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Microcirurgia para Aneurismas Intracranianos Múltiplos: série de 29 casos

Microsurgery for Multiple Intracranial Aneurysms: a review of 29 cases

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ABSTRACT

Background: *A total of 23 patients with 52 aneurysms were surgically treated in single surgery at a Neurosurgical Service of the Health Service of the State of São Paulo from 2009 to 2011.* ***Method:*** *Retrospective analysis of patients undergoing clipping of two or more cerebral aneurysms in a single stage, from January 2007 to July 2012.* ***Results:*** *Twenty-nine patients underwent two or more clipping cerebral aneurysms in a single surgery – 28 with a single craniotomy and one through two craniotomies. Of these, 20, 7, 1 and 1 were submitted to the clipping of 2, 3, 4 and 5 cerebral aneurysms, respectively. Five were male and 24 were female, and the age range was 40 to 66-years-old. Eight left craniotomies were performed to approach 17 lateralized brain aneurysms to the left and five to the right, as well as three anterior communicating complex aneurysms. Twelve craniotomies were performed on the right to approach 23 intracranial aneurysms lateralized to the right and six on the left, as well as 15 anterior communicating artery complex aneurysms and 1 on the basilar artery. Of the 29 patients, 28 evolved with 1-3 pts and only one with 4-5 pts on the Rankin scale, six months after surgery.* ***Conclusion:*** *We advocate microsurgical approach for most of the cases of multiple intracranial aneurysms aiming the microsurgical clipping of all intracranial aneurysms if feasible through a single stage and a single craniotomy.*

Keywords: *Microsurgery; Intracranial aneurysm; Craniotomy*

RESUMO

Introdução: *Um total de 23 pacientes com 52 aneurismas foi tratado cirurgicamente em cirurgia única em um Serviço de Neurocirurgia da Secretaria Estadual de Saúde de São Paulo, entre 2009 a 2011.* ***Método:*** *Análise retrospectiva dos prontuários de pacientes submetidos a clipagem de dois ou mais aneurismas cerebrais, em uma única cirurgia, no período de janeiro de 2007 a julho de 2012. Resultados: Vinte e nove pacientes foram submetidos à clipagem de dois ou mais aneurismas cerebrais em uma única cirurgia – 28*

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por meio de uma única craniotomia e um por meio de duas craniotomias. Desse total 20, 7, 1 e 1 foram submetidos a clipagem de 2, 3, 4 e 5 aneurismas cerebrais, respectivamente. Cinco eram do sexo masculino e 24 do sexo feminino, e faixa etária entre 40 e 66 anos. Oito craniotomias à esquerda foram realizadas para abordagem de 17 aneurismas cerebrais lateralizados à esquerda e cinco à direita, assim como três aneurismas de complexo da artéria comunicante anterior. Doze craniotomias à direita foram realizadas para abordagem de 23 aneurismas cerebrais lateralizados à direita e seis à esquerda, assim como 15 aneurismas de complexo da artéria comunicante anterior e um de artéria basilar. Dos 29 pacientes, 28 evoluíram com 1-3 pts, e somente um evoluiu com 4-5 pts na escala de Rankin, após seis meses da cirurgia. ***Conclusão:*** *Preconizamos abordagem microneurocirúrgica para a maioria dos casos de aneurismas intracranianos múltiplos, buscando a clipagem microcirúrgica de todos os aneurismas intracranianos, se viável, em um único estágio e uma única craniotomia.*

Palavras-chave: *Microcirurgia; Aneurisma intracraniano; Craniotomia*

INTRODUCTION

Multiple intracranial aneurysms are identified in 15-45% of patients diagnosed with subarachnoid hemorrhage[1-3] and, commonly, infer a complex therapeutic management and morbidity and mortality superior to the cases of single intracranial aneurysm[4-7].

A number of risk factors are associated with incidence and prevalence, however, the pathogenesis and the mechanisms involved in the formation of multiple intracranial aneurysms remain indeterminate[1,2,8].

