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ARTICLE

Clinical outcomes of surgical clipping for intracranial aneurysms in patients with a Hunt and Hess grade 4 or 5

Desfechos clínicos da clipagem cirúrgica de aneurismas intracranianos de graus 4 e 5 segundo a escala de Hunt & Hess

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ABSTRACT

We retrospectively evaluated the records of 49 grade 4 and 5 patients with 42 intracranial aneurysms treated within 72 h of subarachnoid hemorrhage (SAH). In total, 35 patients (71%) were grade 4, and 14 (29%) were grade 5. A total of 42 (85%) patients had one aneurysm, 6 (12%) had two aneurysms, and 1 (3%) had three aneurysms. Out of 49 patients, one technical (2%) and one clinical (2%) complication occurred at surgery. Twenty-one (43%) patients recovered well, including 7 with postoperative hematoma requiring an immediate evacuation of a clot. Fourteen (29%) patients had hydrocephalus and required a ventriculo-peritoneal shunt; 12 patients underwent tracheotomy postoperatively due to coma and pulmonary infection. We found that patients with Hunt and Hess grade 4 and 5 aneurysms can undergo successful neurosurgical clipping of the aneurysms after SAH. However, the morbidity and mortality rates remain high because of their poor clinical condition and a high incidence of vasospasm during treatment.

Keywords: cerebral aneurysm; surgical instruments; subarachnoid hemorrhage.

RESUMO

Avaliamos retrospectivamente os registros de 49 pacientes com 42 aneurismas intracranianos de graus 4 e 5, tratados nas primeiras 72 horas após uma hemorragia subaracnóidea (HSA). Trinta e cinco pacientes (71%) apresentavam grau 4 e catorze (29%) grau 5. Quarenta e dois pacientes (85%) tinham um único aneurisma, seis (12%) tinham dois aneurismas, e um paciente (3%) tinha três aneurismas. Dos 49 pacientes, uma complicação técnica (2%) e uma complicação clínica (2%) ocorreram durante a cirurgia. Vinte e um pacientes (43%) recuperaram-se bem, incluindo sete que tiveram hematomas pós-operatórios que requereram a imediata evacuação do coágulo. Catorze pacientes (29%) tiveram hidrocefalia e submeteram-se à derivação ventrículo-peritoneal; doze pacientes submeteram-se à traqueostomia no pós-operatório, devido a coma e infecção pulmonar. Pacientes com aneurismas de graus 4 e 5, segundo a escala de Hunt & Hess podem submeter-se com sucesso à clipagem dos aneurismas após HSA. Entretanto, as taxas de morbidade e mortalidade ainda são altas, devido à condição clínica precária e à alta incidência de vasoespasmo durante o tratamento.

Palavras-chave: aneurisma cerebral; instrumentos cirúrgicos; hemorragia subaracnóidea.

The management of subarachnoid hemorrhage (SAH), which becomes more likely with advancing age, is a clinical challenge. Despite modern microsurgical techniques and intensive care medicine, there remains high morbidity and mortality resulting from SAH, generally caused by a ruptured aneurysm of the intracranial arteries[1]. It is generally accepted that the patient's outcome correlates with their preoperative clinical status. Therefore, it is very important to make early an diagnosis for the endangered patient and to perform the operation when the patient's physical condition is good to improve the outcome. Most aneurysmal SAH patients frequently present with sudden severe headache accompanied by photophobiameningism, nausea, and loss of consciousness[2].

Historically, patients with severe Hunt and Hess grades (4 and 5) have fared poorly and generally consist of approximately 20–30% of those admitted to the hospital with aneurysmal SAH. There is a controversy regarding the timing of surgery, which has a significant impact on the prognosis[3,4].

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In a previously published retrospective review, patients with Hunt and Hess grade 4 or 5 after SAH experienced successful coil embolization of the aneurysms[5]. Early case reports emphasized that the surgery for grade 4 and 5 patients should be delayed until their clinical condition improves from grades 1 to 3. This treatment mode produced a favorable result in 3.8–18% of cases, with a mortality rate of 68–87.4%. Later in early 1990s, several clinical reports indicated that early aggressive medical and surgical treatment could lead to better outcomes, with success rates that ranged from 7% to 42.6%[3,4,6,7].

