THE EFFECT OF CAROTID ARTERIOGRAPHY, USING
35 PER CENT DIODRAST, ON THE PROTEIN
CONTENT OF THE SPINAL FLUID*

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(Received for publication December 22, 1956)

The effect of carotid arteriography on the protein content of the cerebrospinal fluid seems important to determine since a diagnostic lumbar puncture is often deferred until after arteriography has been performed. Bassett et al. noted a significant rise in cerebrospinal fluid protein in experimental animals 30 minutes after the intracarotid injection of 35 per cent Diodrast. The quantity of contrast media employed in these animals, however, was in excess of equivalent amounts used clinically in humans and an elevation in spinal fluid protein might be expected. Stern observed no change in protein values of cerebrospinal fluid in 3 patients from 30 minutes to 5 hours after carotid arteriography using relatively large amounts of 35 per cent Diodrast. This series, however, is too small to draw any valid conclusions. Stein and Fink examined the protein content, cellular pattern, and color of spinal fluid from 21 patients prior to and from 12 to 24 hours following cerebral arteriography using 35 per cent Diodrast. They found an elevation in protein content in 1 case, whereas in the remaining 20 patients, the change was insignificant. The present work largely confirms the studies of Stein and Fink but, in addition, shows that a significant decrease in cerebrospinal fluid protein may occur both in patients following arteriography and in controls after a lumbar puncture.

METHOD

A total of 36 patients undergoing carotid arteriography was studied. The contrast substance used in each case was 35 per cent Diodrast in amounts ranging from 20 to 100 cc. All arteriograms were performed by percutaneous puncture of the carotid artery. The various neurologic entities being investigated by arteriography in this group are shown in Table 1.

A lumbar puncture was performed on each patient from 1 to 12 hours before and 24 hours after arteriography. A differential cell count on the spinal fluid was done immediately after the puncture. The fluid was centrifuged and the supernatant material was placed in the deep freeze until the protein determinations were done.

* This investigation has been made with the assistance of a grant from the Committee on Research, Council of Pharmacy and Chemistry, American Medical Association and by a grant from the National Paraplegic Foundation.
EFFECT OF ARTERIOGRAPHY ON CSF PROTEIN CONTENT

TABLE 1

*Diagnosis in 36 cases of carotid arteriography with 35 per cent Diodrast*

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>No. Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>No intracranial lesion demonstrated</td>
<td>15</td>
</tr>
<tr>
<td>Brain tumor</td>
<td>4</td>
</tr>
<tr>
<td>Cerebral thrombosis</td>
<td>4</td>
</tr>
<tr>
<td>Intracranial aneurysm with subarachnoid hemorrhage</td>
<td>4</td>
</tr>
<tr>
<td>Intracranial aneurysm without subarachnoid hemorrhage</td>
<td>3</td>
</tr>
<tr>
<td>Epilepsy</td>
<td>3</td>
</tr>
<tr>
<td>Intracranial A-V fistula (without subarachnoid hemorrhage)</td>
<td>2</td>
</tr>
<tr>
<td>Intracerebral hematoma</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>36</td>
</tr>
</tbody>
</table>

The protein content of cerebrospinal fluid in each case was determined by the biuret method. The reagent used in this procedure was prepared as described by Gornall *et al.* In the determination, 8 cc. of this reagent are added successively to separate Coleman tubes, each containing 2 cc. of spinal fluid; 2 cc. of 0.85 per cent sodium chloride solution, which serves as a blank; and 2 cc. of a standard containing 30 mg. per cent of protein. The resulting solutions were allowed to stand at room temperature for 30 minutes, following which the optical density of each was read in a Coleman Junior spectrophotometer set at a wave length of 540 mµ. The protein content of the spinal fluid could then be obtained from the expression:

\[
\text{Mg. } \% \text{ CSF protein} = \frac{\text{mg. } \% \text{ protein standard} \times \text{optical density CSF protein}}{\text{optical density of protein standard}}
\]

The protein standard was prepared by suitable dilution of a known concentration of bovine albumin (Armour Laboratories) with a solution of 0.85 per cent sodium chloride.

