Cognitive function in neurosurgical clipping of patients with unruptured intracranial aneurysms: a systematic literature review

Função cognitiva no tratamento cirúrgico de pacientes com aneurismas intracranianos não-rotos: revisão sistemática da literatura

Arthur A. Pereira Filho 1
Matthew M. Kang 2
Tibor Becske 3
Peter K. Nelson 1
Jafar J. Jafar 4

ABSTRACT

There is a consensus that most unruptured intracranial aneurysms can be treated with acceptably low morbidity and mortality. However, some studies recently reported postoperative cognitive impairment, suggesting that it could be attributable to neurosurgical clipping. The goal of this report is to review and discuss aspects referring to cognitive function and neurosurgical repair in patients with unruptured intracranial aneurysms.

Key-words: Cognitive Function; Cerebral Aneurysm; Surgical Clipping.

SUMÁRIO

Existe um consenso na literatura de que a maioria dos aneurismas intracranianos não-rotos pode ser tratada com índices aceitáveis de morbido-mortalidade. No entanto, alguns estudos recentemente reportaram danos cognitivos no período pós-operatório, sugerindo que estes poderiam ser atribuídos à clipagem neurocirúrgica. Os objetivos deste estudo são revisar e discutir aspectos referentes à função cognitiva e ao tratamento neurocirúrgico em pacientes com aneurisma intracraniano não-roteado.

Palavras-chave: Função cognitiva; Aneurisma cerebral; Clipagem neurocirúrgica.
INTRODUCTION

In recent years, a substantial debate over the best treatment for patients with unruptured intracranial aneurysms has developed. Incomplete and conflicting data about the natural history of these lesions and the risks associated with their repair have complicated this discussion.

There is a consensus that most unruptured intracranial aneurysms can be treated with reasonably low morbidity and mortality. In 1998, the International Study of Unruptured Intracranial Aneurysms – ISUIA suggested that the high surgical morbidity could be attributable to impaired cognitive status. The same study suggested that the endovascular treatment might be associated with less immediate risk.

Recently, a series of well designed, methodologically sound studies appeared with contradictory results. While some showed that neurosurgical clipping of unruptured intracranial aneurysms was not associated with cognitive dysfunction, others reported a high neuropsychological decline after neurosurgical clipping.

Due to the contradictory data available to date, the purpose of this report is to review and discuss some aspects of the surgical morbidity and mortality of different treatments for subarachnoid hemorrhage have an approximately 2% prevalence at 2 to 6%.

UNRUPTURED INTRACRANIAL ANEURYSMS: AN OVERVIEW

Cerebral aneurysms are relatively common lesions, with autopsy, imaging, and epidemiological studies placing their prevalence at 2 to 6%. The most recent and possibly the most complete systematic review assessing the prevalence of intracranial aneurysms was published by Rinkel et al. in 1998. The authors reviewed both autopsy and angiographic studies, and concluded that adults with no risk factors for subarachnoid hemorrhage have an approximately 2% prevalence of unruptured aneurysms.

Aneurysms can adversely affect the quality of life if they rupture, cause mass effect, embolize or have a treatment complication. Many investigators have evaluated the incidence of subarachnoid hemorrhage in particular patient populations with reported estimates of as low as 6 per 100,000 to as high as 96 per 100,000 in the Japanese population. However, in the majority of studies involving non-Japanese, the incidence of subarachnoid hemorrhage is estimated to be approximately 10 per 100,000 population.

Subarachnoid hemorrhage and its sequelae are the most common cause of unfavorable outcomes, including sudden death in 8 to 15% and permanent deficits in up to 75% of survivors. The annual risk of rupture from an unruptured cerebral aneurysm has been estimated by various investigators to range from 0.1 to 8% or higher, depending on aneurysm size, location, and other risk factors such as high blood pressure and smoking. These issues raise the question as to what is the most appropriate management of unruptured intracranial aneurysms.

Intracranial aneurysms can be treated by either direct neurosurgical clipping or endovascularly. Clipping has been the most established management. In the past decade, endovascular treatment has grown in popularity as another viable alternative with the potential advantage of sparing invasive intracranial surgery. However, because of the lack of long-term follow-up studies and the high cost of the procedure, most neurosurgeons still prefer direct clipping.

UNRUPTURED INTRACRANIAL ANEURYSMS: SURGICAL MORBIDITY AND MORTALITY STUDIES

Traditionally, the efficacy and safety of neurosurgical clipping techniques have been evaluated by comparing them to the neurological morbidity and mortality of different treatments.

