



Contents lists available at ScienceDirect

International Journal of Surgery Case Reports

journal homepage: www.casereports.com

Surgical case series of multiple aneurysms: A single-centre experience of 16 years



Domenico Murrone*, Bruno Romanelli, Aldo Ierardi

"Di Venere" City Hospital, Unit of Neurosurgery, Bari, Italy.

ARTICLE INFO

Article history:

Received 24 October 2017

Received in revised form

28 November 2017

Accepted 2 December 2017

Available online 15 December 2017

Keywords:

Multiple aneurysms

Intracranial aneurysms

Clipping

Endovascular treatment

ABSTRACT

INTRODUCTION: Multiple aneurysms are present in 10% in patients with intracranial aneurysms. An analysis of the literature, focusing on the different treatments, and a description of our experience are performed.

PRESENTATION OF CASE SERIES: A surgical series with multiple intracranial aneurysms from 2000 to 2016, describing demographic, radiological and clinical features, is showed. In all patients a pre- and post-operative angiography was performed and surgical treatment, based on accurate indications, provided good outcomes in most cases.

DISCUSSION: Successful treatment of multiple intracranial aneurysms can be achieved by an interdisciplinary approach and the main factors influencing surgical treatment are discussed.

CONCLUSIONS: Surgery always remains a definitive treatment and, considering intrinsic lesional features and patient's characteristics, it offers good results for intracranial multiple aneurysms.

© 2017 The Author(s). Published by Elsevier Ltd on behalf of IJS Publishing Group Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

The incidence of multiple cerebral aneurysms after angiography is around 10% [1]. This percentage increases to the finding at autopsy (20%–30%). In literature there are still many controversies about the management of these lesions. Identification of intrinsic lesional features and patient's characteristic are the main problems [2]. We describe our experience during 16 years discussing about the most appropriate surgical treatment of multiple aneurysms.

2. Material and methods

According with the PROCESS criteria [3], we present a retrospective study of a consecutive series of 19 cases of multiple aneurysms for a total of 44 aneurysms, of which 43 surgically treated at the our neurosurgical specialist centre, from 2000 to 2016 (Table 1). This study was approved by our institution's committee on human research and there were no exclusion criteria. Nine cases (47.3%) were male and ten cases (52.7%) females (M/F

ratio = 0.9). The mean age was 53.1 years and in 3 cases the patients were older than 65 years. In 16 cases the aneurysms involved only anterior and/or middle circulation and in 3 cases both the anterior circulation and posterior (1 ipsilateral case, 2 contralateral cases). Fourteen patients presented a double aneurysm, four patients three aneurysms and one patient four aneurysms. Eighteen patients underwent a pre-operative computed tomography (CT) scan showing subarachnoid hemorrhage (SAH) in 15 cases and intracerebral hemorrhage (ICH) in 3 cases. Only in one case there wasn't bleeding and the aneurysms were incidentally detected by magnetic resonance imaging (MRI). In 18 patients with ruptured aneurysms, interval between the onset of symptoms and admission at our institution was 1 day in 11 cases, 2 days in 4 cases, 4 days in one case, 20 days in one case, and more than twenty days in one case. Eight patients presented with comorbidities (chronic obstructive bronchopneumopathy in 4 cases, cardiomyopathy in 3 cases and diabetic nephropathy in one case). Ten patients presented with Hunt-Hess (HH) score 1, two patients with HH score 2 and six patients with HH score 4. In all cases pre- and post-operative angiographic study of intracranial arterial vessels was performed (Figs. 1–3). In only one case early angiography was negative but after two weeks it highlighted a double aneurysm.

3. Results

Pre-operative value was tested in according with age, HH score and presence of comorbidities, while post-operative outcome was measured by Karnofsky Performance Score (KPS) (KPS > 80 = good,

Abbreviations: M/F, male/female; MRI, magnetic resonance imaging; CT, computed tomography scan; SAH, subarachnoid hemorrhage; ICH, intracerebral hemorrhage; KPS, Karnofsky Performance Score; HH, Hunt-Hess; ICG, indocyanine green; ISUIA, International Study of Intracranial Aneurysms; ISAT, International Subarachnoid Aneurysm Trial; ICA, internal carotid artery; MCA, middle cerebral artery; ACoA, anterior communicating artery; PcoA, posterior communicating artery.

