Levels of albumin, \( \alpha \)-fetoprotein, and IgG in human fetal cerebrospinal fluid

The estimation of total protein and the relative concentration of specific components of the cerebrospinal fluid (CSF) have been the subject of many investigations because of their significance as diagnostic aids in various pathological conditions (Kabat, Moore, and Landow, 1942; Burtin, 1960; Laterre, Heremans and Carbonara, 1964; Davson, 1967; Laterre, 1973). Protein levels in samples of lumbar CSF from normal adults range between 20 and 40 mg/100 ml. During the first 3 months of life the total protein concentration of CSF appears to be higher, even reaching 120 mg/100 ml.

We report the results of estimating the levels of three proteins, \( \alpha \)-fetoprotein (AFP), albumin, and IgG, in CSF from human fetuses. These studies are relevant to the question of the origin of AFP in amniotic fluids of fetuses with ‘open’ neural-tube defects and to the problem of the permeability of the blood-brain barrier during fetal life.

Materials and methods

Samples of CSF were obtained by aspiration with a syringe either from the lateral ventricles of the brain or from the upper cervical regions of the spinal cord. Six samples which were absolutely clear and free from contamination by blood were assayed; other samples, slightly contaminated, were discarded. 2 fetuses were fresh specimens, spontaneously aborted and apparently normal. 4 were obtained by hysterotomy; of these, 3 had chromosome abnormalities (Down’s syndrome), while the fourth was a male fetus borne by a female carrier of the gene for haemophilia. CSF from these fetuses was collected within 2–5 hours of the hysterotomy. Ages of the fetuses ranged between 16\( \frac{1}{2} \) and 25\( \frac{1}{2} \) weeks (Table I).

**TABLE I**
Age, cause of abortion, and chromosome complement of the 6 fetuses studied

<table>
<thead>
<tr>
<th>Fetus</th>
<th>Age (w)</th>
<th>Causes of abortion</th>
<th>Chromosome complements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>16( \frac{1}{2} )</td>
<td>Spontaneous</td>
<td>Not tested</td>
</tr>
<tr>
<td>2</td>
<td>19( \frac{1}{2} )</td>
<td>Spontaneous</td>
<td>Not tested</td>
</tr>
<tr>
<td>3</td>
<td>18</td>
<td>Induced</td>
<td>47,XY, + G</td>
</tr>
<tr>
<td>4</td>
<td>25</td>
<td>Induced</td>
<td>46,XY</td>
</tr>
<tr>
<td>5</td>
<td>25( \frac{1}{2} )</td>
<td>Induced</td>
<td>46,XY − G + t(DqGq)</td>
</tr>
<tr>
<td>6</td>
<td>25( \frac{1}{2} )</td>
<td>Induced</td>
<td>47,XY, + G</td>
</tr>
</tbody>
</table>

Albumin level was measured by the single radial diffusion technique and AFP by the one dimensional antigen-antibody electrophoresis (rocket technique), as previously described (Seller et al., 1973). IgG levels were estimated using commercially available immunoplates (Behringwerke, AG, Marburg, Germany).

Results and conclusions

AFP levels in fetal CSF were found to decline from 1220 \( \mu \)g/ml in the 16\( \frac{1}{2} \)-week-old fetus to 52 and 60 \( \mu \)g/ml in the older fetuses tested (Table II). Reduction of the concentration of AFP in CSF, in relation to the ages of the fetuses, was more rapid than that of the levels of AFP in fetal sera. The ratios between the amounts of albumin and AFP in CSF increased with age, passing from 1\( \frac{1}{2} \) in a fetus 18 weeks old to 20 in a fetus 25\( \frac{1}{2} \) weeks old.

IgG in adult CSF ranges from 20–40 \( \mu \)g/ml (Davson, 1967; Laterre, 1973). It was therefore of great interest to find higher levels of IgG in the CSF of the fetuses. Since most of the IgG present

**TABLE II**
Levels of AFP, albumin, and IgG in CSF from 6 fetuses

<table>
<thead>
<tr>
<th>Fetus</th>
<th>Levels of AFP (( \mu )g/ml)</th>
<th>CSF levels (( \mu )g/ml) of</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1) CSF (2) Serum</td>
<td>(3) Alb (4) IgG</td>
</tr>
<tr>
<td>1</td>
<td>1220</td>
<td>760</td>
</tr>
<tr>
<td>2</td>
<td>1040</td>
<td>760</td>
</tr>
<tr>
<td>3</td>
<td>420</td>
<td>760</td>
</tr>
<tr>
<td>4</td>
<td>71</td>
<td>840</td>
</tr>
<tr>
<td>5</td>
<td>52</td>
<td>680</td>
</tr>
<tr>
<td>6</td>
<td>60</td>
<td>1200</td>
</tr>
</tbody>
</table>

\( n = 6 \)
in fetal sera is derived from the maternal circulation and there is no evidence that these proteins are secreted by the choroidal plexi, it seems that IgG molecules present in fetal CSF are derived from blood. These findings support the suggestion that the permeability of the blood-brain barrier is not fully developed during fetal life (Davson, 1967).

The presence of high AFP levels in fetal CSF raises another important point in relation to the increased levels of this fetal protein in the amniotic fluids of fetuses with 'open' neural-tube defects (Brock and Sutcliffe, 1972; Seller et al., 1973). It has been repeatedly suggested that in conditions where the neural tissue is exposed, AFP passes from the CSF into the amniotic cavity. The observation that AFP is present in high concentration in fetal CSF seems to support this hypothesis, though other mechanisms may be involved as well (Adinolfi, 1974).

**Summary**

Cerebrospinal fluid from 6 fetuses, 16½–25½ weeks of gestation, was assayed for the levels of α-fetoprotein, albumin, and IgG. All these proteins were present in significant amounts. The level of α-fetoprotein decreased, albumin increased, and IgG remained roughly constant during this period. These results suggest that the permeability of the blood-brain barrier is not fully developed in the fetus.

This work was supported by the Spastics Society and the Medical Research Council. We thank Susan Blunt, M. R. Creasy, and Dr. J. D. Singer for abortion specimens and chromosome results.

**References**


Levels of albumin, alpha-fetoprotein, and IgG in human fetal cerebrospinal fluid.

M Seller MJadinolfi

Arch Dis Child 1975 50: 484-485
doi: 10.1136/adc.50.6.484

Updated information and services can be found at:
http://adc.bmj.com/content/50/6/484.citation

Email alerting service
Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

Notes

To request permissions go to:
http://group.bmj.com/group/rights-licensing/permissions

To order reprints go to:
http://journals.bmj.com/cgi/reprintform

To subscribe to BMJ go to:
http://group.bmj.com/subscribe/