Experiences with the technique and complications of meglumine iothalamate (Conray) ventriculography

STEPHEN E. NATelson, MARTIN P. SAYERS, AND WILLIAM E. HUNt

From the Division of Neurological Surgery, Ohio State University College of Medicine, and the Section of Neurological Surgery, Columbus Children's Hospital, Columbus, Ohio, U.S.A.

SUMMARY The development of contrast ventriculography is outlined and an experience with 40 meglumine iothalamate ventriculograms in 37 patients is described. The details of the procedure, hazards, value, and indications are discussed.

Ventriculography was introduced as a neurosurgical diagnostic procedure in 1918 by Walter Dandy. Over the years it has proved to be a very useful technique indeed, especially in children (due to the thinness of the skull) and especially since the coronal route has become favoured in many neurosurgical centres.

At first air was used as a negative contrast medium and other gases have also been used. Sometimes large volumes of air must be introduced to obtain adequate pictures, altering the intraventricular pressures and irritating the ependyma, occasionally with disastrous results, and the patient has to be placed in various positions in order to demonstrate the entire ventricular system. In spite of this, there is sometimes difficulty in demonstrating the 3rd ventricle, aqueduct, and 4th ventricle adequately by this method.

A safe method of positive contrast ventriculography has long been sought. In 1928 Balado used Lipiodol in humans, and in 1935 Lysholm mentioned that N. Antoni used Thorotrast in 1932. These substances have serious limitations because of their toxicity.

Iophendylate (Myodil, Pantopaque) ventriculography was introduced by Bull in 1946. This proved to be a relatively non-toxic substance and is rather useful in demonstrating the anterior 3rd ventricle. It has the disadvantage of being heavier than, and insoluble in, spinal fluid, thus showing only that part of the ventricular system inferior to the Pantopaque. It has the further disadvantage of being essentially unabsorbed from the ventricular system, especially in cases of blockage of the aqueduct.

Pantopaque ventriculography requires the services of a radiologist with a fluoroscopic screen or image amplification unit, and spot films must be taken during manipulation of the head.

To remedy some of these objections, Portera-Sanchez, Bravo, and Parera (1964) introduced the use of emulsified Pantopaque. In many neurosurgical units this did not prove to be a satisfactory method of ventriculography because of the vigorous shaking required, the short period of time in which the substance remained emulsified in the ventricles, and the speed with which the pictures had to be taken; nonetheless, still leaving the Pantopaque permanently, in many cases, in the ventricular system. In our hands, a febrile reaction is common with this technique.

Heimburger, Kalsbeck, Campbell, and Healey (1966) published their work with meglumine iothalamate 60% as a water soluble ventriculographic medium. They first experimented with animals and subsequently expanded their studies to humans. The pictures obtained with this medium were quite good. Animal experimentation has shown that injections of this substance into the cisterna magna can cause convulsions or even death. Reports began to circulate among neurosurgeons that meglumine iothalamate ventriculography was not without its hazards in humans. However, other investigators reported that they had virtually no complications (Handa and Handa, 1969).

Feeling that safe, water soluble, positive con-

<sup>1</sup>Conray-60, Mallinckrodt Pharmaceuticals, St. Louis, Missouri 63160, U.S.A.
Contrast ventriculography would be extremely useful, we decided to familiarize ourselves with the techniques and hazards involved.

**TECHNIQUE**

Our method of ventriculography is very simple. In the sedated patient, after suitable preparation in the radiology department, an 18 gauge spinal needle is introduced through the bone near the right coronal suture into the right lateral ventricle. Passage of the needle is facilitated in older children and adults by use of a hand twist drill. Pressure is measured, a sample of ventricular fluid is taken, 2-5 ml. of air introduced, and a single AP spot film obtained to verify satisfactory position of the needle. If a fluoroscopist is available, his services can be utilized instead. From 4 to 6 ml. meglumine iothalamate diluted in an equal amount of spinal fluid have been injected, based on our estimation of the size of the ventricles. The greatest concentration employed was 6 ml. of contrast medium and 4 ml. of spinal fluid. On one occasion saline was substituted for spinal fluid without incident. The fluoroscopist positions the patient in readiness for an AP view and the mixture is injected by moderately rapid push into the lateral ventricle. The stilette is replaced or the stopcock turned and the operator leaves the room while in rapid succession AP, Towne, and left lateral films are taken. These films are processed rapidly and examined immediately. On occasion, films are repeated or different positions used to fill the desired part of the ventricular system. The solution is slightly hyperbaric, and if the injection is made with the patient prone, visualization of the anterior 3rd ventricle is favoured. This is, however, rarely necessary. After satisfactory visualization, the needle is opened and ventricular fluid withdrawn or allowed to drip an approximately equal amount to that which was introduced. The stilette is then replaced and 20 to 30 minutes elapse before withdrawing the needle. Most of the contrast medium is dissipated during this period of time. This precaution avoids allowing large concentrations of contrast medium to leak up the needle track onto the surface of the cortex, as occurred in our first case. A cotton ball with collodion is applied to the needle puncture site on the scalp. The patient is then returned to the ward.