* Corresponding author at: Cda Donnanna SNC, 87067 Rossano, CS, Italy.

E-mail addresses: doflamingo82@gmail.com (D. Murrone), brunoromanelli@alice.it (B. Romanelli), aldo.ierardi@gmail.com (A. Ierardi).

<https://doi.org/10.1016/j.ijscr.2017.12.011>

2210-2612/© 2017 The Author(s). Published by Elsevier Ltd on behalf of IJS Publishing Group Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Table 1
Demographic and clinical features of 19 cases with multiple intracranial aneurysms surgically treated from 2000 to 2016.

Pz	Sex Age (ys)	Pre-operative status	Comorbidities	N° Ans	Site	Timing	Operation time (hours)	Interval symptoms-admission (days)	Length of patient stay (days)	Follow-up (years)	Outcome
1	M 50	ICH HH = 4	None	4	3 right ICA, 1 AcoA	E	6	2	8	5,2	Good
2	M 70	SAH HH = 1	bronchopneumopathy	3	2 right ICA, 1 AcoA	D	4	1	10	1,2	Sufficient
3	F 51	SAH HH = 2	None	3	2 left ICA, 1 AcoA	E	4	1	8	5	Good
4	M 55	SAH HH = 1	None	3	1 left MCA, 1 left ICA, 1 AcoA	E	5	20	8	7	Good
5	F 68	SAH HH = 4	cardiomyopathy	3	2 right MCA, 1 right MCA	D	4	1	10	1,2	Sufficient
6	M 45	SAH HH = 1	None	2	1 left MCA, 1 AcoA	E	4	1	8	10	Good
7	M 48	SAH HH = 4	cardiomyopathy	2	1 left ACA, 1 left PcoA	D	4	2	10	1,1	Sufficient
8	F 71	SAH HH = 4	diabetic nephropathy	2	1 left ACA, 1 right PcoA	D	5	1	10	1,1	Sufficient
9	M 53	SAH HH = 2	None	2	1 right ACA, 1 left PcoA	E	4	35	8	11	Good
10	F 50	SAH HH = 1	bronchopneumopathy	2	1 right MCA, 1 AcoA	D	4	1	8	9,7	Good
11	M 41	ICH HH = 4	None	2	1 left MCA, 1 AcoA	E	4	1	8	8,7	Good
12	F 42	SAH HH = 1	None	2	1 right MCA, 1 AcoA	E	4	4	8	6,9	Good
13	F 38	ICH HH = 4	cardiomyopathy	2	1 right MCA, 1 AcoA	E	4	1	15	1,7	Died for internistic disease
14	M 40	SAH HH = 1	bronchopneumopathy	2	1 left MCA, 1 AcoA	D	4	2	8	13,6	Good
15	F 58	SAH HH = 1	None	2	1 right MCA, 1 AcoA	E	4	2	8	14,7	Good
16	F 60	SAH HH = 1	None	2	1 right MCA, 1 AcoA	E	5	1	8	11	Good
17	M 62	None HH = 0	None	2	1 left MCA, 1 AcoA	D	4	Incidental finding	8	12,7	Good
18	F 55	SAH HH = 1	bronchopneumopathy	2	1 right MCA, 1 AcoA	E	4	1	10	1,2	Sufficient
19	F 52	SAH HH = 1	None	2	1 right MCA, 1 AcoA	E	5	1	8	15,5	Good

SAH: Subarachnoid hemorrhage; ICH: Intracerebral hemorrhage; HH: Hunt-Hess score; ICA: Internal Carotid Artery; MCA: Middle Cerebral Artery; AcoA: Anterior Communicating Artery; PcoA: Posterior Communicating Artery; E: Early Surgery; D: Delayed Surgery.

