Endovascular Treatment of Ruptured Intracranial Aneurysms in Elderly People

Boris Lubicz, Xavier Leclerc, Jean-Yves Gauvrit, Jean-Paul Lejeune and Jean-Pierre Pruvo

AJNR Am J Neuroradiol 2004, 25 (4) 592-595
http://www.ajnr.org/content/25/4/592

AJNR Am J Neuroradiol 25:592–595, April 2004

Endovascular Treatment of Ruptured Intracranial Aneurysms in Elderly People

Boris Lubicz, Xavier Leclerc, Jean-Yves Gauvrit, Jean-Paul Lejeune, and Jean-Pierre Pruvo

BACKGROUND AND PURPOSE: **Endovascular detachable coil is being increasingly used for the treatment of cerebral aneurysms but little information is available about its feasibility and effectiveness in people. We assessed clinical outcomes in elderly patients with ruptured intracranial aneurysms treated with selective embolization.**

METHODS: **Between 1996 and 2002, 68 patients aged 65–80 years (mean age, 71 years) were treated by selective embolization with coils. Among them, 34 had a Hunt and Hess (HH) grade of I or II; 15, an HH grade of III; and 19, an HH grade of IV or V. All patients except four were treated within 72 hours after initial bleeding; those four patients had an HH grade of IV or V and were treated at 3–6 weeks after their clinical recovery. Clinical outcomes were assessed by using the Modified Glasgow Outcome Scale. Mean duration of follow-up was 20 months (range, 6–36 months).**

RESULTS: **Endovascular treatment resulted in 47 complete occlusions (69%), 15 neck remnants (22%), and six incomplete occlusions (9%). Procedural complications occurred in eight patients (12%). Outcomes were good or excellent in 40 patients (59%), including the four treated 3–6 weeks after initial bleeding. A fair or poor outcome was observed in 14 patients (20.5%), including two with an HH grade of I or II. Of 14 patients (20.5%) who died, 13 (93%) had an HH grade of IV or V. No rebleeding occurred during follow-up.**

CONCLUSION: **Endosaccular coiling may be proposed in elderly people with ruptured intracranial aneurysms. However, in patients with HH grade IV or V lesions, morbidity and mortality rates remain high, and embolization should be considered only after their clinical recovery.**

Endovascular treatment of intracranial aneurysms has made remarkable progress over the last 10 years and become widely used. Moreover, selective embolization with detachable coils has been accepted as an alternative to surgical clipping, with lower morbidity and mortality rates in select cases (1). Because embolization is less invasive than surgery, it allows us to treat more patients, including elderly individuals, in whom surgical clipping is considered risky. However, the literature contains only limited data about the feasibility and long-term clinical findings of endovascular treatment in elderly patients with ruptured cerebral aneurysms (2). The aim of this study was to assess the clinical outcomes of such patients.

Methods

Patients

Between June 1996 and December 2002, 482 patients with 520 intracranial aneurysms were treated in our hospital by means of an endovascular approach. Among them, 68 patients (14%) with a ruptured aneurysm were aged 65 years or older. They included 44 women (65%) and 24 men (35%) with a mean age of 71 years (range, 65–80 years).

All patients presented with subarachnoid hemorrhage (SAH) and were classified according to the Hunt and Hess (HH) scale (3). Thirty-four patients (50%) were assigned grade I or II; 15 (22%), grade III; six, grade IV (9%); and 13 (19%), grade V. All patients underwent conventional angiography of both carotid arteries and vertebral arteries. Table 1 shows the location of the aneurysms, 88% of which were in the anterior circulation and 12% of which were in the posterior circulation. Multiple aneurysms were seen in 12 patients (17.6%), but only those responsible for the SAH were treated.

