A Lengthening Procedure for Ventriculo-Atrial Shunts

Technical Note

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In most pediatric hospitals, revisions of ventriculo-atrial shunts present a recurring and an increasing problem. Obstructions of the ventricular catheter are easily overcome, but when the continued growth of the child alters the position of the lower end of the shunt, difficulties occur. Much time can be spent in operations designed to keep the lower end of the tube close to the junction of the superior vena cava and the right atrium. These revisions are associated with a morbidity and mortality directly proportional to the amount of manipulation necessary during this and previous revisions.

A warning that the lower end of the shunt is moving to an unsatisfactory position can usually be obtained from radiographs of the chest. These are repeated at intervals that will depend upon the rate of skeletal growth. Most surgeons prefer to lengthen the shunt before growth of the child brings the lower end into a position that predisposes obstruction. It is generally conceded that revision becomes necessary when radiographs centered on the 6th thoracic vertebra show that the tip of the cardiac catheter has reached the level of the 4th thoracic vertebra.

The lengthening operations have often been time-consuming, and not infrequently a new route for the catheter must be devised. During the past year, we have investigated the degree of obstruction and adhesion to which the tube is subject within the venous channels, and have devised methods to overcome the difficulties identified. A procedure has now been perfected which achieves a great reduction in time and manipulation.

Fig. 1A. Left: Venogram showing the internal jugular vein to be patent as high as the common facial vein. Right: Venogram showing that the lower end of the internal jugular vein is patent. The cardiac catheter lies at the junction of the right and left innominate veins.
During the initial period, venography of the superior vena cava was carried out on all children needing shunt lengthening. In some infants, the venous channels were patent as high up as the point of entry of the cardiac catheter into the internal jugular vein. In others, varying degrees of occlusion had taken place which in some extended down to the superior vena cava (Fig. 1). It was also possible to demonstrate varying degrees of adhesion between the tube and the walls of the veins.

These findings suggested that the difficulties encountered were due to contraction of the walls of the veins around the tube and adhesions between the tube and the vein walls. Although the catheter could be pulled up and away from these adhesions, it did not possess enough rigidity to be pushed down to a lower level. This difficulty was overcome by introducing a stiffening device into the cardiac tube.

The method employs a radio-opaque guide wire which is introduced down the cardiac end of the shunt. The guide wire not only strengthens the tube during subsequent manipulations but allows easy recognition of the lower end in radiographs or with an image intensifier. The procedure can be carried out more easily with the Pudenz-Heyer

Fig. 1B. Left: The right innominate vein is occluded. Right: The right internal jugular vein is occluded, and a considerable collateral circulation is demonstrated.

Fig. 2. Drawing showing the pump placed as high as possible in the parietal region.
Lengthening of Ventriculo-Atrial Shunts

Fig. 3. The distance between the existing position of the tip of the tube (a) and the desired position (b) is measured on the chest radiograph.

Fig. 4. Steps in the lengthening procedure. A. Tube is detached from pump. B. Tube is pulled down and out through cervical incision. C. Wire guide is threaded down the tube to the lower end. D. Tube is lowered to within the cardiac shadow. E. A 20-cm length of tubing is attached at the cardiac end and marked with a silk ligature at x mm from its midpoint. F. Tube is drawn up along a cannula to the parietal incision.
apparatus than the Holter system, but the general principles are applicable to both types.

At the initial operation, no connecting pieces are placed in the cardiac end of the shunt, and maximum length of the cardiac tube is obtained by placing the craniotomy burr hole and the pump as high as possible in the parietal region. This provides a long length of tube for subsequent downward displacement along the veins without the obstructing influence of connecting pieces (Fig. 2).

The subsequent lengthening operation is an elective procedure. Records are kept of the child's height, and radiographs of the chest are obtained at intervals determined by the rate of growth. When the cardiac end of the tube is seen to be clearly within the superior vena cava, the child is brought into the hospital for revision of the shunt. The additional length of tubing required is calculated from a preoperative radiograph (Fig. 3) as the distance (x mm) between the existing position (a) and desired position (b) of the tube tip.

At this revision, the cardiac tube is detached from the pump. A second incision is made in the neck at the point where the tube was previously introduced into the common facial vein. Any ties around the tube at this point are carefully divided without damaging the tube. That portion lying above the cervical incision is then pulled down and out through the wound (Fig. 4 A and B).

A Seldinger wire guide (No. 160) lubricated with a drop of sterile paraffin is then threaded down the tube until it reaches the lower end (Fig. 4 C). This may require radiographic confirmation in the case of the Holter tube. With the wire supporting the tube, it is first pulled up a few centimeters and then pushed downward a few centimeters farther than the estimated distance obtained from the previous radiographs (x mm). Radiographs are then taken so that the position of the lower end is clearly seen; the guide wire should be well within the cardiac shadow (Fig. 4 D).

The guide wire is then withdrawn and a 20-cm length of tube connected to the cardiac end through a stainless steel connector. A marking ligature of silk is placed upon this additional tube x mm from the midpoint of the connecting piece (Fig. 4 E). This additional tube is then drawn up along a cannula to the parietal incision (Fig. 4 F). The tube is divided at the level of the silk marker and then connected to the pump and tied firmly in position. The incisions are then closed (Fig. 5). A radiograph of the chest is obtained on the following day.

Since this routine has been developed, it has not been necessary to introduce the cardiac catheter by any other route, and the saving of time has been considerable; the lengthening procedure can now be completed in 30 minutes.

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