ASSESSMENT OF VARIATIONS IN BRANCHING PATTERN OF MIDDLE CEREBRAL ARTERY

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ABSTRACT

Background: A solid understanding of the cerebral artery’s normal anatomy, branching pattern, and distribution segment is required for the necessary interpretation of radiological images to plan the best treatment course. The present study was conducted to assess variations in branching pattern of middle cerebral artery.

Materials & Methods: 40 cadavers were studied in the department of Anatomy. The internal carotid artery was identified and the origin of the middle cerebral artery was determined.

Results: Length of m1 segment was >20 mm in 5, 17-19 mm in 10, 14-16 mm in 15, 11-13 mm in 6 and <11 mm in 4 cases. Outer diameter of M1 segment >5 mm was present in 2, 3-5 mm in 34 and <3 mm in 4 cases. The difference was significant (P< 0.05). Branching pattern of middle cerebral artery was bifurcation in 25, trifurcation in 13 and ramification in 2 cases. The difference was significant (P< 0.05).

Conclusion: The length and diameter of the M1 segment were within the normal range. In maximum cases, bifurcation pattern was observed.

Key words: Middle cerebral artery, bifurcation, trifurcation

I. INTRODUCTION

The middle cerebral artery (MCA) is the largest and most complex arterial system of the brain. A solid understanding of the cerebral artery’s normal anatomy, branching pattern, and distribution segment is required for the necessary interpretation of radiological images to plan the best treatment course. The MCA divides into four main surgical segments, denominated M1 to M4. The M1 segment is known as Sphenoidal, M2 as Insular, which runs in the lateral fissure; M3 capsular, which comes out from lateral fissure, and M4 as Cortical. The middle cerebral artery runs initially in the lateral; cerebral fissure and then posterosuperior to the Insula and then divides into branches. According to MCA’s branching pattern, the origin of cortical branches differs as orbital branches, frontal branches, parietal branches, and temporal branches.

Anatomic variations of the MCA have been linked to neurovascular diseases; for example, increased hemodynamic stress caused by structural irregularities may predispose to saccular aneurysms. Computed tomography angiography is used for initial evaluations of the cerebral circulation in the context of neurologic disorders, and many studies have reported MCA variations as a radiologic reference. MCA variations have clinical significance on multiple levels. For example, they may predispose to certain diseases or influence clinical presentation. Moreover, they can guide neurosurgical planning and determine the options for treatment and management of postoperative complications. The present study was conducted to assess variations in branching pattern of middle cerebral artery.

II. MATERIALS & METHODS

This study comprised of 40 cadavers which were studied in the department of Anatomy. During post-mortem examination of the cadavers, a skin incision was made in front of one ear to another ear in the coronal plane. The skin was reflected both anteriorly and posteriorly and the skull vault was removed as a single piece taking special...
care not to injure the dura. A small Knick was made over the middle of each side of the frontal lobe. The durometer was divided into two halves with the help of non-toothed forceps. Followed it durometer was further divided into four flaps. The dura was opened from the frontal base in a transverse direction, and after cutting the flax, the frontal lobes were retracted slowly. The optic nerves were exposed and carefully cut along with the internal carotid artery (ICA) at their entrance into the cranial cavity. The brain was removed from the cranial cavity and preserved in 5% of formalin solution and numbered serially for further study. The specimen was soaked for 10–15 min in 10% formaldehyde solution. The internal carotid artery was identified and the origin of the middle cerebral artery was determined. Results were studied statistically with 0.05 value as level of significance.

III. RESULTS

Table I Distribution of the length of M1 Segment

<table>
<thead>
<tr>
<th>Length (mm)</th>
<th>Number</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;20</td>
<td>5</td>
<td>0.02</td>
</tr>
<tr>
<td>17-19</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>14-16</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>11-13</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>&lt;11</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

Table I shows that length of m1 segment was >20 mm in 5, 17-19 mm in 10, 14-16 mm in 15, 11-13 mm in 6 and <11 mm in 4 cases. The difference was significant (P< 0.05).

