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Management of ruptured aneurysms combined with coexisting aneurysms

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Summary

In patients suffering from subarachnoid haemorrhage (SAH) and presenting with multiple intracranial aneurysms (MIA) two questions have to be decided on: 1st when is the ideal moment to eliminate the ruptured aneurysm and 2nd when to treat the coexisting aneurysms.

In our series we retrospectively analysed 124 SAH-patients presenting with a total of 323 aneurysms.

In 57 patients the ruptured aneurysm and all coexisting aneurysms were clipped during the first operation, whereas in 9 patients only some of the coexisting aneurysms (group-A; age in median 55 years) were clipped besides the ruptured one. In 55 patients (group-B; age in median 55 years) the first operation was restricted to clipping the ruptured aneurysm, dealing with the coexisting aneurysm subsequently. Immediately after admission 3 patients passed away. One of the 64 patients waiting (average 60 days, median 14 days) for the subsequent clipping of the not yet secured aneurysms suffered a SAH. Six to 12 months after the initial SAH, 78% of the cases in both groups reached a Glasgow Outcome Score of 4 or 5.

Even if in patients with coexisting unruptured intracranial aneurysms the elimination of each and every aneurysm is recommended, the advantages of an unstaged procedure versus the additional strain caused by the prolongation of the procedure, e.g. approach over the midline, 2 or more craniotomies, and the risk of additional ischemic damage to the brain, caused by increased manipulation of cerebral arteries and brain tissue, have to be carefully considered. This is of special importance in dealing with patients in higher Hunt and Hess grades.

Keywords: Aneurysm surgery; intracranial aneurysms; management outcome; multiple aneurysms; subarachnoid hemorrhage.

Introduction

Eliminating a ruptured aneurysm is a prophylactic procedure preventing rebleeding and facilitating the treatment of delayed vasospasm. Unless a space occupying haematoma or an acute hydrocephalus can be drained, the procedure does not improve the actual condition of the patient, but is apt to hurt the brain even more, as it reacts especially sensitive to additional damage.

In patients suffering from multiple intracranial aneurysms (MIA) not only the ideal moment to eliminate the ruptured aneurysm has to be decided on but also when to treat the coexisting aneurysms.

The aim of this study is a retrospective analysis of our policy dealing with MIA.

Material and method

Evaluation of the records of all the patients having been treated for ruptured intracranial aneurysms in the Neurosurgical Department of the University-Hospital Zurich between 1997 and 2003, established 124 patients presenting with subarachnoid haemorrhage (SAH) and MIA (Table 1).

At time of entering the Neurosurgical Department of the University-Hospital Zurich 60,4% of patients presented with a Glasgow Coma Score of 13–15, 26,6% with 8 points or less (Table 2). Table 3 shows the degree of haemorrhage according to the Fisher-Scale. Immediately after arriving in the Neurosurgical Department and before a treatment could start 3 patients died.

The localisation of the 124 ruptured aneurysms and the 199 coexisting aneurysms is shown in Table 4. 81 patients suffered from 2 intracranial aneurysms, 25 from 3 aneurysms and 18 patients from 4 or more intracranial aneurysms.

Table 1. *Population (n = 124)*

Age	Men	Females	Total
30–39	3	7	10
40–49	7	26	33
50–59	11	29	40
60–69	4	27	31
70–79	0	8	8
80–89	0	2	2
	25	*99*	124

Table 2. *Initial Glasgow Coma Score*

3 to 8	33	(26,6%)
9 to 11	5	(4,0%)
13 to 15	75	(60,4%)
Unknown	11	(8,8%)
	124	

Table 3. *Fisher Grading*

0	3	(2,4%)
1	10	(8,0%)
2	20	(16,1%)
3	27	(21,7%)
4	64	(51,6%)
	124	

Table 4. *Locations of the aneurysms (n = 323)*

	Ruptured (n = 124)		Non ruptured (n = 199)		Total	%
MCA	37	(29,8%)	72	(36,2%)	*109*	33,7%
ICA	29	(23,4%)	75	(37,7%)	*104*	32,2%
Acoma	34	(27,4%)	13	(6,5%)	*47*	14,5%
BA	7	(5,6%)	8	(4,0%)	*15*	4,6%
PICA	6	(4,8%)	7	(3,5%)	*13*	4%
dist. ACA	9	(7,3%)	14	(7,0%)	*23*	7,1%
PCA	2	(1,6%)	5	(2,5%)	*7*	2,2%
Others	0		5	(2,5%)	*5*	1,5%
	124		*199*		*323*	

Results

In 85 patients (69%) the ruptured aneurysm was clipped within 72 hours after the SAH, in 28 of them as an emergency to evacuate a space occupying intracerebral haematoma.