Although the morbidity and mortality of aneurysm clipping clearly depends on the particular neurosurgeon and medical centers being evaluated, several studies have attempted to formulate generalized results. While no consensus has been reached, there is agreement that most unruptured intracranial aneurysms can be managed with acceptably low morbidity and mortality.

Systematic analysis of the literature reveals historically interesting morbidity and mortality rates. In 1983, Wirth et al. published a 6-year retrospective analysis of the outcomes of surgical clipping in 107 incidentally discovered unruptured intracranial aneurysms. They reported a 7% permanent, and 8% transient morbidity rate after surgery. There was no operative mortality.

In 1991, Hadeishi et al. reported 18 of 72 patients (25%) undergoing unruptured aneurysm clipping developed neurological deficits postoperatively. However, the overwhelming majority (17 of 18) had resolution of their symptoms within 2 weeks.

In 1994, Solomon et al. documented the outcomes after 202 consecutive surgeries for microsurgical clipping of unruptured cerebral aneurysms. Excellent or good outcome was achieved in 100% of patients with aneurysms less than 10 mm in diameter.
ter, 95% with aneurysms 11 to 25 mm, and 79% with aneurysms greater than 25mm. Overall, minor and major complications and deaths occurred in 5, 7, and 3.5% of patients, respectively. Additional cohort analysis showed that in patients with incidental aneurysms (17%), the mortality rate was 2.9%.

Also in 1994, Dickey et al. published a retrospective analysis of a series with 86 patients with the diagnosis of intracranial aneurysms. Of a total of 82 patients who underwent neurosurgical clipping, 44 patients had treatment for unruptured aneurysms. The authors reported a major surgical morbidity of 2% with no procedure-related deaths.

Another study, published in 1996 by Deruty et al., reported the surgical results on 83 unruptured cerebral aneurysms in 62 patients. The overall outcome of clipping was: good recovery in 94%, moderate morbidity 1.5%, severe morbidity 1.5% and a mortality of 3%.

Two years later, in 1998, Raaymakers et al. published a remarkable meta-analysis of 61 studies that involved 2460 patients who underwent surgical treatment for unruptured intracranial aneurysms. Through Medline and additional searches, they analyzed studies published from 1966 through June 1996 and found that clipping was associated with a mortality of 2.6% and a morbidity of 10.9%.

In both reports from the ISUIA, prospective assessments of the morbidity and mortality rates associated with surgical intervention were obtained. In the initial report published in 1998, the authors prospectively analyzed a cohort of 798 patients with newly diagnosed unruptured intracranial aneurysms. The overall surgical morbidity and mortality rates for patients one month and one year after surgery were 17.5% and 15.7% respectively. Surgery-related death was reported in 30 patients (3.8%) at a one year follow-up.

In the second part of ISUIA, published in 2003, centers in the USA, Canada and Europe enrolled 1591 patients who underwent open surgery for unruptured intracranial aneurysms. This prospective study reported a surgical morbidity and mortality rates of 13.7% one month after surgery and 12.6% at a one year follow-up. Surgery-related death was reported in 43 patients (2.7%) one year after surgery.

In 2003, Ogivy and Carter studied 493 patients with 604 unruptured intracranial aneurysms who were submitted for clipping between 1992 and 1999. These authors’ rates of morbidity and mortality for the entire group were 15.9 and 0.8% respectively. More particularly, they reported that small aneurysms in the anterior circulation in young patients carry a very low treatment risk (approximately 1%), and treatment in elderly individuals (ages 70 years and older) with large lesions (greater than 10mm), carried a significant risk of poor outcome (5% in the anterior circulation, 15% in the posterior circulation).

Finally, in 2005, Moroi et al. published their results after treating 549 unruptured aneurysms. Their reported outcomes were remarkable for an overall 0.3% mortality, and 2.2% morbidity. More specifically, in aneurysms smaller than 10mm, the mortality and morbidity rates were 0.0 and 0.6 %, and for aneurysms larger than 10mm, these rates were 1.2 and 6.1%.

Our review of the literature revealed interesting and informative results about morbidity and mortality rates associated with unruptured intracranial aneurysm repair. With the advent of improved technology and operative techniques, it is certain that these negative rates have trended down over time. However, increased attention must be paid to newly reported morbidities, such as cognitive impairment following neurosurgical treatment.

