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Technical Notes & Surgical Techniques

Surgical treatment of ruptured intracranial aneurysms: Timing of treatment and outcome

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ABSTRACT

Background: Patients with ruptured intracranial aneurysm should be treated as early as possible, ideally in the first three days post-hemorrhage. However, in countries like Brazil, these patients are usually not admitted to hospital during this period, creating controversies about ideal timing for surgery.
Objective: This study evaluated associations between the timing of treatment and the outcomes of patients submitted to clipping of ruptured intracranial aneurysms.
Methods: A retrospective investigation about 218 patients, with 251 ruptured aneurysms, submitted to surgery for clipping was conducted. All patients were treated on the day of admission. Regarding the timing of treatment post-hemorrhage, patients were divided into early surgery, treatment on days 1 or 2; intermediate surgery, on days 3–10; and late surgery, > 10 days. The grade of subarachnoid hemorrhage on admission was assessed by Hunt and Hess scale. Outcomes on discharge were investigated using the modified Rankin scale and mortality rate.
Results: In 102 patients admitted with good clinical grade, 19 showed poor outcomes (mortality rate: 6.8%), while, in 86 patients admitted with poor clinical grade, 50 showed poor outcomes (mortality rate: 27.9%). No statistically significant relationships were verified between the timing of surgery and a poor outcome and mortality, even classifying patients according to aneurysm location and Hunt Hess scale.
Conclusion: No statistically significant associations among mortality or poor outcome and timing for surgery were demonstrated. Considering the risks of re-bleeding and hospital stay, the surgical clipping should be considerate as soon as possible in patients with ruptured aneurysms.

1. Introduction

The principal causes of death following aneurismatic subarachnoid hemorrhage (SAH) are a devastating initial hemorrhage, rebleeding [1,2], and delayed cerebral ischemia (DCI) [3]. The theoretical benefits of early surgery are a reduction in the risk of rebleeding and the washout of cisternal blood, which is a possible factor in the development of cerebral ischemia [4]. Early clipping of the cerebral aneurysm allows for safer introduction of hypertensive treatment strategies aimed at the prevention and/or treatment of DCI [5].

However, in countries like Brazil, usually, these patients are not admitted to vascular neurosurgery reference hospital in the first three days following an aneurysm rupture. Thus, the timing of treatment is controversial, especially in cases where patients arrives between three and ten days post-hemorrhage.

In such cases, delayed surgical intervention may reduce the morbidity and mortality of the surgical procedure due to improvements in operating conditions and in the individual patient's general condition

Abbreviations: SAH, subarachnoid aneurysmatic hemorrhage; DCI, delayed cerebral ischemia; ACA, anterior cerebral artery; MCA, middle cerebral artery; ICA, internal carotid artery; HH, Hunt and Hess scale; mRS, modified Rankin scale

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[1]. However, delaying surgery inevitably exposes the patient to a greater risk of a devastating rebleed, and may restrict the implementation of hypertensive treatments for vasospasm during the preoperative waiting period [6]. The continuing dilemma is whether surgery should be performed to reduce the risk of rebleeding without causing a significant deterioration in overall management outcome by inflicting excess morbidity and mortality [7].

Thus, this study evaluated the association between the timing of treatment and the outcome of patients submitted to clipping of ruptured intracranial aneurysms.

2. Materials and methods

The present study is a retrospective investigation based in medical records and shows data from procedures performed in a vascular neurosurgery reference hospital from public health system of Brazil, between April of 2008 and September of 2016. In this period, 320 patients, with 414 intracranial aneurysms, were submitted to surgery for clipping. Of these, 218 patients presented ruptured aneurysms from anterior intracranial circulation and were included in this study. All patients with ruptured aneurysms were submitted to cerebral angiography and surgery for treatment on the same day of hospital admission. The Institutional Review Board from the involving hospital approved the present study and all the patients received and agreed an informed consent statement.

2.1. Timing of treatment

Regarding the timing of treatment, the patients were classified into three groups, according to the period between the aneurysm rupture and the treatment for clipping: early surgery, patients treated until the second day after subarachnoid hemorrhage; intermediate surgery, patients treated between 3th and 10th day after SAH; and late surgery, patients treated > 10th day after SAH. Patients submitted to surgery between 3 and 10 days after SAH were established as reference for evaluating clinical evolution and mortality among groups.

