Visualization of Small Extracanalicular Neurilemomas

By Metrizamide Cisternographic Enhancement

Arthur E. Rosenbaum, MD; Burton P. Drayer, MD; Philip J. Dubois, MD; F. Owen Black, MD

- Metrizamide (Amipaque) computerized tomography cisternography (CTC) provides a rapid, simple, and accurate radiographic modality of intrathecal enhancement for detecting and morphologically characterizing cerebellopontine (CP) angle masses. The technique is of especial value in masses <1.5 cm that are not detected on intravenously enhanced computerized tomography. Metrizamide CTC was used in six patients with no CP angle mass and in four patients with acoustic neurilemomas. (Arch Otolaryngol 104:239-243, 1978)

The radiological query of suspected cerebellopontine (CP) angle masses includes conventional and often special diagnostic studies. Specific types of radiological investigations are initially based on clinical estimates of the breadth of tumor boundaries. Conventional skull roentgenograms and/or tomograms usually affirm the intracanalicular component of expanding eighth-nerve masses. However, it is the extracanalicular portion of acoustic neurilemomas that determines the surgical approach. Positive contrast cisternography with iohendylate injection (Pantomap), pneumoencephalography, and/or angiography are usually employed in this sequence to outline the extracanalicular extension of eighth-nerve tumors. Larger extracanalicular neurilemomas have been shown to be vascular by also performing selective external carotid arteriography.

Cranial computerized tomography (CT), especially following intravenous enhancement, provides a relatively safe and reliable modality for demonstrating the extracanalicular

<table>
<thead>
<tr>
<th>Case</th>
<th>History</th>
<th>Cranial Nerve Palsy or Paralysis</th>
<th>Auditory and Vestibular Testing or Patterns</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>R Bell's hearing loss; tinnitus</td>
<td>R VIII, VII</td>
<td>Retrolabyrinthine</td>
</tr>
<tr>
<td>2</td>
<td>R hearing loss; tinnitus</td>
<td>R VIII</td>
<td>Retrolabyrinthine</td>
</tr>
<tr>
<td>3</td>
<td>R trigeminal neuralgia; hearing loss; tinnitus</td>
<td>R V, VII, VIII, IX, X</td>
<td>Retrolabyrinthine</td>
</tr>
<tr>
<td>4</td>
<td>L trigeminal neuralgia</td>
<td>L VII, V</td>
<td>Retrolabyrinthine</td>
</tr>
<tr>
<td>5</td>
<td>L hemifacial spasm</td>
<td>L VII</td>
<td>Normal</td>
</tr>
<tr>
<td>6</td>
<td>L Bell's palsy; L synkinesia</td>
<td>L VII</td>
<td>Bilateral peripheral labyrinthine</td>
</tr>
<tr>
<td>7</td>
<td>L trigeminal neuralgia</td>
<td>L V</td>
<td>Normal cochlear; vestibular tests not performed</td>
</tr>
<tr>
<td>8</td>
<td>L trigeminal neuralgia</td>
<td>L V</td>
<td>Retrolabyrinthine</td>
</tr>
<tr>
<td>9</td>
<td>L hemifacial spasm; L trigeminal neuralgia</td>
<td>L V, VII</td>
<td>Bilateral retrolabyrinthine</td>
</tr>
<tr>
<td>10</td>
<td>R Bell's palsy; R hemifacial spasm; R hearing loss and tinnitus</td>
<td>R VII, VIII</td>
<td>Right retrolabyrinthine</td>
</tr>
</tbody>
</table>

*R indicates right; L, left.
Table 2.—Comparison of Radiological Methods for Visualizing Clinically Suspected Masses of the Cerebellopontine Angle*

