Femoral Artery Catheterization and Vessel Tortuosity

Samuel J. Hessel and Joseph C. Sequeira
Department of Radiology, Harvard Medical School, Brigham and Women’s Hospital, Boston, Massachusetts, USA

Abstract. In the era of selective and superselective arteriography, vessel tortuosity, even in the presence of good pulses, can impede catheterization of the aorta and its branches. We assessed 101 patients who had femoral arteriography to determine whether there was a significant difference in tortuosity between the right and left sides and to define the degree to which significant tortuosity was bilateral.

Fourteen and 21 patients had tortuosity greater than 1 standard deviation above the mean of the population on the right and left sides, respectively. This difference was not statistically significant. Twenty-three of the 29 patients with tortuosity greater than 1 standard deviation above the mean had this finding unilaterally. There is no advantage to preferentially beginning catheterization on a particular side. Furthermore, since 80% of significant tortuosity is unilateral, the contralateral femoral artery should be approached with only minimal delay when tortuosity that impedes catheterization is encountered.

Key words: Atherosclerosis – Vessel tortuosity – Arteriography – Arteries, femoral – Catheters and catheterization

Materials and Methods

From a consecutive series of 114 femoral arterial catheterizations with radiographs exposed from the distal aorta caudad through the femoral arteries, we evaluated 101 studies of patients who had bilaterally patent vessels to the site of catheterization. Eight of the 114 studies were eliminated because vascular obstructions prevented full analysis of the vessels in question and five because they were repeat studies of patients already in this series.

The method of measuring “tortuosity” is based on the simple premise that normal vessels are straight; that tortuosity is, by definition, the degree to which a vessel deviates from a linear course. To measure this deviation, the outlines of the distal aorta and peripheral vessels to the level of catheterization were traced. Beginning at the site of catheter insertion bilaterally, the straightest lines possible were drawn from those points to the distal aorta to simulate the most linear catheter course (Fig. 1 A-C). A protractor was then used to measure the total degree of angulation from the site of entry to the distal aorta. The arithmetic (rather than the vector) sums of these angles were used for all further calculations.

The mean deviation in degrees from absolute linearity and the accompanying standard deviation (SD) were calculated separately for each side. Most vessels showed some deviation from a straight course. To evaluate those sides with the greatest “tortuosity,” we defined two categories: sides whose deviation from linear-
Table 1. Vessel tortuosity analyzed by side

<table>
<thead>
<tr>
<th></th>
<th>Right</th>
<th>Left</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of sides</td>
<td>101</td>
<td>101</td>
<td>202 (100%)</td>
</tr>
<tr>
<td>Number of sides &gt; 5 SD from mean degree of tortuosity</td>
<td>4</td>
<td>9</td>
<td>13 (4%)</td>
</tr>
<tr>
<td>Number of sides 1 SD to 2 SD greater than mean degree of tortuosity</td>
<td>17</td>
<td>26</td>
<td>43 (13%)</td>
</tr>
<tr>
<td>Number of sides &lt; 1 SD from mean degree of tortuosity</td>
<td>87</td>
<td>80</td>
<td>167 (84%)</td>
</tr>
</tbody>
</table>

SD = Standard deviation

Results

On the right side the mean deviation from linearity was 76 ± 70 degrees while on the left side it was 86 ± 80. This difference was not significant (Student’s t-test, P > 0.30). Table 1 shows that there was no significant difference in the number of patients with severe tortuosity on the right or left sides. While there seems to be a trend toward more tortuosity on the left, in the group between 1 and 2 SD above the mean, this was not significant when the total number of cases more than 1 SD above the mean were compared from the two sides (chi-square, P > 0.15). Three quarters of the patients with significant tortuosity had this finding unilaterally (Table 2). Only six of the 101 patients (6%) had bilaterally tortuous vessels and in only one of those cases was that tortuosity greater than 2 SD above the mean on both sides.

Discussion

While 29% of patients demonstrated at least moderate tortuosity, the sides of this tortuosity could not be readily predicted. However, if moderate tortuosity were encountered on one side, the opposite side had an 80% chance of not being significantly tortuous.