

# A New Secured Technique for Suprahepatic Vena Caval Anastomosis in Porcine Liver Transplantation

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## ABSTRACT

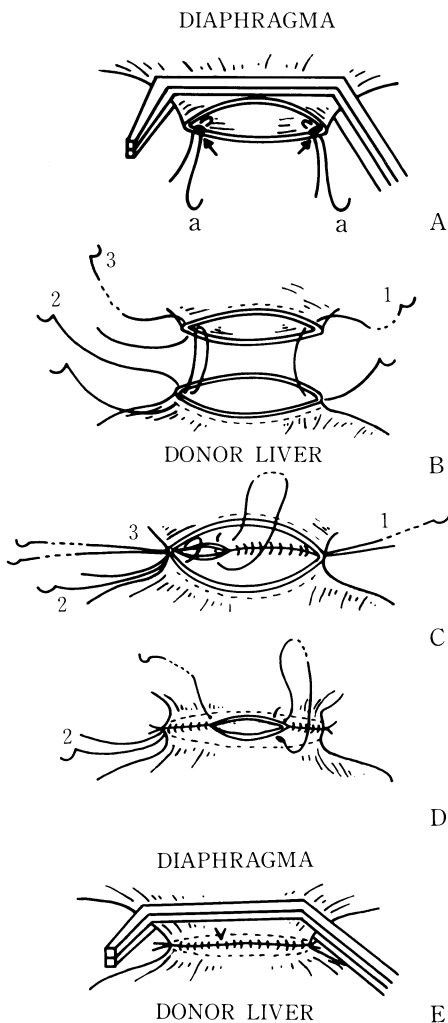
It is well recognized that hemorrhage or kinking of the suprahepatic vena caval anastomosis is the most fatal complication apparent within 24 hr after orthotopic liver transplantation in the pig. A secured technique for suprahepatic vena caval anastomosis is described in detail herein. Our technique include (1) the use of a diaphragmatic cuff, (2) the closure of phrenic vein orifices using transfixation technique, and (3) the application of "stay-suture" in the orifice of right phrenic vein. This technique has added significantly to the strength of the suprahepatic vena caval anastomosis, and there has been no experiences of uncontrollable bleeding and kinking of suprahepatic vena caval anastomosis in 48 porcine orthotopic transplants of the liver. In conclusion, we believe that this technique described herein is a simplified and secured method to avoid the hemorrhage and kinking of suprahepatic anastomosis in porcine liver transplantation.

Surgical techniques for experimental orthotopic liver transplantation in the pig have previously been described<sup>1,3)</sup>. Suprahepatic vena caval anastomosis is the most difficult and dangerous of the four vascular anastomoses, because the lengths of these vessels are very short and the suture line, particularly its posterior portion, cannot easily be reexposed for control of hemorrhage or kinking at any subsequent time. Therefore, a secured reconstruction of suprahepatic vena cava is critically important for successful orthotopic transplantation of the liver. Our preliminary experience with orthotopic liver transplantation in the pig has recently been reported<sup>2)</sup>. A secured technique with facilitates the performance of suprahepatic vena caval anastomosis is described in detail herein.

## TECHNIQUE

Donor hepatectomy is performed as previously described<sup>2)</sup>. By bench surgery, the excess supradiaphragmatic portion of the vena cava and the cuff of the diaphragmatic muscle are trimmed leaving a 2-3 mm cuff on the vena cava. Following completion of recipient hepatectomy and the hemodynamic state undergoing veno-venous bypass becomes steady, the prepared and cooled donor liver is placed in the orthotopic position. To help secure the liver in position and prevent subsequent kinking, the vein lengths are kept as short as possible.

Prior to anastomosis of suprahepatic vena cava, the orifices of both phrenic veins which cause uncontrollable hemorrhage after the revascularization are closed by transfixation technique using 6-0 Surgilene (Fig. 1A). The suprahepatic vena caval anastomosis is performed using a



**Fig. 1.** Schematic diagram of the surgical technique for suprahepatic vena caval anastomosis. The orifices of right and left phrenic veins (1) are closed by transfixation-suture using 6-0 Surgilene (Fig. 1A). A vascular suture is secured at each end of the suprahepatic vena cava. Note the "stay-suture" (designated as 2) that is placed in the orifice of right phrenic vein (Fig. 1B). The suprahepatic vena caval anastomosis is performed using a continuous over-and-over technique with 5-0 Surgilene. Anastomosis of the posterior layer (Fig. 1C). Anastomosis of the anterior layer (Fig. 1D). Completion of the suprahepatic vena caval anastomosis (Fig. 1E).

continuous over-and-over technique with 5-0 Surgilene. A vascular suture is secured at each end of the suprahepatic vena cava, and the "stay-suture" is also placed in the orifice of phrenic vein at which uncontrollable hemorrhage

is frequently seen (Fig. 1B). This stay-suture is tied just after the completion of suprahepatic vena caval anastomosis.

