Experimental model for induction of cerebral aneurysms in rats

FERNANDO ALVAREZ, M.D., AND JOSÉ M. RODA, M.D.

Neurosurgery Service and Laboratory of Microsurgery, Hospital "La Paz," and School of Medicine (Autonomous University), Madrid, Spain

Two groups of rats with induced arterial hypertension were studied. One group underwent section of the left common carotid artery with an end-to-side anastomosis of the proximal segment to the right common carotid artery. The second group was subjected to ligation of the left common carotid artery. The number of aneurysms caused by the procedure in the first group was higher, the difference being statistically significant (p < 0.05, chi-square).

KEY WORDS • experimental cerebral aneurysm • aneurysm • hypertension • arterial anastomosis • rat

In 1980, a group at Kyoto University developed an experimental model for the production of saccular cerebral aneurysms in rats by 1) feeding them β-aminopropionitrile (a lathyrogen); 2) producing hypertension by ligation of the posterior branch of both renal arteries; 3) permitting ad libitum ingestion of 1% NaCl solution as drinking water; and 4) performing a unilateral carotid artery ligation. Their findings were confirmed by Suzuki, et al. Some authors have suggested that using a lathyrogen might induce vessel wall inflammation and that experimental intracranial aneurysms achieved without this agent would more closely resemble those occurring in man.

We undertook this study to identify a method of producing intracranial aneurysms without the use of a lathyrogen. We report here our results with an end-to-side common carotid artery anastomosis performed in rats.

Materials and Methods

Five-month-old female Wistar rats, weighing approximately 250 gm each, were separated into two groups. Group I included nine rats that were subjected to ligation of the posterior branch of both renal arteries and section of one common carotid artery with an end-to-side (left to right) bypass between both common carotid arteries. Group II included 10 rats that were subjected to ligation of the posterior branch of both renal arteries and the left common carotid artery. Anesthesia for both groups was induced with a mixture of diazepam (20 mg), Ketalar (ketamine hydrochloride, 50 mg), atropine (5 mg), and 4 cc of distilled water. This mixture was injected intramuscularly in a dose of 0.8 cc/100 gm body weight. The animals were fed on a standard laboratory diet with a 1% NaCl solution as drinking water. Blood pressure was periodically measured in unanesthetized animals by the tail plethysmographic method.

The experiment lasted 16 weeks with all the animals surviving except one, which died during the 11th week. At sacrifice, the rats were anesthetized and perfused with 50 cc of 1% heparinized normal saline through the exposed abdominal aorta. Next, 3 cc of a solution of contrast medium (Micropaque) and formalin was injected intra-arterially and an angiogram was obtained (Fig. 1). The brains were removed and fixed with 10% formalin. Three weeks later the vessels at the base of the brain were dissected and examined with an operating microscope.

Results

A summary of our findings is presented in Table 1. Of the nine Group I animals, a total of seven aneurysms were found in six rats: four at the anterior cerebral-anterior communicating artery complex, and three at the P2 segment of the left posterior cerebral artery (Fig. 2). Two aneurysms were observed in two of the 10 rats.
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![Panangiograms showing an end-to-side common carotid anastomosis (arrowhead). A: An aneurysm is visible at the anterior cerebral-anterior communicating artery complex (arrow). B: An aneurysm is seen at the posterior cerebral artery (arrow).](image)

in Group II; both were at the P₁ segment of the left posterior cerebral artery. The difference found in the number of aneurysms between the two groups was significant ($p < 0.05$, chi-square).

**Comment**

This experimental model produces intracranial aneurysms with reasonable reliability in an inexpensive laboratory animal. It is presumed that mechanisms of

![Photographs of the circle of Willis perfused with a mixture of iodine contrast material and formalin. A: An aneurysm is seen arising at the anterior cerebral-anterior communicating artery complex. B: A large thrombosed aneurysm is visible at the level of the posterior cerebral artery.](image)

<table>
<thead>
<tr>
<th>Treatment Group*</th>
<th>No. of Rats</th>
<th>No. of Rats with Aneurysms</th>
<th>No. of Aneurysms</th>
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</tr>
<tr>
<td>Group II</td>
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<td>2</td>
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</table>

* For a description of each group see text.
producing aneurysms in this model are close to those causing saccular cerebral aneurysms in humans. Any toxicity of lathyrogen, as used in the Kyoto University model, was avoided.

References

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Address reprint requests to: Fernando Alvarez, M.D., Servicio de Neurocirugia, Hospital “La Paz,” Paseo de la Castellana 261, Madrid 28046, Spain.