Therapeutic alternatives were discussed between the neurosurgical and neurointerventional teams. Indications for endovascular therapy in our patient group mainly concerned anticipated surgical difficulties due to the age of the patients and/or the location of their aneurysms. In 64 patients, embolization was performed within 72 hours after initial bleeding. Four patients with grade IV or V SAH were referred from other institutions; they were treated in our department 3–6 weeks after the initial SAH.

Endovascular Procedure

Endovascular treatment was performed with general anesthesia and systemic heparinization. The adequacy of systemic anticoagulation was monitored with frequent measurements of the activated clotting time (ACT). A baseline ACT was obtained before a bolus administration of heparin (50–75 IU per kilogram of body weight) and hourly thereafter. The bolus was

Received June 9, 2003; accepted after revision September 14.

From the Departments of Neuroradiology (B.L., J.-Y.G., X.L., J.-P.P.) and Neurosurgery (J.-P.L.), Roger Salengro Hospital, University Hospital of Lille, France.

Address reprint requests to Boris Lubicz, Service de Neuroradiologie (Professeur Pruvo), Hôpital Roger Salengro, C.H.R.U Lille, Boulevard J. Leclercq, 59037 Lille Cedex, France.

TABLE 1: Locations of the aneurysms

Aneurysm Location	Number
Anterior communicating artery	30 (44%)
Internal carotid artery	23 (34%)
Middle cerebral artery	4
Pericallosal artery	3
Basilar artery	3
Posterior cerebral artery	2
Posterior communicating artery	1
Posterior and inferior cerebellar arteries	1
Anterior and inferior cerebellar arteries	1

TABLE 2: Clinical outcome related to clinical GOS grade on admission

	HH Grade		
Modified GOS Status (n = 68)	I, II (n = 34, 50%)	III (n = 15, 22%)	IV, V (n = 18, 28%)
Excellent	29	2	2
Good	3	2	2
Fair	2	7	0
Poor	0	3	2
Death	0	1	13

followed by a continuous infusion (1000–1500 IU/h) with the purpose of doubling the baseline ACT. Systemic heparinization was stopped at the end of the procedure in most patients. In some cases with a wide-necked aneurysm or periprocedural complications, systemic heparinization was prolonged for 48–72 hours. One patient had an aneurysm perforation, for which heparinization was immediately reversed with protamine sulfate. All patients were treated by selective embolization with Guglielmi detachable coils (GDCs). The technique for the GDC procedure has already been published in the literature (4–6). In seven cases (10%) with an unfavorable neck-to-sac ratio, the remodeling technique (7, 8) was used to prevent protrusion of the coil into the parent artery. In six patients (9%), arterial tortuosity of the femoral and/or supra-aortic vessels prevented successful access; in these patients, common carotid artery puncture was performed. After endovascular treatment, the patients were transferred to the intensive care unit, where their fluid balance, neurologic status, and blood pressure were carefully monitored.

Immediate Outcome

Patients underwent angiography to document aneurysm obliteration. Angiographic results were classified as complete occlusion (no contrast material filling the aneurysmal sac), neck remnant (residual contrast material filling the aneurysmal neck), and residual flow (residual contrast material filling the aneurysmal body). A senior neurosurgeon (J.-P.L.) recorded the clinical course, including worsening of symptoms and death. Clinical outcome was graded according to a modified Glasgow Outcome Scale (GOS) (9), as follows: excellent (neurologically intact), good (mild hemiparesis, cranial nerve palsy, or other deficit that did not interfere with daily functioning or work), fair (significant hemiparesis, aphasia, confusion, or other deficit that interfered with daily activities or prevented a return to work) or poor (coma or severe neurologic deficit rendering the patient dependent on family or nursing staff).