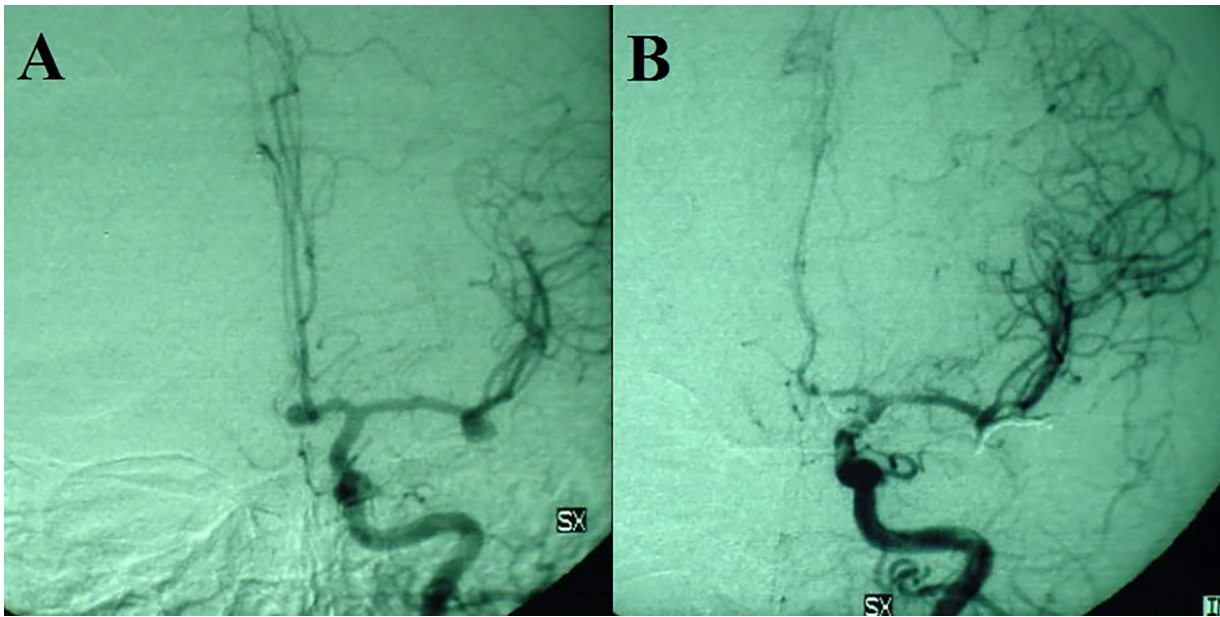


Fig. 1. A) pre-operative and B) post-operative angiography of patient with one aneurysm of AcoA and one of left MCA.