The diagnostic study seeks, mainly, to determine the rupture site, and/or with high risk of rupture, and to understand the morphology, location and neural and vascular relation of intracranial aneurysms.

The therapeutic management varies in the modality selection (microsurgical clipping, endovascular or multimodal), the timing (early or late) and stages (in one or multiple stages) of treatment, with no consensus in the literature about the theme.

The surgical treatment remains associated with a high frequency of complications, despite the advances in surgical and anesthetic techniques. However, it allows the definitive treatment of virtually all intracranial aneurysms, often through a craniotomy and in a single stage[6,8-13]. In this study, we present 23 patients with 57 intracranial aneurysms surgically treated in a single stage in our facilities.

METHODOLOGY

This retrospective study was based on the analysis of medical records from hospitalized patients as well as outpatient follow-ups in our hospital (Hospital Heliópolis). Patients subjected to the clipping of two or more cerebral aneurysms, in one stage, from January 2007 to July 2012 were included. All these surgeries were done/tutored by the assistant surgeons JCRJ, RO, and MNS. This study was conducted after receiving approval from the local Ethics Committee.

The gathered data from the medical records of the patients included in the study was: gender and age; Hunt and Hess's scale[14] at hospital admission; Fisher's scale[15] at hospital admission; diagnosis of the patient presenting or not a cerebral aneurysm rupture; topography and size of cerebral aneurysms detected through preoperative cerebral angiography; laterality of the craniotomy used; and, evaluation in the Rankin's scale in six months post-surgical treatment.

Surgical technique

All patients were subjected to skull computerized tomography (CT) and digital subtraction angiography (DSA) of four blood vessels, as well as a thorough discussion by a medical team composed of twelve neurosurgeons and one neuroradiologist, and the adequate treatment selection (surgical, endovascular, combined, or conservative).

In our hospital, the preconized treatment for multiple intracranial aneurysms is the surgical treatment aiming the clipping of all diagnosed intracranial aneurysms in one stage as detected through a craniotomy. However, this goal may be not feasible and, in fact, the ipsilateral access and clipping of the ruptured intracranial aneurysm or the one with the highest risk of rupture take priority. The second option is the ipsilateral and contralateral access (through the same craniotomy) or bilateral access (through a second craniotomy) for the clipping of the other diagnosed intracranial aneurysms.

RESULTS

From January 2009 to January 2011, 29 patients with eighty-two intracranial aneurysms were subjected to a clipping of two or more cerebral aneurysms in only one surgery. Twenty patients were subjected to the clipping of two aneurysms, seven to the clipping of three aneurysms. And other two to the clipping of four or more aneurysms in only one stage. Five patients were male and twenty-four were female. The age group varied from 45 to 66, with an average age of 53.

Twenty-five patients were diagnosed with subarachnoid hemorrhages on admission. In the Hunt and Hess scale was found Grade I (6), Grade II (5), Grade III (11) and Grade IV (3). Similarly, in the Fisher scale, two were graded as Grade II, 13 as Grade III and 10 as Grade IV. The patients without a diagnosis of cerebral aneurysm rupture, by convention, were classified as Grade I (Hunt and Hess scale) and Grade I (Fisher scale). From 69 clipped cerebral aneurysms, 25 were considered as ruptured and fifty-five incidental. Twelve aneurysms were conservatively treated (one of them, patient # 3, who underwent surgery in stage 2).

Twenty-eight patients of these series were subjected to the microsurgical clipping of two or more intracranial aneurysms in only one stage and in only one craniotomy. One patient (#25) was subjected to the microsurgical clipping of two intracranial aneurysms in only one stage in two craniotomies. Sixty-six of the clipped cerebral aneurysms were located in the anterior circulation, three in the posterior, twenty-six in the right side and twenty-three of them in the left. Eleven craniotomies in the left (eight pterional, two fronto-orbital craniotomies and one frontotemporoparietal) were done to the approach of seventeen cerebral aneurysms lateralized to the left and five to the right, as well as three anterior communicating artery complex aneurysms. Eighteen craniotomies in the right (twelve pterional craniotomies, four frontal-orbitary, one frontotemporoparietal and one frontal) were done to the approach of 23 cerebral aneurysms lateralized to the right and six lateralized to the left, as well as fifteen anterior communicating artery complex aneurysms and one of the basilar artery (Table 1).

