align the inferior vena cavae (IVCs) of the donor and recipient and allows a direct end-to-end anastomosis. Because of the natural course of the left SVC lateral to the aortic arch, an unhindered connection between the donor's innominate vein and the recipient's left SVC can usually be best ensured behind the ascending aorta. Obstruction of this conduit behind the aorta can be avoided by using extra tissue on the aorta, allowing for mild ascending aortic bowing. Although donor cardiectomy including the entire pulmonary artery trunk and extra length of the inferior vena cava is desirable, it is not an absolute necessity, and the use of other donor organs, such as lungs and liver, need not be restricted. We have used a segment of descending donor aorta to reconstruct the central pulmonary artery system in a case in which only the main pulmonary artery (PA) was available. Leaving a large cuff

of systemic atrial tissue attached to the recipient's left-sided IVC further facilitates a connection free from tension, even if no extra length on the donor IVC is available.

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Techniques of inserting peritoneal dialysis catheters in neonates and infants undergoing open heart surgery

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Renal impairment in children undergoing open surgery is preferably managed by peritoneal dialysis. It is common practice to insert a peritoneal dialysis catheter (PDC) in neonates and infants at the end of open heart surgery.^{1,2} One of the authors (G.N.) has been placing PDCs intraoperatively in neonates and infants since 1988 if a high possibility of hemodynamic instability or renal compromise is anticipated postoperatively. We describe the intraoperative techniques used by the authors.

CLINICAL SUMMARY

The 3 procedures, according to their final position, are (1) indirect transperitoneal (ITP), (2) direct transperitoneal (DTP), and (3) transdiaphragmatic (TD). The first 2 procedures consist of opening the peritoneum under the rectus sheath through extraperitoneal fat at the lower end of the

sternotomy wound. The ITP technique (Figure 1, A) involves tunneling the PDC subcutaneously and bringing it out of the mediastinal wound and then passing it through the peritoneal opening in a suprahepatic position with a purse string around the opening.³

In the DTP procedure (Figure 1, B), an artery forceps is passed through the peritoneal opening made at the bottom of the surgical incision and brought out through the abdominal wall. The PDC is then retrieved with the artery forceps and placed in the abdominal cavity. The peritoneal opening is then closed.

In the TD procedure (Figure 1, C and Figure 2), the pericardium is incised vertically onto the diaphragmatic surface for 1 to 2 cm. At the apex of the incision, an opening is made into the peritoneum through the central tendon and a long length of the catheter is inserted (usually 25–30 cm of a 45-cm catheter) in the suprahepatic position. Then, the strong tissue of the central tendon and the diaphragmatic pericardium are sutured together with an absorbable suture 4-0 PDS II (Polydioxanone suture from Ethicon Inc, Somerville, NJ) forming an extraperitoneal tunnel. The PDC is then tunneled subcutaneously.

DISCUSSION

The ITP method has the advantage of minimizing hepatic or bowel injury by insertion of the catheter under direct vision and preventing omental herniation through the skin,

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FIGURE 1. A, Indirect transperitoneal route showing the course of the peritoneal dialysis catheter (PDC) through the skin into the sternal and peritoneal (suprahepatic) cavities. B, Direct transperitoneal route showing the course of the PDC directly into the peritoneal cavity with closed peritoneal opening from the sternal cavity. C, Transdiaphragmatic route showing the PDC placement through a diaphragmatic incision and creating a tunnel.

although it could still herniate into the mediastinum. However, care should be taken in placing the purse string. A loose stitch can allow dialysis fluid to leak into the mediastinum simulating active bleeding or even causing tamponade. A snug purse string can occlude the catheter, cause a kink, or necessitate surgical removal, which occurred in 3 patients in the authors' experience. In 1 child the herniated omentum formed a dense adherent mass in the pericardial cavity, complicating redo surgical dissection. Hemoperitoneum and its consequences (peritoneal inflammation, ileus, and adhesions) are potential problems. To avoid these complications, the authors have used the DTP technique since 1995.

The major advantage of the DTP technique is that it maintains the barrier between the pericardium and the peritoneum, preventing all the described complications. A 20%

incidence (6/30 patients) of omental herniation through the skin was noted by the authors from January to August 2007. Two patients (6.6%) had major fluid leaks from the exit site.

On the basis of these observations, we have modified the ITP technique since May 2008 to the currently used TD technique. The advantage of this procedure is a low incidence of omental herniation, because the tunnel makes a watertight compartment preventing fluid leakage and omental prolapse into the pericardium. In addition, we now use the Surmisil silicone dialysis catheters (Mepro, Saarbrücken, Germany), which are 10F, 45-cm uncuffed silicon catheters, as opposed to the large-bore Tenckhoff PDC (Quinton; Tyco Health Care Group, Mansfield, Mass). Advantages with this catheter are lower cost, smaller diameter, larger individual draining holes, and longer length of draining surface. This, when

FIGURE 2. Steps of the transdiaphragmatic placement of the peritoneal dialysis catheter.

totally inserted into the peritoneal cavity, would ensure that at least part of it would not be obstructed by the omentum.

Our experience in 30 newborns and infants in 2008 with this technique is encouraging. No omental herniation or fluid leak was observed in any of these patients. This technique works well for postcardiopulmonary bypass dialysis, but whether it can be used for long-term peritoneal dialysis is undetermined.

CONCLUSIONS

This is a preliminary report of the TD approach for PDC insertion, which evolved from long-term use of the ITP and

DTP techniques (20 years in total). We are prospectively following this up as our option for PDC insertion in pediatric patients postcardiotomy, but we believe that the last word in PDC insertion has yet to be written.

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