as an indicator for the measurement of blood flow. At 15:00 h, 3% PAH solution (10 ml) was injected into a mesenteric vein, followed by a constant infusion of the same solution (0.5 ml/min) until the end of blood sampling. After a 1.5 h period for equilibration of PAH, blood samples were withdrawn from the carotid arterial, portal and hepatic venous catheters at 1-2 h intervals for a 24 h period. The blood packed cell volume and plasma PAH concentration were determined. Blood flow rates in the portal and hepatic veins were calculated by the method of Roe et al. (1966). The hepatic arterial blood flow was determined as the difference between the portal and hepatic venous flows. Results of 15 observations obtained from 5 sheep are expressed as means with SE. The total blood volume passing through the liver within a day was calculated by integrating the flow rate and the experimental period. The significance of differences between the value at 0.5 h before feeding and the subsequent times was determined by Students's *t*-test after the analysis of variance.

Results and Discussion

The catheters in the portal and hepatic veins could be used for blood sampling for at least 2 months after surgery in all sheep. Food was consumed within 2 h of presentation for all observations. The blood flow rates in the three vessels 0.5 h before feeding were 667±182 ml/min (hepatic artery), 2160±160 ml/min (portal vein) and 2786±195 ml/min (hepatic vein), respectively. The hepatic venous blood flow increased and reached a maximal value (3634±277 ml/min) 1.5 h after feeding ($p < 0.05$). The portal blood flow also increased gradually and reached a maximal value (2839±185 ml/min) at 2.5 h after feeding ($p < 0.05$). The flow rate in the hepatic artery tended to increase after feeding, but the changes were not significant. These values for blood flow rates in the three vessels were very similar to the data of Katz and Bergman (1969b). Our results indicate that the increased blood flow to the liver after feeding dependent on an increase in the portal venous blood flow. Barnes et al. (1983) suggested that the increase in portal blood flow after feeding was mainly due to an increased flow of blood to the rumen and reticulum in sheep. The blood flow rate in all three vessels decreased slowly and returned to the pre-feeding values at 8-10 h after feeding. The total passage of blood through the liver in sheep was 4303±233 l/day with the contributions of the hepatic arterial and portal venous blood being 22% and 78% of the total daily hepatic flow, respectively. Our data are useful in

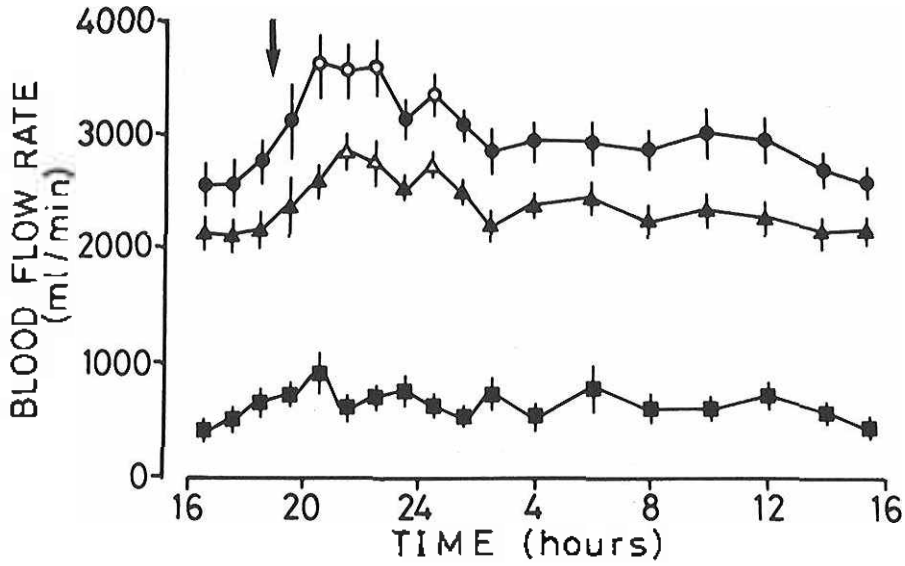

Figure 1. Changes in hepatic, portal venous and hepatic arterial blood flow in sheep. ●, hepatic vein; ▲, portal vein; ■, hepatic artery. Food was given at 19:00 h. Values are means of 15 observations from 5 sheep and SE of the mean. Open symbols indicate significant differences from the values at 0.5 h before feeding ($p < 0.05$).

describing quantative aspects of the net hepatic metabolism of a variety of nutrients in sheep. (**Key Words:** Sheep, Liver, Blood Flow)

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