Twenty-eight of 29 patients surgically treated had developed, six months after the surgery, 1-3 points in the Rankin scale and only one 4-5 points in this same scale. Fourteen patients exhibited complications related to the subarachnoid hemorrhage or to the surgical treatment; seven patients with hydrocephalus (four with non-shunt-dependent hydrocephalus and three with shunt-dependent hydrocephalus), four with clinical vasospasms, three with post-operative stroke and one with rebleeding. No death was found in this series (Table 2).

Table 1. Surgical characteristics of 29 patients undergoing microsurgical treatment for multiple intracranial aneurysms on single stage.

Rupture	Patient	Number of brain aneurysms clipped	Localization of brain aneurysms clipped			Craniotomy
			Right	Central	Left	
No	01	2			ICA (Com) MCA (M1)	Left
	02	2	ICA (Com)		ICA (Com)	Left
	03	2	MCA (M1)		ICA (Opht)	Right
	04	3	ICA (Com)	ACOM	ICA (Com)	Right
Yes	05	3	MCA (M1)	**ACoM** BA		Right
	06	2	**MCA (M1)**		ICA (Com)	Right
	07	2		**ACoM**	ICA (Chor)	Left
	08	2	MCA (M1)	**ACoM**		Right
	09	2	MCA (M1)	**ACoM**		Right
	10	3	ACA (A2)		**ICA (Opht)** MCA (M1)	Left
	11	5	MCA (M1) ICA (Com)	**ACoM** BA	ICA (Com)	Right
	12	4		ACoM BA	**ICA (Com)** MCA (M1)	Left
	13	2	ICA (Com)		**ICA (Com)**	Left
	14	2	ICA (Opht)		**ICA (Opht)**	Left
	15	2	**ICA (Com)**	ACoM		Right
	16	2	**MCA (M2)** MCA (M1)			Right
	17	2			**ICA (Com)** ICA (Chor)	Left
	18	2	MCA (M1)	**ACoM**		Right
	19	3	ICA (Com)	**ACoM**	MCA (M1)	Left
	20	2	**MCA (M1)**	ACoM		Right
	21	3	**MCA (M2)** MCA (M1)	ACoM		Right
	22	3	MCA (M1)	**ACoM**	ICA (Opht)	Right
	23	2	**ICA (Com)**	ACoM		Right
	24	2	ICA (Chor)		**ICA (Chor)**	Right
	25	2	MCA (M1)		**MCA (M1)**	Bilateral
	27	2		**ACoM** ACoM		Right
	26	2	ICA (Com)	**ACoM**		Right
	28	2	**ACA (A2)**		MCA (M2)	Left
	29	3	MCA (M1) ICA (Chor)	**ACoM**		Right

ACA: anterior cerebral artery. ACoM: anterior communicating artery complex. BA: basilar artery. Chor: choroid segment of the internal carotid artery. Com: communicating segment of the internal carotid artery. ICA: internal carotid artery. MCA: middle cerebral artery. Opht: ophthalmic segment of the internal carotid artery.

Table 2. Clinical characteristics and clinical prognosis of 29 patients undergoing microsurgical treatment for multiple intracranial aneurysms in single stage.