Table II Outer diameter of M1 segment

<table>
<thead>
<tr>
<th>Diameter (mm)</th>
<th>Number</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;5</td>
<td>2</td>
<td>0.01</td>
</tr>
<tr>
<td>3-5</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>&lt;3</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

Table II, graph I shows that outer diameter of M1 segment >5 mm was present in 2, 3-5 mm in 34 and <3 mm in 4 cases. The difference was significant (P< 0.05).

Table III Branching pattern of middle cerebral artery

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Number</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bifurcation</td>
<td>25</td>
<td>0.02</td>
</tr>
<tr>
<td>Trifurcation</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Ramification</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Table III shows that branching pattern of middle cerebral artery was bifurcation in 25, trifurcation in 13 and ramification in 2 cases. The difference was significant (P< 0.05).

IV. DISCUSSION

The middle cerebral artery (MCA) is the largest, most important, and most complex of the cerebral vessels and supplies blood to many cortical areas and deep brain structures. Variations in its numbers influence coverage area, resulting in distinct clinical manifestations. Anatomic variations of the MCA have been linked to neurovascular diseases; for example, increased hemodynamic stress caused by structural irregularities may predispose to saccular aneurysms. Computed tomography angiography is used for initial evaluations of the cerebral circulation in the context of neurologic disorders, and many studies have reported MCA variations as a radiologic reference. The MCA originates from the ICA, lateral to the optic chiasma and posterior to the olfactory tract. The artery then takes a lateral course, lying anterior to the optic tract and reaching below the APS to extend perforating branches to internal cerebral structures. The artery enters the lateral fissure where it bifurcates, trifurcates, or terminates as a primary trunk. Within the lateral sulcus, the artery overlies the cortical tissue of the insula and extends multiple cortical branches that spread over the convex superolateral surface of the cerebral hemisphere. The present study was conducted to assess variations in branching pattern of middle cerebral artery.

In present study, length of m1 segment was >20 mm in 5, 17-19 mm in 10, 14-16 mm in 15, 11-13 mm in 6 and <11 mm in 4 cases. Mohan aimed to study the variations in the microsurgical anatomy of the MCA in our population and compared the variables and discuss their importance with anatomic and surgical considerations.
The mean length of the MCA in this study was 12.8 mm with a standard error of 3.79 mm. The outer diameter of the M1 segment was with a mean length of 3.75 mm. In 69.2% middle, Cerebral Artery shows bifurcation and in 20%, it shows trifurcation and in 10.8%, it shows ramification types of branching patterns. The 39.1% cases show Temporo polar, 21.7% orbitofrontal, 9.1% anterior temporal, 6.6% prefrontal, and 4.1% middle temporal branches. Our results also reveal that the origin of the lenticulostriate branch in the middle cerebral artery was 85.85% from the trunk and 14.2% from division, respectively.

We found that outer diameter of M1 segment >5 mm was present in 2, 3-5 mm in 34 and <3 mm in 4 cases. Oo et al\textsuperscript{11} investigated and documented the extent of variations, the MCA in 100 fresh brain hemispheres from 50 deceased patients. Double MCA was observed in 2% of specimens. (e termination patterns were bifurcation (72%), trifurcation (16%), and primary trunk (12%); early bifurcation was also observed (3%). (e mean length of the main trunk (MT) was 20.6 ± 6.2 mm. (e number of perforators ranged from 4 to 15; most arose from the MT (96%), and the others originated at the bifurcation point (3%) and in post bifurcation divisions (1%). All of the perforators (100%) had a single branching pattern. (e number of cortical branches ranged from 6 to 13 and included the orbitofrontal (98%), prefrontal (99%), precentral (95%), central (98%), temporopolar (87%), anterior temporal (89%), middle temporal (24%), posterior temporal (62%), temporo-occipital (69%), anterior parietal (88%), angular (83%), and posterior parietal (57%) arteries. Early cortical branches emerged from the MT in 52% of specimens.

Mohr, JM Benrentt, Stein et al\textsuperscript{12} found that in bifurcation pattern, the superior division always contains orbitofrontal and prefrontal. The inferior division contains the temporopolar, anterior and temporal, and middle temporal. The central branch is always in the upper division, while the posterior temporal is always in the upper division.

V. CONCLUSION

Authors found that in maximum cases, bifurcation pattern was observed. The length and diameter of the M1 segment were within the normal range.

REFERENCES