<table>
<thead>
<tr>
<th>Case</th>
<th>Plain Skull Roentgenograms</th>
<th>Polytomes into Auditory Canals</th>
<th>Iophendylate Injection Cisternogram</th>
<th>Intravenously Enhanced CT</th>
<th>Intrathecally Enhanced CTC, Metrizamide</th>
<th>Surgical Diagnosis, Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Enlarged R IAC</td>
<td>Enlarged R IAC</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>R acoustic neurilemoma, 1 cm</td>
</tr>
<tr>
<td>2</td>
<td>Enlarged R IAC</td>
<td>Enlarged R IAC</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>R acoustic neurilemoma, 1 cm</td>
</tr>
<tr>
<td>3</td>
<td>Surgical</td>
<td>Surgical</td>
<td>No</td>
<td>-</td>
<td>± Poor detail</td>
<td>Recurrent R acoustic neurilemoma, 3 cm</td>
</tr>
<tr>
<td>4</td>
<td>Normal</td>
<td>Normal</td>
<td>No</td>
<td>+</td>
<td>+</td>
<td>L acoustic neurilemoma, 4 cm</td>
</tr>
<tr>
<td>5</td>
<td>? Destruction of apex of R petrous bone</td>
<td>? Destruction of apex of R petrous bone</td>
<td>No</td>
<td>-</td>
<td>-</td>
<td>Microvascular decompression; no tumor</td>
</tr>
<tr>
<td>6</td>
<td>Normal</td>
<td>Normal</td>
<td>No</td>
<td>-</td>
<td>-</td>
<td>Microvascular decompression; no tumor</td>
</tr>
<tr>
<td>7</td>
<td>Normal</td>
<td>Normal</td>
<td>No</td>
<td>-</td>
<td>-</td>
<td>Microvascular decompression; no tumor</td>
</tr>
<tr>
<td>8</td>
<td>Enlarged L foramen ovale</td>
<td>Enlarged L foramen ovale</td>
<td>No</td>
<td>±</td>
<td>±</td>
<td>Microvascular decompression; no tumor</td>
</tr>
<tr>
<td>9</td>
<td>Normal</td>
<td>Normal</td>
<td>No</td>
<td>-</td>
<td>-</td>
<td>Microvascular decompression; no tumor</td>
</tr>
<tr>
<td>10</td>
<td>Normal</td>
<td>Normal</td>
<td>No</td>
<td>±</td>
<td>±</td>
<td>Microvascular decompression; no tumor</td>
</tr>
</tbody>
</table>

*CT indicates computerized tomography; CTC, computerized tomography cisternography; IAC, internal auditory canal; +, positive; --, negative; no, not performed; L, left; R, right.

extension of eighth-nerve neurilemmas. However, this method fails to demonstrate small (<1.5 cm) CP angle masses. Computerized tomography image-reconstruction artifacts in the CP, pontine, and interpunduncular cisterns are principally caused by the very low radiodensity of air in the mastoids and the high radiodensity of the petrous bones. Intravenous enhancement has greatly improved the visualization of medium-sized (1.5 to 3 cm) and large (>3 cm) neurilemmas.

Pharmaceutical and clinical research with nonionic, water-soluble, iodinated contrast media has provided a new agent, metrizamide (Amipaque), that is relatively safe for use above the conus medullaris. After injection into the lumbar subarachnoid space, this contrast can be simply and rapidly displaced from the lumbar theca to the intracranial subarachnoid spaces for immediate computerized tomographic imaging. This technique, called metrizamide CT cisternography (CTC), appears to demonstrate all surgically pertinent regional anatomy affected by CP angle masses (Fig 1). Improved presurgical planning would be afforded by more accurate delineation of the planes of growth of the neoplasm. The safety and efficacy of this method lies in using small doses of this radiodense agent since a high sensitivity of detection is afforded by CT imaging. Were conventional or even sophisticated tomographic radiography used at these doses, masses would not be visualized. This communication will describe the use and value of metrizamide CTC in the demonstration of small eighth-nerve tumors.

METHODS

Metrizamide CTCs were performed on ten patients suspected clinically of harboring a CP angle mass lesion (Table 1). No premedication was used. Lumbar puncture was performed with image-intensified fluoroscopy using a 22-gauge needle with the patient prone on a myelographic tilt table. The intrathecal placement of metrizamide (usually 6 ml of 190 mg of iodine per milliliter [1.14 gm of iodine]) was verified by fluoroscopic screening. The patient was placed erect for displacement of the hyperbaric agent below the level of the spinal needle. The needle was then removed, the patient turned supine, and the table tilted into the -60° position. After the patient had remained head down for one minute, he was returned to the -10° (modified Trendelenburg's) position. The patient had remained head down for one minute, he was returned to the -10° (modified Trendelenburg's) position, placed on a similarly inclined stretcher, and transferred to the CT scanner. The patient's body was elevated above the head throughout scanning with a right-triangular-shaped upholstered pillow in order to keep the hyperbaric radiopaque medium in the intracranial subarachnoid spaces during scanning.