COGNITION AND UNRUPTURED INTRACRANIAL ANEURYSMS

Recently, some authors have suggested that cognitive decline might represent a form of an underdiagnosed morbidity related to unruptured intracranial aneurysm clipping.

The first reference to cognitive outcomes after surgery for unruptured intracranial aneurysms was in the first part of ISUIA published in 1998. The authors reported that, in a group of 798 patients who were submitted to craniotomy, 93 (11.6%) had impaired cognitive status at a 30 days follow-up. However, there was no preoperative baseline evaluation. It is, therefore, unknown what proportion of impaired cognition was present preoperatively.

Fukunaga et al. in 1999 designed a different methodology for their cognitive study. They evaluated the cognitive function of 30 patients with the diagnosis of unruptured intracranial aneurysms before and after neurosurgical clipping. The tests used for neuropsychological assessment were the Mini Mental State Examination, the Kana-Hiroi test and the Maze test. The authors reported a significant deterioration in cognitive testing in 17 patients (55%) at one month, however all patients recovered to preoperative levels at a second cognitive assessment three months after the operation.

In a study published in 2000, Hillis et al. performed detailed cognitive evaluations in 12 patients with the diagnosis of unruptured intracranial aneurysms. All patients were submitted to a battery of neuropsychological test before and after surgical clipping of aneurysms. They evaluated the following criteria: attention, memory, language, parietal lobe function, frontal lobe function, motor/psychomotor function and mood. The authors noted questionable significant differences between preoperative and postoperative performance in only a few tests (measures of word fluency, verbal recall, and frontal lobe function).
The second part of ISUIA published in 2003 also deserves special attention in terms of cognition analysis. In this report, the authors suggested that the surgical morbidity could be attributable to cognitive impairment, as determined by the Mini-Mental State Examination and the telephone interviews for cognitive status. Patients who underwent postoperative cognitive evaluation were found to have a 5.5% incidence of impaired cognitive status at 1 year follow-up. Nevertheless, no preoperative evaluation was obtained (same methodology as the first ISUIA), and these cognitive results cannot be considered reliable.

In another interesting study dealing with cognitive function and clipping performed in 2003 by Ohue et al., the authors analyzed the cognitive aspects in 43 patients with the diagnosis of unruptured intracranial aneurysms before and after surgery. The tests applied were: Mini Mental State Examination, Kanai-Hiroi test, Kohns Block Design test and Miyake’s Memory test. They found that in 40% of patients (n=17), the neuropsychological function had deteriorated 1 month after surgery. However, on follow-up studies 6 months later, six patients had completely recovered, five patients partially recovered, and three patients did not recover.

Good post-surgical neuropsychological outcomes have also been reported. Tuffiash et al. recently reported that neurosurgical clipping of unruptured intracranial aneurysms was not associated with cognitive dysfunction. These authors studied 25 consecutive patients who underwent surgical clipping of unruptured intracranial aneurysms. The patients were submitted 1 week preoperatively, and again postoperatively (before hospital discharge and at 3-month follow-up if they had deficits at discharge), to a battery of neuropsychological tests. The authors found that in 40% of patients (n=17), the neuropsychological function had deteriorated 1 month after surgery. However, on follow-up studies 6 months later, six patients had completely recovered, five patients partially recovered, and three patients did not recover.

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Another recent study with favorable cognitive results was published by Otawara et al. in 2005. The authors performed detailed cognitive analysis before and after surgery for unruptured aneurysms in 44 patients. The tests applied were: Weschler Adult intelligence Scale-Revised Test, Weschler Memory Scale and Rey-Osterreith Complex Figure Test. After analyzing the results, the authors concluded that neurosurgical clipping did not impair cognition.

In our review of the literature we have found that while some publications showed that neurosurgical clipping of unruptured intracranial aneurysms was not associated with cognitive dysfunction, other well designed studies reported a high neuropsychological decline after neurosurgical clipping. Presently, there is no definitive study that vigorously compares the neurocognitive outcome of direct surgical versus endovascular treatment of unruptured intracranial aneurysms. We, therefore, strongly believe that a large randomized clinical trial with full cognitive analysis would be helpful.

REFERENCES

38. Corresponding author: Arthur A. Pereira Filho, MD. Address: 3008 Oscar Pereira Avenue, Porto Alegre, Rio Grande do Sul, Brazil. Phone: (55) 51 98991992. arthurgpereirafilho@gmail.com