Sequence of clipping of the ruptured and the coexisting aneurysms

In 66 (55%) patients several or all the aneurysms were clipped in one session (group A), in 55 (45%) patients initially only the ruptured aneurysm was eliminated whereas the coexisting aneurysms were secured later on. Immediately after admission 3 patients passed away.

Table 5 and Table 6 show the initial (''time of entering the Neurosurgical Department'') Glasgow Coma Score (GCS), respectively Fisher Grade, for patients of group A (''simultaneous'') and group B (''staged'').

Group A (simultaneous procedure): In 57 (this is in 47% of 124 patients) of the 66 (55%) patients not only the ruptured but all the diagnosed aneurysms were clipped within the initial session. In 50 of these 57 patients this could be achieved by performing one craniotomy only – 38 of the coexisting aneurysms were located ipsilateral to the ruptured one, in 12 patients the coexisting aneurysms could be reached by passing the midline. In 7 patients 2 craniotomies were done in the initial session (Table 7). Finally, in 9 patients presenting with 34 aneurysms, the ruptured and several (but not all) coexisting aneurysms were also clipped within the initial session.

Table 5. *Sequence of clipping|Initial Glasgow Coma Score (n = 121)*

	Group A (simultaneous)		Group B (staged)	
GCS-3–8	17	25,7%	16	29%
GCS 9–12	4	6%	4	7,3%
GCS 13–15	42	63,6%	30	54,5%
Unknown	3	4,5%	5	9%
	66		*55*	

Table 6. *Sequence of clipping|Fisher Grade (n = 121)*

Grading	Group A (simultaneous)		Group B (staged)	
Fisher 0	3	(4,5%)	2	(3,6%)
Fisher 1	9	(13,6%)	3	(5,4%)
Fisher 2	11	(16,6%)	6	(16,5%)
Fisher 3	15	(22,7%)	15	(27,2%)
Fisher 4	28	(42,4%)	29	(52,7%)
	66		*55*	

Table 7. *Locations of the aneurysms|Sequence of clipping|operative approach| (n = 112*)*

Unrupt. Aneurysms	Group A (simultaneous)		Group B (staged)	
Ipsilateral	38	(66,7%)	14	(25,4%)
Contralateral	12	(21%)	31	(56,3%)
2 Craniotomies necessary	7	(12,3%)	10	(18,1%)
	*57**		*55*	

* In an other 9 patients presenting with 34 Aneurysms, initially the ruptured and several (but not all) coexisting aneurysms were clipped. Only 2 of these 9 patient had the coexisting aneurysms ipsilateral to the ruptured one.

Group B (staged procedure): In 55 (45%) patients only the ruptured aneurysm was secured initially, whereas the coexisting aneurysms were secured later on. In 7 cases several aneurysms were left due to bad condition several aneurysms were left untouched in 7 of these 55 patients.

Outcome (6 to 12 months after the initial SAH): Table 8 shows the Glasgow Outcome Score (GOS) in patients undergoing 1, 2 or several sessions. About 78% of the cases of each group reached a GOS of 4 and 5 .

With an GCS of 9 or higher at time of entering the Neurosurgical Department 87% of patients reached a Glasgow Outcome Score GCS of 4 and 5.

Table 8. *Sequence of clipping/Glasgow Outcome Score (n = 121)*

GOS	Group A (simultaneous)		Group B (staged)	
1	2	(3,5%)	2	(3,6%)
2	2	(3,5%)	3	(5,4%)
3	8	(14%)	7	(12,7%)
4	22	(38,6%)	21	(38,2%)
5	23	(40,4%)	22	(40%)
	57		*55*	

Table 9. *Correlation initial GCS/GOS*

GCS	GOS4/5
GCS-3–8	54,5%
GCS 9–12	87,5%
GCS 13–15	86,1%
Unknown	37,5%

Discussion

To prevent rebleeding and to facilitate the treatment of possibly arising delayed vasospasm, ruptured cerebral aneurysms should be eliminated from circulation as early as possible, ideally without adding further damage to the brain [2, 3, 5, 13, 14, 27].

About one third of patients suffering from a ruptured cerebral aneurysm are found to have additional asymptomatic aneurysms [8, 12, 16, 20]. In patients with MIA the aneurysms located at the bifurcation, such as the anterior communicating artery and the middle cerebral artery, bleed easily to contrast with lateral aneurysms such as those found at the branching and bending points on the internal carotid artery [23].