**RESULTS AND COMPLICATIONS**

There have been no deaths in 37 patients in our series. Three patients had meglumine iothalamate ventriculograms on two separate occasions. The first later succumbed to the glioblastoma for which he was being treated. There was no evidence of ependymitis or other ill effect from the contrast medium. The other two are alive and apparently have not suffered ill effects from ventriculography.

Four patients have had seizures. In one of these the contrast medium was injected into a subarachnoid 'puddle' by mistake and in another into the interhemispheric fissure. These cases taught us to check the needle position by radiography or fluoroscopy with air. One patient had agenesis of the corpus callosum and the effect was similar, probably because the meglumine iothalamate was not confined to an ependymalined cavity. The fourth patient was our first, mentioned above, in whom contrast medium escaped along the needle track to the cerebral cortex. He taught us to remove the contrast medium and to wait 20 minutes before withdrawing the needle.

Three patients, infants, had extensor spasms of the extremities which could be precipitated by sensory stimuli. In these patients contrast medium in large quantities passed out of the foramina of Magendie and Luschka and provided a clear basal cisternogram and cervical myelogram. Several patients with inadvertent cervical myelograms, however, did not experience these spasms. Less contrast medium and less force of injection should have been used in these early cases.

These complications usually did not occur immediately but often were delayed two and a half to three hours after the procedure. They did not respond to vigorous therapy with diphenylhydantoin and phenobarbitone. They did respond instantaneously to intravenous diazepam, which occasionally had to be repeated. By six hours after the procedure, all patients had returned to normal. 'Prophylactic' diazepam in two of these cases, given after the x-ray films were examined, did not prevent the occurrence of the abnormal discharges.

One of us (W. E. H.), investigating the use of meglumine iothalamate as a myelographic medium for lumbar disc disease, reported no adverse effects until the contrast medium inadvertently came in contact with the conus medullaris. Extensor spasms of only the lower extremities occurred, which responded at once to intravenous diazepam.

The amount of meglumine iothalamate employed was not sufficient to give adequate definition of massively dilated ventricles in two cases.
Excessive doses of water soluble positive contrast media, injected into the cisterna magna or ventricle, were lethal (Heimburger et al. 1966). They reported a hydrocephalic child who died after receiving 10 ml. meglumine iothalamate intraventricularly.

Figures 1 to 7 demonstrate examples of meglumine iothalamate ventriculograms. The table lists all patients in our series. It should be noted that we did not consider a history of seizures a contraindication to this procedure; and, in fact, meglumine iothalamate induced seizures were not a special problem in this group.

**DISCUSSION**

The advantages of meglumine iothalamate ventriculography are:

1. It is possible to perform this study rapidly.
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2. Visualization of the entire ventricular system, if it is not massively dilated, is better than with any other contrast agent in common use.

3. The adverse effects of increased intracranial pressure ascribed to gas ventriculography have not been noted. It should be possible to operate on the patient without delay.

The disadvantages are:

1. The possibility of seizures or spasms.
2. Inability to visualize the area of obstruction with massive ventricular dilatation either because it is obscured by other structures filled with contrast medium or because the contrast is insufficient.
3. Inability to visualize the subarachnoid space.

The first of these objections may be minimized by a careful and judicious technique. Any patient subjected to any type of ventriculography should have close observation for several hours thereafter.

In answer to the second, one may still go on to Pantopaque ventriculography at once in such a case. If visualization of the subarachnoid space is critical, meglumine iothalamate ventriculography is not the procedure of choice.

Most of the complications occurred in the first half of our series and can be ascribed to inexperience. Careful technique combined with the knowledge that it is contact of meglumine iothalamate with pial surfaces that causes the complications affords a sufficient margin of safety for routine clinical use. One might be reluctant to use this contrast medium if there were a known porencephaly, surgical or congenital, or an agenesis of the corpus callosum. Blockages in the ventricular system allow
meglumine iothalamate to be used with even greater confidence.

Injectable diazepam should always be available for treatment of seizures or spasms; and if meglumine iothalamate ventriculography is considered indispensable in a patient with open ventricles, early treatment of these complications should they occur will almost certainly be effective in avoiding sequelae. Considering the experience of Heimburger et al. (1966), greater volumes or higher concentrations of this contrast medium than those recommended here cannot be employed without considerable hazard.

We feel that this method is an extremely promising one and deserves attention by other neurosurgeons.

REFERENCES


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