Identification of the anterior and posterior commissures by angiography

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A simple method has been developed by which the approximate location of the anterior and posterior commissures can be identified on the venous phase of the cerebral angiogram. The venous angle, and the junction of the internal cerebral vein and vein of Galen, are used as reference points since these structures were found by measurement on midline sagittal-sectioned brains to have a relatively constant spatial relationship to the commissures. This method for locating the commissures by angiography does not depend on the relationship of the deep venous structures to bone landmarks on the skull. Its chief limitation is that in 20% of the patients a true venous angle cannot be identified.

Key Words • anterior commissure • posterior commissure • stereotaxic procedures • angiography

Locating the anterior and posterior commissures and the intercommissural line is important in patients with neurological disease treatable by stereotaxic surgical procedures. The approximate location of these structures is usually identified by demonstrating the third ventricle after air has been introduced into the ventricular system. The posterior commissure can usually be seen when air is placed in the posterior part of the third ventricle, and the approximate site of the anterior commissure is identified by its known relationship to the foramen of Monro. An alternative or ancillary method that does not require the introduction of air would further simplify stereotaxic localization. Austin, et al.,1 developed a method of locating the commissures by use of measurements from bone landmarks on the skull. This method can often be used effectively but is usually less accurate than ventriculography since intracranial structures do not have a constant relationship to bone landmarks because of a variation in the size and shape of the skull.

Since the deep venous structures seen by angiography are near the midline and quite constant in location, an angiographic method of locating the intercommissural line has been developed. Although there is often a variation in the location and configuration of the superficial veins of the brain, the deep venous system of the brain including the thalamostriate veins, internal cerebral veins, and great vein of Galen are relatively constant. The venous angle named by Krayenbühl and Richter2 is formed by the
transition of the thalamostriate to the internal cerebral vein as the thalamostriate vein courses from the anterior part of the caudothalamic groove across the medial portion of the floor of the lateral ventricle and through the posterior superior aspect of the foramen of Monro. Here it usually joins the septal vein to become the internal cerebral vein which then courses posteriorly in the tela choriodia along the roof of the third ventricle and posteriorly to join its counterpart from the other side to become the vein of Galen (Fig. 1).

This paper reports measurements made on sagitally-sectioned brains to determine the constancy of the relationship of the anterior and posterior commissures to deep venous structures and describes a method by which the approximate location of the commissures can be determined by cerebral angiography.

**Methods and Results**

Twenty normal adult human brains were carefully suspended in formalin for fixation and were then sagittally sectioned in the midline as illustrated in Fig. 1. The usual location of the venous angle was identified by placing a probe at the posterolateral border of the intaventricular foramen of Monro. A line tangent to the arc formed by the inner curve of the area of junction of the internal cerebral vein and the vein of Galen, and tangent to the apex of the venous angle, was identified with a straight edge touching these points and projecting anteriorly and posteriorly beyond them. We called this the "venous angle-vein of Galen (VA-VG) line." The mean distances shown in Table 1 were obtained and the standard deviations determined. The measurements identified in Table 1 by Nos. 1, 2, 3, and 4 were selected.
TABLE 1

Relationships of commissures to venous structures

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Sagittally-Sectioned Cadaver Brain</th>
<th>Anterior and Posterior Commissures on Cerebral Angiograms:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (mm)</td>
<td>Mean Cadaver Distance</td>
</tr>
<tr>
<td></td>
<td>S.D. (mm)</td>
<td>Plus 20% (mm)</td>
</tr>
<tr>
<td>1. Distance along VA-VG line from the venous angle to a perpendicular line from the VA-VG line to the anterior commissure</td>
<td>4.98 ± 1.1</td>
<td>6.0</td>
</tr>
<tr>
<td>2. Perpendicular distance from VA-VG line to anterior commissure</td>
<td>8.00 ± 1.3</td>
<td>9.6</td>
</tr>
<tr>
<td>3. Perpendicular distance from VA-VG line to posterior commissure</td>
<td>5.60 ± 1.3</td>
<td>6.7</td>
</tr>
<tr>
<td>4. Intercommissural distance</td>
<td>24.95 ± 0.67</td>
<td>30.0</td>
</tr>
<tr>
<td>5. Distance from venous angle to vein of Galen</td>
<td>34.15 ± 2.5</td>
<td>41.0</td>
</tr>
</tbody>
</table>

*Mean distances between several reference points measured on midline sagittally-sectioned cadaver brains and corresponding calculated distances to be used in locating the commissures on cerebral angiograms. The calculated distances were obtained by increasing the cadaver brain distances by 20% (magnification factor). VA = venous angle, VG = vein of Galen.

to be used in a simple method for locating the commissures because they can be readily identified, they have small standard deviations, and all but the intercommissural distance have either parallel or perpendicular relationships to the VA-VG line. The distance from the venous angle anteriorly along the VA-VG line was measured to a point at which this line intersects at right angles a line passing through the center of the anterior commissure. Then the perpendicular distance of each commissure from the VA-VG line and the intercommissural distance were obtained.

