Prevention of Vascular Injury to the Spinal Cord Incidence of a Great Posterior Radicular Artery

By

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Key Words: great posterior radicular artery, spinal cord, cadaver study, great posterior radicular artery syndrome, subarachnoid puncture

Summary: This study investigated in 165 cadavers for the presence and morphology of a great posterior radicular artery (GPRA). The spinal cords were examined for the presence of a GPRA macroscopically and by stereomicroscopy, and the spinal segmental level where the GPRA was located and left-right differences were investigated. A GPRA was found to be present in 10 (6.1%) of the 165 cadavers, and a solitary unilateral GPRA was observed on the left or right side of the spinal cord in each of them. While no differences in laterality were identified, the GPRA was most often seen at the level of the spinal segment T11. The mean outer diameter of the GPRA was 0.43 mm.

No previous studies have described the GPRA in a Japanese population. In the 10 cadavers in which a GPRA found in this study its most common location was at the level of spinal segment Th11. There was a difference of more than 2 spinal segmental levels between the location of the artery in our study and in a European population, suggesting that the spinal segmental level at which the GPRA is located is 1 or 2 levels higher in the Japanese population.

Clinical interest in the great anterior radicular artery has been high because of great anterior radicular artery syndrome¹, however, the great posterior radicular artery is rarely mentioned even in anatomy or spinal surgery²,³ texts. This anatomical dissection study investigated morphology of the great posterior radicular artery in 165 cadavers.

Methods

The spines with spinal cords of 165 cadavers (male: 84; female: 81; mean age: 79.8 y/o) were fixed in formalin, and nerve roots existing the spine were followed to the intervertebral foramen and excised with the dura mater. The nerve root of one of the middle to lower cervical vertebrae was exposed as close as possible to the spinal ganglion to serve as an anatomical marker following excision. The spinal cord was the submerged in water and examined for the presence of a great posterior radicular artery macroscopically and by stereomicroscopy, and spinal segmental level at which the great posterior radicular artery was located and left-right differences were investigated (Fig. 1). Samples of spinal cord were photographed with a ruler, and the diameter of vessels was measured with image analysis software (NIH Image (http://rsb.info.nih.gov/nih-image)). Vessels < 0.3 mm in diameter of were excluded because of difficulty following them macroscopically and because they could easily be missed.

Results

A great posterior radicular artery was identified macroscopically in 10 (6.1%) of the 165 cadavers.

Left/right differences in the great posterior radicular artery

A solitary great posterior radicular artery was observed in all 10 cadavers, it was present on the left side of the spinal cord in 5 cadavers and on the side in the other 5 (Table 1).

Spinal segmental level of the great posterior radicular artery

The spinal segmental levels at which the great posterior radicular artery were identified at T11 (n = 4), T12 (n = 3), T10 (n = 2) or T9 (n = 1) (Table 2).
Outer diameter of the great posterior radicular artery

The outer diameter of the great posterior radicular artery was measured 10 mm lateral from the bifurcation of the posterior spinal artery. No measurements could be made in 7 cadavers because of damage to the artery or nerve root during excision or because of poor fixation. The mean diameter of the great posterior radicular arteries was 0.43 mm (range, 0.38–0.46 mm) (Table 1).

Simultaneous presence of a great anterior radicular artery at the same level

A great anterior radicular artery and a great posterior radicular artery were identified at the same spinal segmental level in only 1 cadaver.

Discussion

The reports by Kadyi\textsuperscript{4)} and Miyachi\textsuperscript{5)} provide the classic descriptions of spinal radicular arteries, but only a very small number of reports have described the great posterior radicular artery\textsuperscript{2,3).}

Spinal segmental level

According to the study by Jellinger et al.\textsuperscript{6)} in a European population, the most common site of the great posterior radicular artery is the level of spinal segment L1 (Table 3). Lang and Baldauf\textsuperscript{7)} reported

