The normal position of the cerebellar
tonsils as demonstrated by myelography

SHEILAH O'CONNOR, M.D., GEORGE DU BOULAY, M.B., F.R.C.P., F.F.R.,
AND VALENTINE LOGUE, F.R.C.P., F.R.C.S.
The National Hospital, Queen Square, London, England

The authors describe a reference line from basion to opisthion above which
the lower border of the normally positioned cerebellar tonsil can be delineated
by Myodil myelography. The study is based on data obtained from 100 cases
with normal tonsils.

KEY WORDS • cerebellar tonsil • myelography • foramen magnum
• normal position

The Chiari Type 1 malformation has
been associated with syringomyelia and several other neurological syn-
dromes in the adult, including impaction of
the cerebellar tonsils in the narrows of the
foramen magnum. In studying this entity
there is a need to establish the normal
location of the tonsils in relationship to the
opening of the foramen magnum so that an
abnormally low position may be recognized.
By “abnormal” we refer to the usual adult
Chiari Type 1 malformation characterized
by herniation of the tonsils and, sometimes,
the medial aspect of the cerebellar hemi-
spheres. This is presumably congenital, but
not associated with spinal myelomeningo-
cele, in contradistinction to the Chiari Type
2 anomaly, which consists of an elongation
of the vermis cerebelli almost invariably in
association with myelomeningocele in the
newborn. The two types run fairly true to
form, and it is only rarely that Type 1 is
associated with spinal dysraphism, or Type
2 with syringomyelia or the syndrome of the
foramen magnum. In this study we try to
establish the normal level of the tonsils as
demonstrated by positive contrast myelo-
ography.

Clinical Material and Methods
Of 450 positive contrast myelograms
studied, 120 were obtained in which supine
lateral views disclosed the complete ana-
tomy of the inferior border of the cerebellar
tonsils in relationship to the foramen
magnum. We excluded 20 cases in which
there was suspicion of a foramen magnum
or intracranial space-occupying lesion. The
remaining 100 cases included diagnoses of
disseminated sclerosis (40%); neck or back
pain of undiscovered cause (15%); motor
euron disease (5%); and various neurologi-
cal conditions (40%) such as migraine,
cervical cord trauma, transverse myelitis,
cervical spondylosis without myelographic
abnormality, and isolated other entities.

The reference line chosen joined the
inferior tip of the clivus (basion) to the
inferior border of the posterior lip of the
foramen magnum (opisthion) (Fig. 1). The
perpendicular distance from the inferior border of the tonsils to this line was measured, and the mean distance and its range of variability was obtained for these 100 cases. Measurements were not corrected for magnification but are given as measured in the radiographs. For true measurement, a correction factor of 0.8 should be applied.

Results

The inferior border of the cerebellar tonsils, both of which always lay virtually at the same level, was above the reference line in all cases. The average distance from the tonsils to the line in the 100 cases was 6 mm (±2 mm). Figure 2 shows the range and distribution of measurements. In the normal person the cerebellar tonsils do not approach nearer than 3.8 mm to the plane of the foramen magnum (basion-opisthion), so that the demonstration of the tonsils at the level of, or passing through, the foramen magnum is strong evidence of the presence of a Chiari malformation if intracranial tumor has been excluded. In some cases, of course, the tonsils extend a considerable distance down the spinal canal.

Discussion

Herniation of the tonsils may be demonstrated by air myelography or encephalography, with or without tomography, but these methods do not always delineate the tonsils as clearly as positive contrast myelography.
Normal position of cerebellar tonsils

<table>
<thead>
<tr>
<th>No. of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
</tr>
<tr>
<td>22</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>18</td>
</tr>
<tr>
<td>16</td>
</tr>
<tr>
<td>14</td>
</tr>
<tr>
<td>12</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>2</td>
</tr>
</tbody>
</table>

Moreover, downward displacement of the brain stem and tonsils as a result of the replacement of large volumes of cerebrospinal fluid (CSF) by air, particularly if the head of the patient is elevated, may make these structures appear lower in the foramen magnum than they were before radiographic positioning. For these reasons we believe the level of the tonsils is best assessed by using Myodil. An essential point in the technique, as emphasized by several authors,1,2,4,6 is that the patient be screened in the supine position. Tonsils herniated by other lesions, such as by raised pressure from intracranial tumors or posterior fossa cysts, could, of course, also be shown. However, these conditions can in most cases be recognized by their clinical features and other more relevant radiological investigations.

Visual proof that the tonsils enter the foramen magnum is needed before proposing surgical decompression of the foramen magnum or upper cervical canal for syringomyelia or the foramen magnum syndromes.

Caution is needed in drawing conclusions from the appearance of the Chiari Type 1 malformation on myelography. This anomaly arises presumably on a congenital basis but does not usually produce symptoms until adult life, although it may be demonstrable myelographically. Occasionally a coincidental disease of the central nervous system occurs, and the demonstration of tonsillar herniation may then cause confusion in the diagnosis.

Fig. 2. Graph showing the range and distribution of the lower margin of the tonsillar shadow in its relationship with the reference line in 100 normal cases.

References