2.2. Aneurysms characteristics

The patients were classified into three groups according to segment of cerebral arteries were affected by the aneurysm: the anterior cerebral artery (ACA) group, the middle cerebral artery (MCA) group and the internal carotid artery (ICA) group.

In the ACA group were included aneurysms from the segment A1 of the ACA, the anterior communicating artery and the pericallosal artery. The MCA group included those in M1, M2, and M3 branches of the MCA and in the MCA bifurcation segment. In the ICA group was included those in the paraclinoid segment (carotid cave, ophthalmic artery and superior hypophyseal artery), posterior communicant segment, anterior choroidal segment and carotid bifurcation.

The size of aneurysms were measured by cerebral angiography, considering the distance between colus to fundus, in millimeters. Aneurysms with size ≥12 mm was classified as large or giant. The presence of multiple aneurysm, in any vascular segment of cerebral circulation, was either investigated.

2.3. Clinical status on admission and outcome

The clinical status on admission was assessed according to the Hunt and Hess (HH) scale for SAH [8]. The patients were grouped by HH scale in HH ≤ II group, good clinical status, and HH ≥ III group, poor clinical status.

The patient outcome was determined according to the modified Rankin scale (mRS) [9] in discharge of hospital. Good outcome was considered with a score of mRS ≤ 2, while a mRS ≥ 3 indicated a poor outcome. The mortality rate into hospital after surgery is also evaluated.

2.4. Statistical analysis

The frequencies and centrality and dispersion measures were calculated for all descriptive variables. The Chi squared test or Fisher's exact test were performed to investigate factors associated with the outcome. Logistic regression assessed the differences for outcome or mortality, stratified by time of treatment. The significance level adopted was $p < 0.05$. The software Medcalc® 10.0 (MedCalc Software, Ostend, Belgium) was utilized for performing the tests.

3. Results

3.1. Sample characteristics

In this study, 155 patients were female and 63 were male, with a mean of age of 50 years old. Thirty-eight patients were treated < 3 days after SAH, 60 patients between 3 and 10 days and 120 patients after > 10 days. Multiple aneurysm and large or giant size were observed in 54 and 16 patients, respectively. Regarding aneurysm location, 85 patients presented aneurysms in the ACA, 78 in the MCA, and 88 in the ICA. In admission, 132 patients showed a good clinical status (HH ≤ II) and 86 patients was admitted with a poor clinical status (HH ≥ II). On discharge, 144 patients had a good outcome (mRS ≤ 2) and 74 a poor outcome (mRS ≥ 3). The mortality rate was 15.1% (Table 1).

3.2. Factors associated with outcome

A number of female patients was 155 and 98 showed good outcome. There were 63 male patients and 46 showed good outcome ($p = 0.22$). Regarding mortality, 28 female patients died during hospitalization and

Table 1
Baseline characteristics from 218 patients with aneurismatic subarachnoid hemorrhage underwent to surgical treatment.

Characteristics	
Gender, n (%)	
Female	155 (71,1)
Male	63 (28,9)
Age, (years)	
Mean (SD)	50,0 (11,2)
Range	21–82
Timing for treatment, n(%)	
Early (0–2 days)	38 (17,4)
Intermediate (3–10 days)	60 (27,5)
Late (> 10 days)	120 (55,1)
Local, n (%)	
ICA	88 (35,1)
MCA	78 (31,1)
ACA	85 (33,9)
Size, n(%)	
Small or intermediate (< 7 mm)	202 (92,7)
Large or giant (≥7 mm)	16 (7,3)
Number of aneurysms, n(%)	
Single	164 (75,2)
Multiples	54 (24,8)
Status on admission, n(%)	
HH ≤ II	132 (60,6)
HH ≥ III	86 (39,4)
Outcome on discharge, n(%)	
Good (mRS ≤ 2)	144 (66,1)
Poor (a mRS ≥ 3)	74 (33,9)
Mortality, n(%)	
Death	33 (15,1)

n: exact number; SD: standard deviation; ICA: internal carotid artery; MCA: middle cerebral artery; ACA: anterior cerebral artery; HH: Hunt and Hess scale; mRS: modified Rankin scale.