With hundreds of varieties of aneurysm clips in different shapes and sizes, surgical clipping has been the gold standard for the treatment of both ruptured and unruptured cerebral aneurysms since the 1960s due to the the mechanical complexity of existing clips as well as the emergence of the operating microscope. However, it remains an invasive and technically challenging procedure[8,9]. The aim of this study was to evaluate the clinical outcome of neurosurgical clipping (NSC) in patients with Hunt and Hess grade 4 or 5 after SAH.

METHOD

We performed a retrospective review of the records of 49 patients with a Hunt and Hess grade 4 or 5 between June 2005 and January 2011 and who were treated with neurosurgery clipping at our institution. The patients included 35 males and 14 females who were 31–82 [average (56.6±25.2)] years old. Eligible SAH patients had a ruptured aneurysm suitable for NSC. All patients were evaluated by a combined neurosurgery and interventional neuroradiology team and treated within 72h of the onset of SAH. For each patient, the following data were analyzed: age, sex, and clinical status according to the Hunt and Hess grading scale. A transfemoral selective four-vessel cerebral angiography was used to identify the localization of the ruptured aneurysm.

All procedures were performed with the patient under general anesthesia and with neurophysiologic monitoring using somatosensory evoked potentials and electroencephalographic monitoring. All patients were treated with surgical clipping within 24h after head computed tomography angiography (CTA) examination. For multiple aneurysms, the most likely aneurysm to have bled was identified on the basis of CT and angiographic images. If the most likely bleeding aneurysm could not be identified, we chose NSC as the treatment for more than one aneurysm.

During the procedure, the following complications were checked: preoperative hemorrhage, intra-operative rupture of the aneurysm, symptomatic vasospasm, hydrocephalus requiring the implantation of a shunt, ventriculitis, postoperative wound infection, and re-bleeding. The outcome was examined according to the Glasgow outcome scale at the time of discharge and during the follow-up period. After 30 days, surviving patients were followed for up to 23 months on an average (range: 6–44 months).

RESULTS

The patient and aneurysm characteristics are outlined in Table 1. From a total of 49 cases of 57 aneurysms, 55 aneurysms were treated. Seven cases had more than one aneurysm. The Hunt and Hess grade at admission was 1–3 in 33% of the cases and changed to grade 4 or 5 because the aneurysms ruptured during examination. There were 35 cases of grade 4 and 14 cases of grade 5. One SAH case was found without aneurysm after two head screw CTA examinations initially, but was confirmed with one aneurysm 1 month after the head CTA.

Surgical clipping of the ruptured aneurysms was performed in 37 patients after external ventricular drainage. Four patients having two aneurysms each underwent clipping in one side initially, and then underwent a secondary clipping of the other aneurysm after a good recovery. One patient had three aneurysms and abandoned further treatment after the first clipping surgery failed on one side. Twenty-one patients recovered well, including 7 cases with postoperative hematoma requiring an immediate evacuation of the clot; 13 cases had acceptable recovery; 14 cases were complicated with hydrocephalus and underwent a ventriculo-peritoneal shunt procedure; and 15 cases had poor recovery. Postoperatively, 12 cases underwent tracheotomy due to coma and pulmonary infection.

Table 1. Characteristics of surgical patients.

Variable	n
Total	49
Male	35
Female	14
Average Age	56.6±25.2
GOS Grade	
IV	35
V	14
Aneurysm	
1	42
>1	7
Aneurysm location	
anterior communicating artery	21
middle cerebral artery	17
posterior communicating artery	17
anterior cerebral artery	2

For an aneurysm patient with SAH, the length of hospitalization and recovery are determined by the severity of the hemorrhage but not by the treatment modality. Most SAH patients will remain hospitalized for a minimum of 2 weeks to monitor the risk of cerebral vasospasm and other complications due to the hemorrhage, including hydrocephalus. Treatment on an inpatient or outpatient basis, with a varied rehabilitation period, may be necessary. Postoperative re-bleeding of a clipped aneurysm occurred once, leading to a poor outcome. Age, surgery, Hunt and Hess grade, re-bleeding, and other factors related to prognosis are analyzed in Table 2.

