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# Studies on hepatic blood flow and the rate of Bromsulphalein clearance in dogs with portacaval transposition

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Portacaval transposition, first described by Child and his group,[3] has been widely used in recent years for the study of hepatic and gastrointestinal physiology. Except for a slowed rate of ammonia detoxification in the preparation, liver function is thought to be normal.[4, 6, 9, 14]

Inasmuch as portacaval transposition involves a radical change in the vascular supply to the liver, knowledge of hepatic blood flow after operation would appear to be important. In the present study, hepatic blood flows were studied with the Bromsulphalein (BSP) method in a group of dogs with portacaval transposition, under resting unanesthetized conditions and under certain conditions of stress. Quantitative corollary data were obtained on the capacity for BSP clearance.

A modification of Child's transposition was used in this study in order to eliminate flow variations resulting from the development of venous collaterals. All ileocaval tributaries from the inguinal ligament to the diaphragm were ligated in conjunction with transposition, and only the renal veins[5] were spared.

## METHODS

Fifteen adult mongrel dogs weighing from 12 to 20 kilograms were used. Transposition was performed under hypothermia[13, 16] 2 months or more before testing. All tributary vessels to the iliac veins and inferior vena cava were ligated except the renal veins.[15] Postoperatively, the animals were taught to lie quietly on an animal table.

On the day of testing, catheters were inserted into the left main hepatic vein and inferior vena cava[16] under local anesthesia. The dogs were given a priming dose of 3 to 6 mg. BSP and then BSP was constantly infused at the rate of .05 mg. per kilogram per minute into a foreleg vein. Preliminary analyses were made of the BSP level in the vena cava. When the plasma level rose or fell appreciably, the BSP con-

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centration in the infusion was corrected by dilution or concentration to provide a constant plasma level. Subsequent variations in plasma level were mathematically corrected, with estimated plasma volume, to give the true rate of BSP clearance.[2]

After a resting and equilibrated state had been achieved, simultaneous samples were drawn from the hepatic vein and vena cava. These were analyzed on a Beckman DU spectrophotometer, using the hemolysis correction described by Shoemaker.[13] Plasma flows were calculated with the Fick equation,[2] and blood flows computed from the hematocrit level.

## RESULTS

**Rate of BSP removed.** The mean rate of BSP removed in 14 dogs was .048 ± .001 (S. E.) mg. per kilogram per minute. Except for one animal, the spread in values was small (Fig. 1). In 4 dogs the BSP removal was repeated 4 months later and was found to be unchanged from the initial determination.

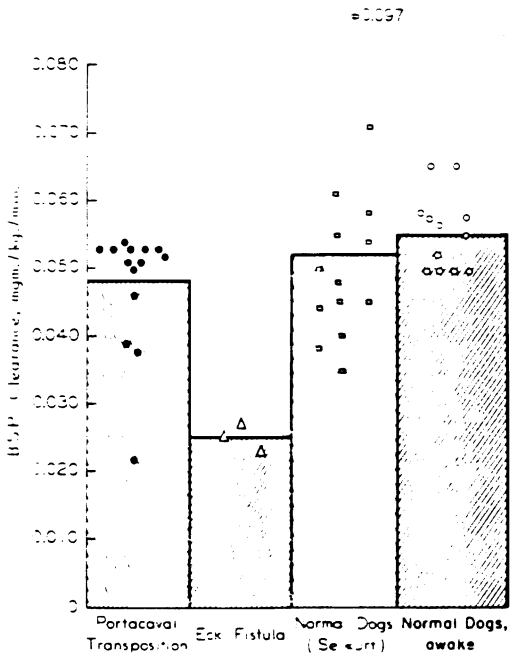


Fig. 1. BSP extraction in dogs with portacaval transposition compared to that of normal animals and those with Eck fistulas. Figures on normal anesthetized dogs calculated from Selkurt's data,[12] and normal awake animals are included for comparison.

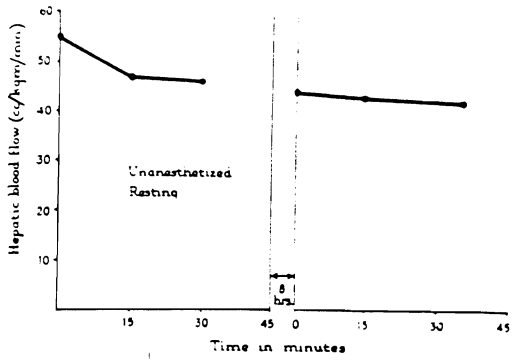


Fig. 2. Hepatic plasma flows at 8-hour interval. Note constancy of flow.

For comparison, BSP removal was measured in 3 dogs with Eck fistulas 2 to 4 weeks after operation. Mean rate of removal was .025 mg. per kilogram per minute (Fig. 1). The probability that the differences between transposition and Eck fistula were due to chance is less than 1 per cent.

A series of 15 unanesthetized normal dogs which had hepatic vessels that had been previously catheterized removed BSP at the rate of .056 ± .001 (S. E.) mg. per kilogram per minute (Fig. 1).

**Hepatic blood flow with transposition.** Fourteen resting dogs were studied. All appeared to be healthy. The hematocrit level was above 30 per cent in 13 animals and above 35 per cent in 10. At least 3 flows at 15 minute intervals were obtained. In some cases, flows were obtained and repeated 8 hours later. Little variation was observed within this time limit (Fig. 2).

