The Anhepatic Model in a Pig

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SUMMARY

A technique is described for creating the anhepatic state in the pig. Reconstitution of flow is achieved by the insertion of a prosthetic graft between portal and systemic vascular systems. Postoperatively, the animals may be studied for periods up to 15 hours.

This model is of value for studying the anhepatic state, and for assessing hepatic assist procedures, although the state is irreversible and does not mirror the syndrome of fulminant hepatic failure, as the abnormal liver is absent.

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Preparation of an anhepatic model allows investigation of various functions in the absence of the liver[1] and may be used to assess forms of hepatic assist.[2,3] The model was originally prepared in the dog in 1921 by Mann and Magath,[4] using glass tubing inserted between the portal vein and the upper and lower segments of the vena cava to reconstitute flow. Subsequently other techniques were devised in one or two stages with the creation of a porta-caval shunt and ligation of the hepatic artery.[5-8] In some experiments the liver was resected off the vena cava,[9,10] in others part of the vena cava was removed with ligation of the vessel,[11] and a technique of end-to-end anastomosis of the vena cava has also been described.[12] Some models require a femorojugular bypass, with or without a pump, to allow venous return from the lower limbs.[11]

Most preparations have been made in dogs[4,5,7] with a few in the pig.[2,13] Preparation of the anhepatic pig always requires resection of the vena cava, since the vessel is almost totally surrounded by hepatic tissue. A technique has been devised in the pig for total hepatectomy, which allows recovery from anaesthesia and study for a period of 12 - 15 hours. No bypasses were required postoperatively. The animals were studied especially for alterations in fibrinolysis after this procedure, which have been previously reported.[14] Preliminary studies of acid-base metabolism were also made.

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METHOD

Ten pigs, weighing 20 - 25 kg, were anaesthetised with nitrous oxide, oxygen and halothane, and anaesthesia was maintained by using a closed Magill-type circuit with intermittent positive pressure respiration.

The liver was skeletalised from all surrounding structures and the hepatic arteries were individually ligated. Heparin 2 mg/kg was given before removal of the liver. Upon clamping of the portal vein, the bypass was opened. The supra- and infrahepatic venae cavae were clamped and the liver removed. Minimal change in blood pressure was noted as long as the portal decompression was adequate.

A segment of Wesolowsky aortic bifurcation graft was prepared for insertion between the portal vein and the ends of the vena cava, and was sutured in place with 4-0 silk. After all air had been evacuated from the segment, the clamps were released and vascular continuity restored (Fig. 1). Positioning of the graft in a correct relationship with the portal vein and inferior vena cava prevented subsequent portal venous kinking when the bowel was returned to the abdominal cavity. The splenojugular bypass was clamped and removed, after splenectomy and ligation of the jugular vein. Heparinisation was not reversed and there was no major haemorrhage. The abdominal wall was closed in layers with 1 - 0 chromic catgut and the skin with continuous nylon.

Postoperatively, all animals awoke rapidly from the anaesthetic and remained alert for 8 - 10 hours. A continuous infusion of 40% dextrose was maintained to prevent the hypoglycaemia which would otherwise have supervened. Acid-base studies showed no change during the first 6 hours. Between 6 and 15 hours postoperatively, a progressive metabolic acidosis developed which was unresponsive to sodium bicarbonate or to further administration of glucose. Circulating blood glucose levels were above 250 mg/100 ml. Coma and death ensued after 10 - 15 hours, and mean survival time was 12,3 hours.

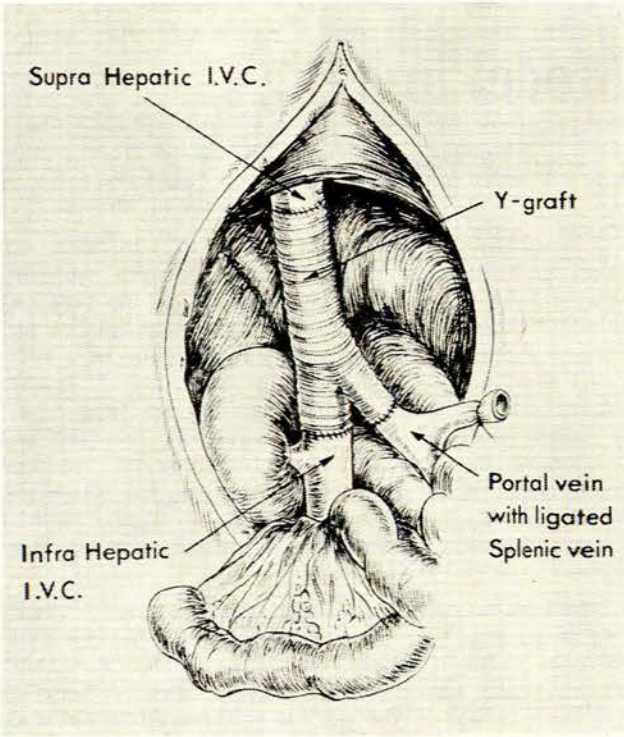

Fig. 1. A schematic representation of the completed model. A Y-segment of Wesolowsky graft is sutured between the portal vein and upper and lower venae cavae. Care is taken to ensure correct siting in the relationship of the portal vein and the lower segment of the vena cava.

DISCUSSION

A simple model of the anhepatic state in the pig is described and it is similar to that recently published by Lempinen *et al.*[13] The only difference in the technique is the creation of a portacaval shunt and the use of a Y-graft for the purpose of portal decompression in our study. The particular advantage of the technique over those previously described in other animals is that there are no external bypasses and the animals are allowed to recover from anaesthesia to be studied when awake. Such a model may be used to study the effects of various forms of hepatic assist for short periods only, since the coma which develops is not reversible. In addition, it does not simulate hepatic failure, since no abnormally functioning liver is present. Nonetheless, for the study of temporary hepatic assist and the reversal of coma, the model is simple and quick to prepare.

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