COMPLICATIONS OF CEREBRAL ANGIOGRAPHY IN 2,000 CONSECUTIVE CASES

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(Received for publication May 4, 1962)

In 1934, Egas Moniz,9 using sodium iodide as a contrast medium, reported a mortality rate of 2 to 3 per cent in patients undergoing cerebral angiography. Other investigators using Diodrast, Urokon and, more recently, Hypaque have reported little improvement in the incidence of complications (Table 1). One of the difficulties is defining exactly what constitutes a complication. There have been errors in both directions; some have been too zealous and others too lax in recording reactions. Cerebral arteriography has been responsible for important diagnostic and therapeutic advances in neurosurgery, and its risks deserve to be evaluated properly. The hazards will assume a categorical value proportionate to the skill and care exerted by the angiographer, but also are determined by the pathologic processes involved.

The records of 2,000 consecutive patients undergoing cerebral angiography from 1956 to 1961 were reviewed. Of these, 84 per cent were private, white patients examined at the Baptist Memorial Hospital; the remainder were Negroes seen at the City of Memphis Hospitals. Sixty per cent were men and 40 per cent were women. All ages were represented, although the majority of patients were 50 years of age or older; 23 per cent of the patients were under 40 years of age (Table 2).

Bilateral percutaneous carotid arteriography was the technique used most commonly (62 per cent). Unilateral carotid arteriography was employed in 26 per cent, while vertebral, retrograde (with and without catheterization), subclavian and brachial arteriograms were made less frequently (Table 3). A solution of 50 per cent Hypaque Sodium was the contrast medium of choice and was used in all patients except those showing signs of sensitivity. A total of 2,332 arteriograms were performed and 3,787 arteries were injected.

Cerebral vascular disease was the malady encountered most frequently. Vascular disease as a whole accounted for 47 per cent of the clinical diagnoses (Table 4). The largest category in Table 4, entitled “Miscellaneous,” represents a galaxy of neurological conditions which have not been classified for this paper.

TECHNIQUE

Arteriography was performed under local anesthesia in 98.5 per cent of the procedures. In order to test for sensitivity, a drop of Hypaque solution is placed in the conjuctiva or a few ml. are injected intravenously. A small amount of procaine is infiltrated into the skin; if too much solution is injected deep into the neck, the vessel cannot be palpated. A 17-gauge sharp-pointed needle is used to make a path directly to the top of the carotid artery. An 18-gauge arteriographic needle then is directed along the path just above the vessel. Gentle pressure on the needle occludes the distal vessel which can be palpated easily. The needle is inserted quickly into the artery. The neck should not be probed to find the vessel, since this tends to increase spasm and bleeding around the artery. A polyethylene tube is attached to the needle with a 2-way plastic stopcock connected to the syringe. Before Hypaque is injected, the tubing must be aspirated carefully to remove any existing clots. For direct carotid arteriography, 8 ml. of Hypaque are used for each injection. Up to 130 ml. of the solution have been injected into the same patient without difficulty, While the films are being developed, the needle is irrigated at fre-
of the proximal part of the left common carotid artery proximal to the bifurcation. Percutaneous vertebral and subclavian arteriography now is employed only in unusual circumstances.

**EVALUATION OF COMPLICATIONS**

Complications caused directly by angiography were classified as mild, severe and fatal. A mild complication was considered to be any transitory untoward effect occurring within 24 hours of the procedure and clearing in 6 hours. A severe complication was con-

**TABLE 2**

_Per cent in each age group_

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>0-9</th>
<th>10-19</th>
<th>20-29</th>
<th>30-39</th>
<th>40-49</th>
<th>50-59</th>
<th>60-69</th>
<th>70-79</th>
<th>80-89</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per cent</td>
<td>1</td>
<td>4</td>
<td>7</td>
<td>11</td>
<td>17</td>
<td>28</td>
<td>21</td>
<td>10</td>
<td>1</td>
</tr>
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