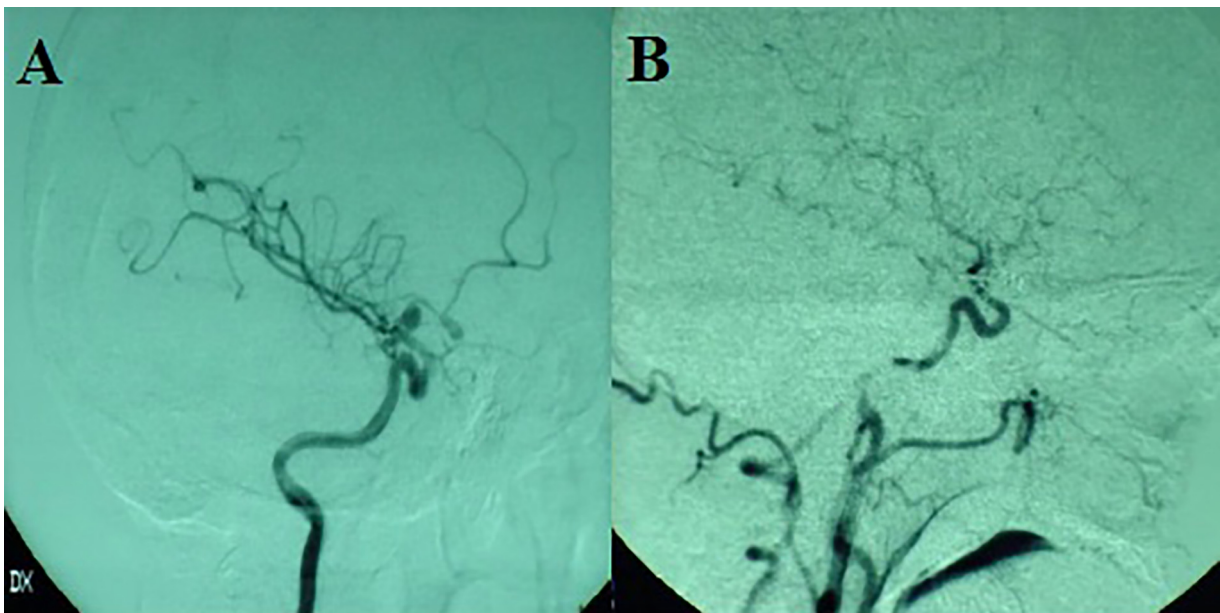


Fig. 2. A) pre-operative and B) post-operative angiography of patient with aneurysm of AcoA and two aneurysms of right ICA.

KPS 80–60 = sufficient, KPS < 60 = bad). Mean length of stay was 8,8 days and the mean follow-up was 7,2 years. Early surgical treatment was preferred in 12 patients [age < 65 years, HH score 1–2 and selected cases of HH = 4 with no comorbidities] with good outcome in 10 cases and sufficient outcome in one patient dead after 1,7 years for internistic diseases. Seven patients (age > 65 years, HH score 4, presence of severe comorbidities, unruptured aneurysms) were treated in a later stage with good outcome in 3 cases and sufficient outcome in 4 cases. Mean operation time was 4,3 h. Eighteen patients underwent a surgical clipping of all multiple aneurysms. In one case of double aneurysm only ruptured aneurysm was clipped and a later embolization was performed for the unruptured one. In the case of asymptomatic patient with incidental detection of multiple aneurysms, embolization failed and a surgical treatment was done with good outcome. In all patients a pre- and post-operative

angiography was performed and a good outcome was reported in 72,2% of cases.

4. Discussion

In many published articles, the rate of multiple intracranial aneurysms has been reported as being between 7% and 45% [4]. The female preponderance has been observed [5] and Moya–Moya disease and sickle cell disease are frequently associated [6,7]. Successful treatment of intracranial aneurysms may only be achieved by an interdisciplinary approach based on availability of both neurosurgical and neurointerventional expertises, pondering the optimal strategy and tailoring individual therapeutic approaches, considering intrinsic lesional features and patient's characteristic [1]. One of the main factors influencing the results of treatment of