CT Technical Factors

Our institution had an EMI scanner (Mark I) with the 160 x 160 matrix. Usually the information was collected at window width 50 and window level 28 (center) on 8-mm slices. When indicated, 4-mm slices provided more detailed information concerning the presence, nature, and size of the CP angle masses; however, there was more quantum noise owing to the reduction in the intensity of the x-ray beam. Recently, we have routinely obtained two contiguous pairs of 8-mm cuts and have advanced the couch 12 mm rather than 16 mm after obtaining the first pair of slices. This results in a 4-mm overlap of the more central posterior fossa slices.

Metrizamide Investigational Protocol

Each patient suspected of a CP angle tumor underwent neuro-otologic investigations prior to specialized radiological studies. The investigational protocol precluded use of metrizamide in any patient with a history of seizures, recent neurologic medication, or iodine allergy. Subsequent to the metrizamide CTC, follow-up clinical evaluations were made at six and 24 hours after injection. Physiological values and adverse symptoms were recorded for at least 24 hours.
RESULTS
Clinical and Radiological Findings

The pertinent clinical observations and the results of plain skull roentgenograms, internal auditory canal tomograms, iophendylate cisternography, and CT techniques in the ten cases that were clinically suspected of CP angle neoplasm are summarized in Table 2. Preintravenously and postintravenously enhanced CT scans detected an abnormality in only one of the four cases of eighth-nerve neurilemoma that was well localized by intrathecal metrizamide enhancement (Fig 2 through 4).

Normal Water-Soluble CTC
Surgical confirmation of normality was obtained in the six patients with normal results of metrizamide CTC studies since they underwent microvascular decompression (for trigeminal neuralgia or hemifacial spasm). In one of these six surgically verified "normal" patients, routine and intravenously enhanced CT indicated a small "cystic" low-absorption process in the left CP angle; however, intrathecal metrizamide opacification (CTC) showed no abnormality of the region, thereby proving that the low-absorption process was a computer-generated artifact.

The normal metrizamide CT cisternograms showed a strikingly consistent morphology of the CP angles and adjacent cisterns (Fig 1) that could be readily correlated with gross anatomic and pneumoencephalographic appearances.

Abnormal Water-Soluble CTC
Histopathologic confirmation of an acoustic neurilemoma was obtained in the four patients with abnormal results of metrizamide CTC studies (Table 2). Compartmental abnormalities that suggest a small (<1.5 cm) CP angle space-taking lesion include the following: (1) subarachnoid space abnormalities, including (a) filling defect, discontinuity, deformity, or obliteration of the CP angle cistern (Fig 2); (b) an enlargement of the ambient cistern adjacent to the mass (Fig 3); or (c) a subarachnoid metrizamide coating of the medial surface of the mass confirming its extra-axial location; (2) flattening of the lateral margins of the fourth ventricle (Fig 3). (Larger tumors would result in rotation or midline displacement, as shown on pneumoencephalography); and (3) rotation or angulation of the brainstem about the CP angle mass.

Other criteria include an improved capacity for posterior fossa definition when residual iophendylate obscures regional structures and causes "high density" spray artifacts (Fig 4), and abnormalities of CSF dynamics.

Adverse Reactions
When present, these were all transient and of minimal to moderate severity. Any reactions occurred after a four- to six-hour lag of well-being and lasted no longer than 24 hours. The side effects included headache (5/10), nausea (5/10), vomiting (1/10), and subtle perceptual aberrations (1/10). Three patients were totally free of any adverse reaction. When the observers compared metrizamide CTC with pneumoencephalography for visualizing the posterior fossa subarachnoid spaces (and ventricular system), they believed the morbidity of metrizamide CTC to be substantially less. Moreover, since the CT definition of the process seemed so complete, no additional specialized studies were usually necessitated prior to surgery.

Fig 1.—Normal axial plane computerized tomography (CT) scans of cerebellopontine (CP) and adjacent sites of common growth of eighth-nerve neurilemomas. Three upper slices were made with common technique (50 window width, window level 28 [center]). Lower three slices are of same planes; however, window width is broader (100) and window level is centered between 55 and 75.

A, Metrizamide in CP angle cisterns are not well separated from adjacent petrous bone (top). Choosing more suitable level for morphology in question (bottom) differentiates metrizamide-filled CP angle cistern (arrowheads) from absorption density of petrous bone.