Coexisting aneurysms of all sizes in patients with SAH due to another treated aneurysm carry a higher risk for future haemorrhage than similar sized aneurysms without a SAH history and have to be considered for treatment [1].

Actually, in treating ruptured aneurysms, early operation (day 0–3) is generally accepted, at least in patients in good condition [17, 21]. Even if there is no clear evidence advocating early or late surgical treatment after aneurysmal rupture [3], ultra early surgery and a nonselective policy need not necessarily generate a large number of dependent survivors, even among elderly poor-grade patients [4, 14].

In patients with coexisting unruptured intracranial aneurysms the elimination of all the aneurysms is recommended [5, 7, 29], at best within one session [18, 24, 26] and within one week from onset [15]. An unstaged procedure has several advantages over a staged one:

- In case of difficulties in identifying the ruptured aneurysm clipping all the coexisting aneurysms prevents further bleedings [9].
- It allows an aggressive treatment of delayed cerebral ischemia without risking the rupture of unsecured coexisting aneurysms.
- The patient need not be confronted with the possibilities of suffering further bleedings or subsequent procedures.

These advantages have to be balanced against the additional strain caused by the prolongation of the procedure, e.g. approach over the midline, 2 or more craniotomies, and the risk of additional ischemic damage to the brain, caused by increased manipulation of cerebral arteries and brain tissue. This is of special importance in dealing with patients in higher HH-grades.

Our retrospective analysis includes 124 patients (80% women) suffering from subarachnoid haemorrhage, presenting a total of 323 aneurysms. Women seem to present a higher percentage of MIA than men [10, 12, 16]. The highest rate of rupture was found in aneurysms located at the Acom (72%), followed by aneurysms of the BA (46%) and finally of the ICA.

In 57 patients all the coexisting aneurysms were clipped within the same session as the ruptured one, whereas in 9 patients only some of the coexisting aneurysms (group-A; age in median 55 years) were clipped at the same time. In 55 patients (group-B; age in median 55 years) the first operation saw only the clipping of the ruptured aneurysm, the coexisting aneurysms being treated subsequently.

1 of the 64 patients waiting (average 60 days, median 14 days) for the subsequent clipping of the not yet secured aneurysms suffered a SAH.

In spite of the differences of the stress caused by the one-step procedure in comparison with a staged procedure – 20% of patients in group A needed an approach over the midline to the contralateral side, in an other 14% 2 craniotomies had to be done – about 78% of the cases in both groups reached a GOS of 4 or 5, 6 to 12 months after the initial SAH . There is no striking difference in age between group A and group B (53,5 years and 56 years respectively). Concerning GCS at time of entering the Neurosurgical Department and Fisher-Grade, there are more patients with a high GCS and a low Fisher-Grade in group A (Table 5 and 6).

One of the reasons for reaching a GOS of 4 or 5 in about 78% of our population might be the fact, that in patients with low GCS and high Fisher Grading we are given to proceed stepwise in securing the aneurysms. Another one might be our attitude to decide during surgery about how to handle the coexisting aneurysms. In patients presenting a tight, swollen brain, it is wise not to persist in a one-step procedure, the same is true when clipping of the ruptured aneurysm turns out to be unexpectedly difficult [6, 8, 18, 19].

Nevertheless, deciding on a staged procedure, demands careful inspection of the aneurysms as to eliminate the appearance of a recent ruptured aneurysm and the risk of subsequent bleedings from untreated aneurysms has to be realised [22, 26, 28].

