Short Report

Segmental duplication of the fetal anterior cerebral artery

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Abstract

Segmental duplications (also termed ‘fenestrations’) of the fetal anterior cerebral artery are a relatively rare anomaly. Their occurrence was studied in 200 fetuses at 20–40 wk gestational age. Duplications were found in 21 of the 200 fetuses, i.e. 10.5%. In 2 fetuses, i.e. 1%, the duplications were bilateral. In 1 case, i.e. 0.5%, 2 duplications were found on the left anterior cerebral artery. There were 15 segmental duplications on the left anterior cerebral artery, i.e. 62.5% of all duplications, and 9 on the right, i.e. 37.5%. The duplications were located in the distal part of the A₁ segment in 45.7%, at the level of the anterior communicating artery (A₁–A₂) in 37.7%, and in the initial part of the A₂ segment in 16.6%. The duplications had 4 different forms namely oviform, fissured, triangular and punctate.

Key words: Vasculature; fenestration; cerebral aneurysms.

Introduction

Segmental duplication of the cerebral arteries, also referred to as ‘fenestration’, was identified in autopsies by Ito et al. (1981). Such duplications have achieved importance over the last 15 to 20 y, because it was observed that an aneurysm may arise at the proximal end of a duplication (Shinichiro et al. 1981; Samuel & Linda, 1984). It was found that a defect of the media may be present at the proximal end of the duplication, leading to the formation of an aneurysm (Tohru et al. 1982). The frequency of fenestrated anterior cerebral arteries with aneurysm formation is unknown, but is not low (Takashi et al. 1985).

Segmental duplication of the anterior cerebral artery is a rare embryonic malformation, arising from incomplete fusion of the small branches which are the precursors of the artery at about 35 d postconception (Padget, 1944; Tohru et al. 1982). The location of such duplications in all described cases was usually in the distal one third of the A₁ segment of the anterior cerebral artery (Takashi et al. 1985). Segmental duplications of this artery have been observed mainly in adult autopsy cases, but they have been reported rarely as an angiographic finding (Ito et al. 1981). As we failed to find descriptions of segmental duplications in fetal material in the literature the present study was undertaken on the fetal anterior cerebral artery.

Material and Methods

Segmental duplication of the anterior cerebral artery was studied in 200 fetuses at 20–40 wk gestational age. After the beginning of the fetal period (52 d embryo; Padget stage 7; Carnegie stage XXIII), all anatomical features, anomalies and variations of the segments of the circle of Willis are formed (Padget, 1944; Milenković et al. 1985; Owerbeeke 1991). We obtained the fetuses from the Gynaecology and Obstetrics Clinic of the Medical Faculty of Niš. The arterial system of the fetuses was injected with Micropaque contrast medium. The brains were carefully removed from the skulls and kept for 7–10 d in 10% formaldehyde. The presence of segmental duplication of the anterior cerebral arteries was studied by macro and microdissection using an operating microscope.

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The diameter of the A₁ segment of the fetal anterior cerebral artery was 0.25–0.93 mm, its length being 3–10 mm. Segmental duplication of the artery was found in 21 out of the 200 fetuses, i.e. in 10.5% of examined fetuses (Table, Figs 1–3). In 2 fetuses segmental duplications were found on both anterior cerebral arteries, i.e. in 1% of our cases (Fig. 4). In 1 fetus, i.e. in 0.5%, 2 segmental duplications were found on the left anterior cerebral artery (Fig. 5). Thus we found a total of 24 segmental duplications in 21 fetuses, out of which 15 were on the left and 9 were on the right, i.e. 62.5% of all duplications were on the left and 37.5% on the right (Table). The duplications were located in the distal part of the A₁ segment of the artery (Figs 1, 2), on the left in 7 cases and in 4 on the right, i.e. in the distal part of the A₁ segment the duplications were located in 29.1% of all duplications on the left and in 16.6% on the right. The second most frequent location for segmental duplication was at the level of the anterior communicating artery (Fig. 3), in 5 cases on the left and in 4 cases on the right, i.e. at the level of the anterior communicating artery the duplications were located on the left in 20.7% and on the right in 16.6% of all duplications (Table). The third most frequent location was at the initial part of the A₂ segment of the anterior cerebral artery (Fig. 6), in 3 cases on the left and in 1 on the right, i.e. in the initial part of A₂ segment on the left side the duplications were located on the left in 12.5% and on the right in 4.1% of all segmental duplications (Table).