DISCUSSION

In this report, 49 patients in our hospital were analyzed to identify the clinical outcome and complications for neurosurgical clipping treatment. The findings of the present study can be generalized to elderly patients similar to those enrolled, i.e., patients with a good Hunt and Hess grade who have a ruptured anterior circulation aneurysm with a suitable anatomy for NSC[10]. Complications particularly related to NSC include stroke, vasospasm, seizure, and bleeding.

Previous studies have shown that early neurosurgical aneurysm treatment is inappropriate in elderly patients with a poor Hunt and Hess grade; moreover, in many centers, conservative treatment has been advocated for patients > 60 years. At present, the neurosurgical treatment of a ruptured aneurysm would be considered, even in elderly patients (> 80 years old), if their prior physical condition and life quality were good. Nevertheless, elderly SAH patients have a greater risk of poor outcomes than younger patients[11,12,13]. We confirmed that the reasons that the elderly patients have a poorer prognosis are that they have less active management, poorer clinical grades on admission, and a higher frequency of comorbidity. In addition, patients > 50 years tolerate craniotomy and clipping of intracranial aneurysms less well.

Table 2. The prognosis analysis.

Variable	Number of patients	Prognosis	
		Good	Bad
Age			
< 60y	18	14	4
≥ 60y	10	4	6
Hunt-Hess grade			
IV	16	10	6
V	12	8	4
Rebleeding (24h)			
Yes	18	9	9
No	10	9	1
Complication			
Hypertension	14	8	6
Hemorrhage	16	10	6

The clinical outlook also depends on whether any brain damage occurred from bleeding pre-, intra-, or postoperatively[14,15,16]. Brain aneurysm with no symptoms can usually be prevented from becoming larger and rupturing by treating with open surgery or endovascular repair. A highly feared intra-procedural complication during neurosurgical clipping of an intracranial aneurysm is aneurysm rupture and re-bleeding, which is associated with less favorable outcomes. Here, the aneurysmal re-bleeding rate during treatment was 64%, and there was a statistically significant relationship between re-bleeding and early surgery treatment[17]. The prognosis rate was 50% for the non-re-bleeding group and even better (90%) for the non-re-rupturing group. The patient's clinical outcome is often related to the location of the ruptured aneurysm. When patients were broken down into groups in terms of right- or left-sided aneurysms, aneurysm neck size, lumen diameter, WFNS or Fisher grade, and patient age, previous studies have revealed that there is no difference in outcome between the treatment groups. However, because of the limited number of patients with ruptured aneurysms, these results must be interpreted with caution. Further studies and additional follow-up are warranted to document its efficacy and safety.

The patients who underwent NSC were more likely to suffer infections and pulmonary complications, particularly those patients who had prolonged bed rest, artificial ventilation, and an increased length of intensive care unit stay[16,17,18,19]. Furthermore, it was reported that out of 159 Hunt and Hess 4–5 grade patients (44%) that had intracranial hematoma, the prognosis for the majority of Hunt and Hess grade 4 patients improved (53.9%), in contrast to 24.1% of Hunt and Hess grade 5 patients. Early surgical intervention is highly recommended for patients with intracranial hematoma. In our study, 37 patients underwent intraventricular penetrating, ventricular drainage, and decompressive craniectomy to control intracranial pressure and cerebral perfusion before aneurysm surgery, which improved the overall prognosis rate (55%). Previous literature has also reported that high blood pressure can be an independent factor affecting the prognosis of high-grade aneurysms; however, our results were not statistically significant.

In summary, in our study, although the patients with Hunt and Hess grade 4 or 5 after SAH have a poor medical condition and a high risk of vasospasm during treatment, they can still undergo successful neurosurgical clipping. Microsurgical techniques and the prevention of cerebral vasospasm might be the key to success for early aneurysm surgery.

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