The intercommissural distance when measured from the center of the anterior commissure to the center of the posterior commissure on sagittally sectioned brains had a range of only 23 to 27 mm, with a mean of 24.95 mm (S.D. ± .67). The perpendicular measurements from the VA-VG line to the commissures were also quite uniform (Table 1). The distance from the venous angle to the vein of Galen had greater variability and was not used in our method for locating the commissures.

To determine the amount of magnification on the angiogram of structures in the midline of a brain, a grid containing 1-cm squares projected on the x-ray film measured 1.2 cm, so the x-ray magnification factor at this distance was approximately 20%. The measurements obtained on cadavers were increased by 20% and the resulting distances shown in Table 1 were used to identify the anterior and posterior commissures on the venous phase of the cerebral angiograms.

By increasing the distances measured on the cadaver by 20% (x-ray magnification factor), the approximate location of both commissures could be identified and the intercommissural line defined on the angiogram if the venous angle and the vein of Galen were visualized. First, a line was drawn tangent to the inner curve of the most dependent portion of the area of junction of the internal cerebral vein and the vein of Galen and tangent to the venous angle (Fig. 2). The approximate position of the anterior commissure was located by measuring 6 mm anteriorly along the VA-VG line from the most anterior portion of the venous angle, and then dropping a perpendicular line 9.6 mm below the VA-VG line. The approximate position of the posterior commissure was located by dropping a 6.7 mm line perpendicular to the VA-VG line, either 30 mm posterior to the location of the anterior commissure, or 24 mm posterior to the venous angle. The 24 mm distance was obtained by subtracting the 6 mm anterior projection along the VA-VG line from the venous angle to the perpendicular line to the anterior commissure, from the intercommissural distance. After the commissures had
Angiographic identification of commissures

![Diagram of reference points and measurements for location of anterior and posterior commissures on the lateral view of the venous phase of the cerebral angiogram.]

been located the intercommissural line was identified. To demonstrate the location of the stereotaxic probe tip at the time of the surgical procedure, the intercommissural line was transferred to plain lateral skull films by superimposing them on the angio-

Discussion

The venous angle is one of the important points of reference seen on the venous phase of the cerebral angiogram, and it is the chief reference point used in our method for determining the location of the intercommissural line. Measurements on the cerebral angiogram from various bone structures of the skull to the venous angle have been used by several investigators attempting to develop methods to determine if the venous angle is normally located. These methods have not been satisfactory because of variations in the size and shape of the skull. Since bone landmarks are not used in our method, such variations are not a problem.

Although several methods, referred to above, have been used to determine whether the venous angle is displaced by studying its relationship to bone landmarks on the skull, there have been few attempts to identify the location of other intracranial structures by using the venous angle as a point of reference as in this study. The venous angle is usually easy to identify but in some instances there is a “false” venous angle. A false venous angle is formed if the thalamo-

striate vein is small and other tributaries of the internal cerebral vein are larger than usual. These tributaries from the wall of the lateral ventricle, choroid plexus, and other structures pass between the fornix and the thalamus posterior to the foramen of Monro, and if they are large they can be seen more prominently on the angiogram than the true venous angle. Sometimes a true venous angle is entirely absent. According to Probst, failure to visualize the true angle may be due to aplasia, hypoplasia, or inadequate contrast filling. He also pointed out that the term “angle” is not altogether correct. This structure sometimes has a rounded appearance on the cerebral angiogram so that it forms a curve rather than an angle. If the venous angle is to be used as a point of reference, it is important to determine whether a false or a true venous angle is present. Mokrohisky, et al., have listed four criteria for recognizing a false venous angle: 1) the absence of the ascending portion of the internal cerebral vein so that the venous angle is located too far posteriorly; 2) a dot on the tributary forming the false venous angle which marks the lateral entrance of the caudate vein; 3) loss of the smooth curve of the striate vein; and 4) tributary veins entering the internal cerebral vein at right angles.

The apex of a true venous angle, which may be seen in about 80% of all carotid angiograms, marks the posterior and superior limit of the interventricular foramen. Ring found that 19% of the cerebral
angiograms that he studied were characterized by a false venous angle. The false venous angle was usually located very close to the posterior superior aspect of the foramen of Monro but occasionally it was several millimeters behind this landmark.

Although thalamotomy is currently used less frequently than before L-dopa became available, it is still useful in some cases of Parkinson's disease as well as in cases of multiple sclerosis with severe ataxia, chronic pain, and occasionally in other conditions.

The angiographic method described here for locating the intercommissural line may be helpful in about 80% of the persons treated with intracranial stereotactic procedures. Since the VA-VG line appears to have a relatively constant relationship to the midline structures of the brain, it may also become useful in determining displacement due to intracranial disease of other structures demonstrated by cerebral angiography.

References

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