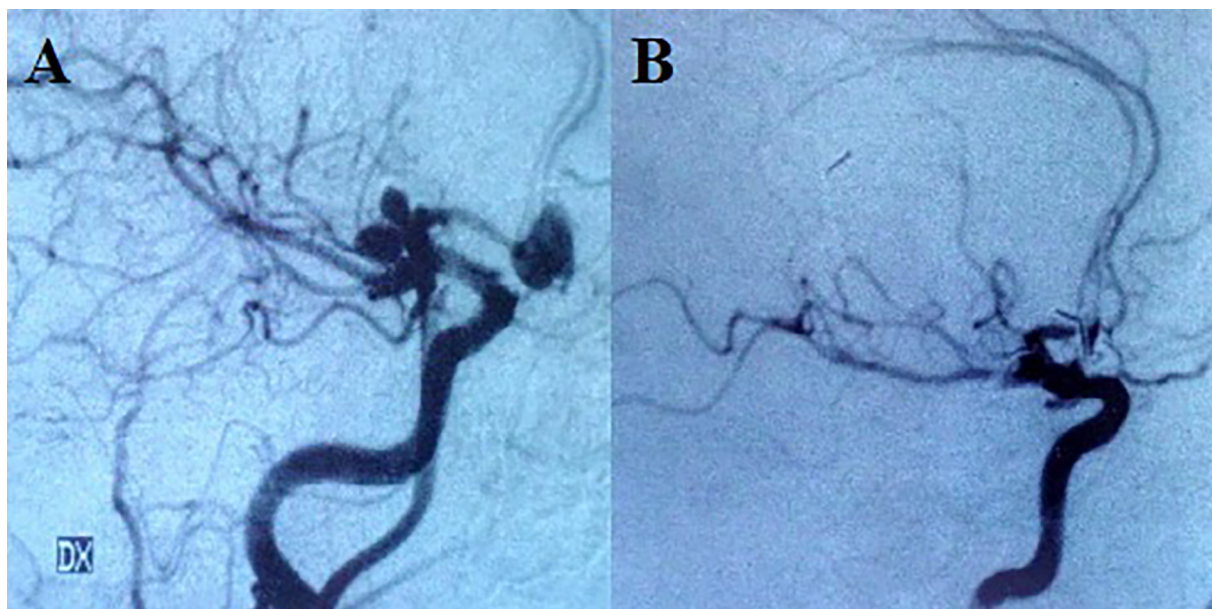


Fig. 3. A) pre-operative and B) post-operative angiography of patient with one aneurysm of AcoA and three aneurysms of right ICA.

multiple cerebral aneurysms is recognition of bleeding aneurysms. Several studies showed that multiple aneurysms are associated with a less favorable outcome than are single aneurysm cases after SAH [8,9]. For unruptured aneurysms, surgery is recommended for multiple aneurysms, one of them not amenable to coiling [10] and for ruptured aneurysms surgical treatment is mandatory if life-threatening hematoma is present [11]. Other main factor regards timing to operate all aneurysms simultaneously or in different stages [12]. A simultaneous rupture is very rare and mirror-like aneurysms are encountered in 9.4% of patients [13]. In literature the majority of neurosurgeons nowadays trend to operate on all detected aneurysms [2]. In our series bilateral aneurysms were treated by an unilateral approach. For these cases the ability of the surgeon through a unilateral approach spares the patient the risk and inconvenience associated with a separate craniotomy. The contralateral approach for aneurysm repair is technically feasible and safe in appropriately selected patients [14]. The advancement of vascular devices has ensured that in patients with unruptured aneurysms endovascular treatment of all aneurysms in one or more sessions is less traumatic than surgical treatment even if surgery, requiring multiple craniotomies in most cases, is a definitive treatment. Both the International Study of Intracranial Aneurysms (ISUIA) and the International Subarachnoid Aneurysm Trial (ISAT) have reported better outcomes with endovascular coiling if compared with microsurgical clipping [10,11]. These conclusions are significant only for aneurysms whose anatomy is suitable for both techniques and this is not the case in many instances. Other factor to consider concerns decision making about early surgery (<24 h) or delayed surgery (>24 h). In our experience the main indications for early surgical treatment are young age (<65 years), life-threatening hematoma and progressive neurological deficit while indications for delayed surgical treatment are elder age (>65 years) and presence of severe comorbidities, even if in recent literature age is no longer considered a contraindication [11,15]. Value of HH score should be related to other parameters for the choice of the best surgical timing [15]. A patient with low H–H score and severe comorbidities could have a better outcome with delayed surgery after a clinical stabilization, while a patient with high H–H score and no comorbidities should benefit better with an early surgery. The clipping of aneurysms nowadays remains an intricate procedure and additional tools can be very useful [4].

5. Conclusion

Multiple intracranial aneurysms are complex lesions and different combinations of modalities and techniques can be used in their treatment. In patients with unruptured aneurysms endovascular treatment is less traumatic than surgical treatment, that still offers good results, considering lesional and patient's features. In patients with ruptured aneurysms analysis of specific parameters should indicate the best surgical timing. In both cases surgery always remains the definitive treatment.

Conflicts of interest

No conflict of interest.

Funding

No funding has been used for this research.

Ethical approval

No ethical approval has been applied for this case report study, only the written and oral consent by the patient.

Consent

A written consent has been obtained from the patient for publication of this case report and accompanying images and is available for review on request.

