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Aneurysm

In vivo intraaneurysmal pressure measurements in experimental lateral wall aneurysms before and after onyx embolization

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Abstract

Background: The aim of this study is to measure and compare the in vivo intraaneurysmal pressures of experimental lateral wall aneurysms, before and after onyx embolization. The data of this experiment will carry an important role in forming the scientific basis for the clinical endovascular applications.

Materials and Methods: Five experimental lateral wall aneurysms were created by microsurgical techniques in 5 New Zealand rabbits' right common carotid arteries. Onyx embolization was applied to the aneurysms. Intraaneurysmal dome pressure and parent artery measurements before and after the procedure were recorded.

Results: The mean arterial pressure recording in parent artery was 69.2 ± 2.588 mm Hg under anesthesia. Mean heart rate was 131 beats per minute. The values were in physiologic limits. Meanwhile, aneurysm intradomal pressure recording showed a mean value of 59.2 ± 5.069 mm Hg. Although there was incomplete occlusion of the aneurysm, intradomal mean pressure was recorded to be 24.4 ± 8.876 mm Hg. After complete occlusion by onyx, mean intradomal aneurysm pressure was found to be 1.8 ± 0.836 mm Hg.

Discussion: This study is the first study reporting on intraaneurysmal pressure measurements before and after onyx embolization. The results in this experiment tend to show the adequate intraaneurysmal pressure control of onyx. This is important in the stabilization of the aneurysm to prevent rupture and rerupture. When compared with the findings of GDC coil, onyx embolization seems to be superior in intraaneurysmal pressure control.

Conclusion: In this study, it has been shown that onyx embolization decreases the intradomal aneurysmal pressure effectively.

Keywords: Aneurysm; In vivo; Onyx; Pressure

1. Introduction

The treatment options of cerebral aneurysm disease can be summarized under 2 headlines: surgical clip application and endovascular embolization. These 2 options carry complimentary characteristics in serving the objective of putting the aneurysm out of the circulation. With the rapid innovation of equipment and application techniques, the treatment indications for both modalities change dynamically. Ten years ago, as the endovascular technologies were being introduced for practice, they were applied to cases where surgery carried major contraindications and risks as the last resort of treatment. With recent improvements in

Abbreviations: DMSO, dimethyl sulfoxide; DSA, digital subtraction angiography; EVOH, ethylene vinyl alcohol copolymer; FDA, Federal Drug Administration; GDC, guglielmi detachable coil.

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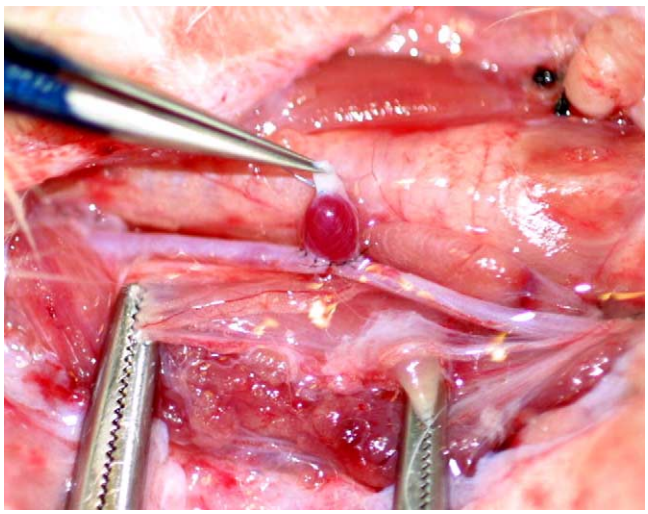

Fig. 1. The lateral wall aneurysm created by microsurgery. Note the visible circulation inside the aneurysm.

technology, endovascular modalities such as coil and onyx are becoming the primary treatment options in most of the medical centers [4,5].

Today, these endovascular modalities are used widely, but hemodynamic and biophysical studies on these issues are few in number. Most of the studies are clinical [7,11,18]. To give a scientific decision on the availability of these modalities, one has to have objective physical experimental data of the applications.

