Innovative Therapeutic Development of Isolated Liver Perfusion: Applicability to the Treatment of Hepatic Malignancy

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Purpose

To evaluate the effect of total isolated liver perfusion on hepatic circulation and the feasibility of a percutaneous approach in a pig model.

Materials and Methods

In twenty-five pigs undergoing total isolated liver perfusion (**Fig. 1**), the unilateral common femoral artery and the bilateral common femoral veins and the right jugular vein were exposed through a cut-down incision, and sheaths (8 Fr., 12 Fr., 9 Fr. and 9 Fr. each) were inserted into each of them. The thyrocervical artery was exposed, and a 5 Fr. cannula sheath was inserted to monitor blood pressure during the procedure. Arterial blood pressure were recorded before, and 0, 5, 10, 15, 20, 25, and 30 minutes after the start of perfusion. Catheters were placed in the proper hepatic artery and the inferior vena cava (IVC). The portal vein branch was punctured by a PTCD needle under ultrasonographic guidance, and a 12 Fr. sheath was inserted. Then, a balloon catheter was inserted into the portal vein trunk. We developed two kinds of balloon catheters, a first version (n=19) and a second version (n=6). They had specially designed side arms to allow high flow and to keep the pressure in the pump-system low during withdrawal and return of the blood through the catheter. After systemic heparinization (120U/kg), balloons were used to occlude the proper hepatic and the portal vein trunk and the infrahepatic and suprahepatic IVC. Blood was withdrawn from the portal vein with one rotary pump (120m*l*/min) and returned to the proper hepatic artery (120m*l*/min) with contrast medium or cisplatin (2.5mg/kg) through the balloon catheter with another rotary pump. To maintain blood pressure blood was withdrawn from the infrahepatic IVC with one rotary pump and returned to the jugular vein through the sheath with another rotary pump. Blood was withdrawn from the superior mesenteric vein and returned to the jugular vein through the sheath with a rotary pump. Perfusion was carried out for 30 min.

Results

The 19 pigs with the first version of the balloon catheter were hemodynamically unstable. It was impossible to assess the effect of the new isolated liver perfusion system. The remaining 6 pigs with the second version of

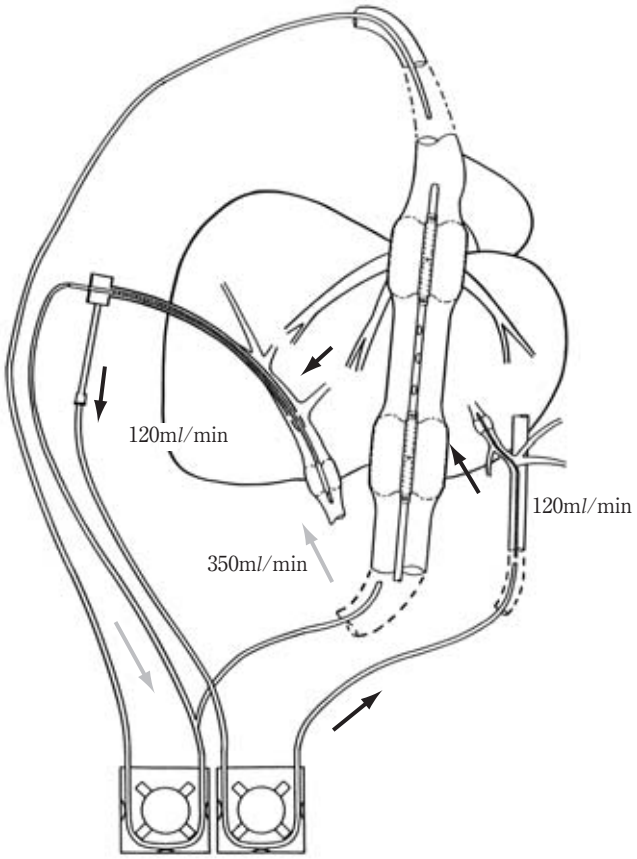

Fig. 1. Illustration of new isolated liver perfusion

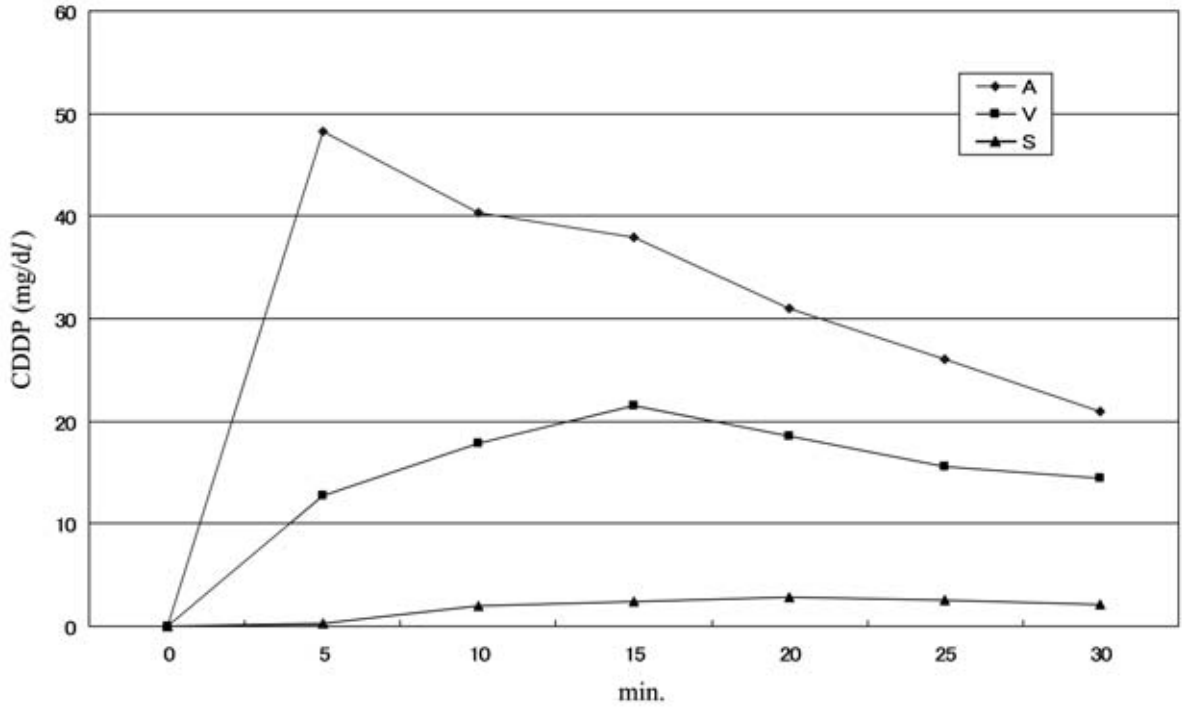

Fig. 2 Concentration of CDDP

the balloon catheter were hemodynamically stable. During complete occlusion of hepatic veins contrast medium was seen to drain in a reverse direction into the portal vein in 6 pigs. Collateral vessels could not be demonstrated. Concentrations of cisplatin in the hepatic artery, the portal vein, and the systemic circulation are shown in **Fig. 2**.

Conclusion

Total isolated perfusion accomplished by occlusion of the IVC and the portal vein in combination with aspiration applied in the portal circulation results in rapid and extensive arterioportal shunting without visualization of collateral vessels. This percutaneous approach is technically feasible, but its hemodynamic safety must be evaluated before clinical application.