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Research article

Risk factors analysis of mirror aneurysms: A multi-center retrospective study based on clinical and demographic profile of patients

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ABSTRACT

As a special subgroup of multiple intracranial aneurysms, mirror aneurysms are located bilaterally on the corresponding intracranial arteries. The current study sought to compare the clinical and demographic features of patients harboring mirror aneurysm, and to elucidate the corresponding risk factors. We performed a retrospective cohort study of 2641 intracranial aneurysms patients, who were admitted to our hospitals between January 2005 and June 2014. Patients were subdivided into three groups based on the inclusion criteria: (i) single (n = 2250); (ii) non-mirror multiple (n = 285); and (iii) mirror aneurysms (n = 106). Clinical and demographic files of the three groups were collected and compared, and medical histories including stroke, hyperlipemia, hypertension, hyperglycemia, valvular heart disease were considered as potential risk factors. Potential morphological reasons for mirror cerebral aneurysms rupture, including aneurysms size, irregular walls and cerebral hemispheric dominance, were also compared. Our data showed that the male to female ratio of mirror aneurysms patients was 1:3.61, which was significantly different from that of single aneurysm (1:1.27) and multiple aneurysms (1:2.00). The prevalence of mirror aneurysms in women is higher than that in men ($P < 0.001$). Older patients (especially 60–69 years old) also appear to be more vulnerable to mirror aneurysm than single aneurysm ($P < 0.001$). In 84 mirror aneurysm patients the aneurysms were located on the internal carotid arteries (79.2%), most typically at the PComA or in the Cavernous ICA. Patients with medical history of hyperlipemia appear to have an increased risk of harboring mirror aneurysms. Larger aneurysm size and presence of an irregular aneurysm wall appear to be the morphological factors that predispose for mirror aneurysms rupture.

1. Introduction

Intracranial aneurysms are a cerebrovascular disorder that afflicts approximately 5% of the population worldwide, and of these 20–30% harbor multiple aneurysms [1,2]. Although most of the intracranial aneurysms remain unruptured, the consequence of subarachnoid hemorrhage (SAH) induced by aneurysms rupture are catastrophic, carrying a high mortality rate of around 40% [3–6].

Mirror aneurysm, also known as symmetrical bilateral intracranial aneurysm or "twin" aneurysms, account for less than 5% of all aneurysms [7]. However, mirror aneurysms account for roughly 40% of the multiple aneurysms [6]. Mirror aneurysms are typically diagnosed on both sides at the same time and can be found in various locations of the intracranial arterial system [5]. Previous studies on mirror aneurysms are mostly case reports, and there is limited information available in the literature about risk factors, demographics, outcome and follow-up of patients with such aneurysms. We therefore conducted this large retrospective cohort study to increase our knowledge about these aneurysms.

As a subgroup of multiple aneurysms, mirror aneurysms should also be compared with non-mirror multiple aneurysms. However, most previous research has combined single aneurysms and non-mirror

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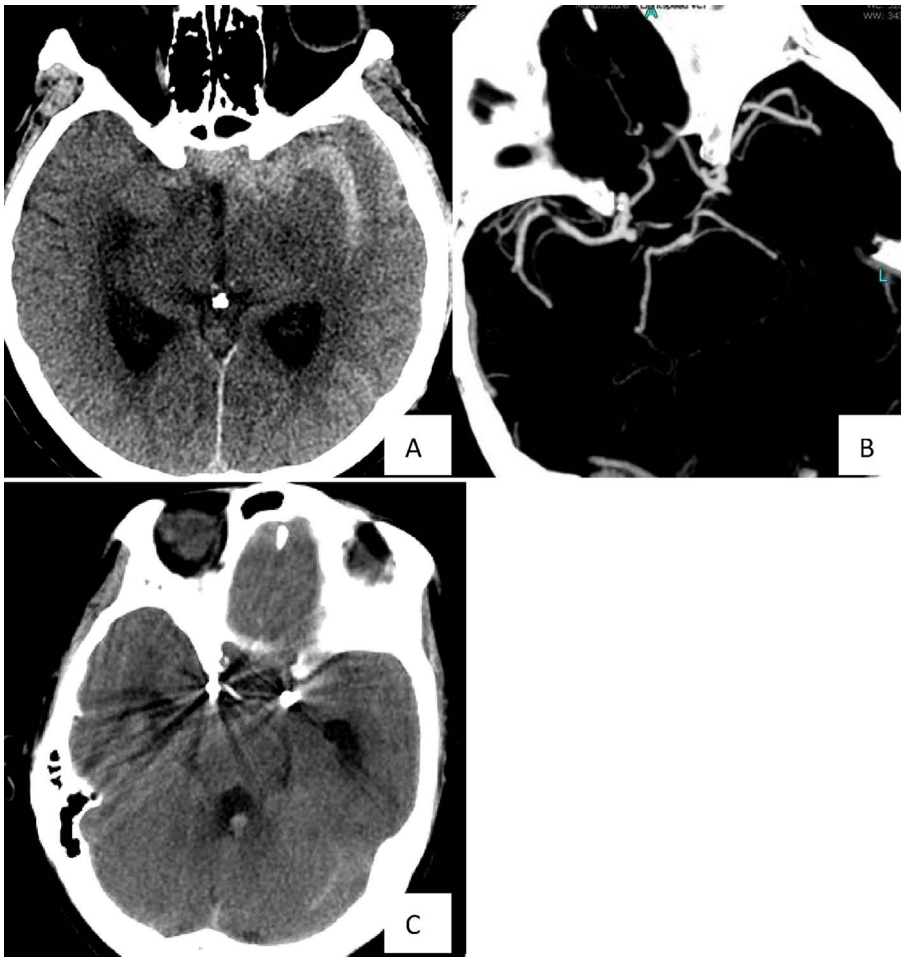