B, Computerized tomography slice 8 mm more superior. Top. Metrizamide in subarachnoid space opacifies pons (P) on its anterior and lateral surfaces. Contiguity with inferior portion of suprasellar cistern is well shown. Bottom. Note basilar artery (arrow) within metrizamide-filled cistern anterior to pons and higher density of more anteriorly situated dorsum sellae.

C, Slice 8 mm more superior than B. Top. Midbrain plane shows full extent of subarachnoid cisterns surrounding this structure. Note superior portion of suprasellar cistern that contains optic chiasm (central filling defect). Bottom. Broader and higher CT windows show to better advantage quadrigeminal cistern encompassing tectum (open arrow). Moreover, full breadth of optic chiasm is now visualized (closed arrows).
Animal experiments have confirmed the relatively low toxicity of metrizamide in the intracranial subarachnoid spaces when it is compared with iothalamate meglumine injection (Conray) and ioacarmate meglumine (Dimer-X). In baboons, following the suboccipital intracisternal introduction of metrizamide, toxic side effects were found to be directly dose dependent, which militates against the very safe conventional radiographic demonstration of the posterior fossa subarachnoid spaces. Since CT is far more sensitive than conventional radiography in detecting subtle absorption differences, the adult metrizamide dose described here (1.14 gm of iodine) is sufficient to obtain precise representation of the basal subarachnoid cisterns and the fourth ventricle. With this low-dose technique and immediate intracranial placement of the lumbar-injected metrizamide, the majority of side effects have been mild, no seizures have occurred, and no anticonvulsant prophylaxis was necessary.

Metrizamide CTC provides a relatively low morbidity, highly graphic technique for visualizing the basal cisterns of the region of the CP angle, porus acusticus, and internal auditory canal. Its value can be related to other techniques.
Iopamidol in small quantities can define small lesions well; however, since the magnitude of CP angle involvement cannot be predicted from plain films or tomograms when a medium- or larger-sized tumor is present, iopamidol cisternography can end in an uncontrolled, rapid, irreversible spill of the agent into the middle cranial fossa. Moreover, arachnoiditis, whether it is clinically evident or not, is a consequence of residual iopamidol. In addition, subsequent CT scans for tumor recurrence are more difficult to evaluate in the presence of residual iopamidol.

Pneumoencephalography with pluridirectional tomography is an elegant, but almost invariably morbid technique. Better definition usually relates to larger quantities of gas in the subarachnoid space when both CP angle cisterns are examined simultaneously. Vertebral angiography usually defines the presence, but not the character, of a CP angle mass. The capsule and definitive angiographic demonstration of the mass is usually derived from selective catheterization of the ascending pharyngeal or occipital branches of the external carotid artery. In the awake patient, this procedure may be quite painful and is most helpful in assessing larger lesions. From current observations, it is believed that CT scanning with intravenous enhancement is likely to demonstrate only CP angle tumors larger than 1.5 cm. Since the clinical thrust in recent years is to detect small, “early” tumors, metrizamide CTC provides an important new modality to augment the otologic methods.

When otologic and preliminary radiologic examinations strongly suggest the presence of an eighth-nerve neurilemoma or other tumor in the CP angle, intravascularly enhanced CT is very likely to show medium- and larger-sized masses. However, when intravascularly enhanced CT detects no abnormality, metrizamide CTC appears to be the definitive study, thereby obviating the need for additional radiologic examinations.

The definition already offered by newer scanners (Fig 5) strongly suggests that metrizamide can be seen in the region of the porus acusticus and is likely to be visible within the internal auditory canal; thus, CT can show the bony morphology of the internal canals satisfactorily and metrizamide CTC can show the intracanalicular subarachnoid space. Thus, the role of iopamidol injection cisternography in the future is questioned since this simple intrathecal examination of metrizamide should excellently define both the extracanalicular and intracanalicular presence of acoustic nerve neoplasms. Coronal- and sagittal-plane computer sections are also becoming more broadly available if there is the need for further confirmation of very small masses.

Conventional radiography or conventional tomography can be used to image metrizamide placed in the internal auditory canals or CP angle cisterns. However, without the high sensitivity of CT (approximately 100-fold that of radiography), larger doses and much more severe side effects can occur (eg, seizures). Computerized tomography imaging is therefore stressed.

Metrizamide was provided by Nygaard & Co, Oslo, and by Sterling-Winthrop Research Institute, Rensselaer, NY.

Nonproprietary Name and Trademark of Drug

Metrizamide—Amipaque.

References