VENTRICULOVENOUS ANASTOMOSIS IN OBSTRUCTIVE AND ACQUIRED COMMUNICATING HYDROCEPHALUS*

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Following successes in controlling increasing intracranial pressure of infantile congenital hydrocephalus by shunting the cerebrospinal fluid from the lateral cerebral ventricle into the internal jugular vein, superior vena cava, and right cardiac auricular system, other types of cases presented themselves in which indications for palliative shunting procedures seemed to be present. Both the Holter valve, as advocated by Nulsen and Spitz, and the Heyer valve, introduced by Pudenz et al., were utilized as the conveying system in the cases in this series.

Falling into several categories, these cases may be broadly classified as inoperable lesions of the central nervous system producing progressive hydrocephalus. More specifically they may be divided into neoplastic or other lesions producing an obstruction in the flow of cerebrospinal fluid, and inflammatory or irritative lesions interfering with absorption of cerebrospinal fluid.

The use of a palliative shunting procedure in any given case brings up several serious considerations, an important one being that the patient be given a chance for a period of useful survival, without serious neurological deficit, as the direct result of the procedure. If the lesion can be successfully attacked directly, palliative shunting is contraindicated.

Certainly, if radiological and clinical evidence indicate the possibility of an obstructive lesion below the aqueduct of Sylvius exploration of the posterior fossa is indicated, since a number of operable lesions may occur in this location. Upon determination, however, that the lesion is inoperable, then a Torkildsen by-pass procedure or ventriculovenous anastomosis may be performed, whichever seems indicated by the type and location of the lesion. For example, a lesion such as adhesive arachnoiditis preventing proper circulation of cerebrospinal fluid into the absorbing area may be handled best by the latter procedure.

On the other hand, the fact must be faced that at the present time pontine and midbrain neoplasms are inoperable directly and the occasional relative obstructive atresia of the aqueduct of Sylvius does not lend itself to dilatation. If radiological and clinical evidence is conclusively in favor of an inoperable lesion between the fourth ventricle and posterior part of the third ventricle, palliative ventriculovenous anastomosis may be performed. Roentgen-ray therapy should then be given to the suspected neoplastic lesions without knowledge of the cell type in hopes that response to roentgen irradiation will occur.

Direct operative approach to neoplasms in the posterior part of the third ventricle carries a high mortality and a large degree of neurological deficit in many of the surgical survivors. Only certain of the lesions in this area are pinealomas, which may respond to roentgen ray. It would seem that palliative shunting instead of subtemporal decompression, as has been advocated, would be more effective for the control of increased intracranial pressure. It is hoped that the response of those patients with pinealomas sensitive to roentgen ray will justify the decision. It must be remembered, however, that

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colloid cysts and other removable lesions do occur in the third ventricle, and direct exploration of this area may be indicated on suspicion of this type of lesion.

COMPARISON OF SYSTEMS AND GENERAL TECHNIQUES

We have had experience with both types of valves and in our opinion both systems are effective and must be considered important adjuncts to the treatment of progressive hydrocephalus. The Heyer valve has a more simple construction and is less bulky. Its installation, in adults at least, is a more simple procedure—yet the mere relative bulkiness of the Holter valve is secondary to a compressible pump. In infants with open fontanelles the clinical signs of a functioning system usually are obvious. However, in adults, the state of function of the system may at times be in doubt. In this situation, the presence of the pump is advantageous.

The location of a valve at the peripheral end of the system is said to be important in preventing possible reflux of blood. The peripheral end of the system should rest at least within the superior vena cava and if it be placed within the right cardiac auricle should not impinge upon the tricuspid valve or be allowed to enter the right cardiac ventricle. We feel that irritation of the tricuspid valve may predispose to its incompetence and to the development of thrombi which might become the seat of infection at the time of a transient bacteremia. It is possible that if the tip of a system becomes adherent to the tricuspid valve or to the auricular wall, thrombotic tissue might occlude the area of emergence of the cerebrospinal fluid and result in obstruction of the system. The entrance of the tip of a system into the right cardiac ventricle with periodic rises in systolic pressure could result in intermittent obstruction to the outflow of cerebrospinal fluid. Since the location of the cardiac end of the system seems so important, it has been our practice to measure on a previously made roentgenogram of the chest the distance between the lower border of the clavicle and the center of the right cardiac auricle. The tip of the system is inserted to the desired depth, adding the distance from the point of insertion in the jugular vein to the lower clavicular border. Filling the system with radiopaque substance, another roentgenogram is made on the operating table to then determine the exact location of the tip of the system. Since the junction of the superior vena cava and right auricle is seen readily and the tricuspid valve lies to the left of the vertebral column, it is felt that the tip of the system should be positioned to the right of the vertebral column. The inclusion of a radiopaque substance in the tip should simplify positioning. Recently Robertson et al. have suggested a unique technique for determining the location of the tip in relation to either the auricle or ventricle. Filling the system with normal saline and connecting it to a metallic tipped syringe, this combination is used as a lead of an electrocardiogram.

Thus as the end of the system passes into the auricle, a characteristic diphasic or inverted p complex is recorded which is modified and becomes upright as the tip approaches the region of the tricuspid valve.

In using the internal jugular vein as a conducting tube for the peripheral end of a system, it would seem wise not to interrupt the flow of venous blood by ligating the vein centrally. In older patients the system may be introduced through the common facial vein and a ligature passed around the cuff of this vein.

The central end of a system presents few problems not solved by careful installation and fixation of the cerebral ventricular tube. Consideration should be given to the fact that decrease in ventricular size will take place as intracranial pressure is lowered and allowance must be made so that the cannular tip will not impinge upon the septum pellucidum or ventricular wall. Bits of brain tissue upon occasion have blocked the central end of the system. Careful irrigation before final connection should minimize the possibility of this complication.

In older patients the stretch or migration upward from the heart of a system caused by growth of the individual is not the important