Fig. 1. A. CT scan detected SAH with laterality (notably more blood agglomeration in the left bilateral than in the right bilateral). B. Maximum intensity projection image (with 10 mm slice thickness, window level and window width equal to the Hounsfield units within the aneurysm) detected that mirror aneurysms were located at ICA (symmetrically, same orientation). Mirror aneurysms in the left hemisphere was determined as the ruptured one based on SAH types. C. Examination of patients underwent vascular coiling after 7 days found that basically the SAH get absorbed and disappeared using plain CT scan, showing good prognosis (GOS, point 4) when discharge.

multiple aneurysms into one group, making no distinction between multiple aneurysms and mirror aneurysms [7–12]. This study aimed to compare the demographic characteristics, medical history and aneurysm location for patients with mirror aneurysms, non-mirror multiple aneurysms and single aneurysms.

To this end, we included 2641 consecutive patients with intracranial aneurysms admitted to our university-affiliated hospitals. Among them, 2116 patients were with SAH. Comparison was then made between the groups to determine specific clinical and demographic features of mirror aneurysms.

2. Patients and methods

This retrospective study was approved by the ethical committees of our hospitals, and patient informed consent was waived due to the study design. Patients admitted to our hospitals with SAH are examined using head imaging technique to determine the cause of the bleed and to reveal the relevant information about cerebral arteries.

Inclusion criteria for mirror aneurysm group were as follows: the presence of paired or “twin” intracranial aneurysms located in similar positions bilaterally on the parent arteries (Fig. 1), but with no sign of symmetry or specific direction of aneurysm growth, and no sign of extracranial-intracranial aneurysms [5,13,14]. Mirror aneurysm patients with arteriovenous malformations or Moyamoya disease were excluded from the study.

Patients with single aneurysms were included in the single group, patients with multiple aneurysms, but not mirror-like aneurysms, were classified in the non-mirror multiple group, and patients with mirror aneurysms were added to the mirror group, on the basis of surgical results and angiographic findings. For patients who did not receive surgery or DSA, CTA images were observed independently by two neuroradiologists blinded to the clinical and demographic files of the patients, as previously described by Huang et al. [15]. Cases of dissent were discussed before a decision was made jointly. Intracranial aneurysm measurement was conducted independently by another two neuro-radiologists, and the values are averaged for statistical analyses afterwards.

The sites of the aneurysms were grouped into four locations: a) ICA, internal carotid artery (including ICA terminus; PComA; Cavernous ICA); b) ACA, anterior cerebral artery; c) MCA, middle cerebral artery (including the M1–2 bifurcation); and d) Posterior circulation artery (including vertebral artery and posterior cerebral artery) [13,14,16,17]. For patients with mirror aneurysms, the ruptured aneurysm was identified on the basis of the pattern of hemorrhage on CT and surgical outcome. For mirror-aneurysm patients with acute SAH, the ruptured aneurysm was treated first, and then the non-ruptured aneurysm was treated in the same session if feasible. However, if it was not clear which aneurysm was ruptured, coiling was always attempted for all potentially ruptured aneurysms in the same session.

Patients’ medical history was questioned recorded upon admission. Sex, age, aneurysm locations, and medical history (including stroke, hyperlipemia, hypertension, hyperglycemia, and valvular heart disease) were compared among the above-mentioned three groups. In this retrospective study, the medical records of 2641 patients were analyzed. Among them, 2250 patients had single aneurysm, 285 had multiple aneurysms, and 106 had mirror aneurysms.

2.1. Statistics analysis

Statistical analyses were performed using SPSS19.0 software