Normal position of the aqueduct of Sylvius

Part 1: Significance of aqueduct to dorsum sellae measurements

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Radiographic studies of the cerebral aqueduct of Sylvius are important because of the significance of alterations in its position. These changes may be overlooked if one relies on visual estimation alone; interpretation of the lateral pneumoencephalogram must be based on knowledge of the normal position of the iter expressed by a single figure.

The purpose of the present communication is to introduce a mathematical formula which expresses the normal position of the aqueduct and can be applied to all skull dimensions.

Material and Method

One hundred normal pneumoencephalograms (PEG) were studied. Each was determined to be normal according to the criteria and methods of Sahlstedt and Twining (Fig. 1). The age ranged from 2 to 62 years (Fig. 2). Oxygen was used in all studies and injected by the lumbar route. The lateral view of each PEG was studied and a tangent drawn to the posterior surface of the dorsum sellae. An anatomical study of the upper posterior surface of the dorsum sellae was performed in 18 autopsy specimens, eight complete skulls and 10 sellae turcica removed from normal human skulls (Fig. 3). The thin dura in this area was tightly adherent to the bone; therefore, in the lateral x-ray, the profile of the dorsum sellae corresponded to the surface of the dura. By examination of the eight skulls the areas corresponding to the adherent dural lining could be traced in the bone structure. In the PEG these represented the posterior surface on which the tangents were based and drawn. Variations in the shape of the surface are summarized in Table 1. The surface area ranged from 36 to 115 mm²; the mean value was 75.4 mm². Perpendicular lines were erected on the tangents (Fig. 4), passing through the aqueduct to the scalp. The direction of the lines and their intersection with the aqueduct are described and the ratio A:B calculated. Letter A represents the distance from the scalp to the dorsal surface.
of the gas-filled aqueduct; B represents the distance from the scalp to the tangent on the dorsum sellae. Both distances were measured to the nearest millimeter in the midsagittal plane using a ruler with an accuracy of not more than ± 0.5 mm. During the PEG examination the quadrigeminal plate was frequently outlined by air showing the midbrain and the distal border of the aqueduct. The total shadow of the aqueduct was divided into equal thirds, and the direction of the perpendicular lines classified according to which third they traversed.

Results

The points of intersection between Sahlstedt's line and the aqueduct were found at the border between the ventral third and the dorsal two-thirds (Sahlstedt's point) in nine cases and ventral to Sahlstedt's point in 90 cases. In only one case did the aqueduct cross the Sahlstedt line dorsal to this point; that
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**TABLE 1**

*Shape of the upper posterior surface of the sella turcica in 18 autopsy specimens*

<table>
<thead>
<tr>
<th>Form of Surface</th>
<th>Nos. of Specimens</th>
</tr>
</thead>
<tbody>
<tr>
<td>flat</td>
<td>7</td>
</tr>
<tr>
<td>concave frontally</td>
<td>2</td>
</tr>
<tr>
<td>convex-concave</td>
<td>4</td>
</tr>
<tr>
<td>convex dorsally</td>
<td>5</td>
</tr>
</tbody>
</table>

Location was defined as the dorsal limit for normally placed aqueducts according to Sahlstedt's method.

Of 100 perpendicular lines erected upon the dorsum sellae, three passed through the third ventricle, one through the border between the third ventricle and the aqueduct, 19 through the rostral third of the aqueduct, 50 through the middle third, and 23 through the distal third; four passed through the distal border of the aqueduct. Figure 5 summarizes the dispersion of the mean value of the quotients in each third of the aqueduct field as well as the corresponding ranges. The mean normal value of A:B was 0.72 ± 0.02, with a range of 0.68 to 0.75.

Figure 6 shows plottings of the distances A and B. The ratio line 0.75 represents the up-
per normal value and corresponds to the anterior normal limit of the position of the iter, while the ratio line 0.68 corresponds to the most dorsal but still normal position of the cerebral aqueduct. Plottings below 0.68 (Fig. 6) indicate a dorsal displacement of the aqueduct.

Discussion

Sahlstedt's line has been used as the most reliable reference for proportional measurements of the normal position of the cerebral aqueduct ever since its introduction nearly 40 years ago. The line is, however, ill-defined and does not allow comparative measurements. Hilal, et al., introduced a mixed proportional and absolute measuring method to locate the aqueduct; their system has proved troublesome in practical clinical use. Our method uses only the proportional measurement so that the ratio A:B expresses the position of the aqueduct. The perpendicular lines depicted in our studies depended on the direction of the dorsum sellae in the frontal plane, and thus the ratios calculated were independent of the head shape per se. Our material represented an age range of 2 to 62 years, yet the mean value of the ratios was still within the narrow limits of 0.72 ± 0.02. Therefore, we may conclude that the ratios are also independent of age. Finally, the ratios calculated from PEG's of women and men did not differ significantly, suggesting that they are independent of sex.

Position of the aqueduct may be compared from patient to patient or at intervals in the same patient. Growth of the head and its internal structures probably conforms to a predetermined pattern retaining the original proportions (measured in the midsagittal plane) between the dorsum sellae and the occipital bone. This assumption is strengthened by a recent investigation applying the ratio A:B method to infants of the age group 0 to 2 years. Even in this group the values calculated fell within the same narrow limits indicated by the ratio lines 0.68 and 0.75, as shown by the dotted lines in Fig. 6. Thus our method is valid for different skull dimensions and independent of the age group examined. The position of the cerebral aqueduct may be determined in well-defined and reproducible terms.

References


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