Table 1. Cadavers in which a great posterior radicular artery identified

<table>
<thead>
<tr>
<th>No.</th>
<th>Laterality</th>
<th>Spinal cord level</th>
<th>Outer diameter (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1337</td>
<td>Rt</td>
<td>Th11</td>
<td>not measured</td>
</tr>
<tr>
<td>1340</td>
<td>Lt</td>
<td>Th11</td>
<td>not measured</td>
</tr>
<tr>
<td>1342</td>
<td>Rt</td>
<td>Th11</td>
<td>not measured</td>
</tr>
<tr>
<td>1345</td>
<td>Lt</td>
<td>Th12</td>
<td>not measured</td>
</tr>
<tr>
<td>1353</td>
<td>Lt</td>
<td>Th11</td>
<td>not measured</td>
</tr>
<tr>
<td>1366</td>
<td>Rt</td>
<td>Th12</td>
<td>not measured</td>
</tr>
<tr>
<td>1367</td>
<td>Lt</td>
<td>Th10</td>
<td>not measured</td>
</tr>
<tr>
<td>K337</td>
<td>Lt</td>
<td>Th11</td>
<td>0.46</td>
</tr>
<tr>
<td>K828</td>
<td>Rt</td>
<td>Th10</td>
<td>0.38</td>
</tr>
<tr>
<td>K844</td>
<td>Rt</td>
<td>Th11</td>
<td>0.46</td>
</tr>
</tbody>
</table>

Fig. 1. Great posterior radicular artery (K844). The arrow is pointing to the right great posterior radicular artery (Th11).
that great posterior radicular arteries at the level of
the thoracic spine occur slightly more frequently
on the left side than on the right, whereas in the
lumbar spine, the arteries are most often seen at
the level of spinal segment L1, and they occur on
the left side more often than on the right\(^7\).

This is the first study to describe a great poste-
rior radicular artery in a Japanese population. In
the 10 cadavers in which a great posterior radicular
artery was identified in this study, it was most com-
monly located at the level of spinal segment T11
and there were no differences in laterality.

According to studies on the great anterior rad-
cicular artery published by Mannen\(^8\) and Miyachi\(^9\),
the great anterior radicular artery is most com-
monly located at the level of spinal segment T9
whereas the European study by Jellinger et al.\(^6\)
identified the spinal segment T10 as the most com-
mon level of the spine for the great anterior rad-
cicular artery.

There was a difference of >2 spinal segmental
levels between the level of the great radicular ar-
tery in the present study and the study by Lang and
Bedauf\(^7\), suggesting that the great anterior and
posterior radicular arteries occur 1–2 levels higher
in the Japanese population.

**Outer diameter of the great posterior radicular artery**

Suh and Alexander\(^9\) conducted a histological
study of radicular arteries, and reported that the
maximum diameter of “insignificant radicular ar-
teries” (macroscopically confirmed radicular ar-
teries) was 214 \(\mu\)m (0.214 mm)\(^9\). In the present
study, vessels with an outer diameter of \(\geq 300 \mu\)m
(\(\geq 0.3\) mm) were therefore considered to repre-
sent great posterior radicular arteries, and smaller ar-
teries were excluded because they could easily have
been missed and could have lowered measurement
accuracy.

Clinically, the great anterior radicular artery has
been identified as the vessel involved in anterior
spinal artery syndrome. Although rare, posterior

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**Table 2. Level of the great posterior radicular artery**

<table>
<thead>
<tr>
<th>Spinal cord level</th>
<th>Number of arteries present</th>
</tr>
</thead>
<tbody>
<tr>
<td>Th 9</td>
<td>1</td>
</tr>
<tr>
<td>Th10</td>
<td>2</td>
</tr>
<tr>
<td>Th11</td>
<td>4</td>
</tr>
<tr>
<td>Th12</td>
<td>3</td>
</tr>
</tbody>
</table>

**Table 3. Level of the great posterior radicular artery in 100 European cadavers (Jellinger et al.)**

<table>
<thead>
<tr>
<th>Percentage (%)</th>
</tr>
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<tbody>
<tr>
<td>Th9</td>
</tr>
<tr>
<td>Th10</td>
</tr>
<tr>
<td>Th11</td>
</tr>
<tr>
<td>Th12</td>
</tr>
<tr>
<td>L1</td>
</tr>
<tr>
<td>L2</td>
</tr>
<tr>
<td>L3</td>
</tr>
<tr>
<td>L4</td>
</tr>
<tr>
<td>L5</td>
</tr>
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spinal artery syndrome have been reported\textsuperscript{10}) that the great posterior radicular artery may occur and it includes cutaneous hyposensitivity at the spinal segmental level affected, deep sensory disturbance below the spinal segmental level affected, and bladder and rectal disturbances. Depending on the extent of the lesion, pyramidal tract disturbances may also occur.

In the future, we plan to study the great posterior radicular artery in more Japanese subjects and publish the results as a reference.

Conclusions

A great posterior radicular artery was identified in 10 of 165 cadavers by anatomical dissection (6.9%), and a solitary great posterior radicular artery was present on just one side of the spinal cord in each of the 10 cadavers. No differences in laterality were identified, but the most common level of great posterior radicular artery was at the spinal segment T11. The mean outer diameter of the great posterior radicular arteries was 0.43 mm.

References