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Original research article

Clinical outcomes of multiple aneurysms microsurgical clipping: Evaluation of 90 patients☆

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ABSTRACT

Background: The incidence of multiple intracranial aneurysms (MIAs) among patients who are diagnosed with aneurysm is 15–45% in the literature. Treatment options depend on the patient's status, age, aneurysm location and neurosurgeon's experience. In this study outcomes of micro-surgically clipped 90 patients have been evaluated.
Materials and methods: Medical records of 90 (49 women and 41 men) patients of MIAs who underwent surgery by the authors, during a 3-year period from 2011 to 2013 were retrospectively reviewed of prospectively collected patients' data. Surgically treated patients underwent a lateral supraorbital craniotomy followed by microsurgical clipping of all reachable aneurysms.
Results: The mean age of the sample is 50.8 ± 11.9 (25–82) years. There were 67 patients presented with SAH. The most common complaint was severe headache of sudden onset (94%) in SAH group and migraine type headache (60.8%) in incidentally diagnosed group. According to location of the arteries; ACoA (50), MCA (R:49,L:45), ICA (R:34,L:15), PCoA (R:9, L:4), ACA (R:6,L:4), basilar artery (3) and SCA (2). Mortality rate was 13.3% ($n = 12$), morbidity rate (new deficit was developed) was 18.8% ($n = 17$) [7 out of them were partially/completely dependent on others for daily living activities before surgery (i.e. GOS < 3)] and 67.8% ($n = 61$) of the patients returned to their normal jobs and daily activities.
Conclusions: Multiple cerebral aneurysms are not associated with a less favorable outcome than are single aneurysm cases. Authors prefer microsurgical clipping of all the aneurysms, be it on the reverse side, if the aneurysm location is reachable and that includes bilaterally presenting MIAs.

☆ This study was approved under decision number: (573) by the medical ethics committee of Bakırköy Research and Training Hospital for Neurology Neurosurgery, and Psychiatry (BRSHH) in Istanbul-Turkey.
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1. Introduction

Cerebral aneurysms occur in 1–2% of the population and account for about 80–85% of non-traumatic subarachnoid hemorrhages (SAH). Autopsy studies indicate prevalence in the adult population between 1% and 5%; however, 50–80% of all aneurysms do not rupture during the course of a person's lifetime. Unruptured intracranial aneurysms are more common in women as much as three times [1,2]. Some rare familial forms of aneurysms have been associated with conditions such as autosomal dominant polycystic kidney disease, Marfan's syndrome, Ehlers–Danlos syndrome type IV, fibromuscular dysplasia, Moyamoya disease, sickle cell disease, and arteriovenous malformations of the brain [1]. An important risk factor for aneurysm is the family history. Patients with one affected family member have approximately a 4% risk of having an aneurysm, whereas patients with 2 or more affected first-degree family members have an 8–10% risk of developing an aneurysm [1].

Despite the fact that no accurate number, we estimate that the incidence of SAH that related to ruptured cerebral aneurysms in Turkey is approximately 8/100,000 person-years (our hospital is one of main four reference centers in Istanbul, in which yearly operated on approximately 150 patients). SAH is more common in women than in men (2:1) with the peak incidence occurring in age group 50–60 years old [2,4]. The mortality rate for SAH is 8.3–66.7%, and as high as 3 in 5 of those who survive SAH may be functionally dependent [3].

It is still being debated when neurosurgeons have to treat unruptured aneurysms especially in multiple intracranial aneurysm (MIA) cases. It is well-known that aneurysms over years will grow and may get ruptured. The rupture risk assessments for MIAs are mainly based on morphology [1,3–8]. Hemodynamics play a fundamental role in aneurismal rupture [3,6–8]. It is largely unknown whether hemodynamic factors are also involved in modulating the risk of rupture in MIAs. Several studies showed that MIAs are associated with a less favorable outcome than are single aneurysm cases after SAH [2,8]. Herein, the authors reviewed their own microsurgical clipping experience for treatment of MIAs.

2. Materials and methods

This present retrospective study was approved by the medical ethics committee of our hospital. Written informed consent was obtained from all patients or from their first-degree relatives (if they are not neurologically intact) for publication of their cases and accompanying images.

Medical records were prospectively collected (all entrance data were collected at the time of hospitalization) from consecutive 409 cases of cerebral aneurysms which were treated surgically at Department of Neurosurgery of our hospital, between the years 2011 and 2013. Only the patients diagnosed as having multiple aneurysms and at least one of their aneurysms surgically treated were included in this study (n = 90). Clinical outcomes were evaluated using patients' complaints, locations, treatment choices, comorbidities, complications, mortality and morbidity rates. The clinical outcomes were evaluated using Glasgow Outcome Scale (GOS). Surgically treated patients underwent a craniotomy then microsurgical clipping of all aneurysms that had been accessed. The aneurysms not appropriate for clipping were wrapped by a thin layer of very small cotton pad, or sent to coiling/embolization.

Statistics below are expressed as the mean ± standard deviation values together with the range between parentheses. Differences among groups were assessed with the one-way analysis of variance (ANOVA) using the SPSS 21.0 statistical package. Significance in the multivariate model was determined by a $p < 0.05$, and a trend-level effect was assigned to a $p = 0.05–0.10$, all p values were given with odds ratio (OR).

2.1. *Surgical procedure*

First of all; brain computerized tomography (CT), cerebral angiogram, high-quality three-dimensional CT angiography (3-DCTA) and/or digital subtraction angiography (DSA) are well studied. Aneurysms' number, their projections, abnormal morphological changes, hypoplasic arteries and/or ruptured aneurysms are evaluated. According to all of these variants surgeon tries to understand the place and projection of ruptured aneurysms. The conditions where anatomy permits unilateral approaches should be assessed in detail and decided preoperatively, preferring ipsilateral approaches over bilateral approaches and single stage over multiple stages. Ruptured, irregularly shaped and large aneurysms (good candidates for rupturing) are first priority for repairing.

Craniotomy should always be performed on the side of the ruptured aneurysm. The desire to clip all the aneurysms must not put the patient in danger by starting from the non-ruptured site so as to facilitate the single stage clipping of all the pathology. After the bleeding aneurysm is dealt with, incidental one/s must come into light. The projection of contralateral or distal aneurysms, the depth required to reach the distal aneurysms and experience of the surgeon are other factors may play role in craniotomy place and size.

Under general anesthesia the patients are positioned supine with the head held in fixation device after slightly extended the malar eminence to be uppermost. The head generally turn to the opposite side in 45 degree and tilted the same amount. This will facilitate the exposure of the Sylvian fissure and especially help exposing of the aneurysms on the contralateral side by allowing the contralateral A1 and M1 to line up and be seen as a near-straight path flowing distally. In this series, the neurosurgeon used lateral supraorbital craniotomy for all aneurysms about 3-cm to 3-cm in size that are planned for single stage clipping, except for additional pericallosal and/or callosomarginally situated ones which are dealt with a slightly larger but single craniotomy extending medially stopping in the immediate midline to be able to visualize interhemispheric fissure. The appropriate basilar tip aneurysms are of no exception. Basillary trunk and/or other posterior system aneurysms are not considered to be appropriate for single stage intervention together with anterior system aneurysms.

After suitable craniotomy is performed the roof and the lateral walls of the orbit are radically thinned to a near total, and the sphenoid ridge is drilled to allow an extra space for

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