Rupture	Patient	Age and sex	Hunt & Hess	Fisher	Rankin
No	01	54/F	0	-	1
	02	50/F	0	-	0
	03	59/F	0	-	0
	04	46/F	0	-	0
Yes	05	49/F	2	4	1
	06	50/F	1	2	0
	07	60/F	3	4	0
	08	49/F	3	2	1
	09	49/F	3	4	1
	10	42/F	3	3	3
	11	46/M	3	4	2
	12	53/F	3	2	1
	13	40/F	1	4	1
	14	66/F	3	3	2
	15	53/F	3	3	1
	16	62/F	1	4	2
	17	53/F	3	4	1
	18	42/M	4	4	1
	19	43/F	1	3	0
	20	65/M	1	1	0
	21	52/M	4	4	5
	22	46/M	4	3	2
	23	61/F	1	4	0
	24	28/F	2	3	0
	25	47/F	3	3	2
	27	40/F	2	3	1
	26	54/F	3	3	1
	28	41/F	2	3	1
	29	44/F	3	3	2

DISCUSSION

Bigelow[16], in 1955, published the first literature review of multiple intracranial aneurysms identifying in a series 2,237 cases of intracranial aneurysms, a frequency of 10% of intracranial multiple aneurysm. Currently, this frequency is superior to the described by Bigelow and calculated around 15-45%, probably due to an increase in the utilization, in the quality and quantity of vessels studied in brain DSA and the forward policies[17].

Currently, the two treatment modalities most used and effective in the treatment of intracranial aneurysms are the microsurgical clipping and coil embolization. The decision of the surgical or endovascular treatment usage is based on the morphology of the aneurysm, on the patient's age and clinical status[2], as well as the technique and experience of the neurosurgeon or neuroradiologist. According to the literature, the surgical treatment presents a frequency of upper complete obliteration and a lower risk of recanalization compared to endovascular treatment and, in fact, it remains as the therapeutic modality more appropriated, especially in patients with below 50-years-old and with reasonable clinical status[2]. However, there is no consensus on this issue, considering the increase in the number of studies indicating lower morbidity and mortality and similar efficacy (mainly with the advance of new technologies) of endovascular treatment compared to the microsurgical treatment.

In this casuistry, 24 of the 29 patients were female (as in literature, with a predominance of women in cases of multiple intracranial aneurysms)[4,7,17], the age group was between 40 and 60 years (in the literature, this age group was found with the highest incidence of aneurysmatic subarachnoid hemorrhage)[4,7] and so as in all the revised studies[7,8,10,11,15-20]. The aneurysmatic rupture was the most common form of presentation (25 cases of 29 patients) making the preoperative identification of the ruptured aneurysm a *sine qua non* condition for the decision and planning of the therapeutic strategy. The identification of the aneurysmal rupture site was performed using an algorithm developed by Nehls et al. [18], in 1985, based on information obtained from cranial tomography, cerebral angiography and clinical examination of patients with multiple intracranial aneurysms. From 25 cases diagnosed with aneurysmal rupture, 14 patients were admitted with moderate to severe impairment of neurological status (Grade III and IV – Hunt and Hess scale)[14] and 14 evolved with important complications associated with subarachnoid hemorrhage. No death was found in this series, and only two patients (cases #10 and #21), after six months of surgical treatment, were scored with three or more points on the Rankin scale. Both had a moderate to severe impairment of neurological status in the preoperative period and evolved with important complications from bleeding subarachnoid. In consonance with the literature, the subarachnoid hemorrhage and clinical and neurological preoperative status are the main determining factors of the prognosis of surgical treatment of intracranial multiple aneurysms, added to the patient's age and the presence of giant intracranial, complex or located in the posterior circulation aneurysm[16].