Patient Follow-Up

Imaging follow-up included MR examinations at 6, 12, and 36 months after treatment and conventional angiography at 12 months. We assessed the brain tissue by using an axial spin-echo T1-weighted sequence, a T2-weighted sequence, and a fluid-attenuated inversion recovery (FLAIR) sequence. We also evaluated the intracranial vessels by using rime-of-flight (TOF) and gadolinium-enhanced angiography. A senior neurosurgeon simultaneously performed a clinical examination with the imaging control. Some patients were lost to follow-up after 12 months; therefore, that mean duration of follow-up was 20 months (range, 6–36 months). Follow-up angiograms were compared with immediate postembolization angiograms and then assigned to one of three categories: 1) further thrombosis, when the amount of contrast agent filling the aneurysm decreased; 2) unchanged, when a similar degree of aneurysm occlusion was found on multiple projections; and 3) recanalization, when the amount of contrast material filling the aneurysm increased. Together, two senior neuroradiologists (B.L., X.L.) reviewed the conventional angiograms, MR angiograms, and MR images of all patients. For the correlation between HH grade and GOS status, a statistical analysis was performed by using chi-square tests of association and Spearman correlation coefficients.

Results

Endovascular Procedure

Selective embolization was successful in all patients and resulted in 47 (69%) complete occlusions, 15 (22%) neck remnants, and six (9%) incomplete occlusions. Complications related to the procedure occurred in eight patients and included six clotting episodes, one stretching of a coil, and one perforation. Thromboembolic events (n = 6) were totally regressive in four cases and led to definitive neurologic impairment in two cases despite prolonged heparinization for 72 hours. In one patient with stretching of a coil during the procedure, a lasso was used to retrieve the coil. Heparin therapy was continued for 48 hours and prevented neurologic impairment. One patient with a ruptured anterior communicating artery aneurysm experienced bleeding during placement of the last coil. Heparinization was immediately reversed, and the control angiogram obtained 3 minutes later showed no contrast-agent extravasation and complete occlusion of the aneurysm. The patient woke up with moderately severe increased headaches without the neurologic deficit seen at clinical examination.

Clinical Outcome

Table 2 shows the clinical outcome related to the HH grade on admission. Statistical analysis revealed a significant correlation between these two variables ($P < .001$).

The modified GOS grade (9) showed that 40 patients (59%) had a good or excellent outcome; these included 32 patients with a low HH grade (I, II), four with an HH grade of III, and four with an HH grade of IV or V. The clinical outcome was judged poor or fair in 14 patients (20.5%), including 12 with a high HH grade (III–V) and two with a low HH grade (I, II). The remaining 14 patients (20.5%), including 13 (93%) with an HH grade IV or V, died from comor-

bid medical conditions (congestive heart failure, sepsis, pneumonia, pulmonary edema, gastrointestinal bleeding). One 72-year-old woman with a ruptured basilar tip aneurysm (SAH grade III) died 8 days after uneventful embolization. Doppler study showed major vasospasm of the middle cerebral artery. She died from bilateral cerebral infarction.

Patient Follow-Up

No rebleeding occurred during follow-up (mean, 20 months). Clinical results remained unchanged in 40 patients with a good or excellent outcome. Among 14 patients with a fair or poor outcome, the neurologic condition improved in four; however, these patients remained dependent on their family or nursing staff.

Imaging follow-up revealed complete occlusion or neck remnant in most patients ($n = 48$). Recanalization was observed in six: Five were treated by selective embolization (including three with the remodeling technique), and one was treated surgically.

Discussion

Our results show that selective embolization of ruptured intracranial aneurysms in elderly people is effective and prevents rebleeding. However, clinical outcomes mainly depend on the patient's clinical grade on admission. In patients with an HH grade of I–III, endovascular occlusion of the aneurysmal sac may be considered at an early stage, whereas in patients with an HH grade of IV or V, the treatment should be delayed and performed only in cases of clinical improvement.

