Surgical Management of Superior Vena Cava Obstruction Complicating Ventriculoatrial Shunts*

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Although it is generally agreed that the results of treatment of hydrocephalus by ventriculo venous shunting procedures are better than with earlier forms of management, a great variety of complications may occur.1-4, 6-9, 11, 15-19, 21 Complications produced by the child’s linear growth or by occlusion of the shunting tube are usually readily overcome by revision of the affected end of the shunting tube, but thromboembolism, indolent bacteremia and frank obstructions of the inflow channels of the heart present difficult problems. This study deals with the management of the last of these problems. We have now treated 6 children with partial or complete obstruction of the superior inflow channels of the heart. This group of patients comprise 7.7% of our present series of 65 children treated for infantile hydrocephalus by atrio-ventricular shunting during the past 5½ years.14

Case Report

Case No. 1. An 18-month-old girl had had a lumboperitoneal shunt performed elsewhere when she was 4 weeks old because of congenital communicating hydrocephalus. The complication of meningitis converted the hydrocephalus to a non-communicating type and after one revision of the lumboperitoneal shunt, a Holter valve was implanted elsewhere when the patient was 3 months old. Four months later this shunt became occluded at its cardiac end and she came under our care. It was impossible to replace the catheter by the usual route into the right heart. An attempt was then made to pass another catheter into the heart by using the opposite (left) internal jugular vein, but the catheter could not be advanced any farther than the junction of the innominate vein with the occluded superior vena cava. The catheter was left in a position just proximal to the point of venous obstruction; the venous pressure was noted to be 14 to 15 cm. in the innominate vein. The shunt functioned for only 1 month; there was progression of the hydrocephalus and the child died without further surgical therapy.

Case No. 2. A Pudenz-Heyer valve was utilized in a 3-year-old girl because of aqueduct stenosis at the age of 1 month. Revision of the ventricular end was necessitated by a fibrin plug in the distal tip of the ventricular catheter and re-expansion of the cerebral mantle which occluded the lateral perforations of the catheter. Her course was further complicated by recurrent staphylococcus albus septicemia with remission under antibiotic therapy. Her mental and physical development continued normally.

Second Revision. When the cardiac end of the system stopped functioning, efforts to pass a new shunting tube into the heart were unsuccessful because of partial occlusion of the superior vena cava andazygos vein at its junction with the right atrium. On one occasion x-ray showed the shunting tube had passed into the left subclavian vein (Fig. 1). Because of our experience with Case No. 1, it was decided to place the shunt in this patient’s right atrium by direct transthoracic approach. This was accomplished by a right submammary incision entering the chest near the sternum between the 4th and 3rd ribs. The thrombosis of the superior vena cava andazygos veins were confirmed by gentle palpation after the pericardium had been opened. The valve tip was then relocated in the mid atrium after placing it in the heart by using the auricular appendage (Fig. 2). Access to the chest from above was via the root of the neck beneath the clavicle andmanubrium.

The postoperative course was complicated by a small amount of right upper lobe atelectasis readily restored to function by intubation and reinfation of the right lung. Electrocardiographic monitoring and follow-up EKGs were normal. The child was discharged on the 9th postoperative day.

Third Revision. Forty days later the valve again stopped functioning because of a fibrin plug in the tip of the Pudenz-Heyer valve. Replacement at this time was via the midportion of the right atrial wall proper. The tubing was directed upward in the mediastinum at the superior end of the pericardial incision (Fig. 3). A small sleeve cut from a number 8 French catheter was utilized to insure that the shunting tube did not withdraw from the atrium.

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Postoperative Course. The child again did well, had no postoperative complications and was discharged home on the 8th postoperative day. She suffered another systemic episode of infection 2 months postoperatively which responded to antibiotic therapy.

Fourth Revision. Eight months after this 2nd procedure her eyes became swollen, she became anorexic, lethargic, weak and ataxic in the legs and revision of the cardiac end was necessary. The cause of the malfunction at this time was occlusion by proliferation of the scar and endocardial tissue surrounding the tube within the right atrium. For this reason another modification was made in the placement of the shunting tube. The tube was inserted at a right angle to the atrial wall and no fixation sutures were used to align the tube with the wall of the atrium (Fig. 4). It was believed that the end of the tube would now be more free within the atrium and therefore perhaps less likely to be occluded by regrowth of scar tissue. The new shunting tube was united to the proximal end of the old shunting tube within the chest, thus avoiding reopening the neck incision.

Postoperative course again was uneventful and the child returned home on the 5th postoperative day.

Fifth Revision. Eight months later, the cardiac end of the tubing again became non-functional. Revision showed a very large pedunculated thrombus within the right atrium surrounding the cardiac tip of the catheter (Fig. 5). The spinal fluid draining from the catheter was clear. We believed it unsatisfactory to replace the tube in the right atrium immediately after removal of a thrombus and accordingly placed it in the left

Fig. 1. Shunting tube passing out innominate vein to the left subclavian vein because of obstruction of superior vena cava by multiple thrombi.

Fig. 2. Placement of cardiac segment of shunt in the right atrium by utilizing the auricular appendage.