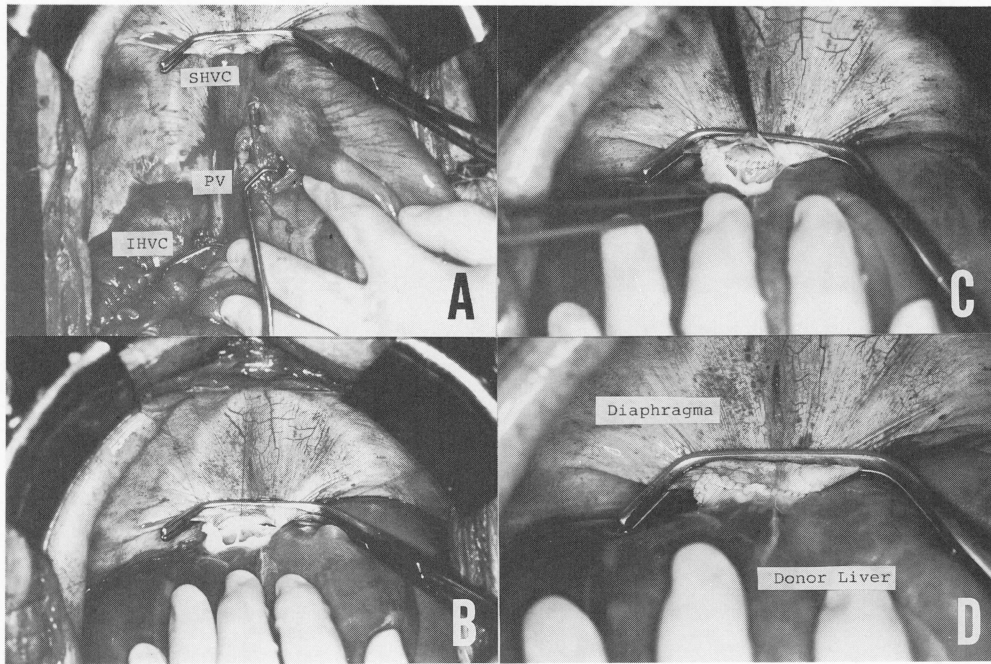
The posterior layer is anastomosed from with the lumen (Fig. 1C). Care is taken to include the diaphragmatic cuff in each bite. The anterior layer is then anastomosed as fine as possible to avoid the purse-stringing of the anastomosis (Fig. 1D). Prior to completing the anterior layer of this anastomosis, the lumen is filled with heparinized saline to exclude air bubbles. Vascular sutures of anterior and posterior layer is tied at the near midportion of the anterior sutureline (Fig. 1E). The surgical technique for suprahepatic vena caval anastomosis is shown photographically in Fig. 2. Following the completion of portal vein anastomosis, the vascular clamp of suprahepatic vena cava is removed, allowing perfusion of the liver with portal vein.

## RESULTS

We have performed 48 porcine orthotopic transplants of the liver using this technique described herein for the suprahepatic vena caval anastomosis. There have been no experiences of uncontrollable bleeding and/or kinking of suprahepatic vena caval anastomosis in this series. One pig is still alive 8 months after transplantation. We have been able to achieve operative survival rates in excess of 80% in our transplanted animals.

## DISCUSSION

To date, this technique has provided excellent suprahepatic vena caval anastomosis with no evidence of technical failures. Bleeding or kinking of the suprahepatic vena cava consisted the major limiting factor in immediate survival of hepatic transplanted pigs. Our technique for the suprahepatic vena caval anastomosis include (1) the use of a diaphragmatic cuff of donor liver, (2) the trimming of the recipient's vein as short as possible, (3) the closure of orifices of the phrenic veins using transfixation technique prior to this anastomosis, and (4) the application of "stay-suture" in the orifice of right phrenic vein. These modifications add significantly to the strength of the suprahepatic vena caval anastomosis, and facilitates the performance of the most difficult of the four vascular anastomoses. We believe that this technique described herein



**Fig. 2.** Photographs of the surgical technique for suprahepatic vena cava. Fig. 2A shows the status following recipient hepatectomy. SHVC., Suprahepatic vena cava; IHVC., Infrahepatic vena cava; PV., Portal vein. Anastomosis of the posterior layer (Fig. 2B). Anastomosis of the anterior layer (Fig. 2C). Completion of the suprahepatic vena caval anastomosis (Fig. 2D).

is easily performed and the secured method of choice for suprahepatic vena caval anastomosis in porcine liver transplantation.

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