Author contribution

All the authors have contributed equally to the paper.

Registration of research studies

Research Registry.
 UIN researchregistry3169.

Guarantor

Aldo Ierardi.
Bruno Romanelli.

References

- [1] N. Nighoghossian, R. Deruty, P. Trouillas, C. Mottolese, Multiple intracranial aneurysms: discussion of the therapeutic management of a case, *Neurochirurgie* 36 (1990) 176–179.
- [2] E. Zderkiewicz, Management in cases of multiple cerebral aneurysms, *Pol. Merkur. Lekarski* 3 (1997) 295–298.
- [3] R.A. Agha, A.J. Fowler, S. Rajmohan, I. Barai, D.P. Barai, P. Group, Preferred reporting of case series in surgery; the PROCESS guidelines, *Int. J. Surg.* 36 (2016) 319–323.
- [4] S.A. Hosainey, T.R. Meling, A 54-year-old man with 12 intracranial aneurysms and familial subarachnoid hemorrhage: case report, *Neurosurg. Rev.* 39 (2016) 711–716.
- [5] N. Ajiboye, N. Chalouhi, R.M. Starke, M. Zanaty, R. Bell, Unruptured cerebral aneurysms: evaluation and management, *Sci. World J.* 2015 (2015) 954954.
- [6] S. Ozaki, A. Inoue, H. Miyazaki, S. Onoue, H. Ichikawa, S. Fukumoto, S. Iwata, K. Kohno, Hemorrhagic adult unilateral moyamoya disease with multiple unruptured intracranial aneurysms: a case report, *No Shinkei Geka* 44 (2016) 121–128.
- [7] L.W. Diggs, D. Brookoff, Multiple cerebral aneurysms in patients with sickle cell disease, *South. Med. J.* 86 (1993) 377–379.
- [8] M. Kaminogo, M. Yonekura, S. Shibata, Incidence and outcome of multiple intracranial aneurysms in a defined population, *Stroke* 34 (2003) 16–21.
- [9] J. Rinne, J. Hernesniemi, M. Niskanen, M. Vapalahti, Management outcome for multiple intracranial aneurysms, *Neurosurgery* 36 (1995) 31–37 (discussion 37–38).
- [10] J. Raymond, F. Guillemin, F. Proust, A.J. Molyneux, A.J. Fox, J.S. Claiborne, J.F. Meder, I. Rouleau, Trial ONEAMCG: unruptured intracranial aneurysms: a critical review of the international study of unruptured intracranial aneurysms (ISUIA) and of appropriate methods to address the clinical problem, *Interv. Neuroradiol.* 14 (2008) 85–96.
- [11] M. Kozba-Gosztyla, B. Czapiga, W. Jarmundowicz, Aneurismal subarachnoid hemorrhage: who remains for surgical treatment in the post-ISAT era? *Arch. Med. Sci.* 11 (2015) 536–543.
- [12] H. Tsurushima, K. Meguro, K. Narushima, A. Tsukada, T. Nose, Simultaneous rupture of multiple intracranial aneurysms: a case report, *No Shinkei Geka* 24 (1996) 385–388.
- [13] C.E. Baccin, T. Krings, H. Alvarez, A. Ozanne, P. Lasjaunias, Multiple mirror-like intracranial aneurysms. Report of a case and review of the literature, *Acta Neurochir. (Wien)* 148 (2006) 1091–1095, discussion 1095.
- [14] R.E. Clatterbuck, R.J. Tamargo, Contralateral approaches to multiple cerebral aneurysms, *Neurosurgery* 57 (2005) 160–163, discussion 160–163.
- [15] M. Asilturk, A. Abdallah, Clinical outcomes of multiple aneurysms microsurgical clipping: evaluation of 90 patients, *Neurol. Neurochir. Pol.* (2017) [Epub ahead of print].

Open Access

This article is published Open Access at [sciencedirect.com](https://www.scienceopen.com). It is distributed under the [IJSCR Supplemental terms and conditions](#), which permits unrestricted non commercial use, distribution, and reproduction in any medium, provided the original authors and source are credited.