The mean hepatic blood flow was 43 ± 4 (S. E.) ml. per kilogram per minute. We did not observe the variations in hepatic blood flow to be related to differences in hematocrit or other obvious factors.

**Effect of stress on hepatic blood flow.** Muscular activity or excitement caused large and erratic rises in hepatic flow. When a source of irritation was protracted, rises in flow were sustained for long periods (Fig. 3).

The chronic placement of the catheters

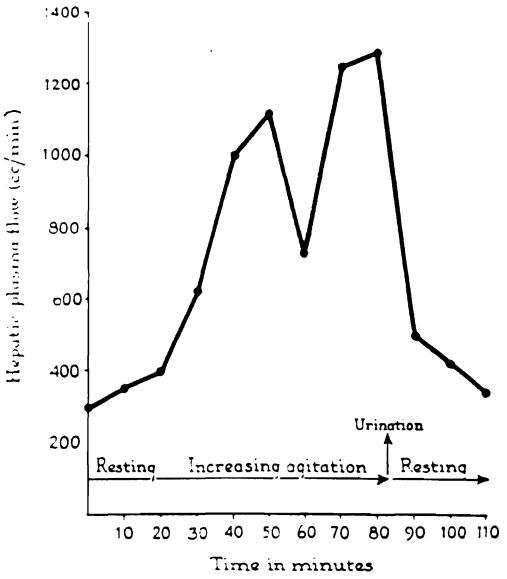


Fig. 3. Influence of painfully distended bladder on hepatic plasma flow.

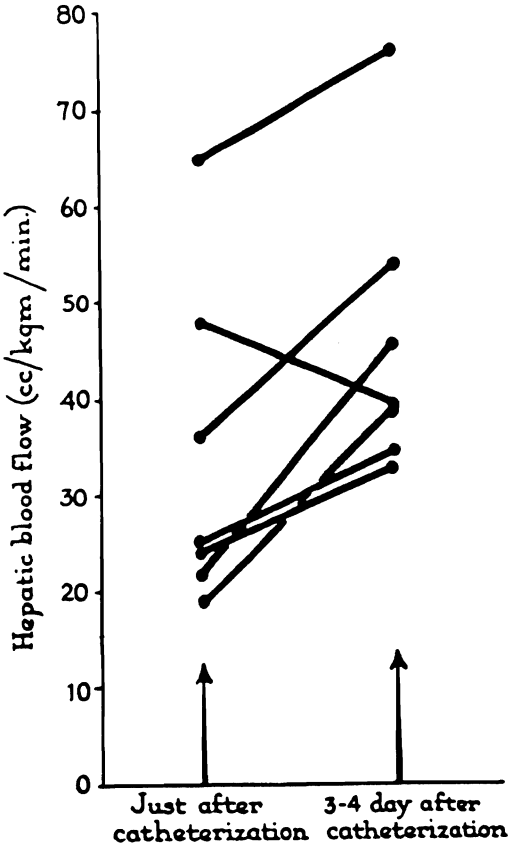


Fig. 4. Influence of indwelling catheters on hepatic blood flow. Dogs developed fever with prolonged catheterization.

was responsible for rises in flow. In 7 dogs, the catheters were left in place for 3 to 4 days. During this period, the dogs developed fever, and, in some cases, ceased eating. Hepatic blood flow rose in 6 of the 7 animals (Fig. 4).

## DISCUSSION

Quantitation of hepatic blood flow after portacaval transposition has received little attention. Heer, Sylvius, and Harper,[9] using the colloidal gold technique, reported a mean hepatic blood flow of 43.6 c.c. per kilogram per minute in 6 dogs with transposition under unstated conditions. Mean flow in the present study, using a different method, was 43 ml. per kilogram per minute in the resting unanesthetized state.

Portacaval transposition has been used in two general types of investigation: where it is desirable to avoid a direct hepatic influence on splanchnic hemodynamics or chemical constituents, and where it is desirable to divert splanchnic substances which could affect the function of the liver. The advantage of the preparation has been assumed to be that hepatic function and vascularity are normal, although vascularization is altered.[6, 14]

Data in the present study support this concept. The mean hepatic blood flow of 43 ml. per kilogram per minute is essentially the same or slightly higher than the flows in normal dogs which have been obtained by numerous investigators with various techniques.[1, 5, 7, 10-13, 17]

Evaluation of BSP extraction also provides a highly quantitative minute to minute evaluation of one facet of liver function. The dye clearance of .048 mg. per kilogram per minute is almost the same as that described for normal anesthetized dogs by Selkurt[12] of .052 mg. per kilogram per minute (Fig. 1) and is identical if a single anomalously low value is excluded from computation of present statistics. The BSP extraction rate of the transposed group was also similar to the rate of BSP extraction of the unanesthetized intact dogs which were studied in our own laboratories.

## SUMMARY

Hepatic plasma and blood flows were determined in dogs with modified portacaval transposition. Mean hepatic blood flow was 43 ml. per kilogram per minute, approximately that expected in a normal dog. Similarly, the rate of Bromsulphalein clearance was in the range expected for normal dogs.

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