Control of Aneurysm Volume by Adjusting the Position of Ligation During Creation of Elastase-Induced Aneurysms: A Prospective Study

**BACKGROUND AND PURPOSE:** Animal models with appropriate volume are crucial for preclinical assessment of aneurysm therapies. Our purpose was to control the aneurysm volume by adjusting the position of ligation during creation of elastase-induced aneurysms in rabbits.

**MATERIALS AND METHODS:** Sixty elastase-induced aneurysms in rabbits were created. Two different methods were used for creation, including group 1 (n = 30) by using a lower ligation (from the origin of the right common carotid artery [RCCA] to the ligation point, 10 mm) and group 2 (n = 30) by using a higher ligation (from the origin of the RCCA to the ligation point, 15 mm). Aneurysm sizes (neck diameter, width, and height) and volumes in the 2 groups were measured and calculated, and they were compared by using the Student t test.

**RESULTS:** The mean aneurysm neck diameter, width, and height for group 2 were significantly larger than those of group 1 (3.3 ± 0.8 versus 2.7 ± 0.6 mm, P < .001; 3.7 ± 0.7 versus 2.5 ± 0.7 mm, P < .001; 9.0 ± 1.7 versus 7.3 ± 1.9 mm, P < .001, respectively). The aneurysm volume in group 2 was significantly larger than that in group 1 (102.4 ± 54.8 mm³ versus 36.6 ± 26.8 mm³, P < .001).

**CONCLUSION:** The aneurysm volume of elastase-induced models in rabbits can be controlled by adjusting the position of the ligation. Using a higher ligation can create relatively more voluminous aneurysms, compared with using a lower ligation.

### Aneurysm sizes in Groups 1 and 2

<table>
<thead>
<tr>
<th></th>
<th>Group 1 (n = 30)</th>
<th>Group 2 (n = 30)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck diameter</td>
<td>2.7 ± 0.6</td>
<td>3.3 ± 0.8</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Width</td>
<td>2.5 ± .7</td>
<td>3.7 ± 0.7</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Height</td>
<td>7.3 ± 1.9</td>
<td>9.0 ± 1.7</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Volume</td>
<td>36.6 ± 26.8</td>
<td>102.4 ± 54.8</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

**Materials and Methods**

**Aneurysm Creation**

Elastase-induced saccular aneurysms were created in 60 New Zealand white rabbits. All procedures were approved by the Institutional Animal Care and Use Committee at our institution.

Two groups were studied in a prospective fashion, including group 1 (n = 30) by using a lower ligation (from the origin of the right RCCA [RCCA] to the ligation point, 10 mm) and group 2 (n = 30) by using a higher ligation (from the origin of the RCCA to the ligation point, 15 mm). Aneurysms were created mainly according to a method previously described with some modifications. Details of the modifications follow.

An 8-cm right paramidline incision was made from the thyroid cartilage to the sternum. Both the right sternomastoid muscle and the right sternothyroid muscle were dissected. The attachments of the right pectoralis tenuis muscle to the top of the sternum were dissected and reflected. After removing surrounding tissue gently, the origin of the RCCA at its junction with the subclavian and brachiocephalic arteries was completely exposed. A 5F sheath (Cordis Endovascular, Miami Lakes, Fla) was advanced retrograde in the RCCA. The inflated balloon was placed completely in the brachiocephalic and right subclavian arteries in all rabbits. After 20 minutes of incubation of the elastase solution, the balloon and sheath were removed, and the RCCA was ligated at a lower level (10 mm, group 1, n = 30) and at a higher level (15 mm, group 2, n = 30) cephalad to the RCCA origin. The proximal RCCA was transected just cephalad to site of ligation. The skin was closed with a 4–0 vicryl running suture.

**Follow-Up Angiography**

Intra-arterial digital subtraction angiography (IADSA) was performed at least 3 weeks after creation because our previous study indicated that the elastase-induced aneurysms remain stable beyond 3 weeks. The animals were anesthetized as described previously. Using a sterile technique, the surgeon performed exposure of the right common femoral artery and placed a 5F vascular sheath. Heparin (100 U/kg) was administered by the sheath. A 5F catheter (Envoy, Cordis Endovascular) was advanced into the brachiocephalic artery, and...
Mean neck sizes for groups 1 and 2 were 2.7 ± 0.6 mm (range, 1.2–3.9 mm) and 3.3 ± 0.8 mm (range, 1.7–4.4 mm), respectively (*P* < .001). Neck size in group 2 was significantly larger than that of group 1.

**Aneurysm Width**

Mean widths for groups 1 and 2 were 2.5 ± 0.7 mm (range, 2.6–4.7 mm) and 3.7 ± 0.7 mm (range, 2.8–5.9 mm), respectively (*P* < .001). Aneurysm width in group 2 was significantly larger than that of group 1.

**Aneurysm Height**

Mean heights for groups 1 and 2 were 7.3 ± 1.9 mm (range, 3.3–10.7 mm) and 9.0 ± 1.7 mm (range, 6.7–15.3 mm), respectively (*P* < .001). Aneurysm height in group 2 was significantly larger than that of group 1.

**Aneurysm Volume**

Mean aneurysm volumes for groups 1 and 2 were 36.6 ± 26.8 mm$^3$ (range, 3.7–115.8 mm$^3$) and 102.4 ± 54.8 mm$^3$ (range, 33.4–312.4 mm$^3$), respectively (*P* < .001). Aneurysm volume in group 2 was significantly larger than that of group 1.

**Results**

Aneurysm sizes are shown in the Table. Representative images are shown in Fig 1.

**Aneurysm Neck Size**

Mean neck sizes for groups 1 and 2 were 2.7 ± 0.6 mm (range, 1.2–3.9 mm) and 3.3 ± 0.8 mm (range, 1.7–4.4 mm), respectively (*P* < .001). Neck size in group 2 was significantly larger than that of group 1.

**Aneurysm Width**

Mean widths for groups 1 and 2 were 2.5 ± 0.7 mm (range, 2.6–4.7 mm) and 3.7 ± 0.7 mm (range, 2.8–5.9 mm), respectively (*P* < .001). Aneurysm width in group 2 was significantly larger than that of group 1.

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Mean heights for groups 1 and 2 were 7.3 ± 1.9 mm (range, 3.3–10.7 mm) and 9.0 ± 1.7 mm (range, 6.7–15.3 mm), respectively (*P* < .001). Aneurysm height in group 2 was significantly larger than that of group 1.

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References