From the 29 patients submitted to surgical treatment for multiple intracranial aneurysms in a single stage, 20 were submitted to the clipping of two intracranial aneurysms and nine underwent the clipping of more than two intracranial aneurysms (only two patients were submitted to the clipping of more than three intracranial aneurysms). The most frequent sites were the internal carotid artery (from 24 aneurysms, 14 were located in the communicating segment) and in the anterior communicating complex (18 aneurysms). Likewise, the internal carotid artery and the anterior communicating complex were the most common rupture sites (eight ruptured aneurysms located in the internal carotid artery – six of which are in the communicating segment – and 11 ruptured aneurysms in the anterior communicating complex). If considered only double lesions, the most frequent combinations were: an aneurysm located in the internal carotid artery, added to a second aneurysm in the anterior communicating complex (five combinations; of these, four aneurysms in the communicating segment and one in the ophthalmic segment of the internal carotid artery); and an

aneurysm located in the internal carotid artery, added to a second in the internal carotid artery (five combinations; of these, four combinations in the communicating segment of the internal carotid artery, implying the mirror arrangement).

According to the literature, there are three forms of microsurgical approach to multiple intracranial aneurysms in a single phase: unilateral, contralateral and bilateral access[15,20]. Unilateral is most often used to clip intracranial aneurysms located centrally and ipsilaterally in the anterior circulation and in the upper part of the posterior circulation. The contralateral (through a single craniotomy) and bilateral access (through two craniotomies) are most often used for contralaterally located aneurysms. The unilateral location of multiple intracranial aneurysms in the anterior circulation facilitates the decision for surgical treatment for all intracranial aneurysms and in a single phase (multiple intracranial aneurysms located in the contralateral anterior circulation or in the posterior circulation) [15,21]. In our study, 28 patients underwent surgical treatment for multiple intracranial aneurysms using a single craniotomy, and only one patient underwent two craniotomies and, thus, bilateral access. The contralateral route was used for microsurgical clipping of 10 incidental aneurysms (nine of the internal carotid artery and one of the distal anterior cerebral artery) located in the hemisphere contralateral to the craniotomy (two fronto-orbital or eight pterional craniotomies) in 10 patients. Contralateral access is a microsurgery technique systematized by Oliveira et al.[20] and Vajda et al.[22]. A single access for clipping aneurysms located ipsi and contralaterally, if feasible, is recommended in all cases of multiple intracranial aneurysms in our hospital service, as it provides definitive treatment in a single phase and with a single craniotomy. Consequently, it reduces hospitalization time without adding complication risks of a second craniotomy.

Twelve incidental intracranial aneurysms in 11 patients were treated conservatively; of these, four were in the cavernous segment of the internal carotid artery; one was in the ophthalmic segment of the internal carotid artery (patient #3), measuring 4 mm and showed signs of intraluminal thrombosis and parietal calcification; four were intracranial aneurysms smaller than 2 mm (1 of PICA in the cortical segment in patient #10, two in the middle cerebral artery in patients #11 and # 25, two in the internal carotid artery in the communicating segment in patients #15 and #29, and one in the anterior cerebral artery in segment A3 in patient #21) and were distant or contralaterally to the access. An internal carotid artery aneurysm in the communicating segment, measuring 4 mm, was surgically treated in a second phase and a second hospitalization, due to difficulties in microsurgical clipping during the first phase.

According to Rinne et al. [21], despite an active surgical policy, up to one third of diagnosed intracranial aneurysms can remain untreated, most of them in patients with multiple intracranial aneurysms. Severe impairment of clinical status, advanced age and patient reluctance, as well as intracranial aneurysms considered unqualified for surgical treatment, would be the main reasons for conservative treatment[23].

CONCLUSION

In our casuistry, 29 patients with multiple intracranial aneurysms were submitted to microsurgical clipping of two or more intracranial aneurysms (totaling 71 intracranial aneurysms submitted to microsurgical clipping), including 10 located in the anterior circulation contralateral to the access and three located in the posterior circulation, in a single stage and with one (in 28 patients) or two (only in one patient) craniotomies. There were no important complications added by surgical treatment, and only two of the 29 patients in this series evolved with moderate to severe commitment of functional status, six months after surgery, as a result of complication related to subarachnoid hemorrhage. We recommend a microneurosurgical approach for the majority of cases of multiple intracranial aneurysms, seeking for microsurgical clipping of all intracranial aneurysms, if feasible, in a single stage and with a single craniotomy.

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