Dimethyl sulfoxide is a solution produced from lignin. It was first found in 18th century in Russia. This solution was approved by the FDA in 1980. Onyx liquid agent is a mixture of EVOH, DMSO, and micronized radiopaque tantalum powder. When onyx faces a liquid solution like blood, it immediately forms a permanent spongy mass with precipitation and solidification. Recently, onyx is used in intracranial aneurysm embolizations in indicated patients [1,6,13].

The aim of this study is to measure and compare the in vivo intraaneurysmal pressures of experimental lateral wall aneurysms, before and after onyx application. The data of this experiment will carry an important role in forming the scientific basis for the clinical applications.

2. Materials and methods

Experimental aneurysm model formations are described in New Zealand rabbit common carotid arteries [8]. The bifurcation and lateral wall aneurysms on New Zealand rabbit common carotid arteries were used and recommended as a model for endovascular experimental applications [8,22]. The size of the parent artery and aneurysm in this model mimics human Willis polygon artery and aneurysm sizes.

Five experimental lateral wall aneurysms were created by microsurgical techniques in 5 New Zealand rabbits' right common carotid arteries (Fig.1). Onyx embolization was applied to the aneurysms. Intraaneurysmal dome pressure and parent artery measurements before and after the procedure were recorded.

2.1. Onyx application and pressure measurements

Three weeks after the microsurgical aneurysm formation, onyx application and pressure measurements were carried out in 5 aneurysms. All applications were done in the angiography unit under sterile conditions.

The rabbit was placed in the DSA device in supine position with legs and arms fixed to the table. The anesthesia was succeeded by 35 mg/kg IM ketamine in combination with 2 mg/kg IM xylazine injections.

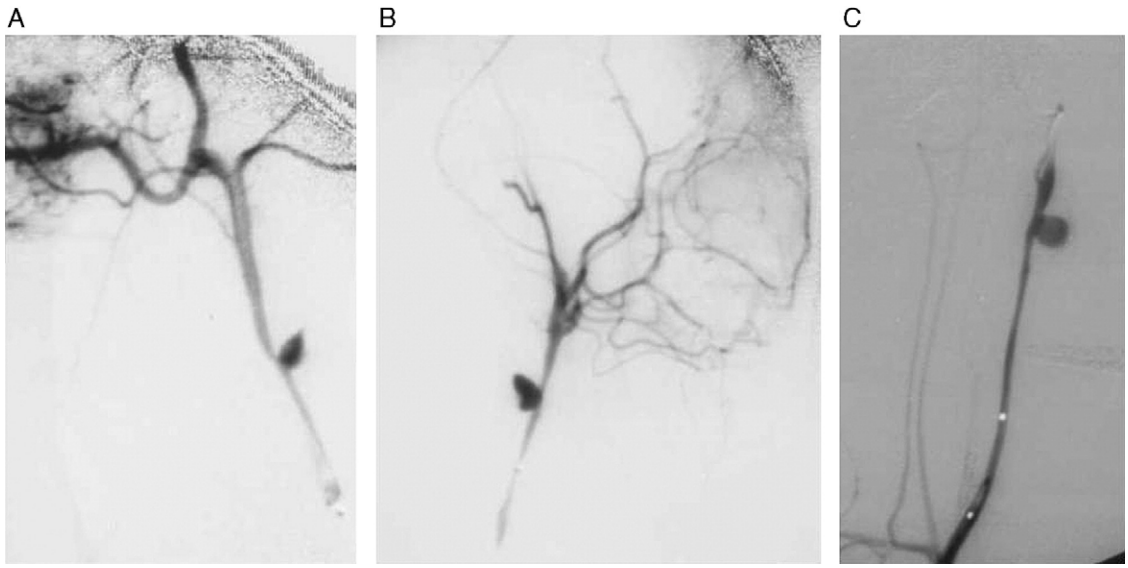

Fig. 2. The DSAs of 3 lateral wall aneurysms before embolization. A, B, and C demonstrate the angiographies of 3 different experimental aneurysms.