Positive Pressure Ventriculography for Stereotaxic Surgery

Technical Note

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We have developed a simplified method for visualizing the entire third ventricle, and hence the anterior and posterior commissures. This technique allows the operator to perform all necessary procedures for a stereotaxic operation in a single stage and without any change in the supine position of the patient. It is reliable, easily performed, and produces minimal discomfort to the patient. The stereotaxic landmarks of the third ventricle have been consistently visualized without difficulty.

Method

On the day preceding the stereotaxic procedure a coronal burr hole is made under local anesthesia 2 cm lateral to the midsagittal plane and overlying the coronal suture. On the day of operation, the patient is secured in the Riechert Stereotactic Apparatus in the supine position. Through the burr hole, an 18-gauge ventricular catheter (Fig. 1) is introduced into the anterior horn in the direction of the foramen of Monro. The coordinates for this placement are the inner canthus of the eye and a point 1 cm anterior to the external auditory meatus. After the stylet is withdrawn and the flow of ventricular fluid ceases, 5 cc of air are introduced and the ventricular fluid is again allowed to flow until it ceases. The process is repeated until only air returns. At this time, both anterior horns have been filled with air to the level of the foramen of Monro (Fig. 2) and the intraventricular pressure is essentially unchanged.

A three-way stopcock is attached to the ventricular catheter and connected by a short, sterile, rubber tube to a mercury manometer (Fig. 3). Ten cubic centimeters of air are then introduced in 10 to 20 seconds. By manipulation of the stopcock, the ventricular pressure may be read (usually 10 to 12 mm Hg). Without losing this pressure, an additional 10 cc of air are introduced, and the pressure is again noted (usually 20 to 25 mm). A final 5 cc of air will usually bring the intraventricular pressure to 30 mm. The stopcock is closed to maintain the induced pressure, and Polaroid as well as conventional x-rays are exposed in the anteroposterior and lateral projections (Fig. 4).

The Polaroid films are interpreted while awaiting the conventional films. If the...
commissures are satisfactorily visualized, the pressure in the system is slowly released, thus returning the intraventricular pressure to atmospheric. The ventricular catheter is then removed. The total time during which the intraventricular pressure is elevated usually does not exceed 2 minutes. Calculations for placement of the stereotaxic probe are then made on conventional x-ray films, and the probe is inserted through the coronal burr hole for completion of the desired procedure.

Results

We have performed positive-pressure ventriculography in 45 patients including 7 children. Four patients experienced mild nausea without vomiting; this symptom disappeared after release of the pressure in the ventricular system. Twenty-one patients complained of mild headache, which also abated as soon as the pressure was released. Initially in our series, pressures up to 50 mm Hg were induced in adult patients. In these, headaches were moderate to severe, but no significant vital sign changes were detected. No complications have resulted from this procedure.

An intraventricular pressure of 30 mm Hg is, with rare exceptions, sufficient to displace the fluid from the third ventricle posteriorly through the aqueduct of Sylvius and thereby visualize the entire third ventricle as well as both commissures simultaneously. In children a pressure exceeding 15 mm Hg has seldom been required to demonstrate the third ventricle. This is usually obtained with approximately 15 cc of air.

When pressures above 30 mm Hg were employed, air was frequently visualized over the frontal cortex and in the basilar and interpeduncular cisterns, as well as in the aqueduct of Sylvius and fourth ventricle. Most of this subarachnoid air apparently escaped from the foramina of Luschka and Magendie, although some may have also escaped from around the ventricular catheter. The discomfort associated with the presence of this subarachnoid air appears no greater than that associated with conventional pneumoencephalography.

Discussion

The use of intracranial reference points, as suggested by Spiegel, et al., in 1947 and further elaborated by Wycis, et al., in 1949 is now a well-established prerequisite for accurately determining target placement during stereotaxic procedures. Structural landmarks of the third ventricle, namely, both the anterior and posterior commissures, are used by the majority of authors. Simultaneous vi-

Fig. 3. Three-way stopcocks and rubber hose connecting the ventricular catheter to the mercury manometer. A 10-cc syringe is attached to the upper stopcock. Lower stopcock serves only as a connector.
FIG. 4. Lateral view of the third ventricle following introduction of 25 cc of air. A pressure of 30 mm Hg is present in the system. The anterior and posterior commissures and aqueduct of Sylvius are well demonstrated. “S” is a reference point from the Riechert frame.

Visualization of these commissures and use of the intercommissural line was recommended by Talairach.3,26 This may usually be performed by pneumoencephalography, but when inadequate filling of the third ventricle occurs, positive contrast ventriculography is generally employed using Pantopaque as recommended by Bull.3 Though safe, these procedures have certain disadvantages which our method circumvents.

The technique of positive pressure ventriculography allows the patient to remain supine throughout the process of demonstrating the reference points and completion of the desired stereotaxic procedure, thereby avoiding any change in position. Also, it consistently allows the simultaneous visualization of all the structural components of the third ventricle, avoids the introduction of any synthetic materials into the ventricular system, and allows the entire stereotaxic procedure to be performed in a single stage, thereby saving considerable operating time for the surgeon and discomfort for the patient. The total time required (following positioning of the patient in the frame) until the conventional x-rays are available is usually about 20 minutes. Although we prefer to make the coronal burr hole on the day before the stereotaxic procedure, this could be done just after the patient is secured in the stereotaxic apparatus.

Clark, et al.,4 have recently reported a method of performing ventriculography with the patient in the supine position by connecting the lumbar subarachnoid space to the intraventricular space through an external tube with an interposed graduated cylinder containing air and sterile saline. By lowering or raising the cylinder, a fluid-air interface is lowered or raised in the lateral and third ventricles. This method does allow a single positioning of the patient throughout the stereotaxic procedure, but requires a lumbar puncture and an indwelling polyethylene catheter in the lumbar subarachnoid space. Positive-pressure ventriculography obviates the necessity of the additional opening into the subarachnoid space.

One possible disadvantage of our procedure is significant distortion of the width of the third ventricle in the anteroposterior
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x-ray projection due to pressure. Echoencephalographic analysis of the alteration in width of the third ventricle while using this technique indicates that, with pressures up to 30 mm Hg, the width of the third ventricle is expanded an average of 0.2 mm (range 0.0 to 0.5 mm), while with pressures of 50 mm Hg, the width is increased an average of 1.0 mm (range 0.3 mm to 1.5 mm). Since the technique usually requires only 30 mm Hg pressure, we have concluded that no significant distortion occurs with this method.

This procedure has not been used in the presence of increased intracranial pressure, a situation which should be easily recognized following removal of the stylet from the ventricular catheter. We have restricted its use to those patients being treated for involuntary tremor not associated with a space-occupying lesion.

Summary

We have described positive-pressure ventriculography, a safe, simplified technique for simultaneously demonstrating the structural landmarks of the third ventricle in supine patients undergoing stereotaxic surgical procedures. No positional change is required for performance of the stereotaxic surgery. The technique is reliable, easily performed, and produces minimal discomfort to the patient. No complications have occurred. The side effects of mild headache and nausea without vomiting have terminated with release of the induced intraventricular pressure.

References


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