References

1. Bederson JB, Awad IA, Wiebers DO, Piepgras D, Haley EC Jr, Brott T, Hademenos G, Chyatte D, Rosenwasser R, Caroselli C (2000) Recommendations for the management of patients with unruptured intracranial aneurysms: a statement for healthcare professionals from the Stroke Council of the American Heart Association. Stroke 31: 2742–2750
2. Chyatte D, Fode NC, Sundt TM Jr (1988) Early versus late intracranial aneurysm surgery in subarachnoid hemorrhage. J Neurosurg 69: 326–331
3. de Gans K, Nieuwkamp DJ, Rinkel GJ, Algra A (2002) Timing of aneurysm surgery in subarachnoid hemorrhage: a systematic review of the literature. Neurosurgery 50: 336–342
4. Elliott JP, Le Roux PD (1998) Subarachnoid hemorrhage and cerebral aneurysms in the elderly. Review. Neurosurg Clin N Am 9: 587–594
5. Findlay JM (1997) Current management of aneurysmal subarachnoid hemorrhage guidelines from the Canadian Neurosurgical Society. Can J Neurol Sci 24: 161–170
6. Grigorian AA, Marcovici A, Flamm ES (2003) Intraoperative factors associated with surgical outcome in patients with unruptured cerebral aneurysms: the experience of a single surgeon. J Neurosurg 99: 452–457
7. Heiskanen O (1981) Risk of bleeding from unruptured aneurysm in cases with multiple intracranial aneurysms. J Neurosurg 55: 524–526
8. Hernesniemi J, Rinne J (2003) Multiple aneurysms. Surg Neurol 60: 136–137
9. Hino A, Fujimoto M, Iwamoto Y, Yamaki T, Katsumori T (2000) False localization of rupture site in patients with multiple cerebral aneurysms and subarachnoid hemorrhage. Neurosurgery 46: 825–830
10. Inagawa T (1991) Surgical treatment of multiple intracranial aneurysms. Acta Neurochir (Wien) 108: 22–29
11. International Study of Unruptured Intracranial Aneurysms Investigators (1998) Unruptured intracranial aneurysms – risk of rupture and risks of surgical intervention. N Engl J Med 339: 1725–1733
12. Kaminogo M, Yonekura M, Shibata S (2003) Incidence and outcome of multiple intracranial aneurysms in a defined population. Stroke 34: 16–21
13. Kassell NF, Torner JC, Jane JA, Haley EC Jr, Adams HP (1990) The international cooperative study on the timing of aneurysm surgery. Part 2: surgical results. J Neurosurg 73: 37–47
14. Laidlaw JD, Siu KH (2002) Ultra-early surgery for aneurysmal subarachnoid hemorrhage: outcomes for a consecutive series of 391 patients not selected by grade or age. J Neurosurg 97: 250–259
15. Mizoi K, Suzuki J, Yoshimoto T (1989) Surgical treatment of multiple aneurysms: Review of experience with 372 cases. Acta Neurochir (Wien) 96: 8–14
16. Nehls DG, Flom RA, Carter LP, Spetzler RF (1985) Multiple intracranial aneurysms: determining the site of rupture. J Neurosurg 63: 342–348
17. Ohman J, Heiskanen O (1989) Timing of operation for ruptured supratentorial aneurysms: a prospective randomized study. J Neurosurg 70: 55–60
18. Orz Y, Osawa M, Tanaka Y, Kyoshima K, Kobayashi S (1996) Surgical outcome for multiple intracranial aneurysms. Acta Neurochir (Wien) 138: 411–417
19. Rinne J, Hernesniemi J, Niskanen M (1995) Management outcome for multiple intracranial aneurysms. Neurosurgery 36: 31–38
20. Rinne J, Hernesniemi J, Puranen M, Saari T (1994) Multiple intracranial aneurysms in a defined population: prospective angiographic and clinical study. Neurosurgery 35: 803–808
21. Solomon RA, Onesti ST, Klebanoff L (1991) Relationship between the timing of aneurysm surgery and the development of delayed cerebral ischemia. J Neurosurg 75: 56–61
22. Swift DM, Solomon RA (1992) Unruptured aneurysms and postoperative volume expansion. J Neurosurg 77: 908–910
23. Ujiie H, Sato K, Onda H, Oikawa A, Kagawa M, Takakura K, Kobayashi N (1993) Clinical analysis of incidentally discovered unruptured aneurysms. Stroke 24: 1850–1856
24. Ulrich P, Perneczky A, Muacevic A (1997) Surgical strategy in cases of multiple aneurysms. Zentralbl Neurochir 58: 163–170
25. Vajda J, Juhasz J, Pasztor E, Nyary I (1988) Contralateral approach to bilateral and ophthalmic aneurysms. Neurosurgery 22: 662–668
26. Vajda J (1992) Multiple intracranial aneurysms: a high risk condition. Acta Neurochir (Wien) 118: 59–75
27. Whitfield PC, Kirkpatrick PJ (2001) Timing of surgery for aneurysmal subarachnoid haemorrhage. (Review). Cochrane Database Syst Rev: CD001697
28. Wiebers DO, Whisnant JP, Hoston J, Meissner I, Brown RD Jr, Piepgras DG, Forbes GS, Thielen K, Nichols D, O'Fallon WM, Peacock J, Jaeger L, Kassell NF, Kongable-Beckman Gl, Torner JC, International Study of Unruptured Intracranial Aneurysms Investigators (2003) Unruptured intracranial aneurysms: natural history, clinical outcome, and risks of surgical and endovascular treatment. Lancet 362: 103–110
29. Winn HR, Almaani WS, Berga SL, Jane JA, Richardson AE (1983) The long-term outcome in patients with multiple aneurysms. Incidence of late hemorrhage and implications for treatment of incidental aneurysms. J Neurosurg 59: 642–651

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