In 2 fetuses with segmental duplications on both anterior cerebral arteries, these were located at the

<table>
<thead>
<tr>
<th>Location of duplications</th>
<th>All sites</th>
<th>A₁ right</th>
<th>A₁ left</th>
<th>A₁–A₂ right</th>
<th>A₁–A₂ left</th>
<th>A₂ right</th>
<th>A₂ left</th>
<th>ACA right</th>
<th>ACA left</th>
<th>Length of duplications (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nos of SDs</td>
<td>24*</td>
<td>4</td>
<td>7</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>3</td>
<td>9</td>
<td>15</td>
<td>—</td>
</tr>
<tr>
<td>SD frequency (%)</td>
<td>12.0</td>
<td>2.0</td>
<td>3.5</td>
<td>2.0</td>
<td>2.5</td>
<td>0.5</td>
<td>1.5</td>
<td>4.5</td>
<td>7.5</td>
<td>—</td>
</tr>
<tr>
<td>Proportion of total no. of SDs (%)</td>
<td>16.6</td>
<td>29.1</td>
<td>16.6</td>
<td>20.7</td>
<td>4.1</td>
<td>12.5</td>
<td>37.5</td>
<td>62.5</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Fissured form</td>
<td>8</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>—</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>0.3–1</td>
</tr>
<tr>
<td>Triangular form</td>
<td>6</td>
<td>—</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>—</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>0.6–2</td>
</tr>
<tr>
<td>Oviform form</td>
<td>4</td>
<td>—</td>
<td>2</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>4</td>
<td>0.3–0.6</td>
</tr>
<tr>
<td>Punctuate form</td>
<td>6</td>
<td>2</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>0.1–0.2</td>
</tr>
</tbody>
</table>

* Includes 2 cases with unilateral and 1 case with bilateral double duplications.
level of the anterior communicating artery (Fig. 4). In the case with a left anterior cerebral artery with 2 duplications, the first was located in the distal third of the A₁ segment and the other at the level of the anterior communicating artery (Fig. 5). The length of the duplications measured in a proximodistal direction was 0.1 to 2 mm (Table). We found 4 different forms of duplication visible to the naked eye: (1) punctate (Fig. 5); (2) oviform (Fig. 4); (3) triangular (Figs 2, 6); and (4) a fissured form (Fig. 1). The fissured form was found in 8 cases (Fig. 1), this being located in the distal part of the A₁ segment in 3 cases, at the level of the anterior communicating artery in 4 cases, and in the initial part of the A₂ segment in 1 case (Table). The length of these duplications measured in a proximodistal direction was 0.3−1 mm (Table). The triangular form was found in 6 cases (Figs 2, 6), was located in the distal part of the A₁ segment in 2 cases, at the level of the anterior communicating artery in 3 cases and in the initial part of the A₂ segment in 1 (Table) and had a length of 0.6−2 mm (Table). The punctate form was found in 6 cases (Fig. 5) and was located in the distal part of the A₁ segment in 4 cases, and in the initial part of the A₂ segment of the anterior cerebral artery in 2 (Table). Its length was 0.1−0.2 mm (Table). Finally, the oviform type was observed in 4 cases (Fig. 3) and was located in the distal part of the A₁ segment in 2 cases and in 2 cases at the level of the
anterior communicating artery (Table). Its length was 0.3–0.6 mm (Table).

**DISCUSSION**

According to Tohru et al. (1982), by that date only 38 cases of segmental duplication in the anterior cerebral artery (all in the A1 segment) had been reported; of these 33 were confirmed by autopsy and 5 by angiography. They were located in the distal one third of the horizontal portion of the anterior cerebral artery (Takashi et al., 1985) but their accurate incidence is still unknown. According to Ito et al. (1981), Hasebe found 6 cases of segmental duplication of the anterior cerebral artery in 83 brains, whereas Fawcett et al. found only 1 instance in 700 brains. The duplications were located in the medial half of the horizontal segment of the artery (Ito et al. 1981). Our findings are more detailed: we found 21 fetuses with segmental duplications, i.e. in 10.5% of examined fetuses. In 1% of our cases we observed duplications on both sides. Ito et al. (1981) stated that bilateral duplications had not been detected in any brain. In 0.5% of our cases we found 2 duplications on one anterior cerebral artery, but we could not locate a similar finding in the literature. Out of the total of 24 duplications, in 62.5% they were situated on the left anterior cerebral artery and in 37.5% on the opposite artery. In 45.7% cases they were located in the distal part of the A1 segment, at the level of the anterior communicating artery in 37.7% and in the initial part of the A2 segment in 16.6%. Marinković et al. (1986) described fenestration which was present are the same time in the A1 and A2 segments of the anterior cerebral artery. We did not observe this if we exclude our findings at the level of the anterior communicating artery. The correlation between abnormalities of the circle of Willis and cerebrovascular events is strong as is most evidence in the anterior portion of the circle (Perlmutter & Rhoton, 1976). Our findings on the location of segmental duplication of the anterior cerebral artery agree with this statement. All were located at the level of the anterior cerebral – anterior communicating artery complex.

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**REFERENCES**