Fourteen patients who did not undergo arteriography served as controls. In this group, 2 lumbar punctures were performed on each patient 24 hours apart and the protein content of the cerebrospinal fluid was determined as described above.

RESULTS

The changes in the protein content of the cerebrospinal fluid 24 hours following carotid arteriography using 35 per cent Diodrast are summarized in Table 2. An increase or decrease of 10 mg. per cent or more is considered to be a significant change. A decrease in the protein content, ranging from 10 to 20 mg. per cent, occurred in 8 patients, whereas in 27 patients there was no significant change from control values. Only 1 patient in this series of 36 cases showed an increase in protein content 24 hours following arteriography. This was a 33-year-old man who had an intracerebral hematoma. The spinal fluid protein in this case was 96 mg. per cent before and 120 mg. per cent 24 hours after arteriography.
The effect of carotid arteriography, using 35 per cent Diodrast, on protein content of the cerebrospinal fluid in 36 patients

<table>
<thead>
<tr>
<th>Protein Content of Cerebrospinal Fluid 24 Hours after Arteriography</th>
<th>No. Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>No change</td>
<td>27</td>
</tr>
<tr>
<td>Greater than 10 mg.% increase</td>
<td>1</td>
</tr>
<tr>
<td>10-20 mg.% decrease</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>36</td>
</tr>
</tbody>
</table>

There was one adverse reaction following arteriography and it was assumed to be secondary to the procedure. This occurred in a 45-year-old man with a left parietal lobe tumor and consisted of a marked right hemiparesis which was first noted 4 hours after arteriography. It is interesting to note in this patient that the cerebrospinal fluid protein was 80 mg. per cent 1 hour before the arteriogram and 82.5 mg. per cent 24 hours later.

Fourteen patients served as controls for those in whom arteriography was carried out. In the control group, 2 lumbar punctures were performed on each patient 24 hours apart. The results of this study are shown in Table 3. Ten patients showed no significant change and 4 showed a 10 to 20 mg. per cent decrease in cerebrospinal fluid protein 24 hours following a lumbar puncture.

There were no consistent changes in the cellular pattern of the spinal fluid either in the group undergoing arteriography or in the controls.

**COMMENT**

The changes in cerebrospinal fluid protein 24 hours following carotid arteriography with 35 per cent Diodrast were not significantly different from those 24 hours following a lumbar puncture. A 10 mg. per cent or greater decrease occurred in 8 out of 36 patients undergoing arteriography and in 4 out of 14 controls. The reason for the decrease is not clear. Sweet et al.6
have shown that under normal conditions very little mixing of ventricular, cisternal and lumbar fluids occurs. It may be that following a lumbar puncture, leakage of cerebrospinal fluid at the site of the dural puncture allows the ventricular and cisternal fluids to mix more than normally with the lumbar subarachnoid fluid. Since ventricular and cisternal fluids each have a protein content less than that found in the lumbar subarachnoid space, this would result in a lower value 24 hours later.

The failure to demonstrate an elevation in the protein content of the cerebrospinal fluid after arteriography in the patient who experienced a reaction to the procedure is not surprising since Stein and Fink\(^3\) did not observe a significant change in 3 patients who showed a transient hemiparesis following arteriography.

**SUMMARY**

The protein content of cerebrospinal fluid was determined prior to and 24 hours following carotid arteriography using 35 per cent Diodrast in 36 patients. Of these, 27 showed no significant change; 8 showed a 10 mg. per cent or greater decrease; and 1 showed a 24 mg. per cent increase in the protein content of the cerebrospinal fluid following arteriography.

The changes in protein content of the cerebrospinal fluid in a control group of 14 patients, 24 hours following a lumbar puncture, with 1 exception, were similar to those following arteriography.

There were no consistent changes in the cellular pattern of the cerebrospinal fluid either in the group undergoing arteriography or in the controls.

**REFERENCES**

5. Stern, W. E. Personal communication.