Endovascular treatment

The procedure of endosaccular coiling of intracranial aneurysm has been described in the literature (4–6). However, specific situations may be encountered in elderly people. Tortuosity or stenosis of the femoral and/or supra-aortic vessels may limit intracranial arterial access. In our series, six patients (9%) could not be treated successfully via the femoral approach: the carotid and/or the femoral artery had a tortuous course that prevented safe catheterization of the aneurysm with the microcatheter. Common carotid artery puncture were performed to allow better catheter pushability and stability. Endovascular treatment was performed with heparinization, and the common carotid artery was compressed for 15 minutes at the end of the procedure to prevent any local complication at the puncture site.

Procedural complications may occur during endosaccular coiling of an intracranial aneurysm and are mostly of thromboembolic and hemorrhagic origin. Sedat et al (2) showed that thromboembolic events during embolization of a ruptured aneurysm are more frequent in elderly people than in younger patients (13% vs 4.2%). Although our results were not compared with those of younger patients, they seem to confirm these findings. We observed six thromboembolic events (9%) that resulted in a persisting neurologic deficit in two patients. The higher rate of embolic complication is probably related to atheromatous degeneration and tortuosity of the intracranial and/or the supra-aortic vessels that may increase the difficulty of catheterization and the duration of treatment.

In cases of wide-necked aneurysms, the remodeling technique (7, 17) has proved to be effective, preventing coil protrusion into the parent artery. This technique is associated with a higher rate of embolic complications (10) because of the second microcatheter and successive parent-artery occlusions. In the present series, the remodeling technique was successfully performed in seven patients without any complications; this result supports the application of this technique, even in elderly people.

Clinical Outcome

To our knowledge, only one large series (2) has assessed the results of selective embolization of ruptured intracranial aneurysms in people aged 65 years or older. Sedat et al (2) reported that 48% of their patients had a good or excellent outcome, and 29% had a fair or poor outcome, with a mortality rate of 23%. In our series, a good or excellent clinical outcome was observed in 40 patients (59%), and a fair or poor outcome, in 14 (20.5%). Our mortality rate was 20.5% (14 patients). The larger number of low HH grades (I–III) in our study may explain this slight difference. These results compare favorably with those of surgical series (11–14) reporting 37%–48% rates of good or excellent outcomes with mortality rates of 16%–35%.

Although early embolization of patients with low HH grades (I– III) is now generally accepted, the care of those with high HH grades (IV and V) remains controversial. Endovascular series in patients of any age and HH grades of IV of V have had mortality rates of 12%–59% (6, 15–18). The only large series (2) assessing this problem in elderly people reported a significant correlation ($P < .05$) between high HH grade and poor GOS, with only 16% of patients achieving a favorable outcome and with a mortality rate of 42%. We confirmed these findings in our series: 15 (79%) of 19 patients with an HH grade of IV (six patients) or V (13 patients) were treated within 72 hours of the SAH and ultimately died or had a poor outcome ($P < .001$). The high percentage of grade V disease in our patients, as compared with the rate in the series by Sedat et al (2) (19% vs 2%), and concurrent medical complications in elderly patients may explain the different results. The remaining four patients who were treated 3–6 weeks after initial bleeding made good recoveries. These four female patients presented to other institutions with HH grades of IV or V and were thought to be too critically ill to undergo surgical or endovascular treatment. They were medically treated, made good clinical recoveries, and were then referred to our department for selective embolization.

Conclusion

Endovascular treatment of ruptured intracranial aneurysms has been accepted as an alternative to surgical clipping, but information about its feasibility and long-term results in elderly patients is limited. To our knowledge, this series is the largest reported experience in this group of patients. Selective embolization of ruptured intracranial aneurysms in patients aged 65 years or older is effective and prevents rebleeding. However, the morbidity and mortality rates are higher with high HH grades. This finding suggests that timing of treatment should be based on the patient's initial clinical status.

References

1. International Subarachnoid Aneurysm Trial (ISAT) Collaborative Group. **ISAT of neurosurgical clipping versus endovascular coiling in 2143 patients with ruptured intracranial aneurysms: a randomized trial.** *Lancet* 2002;360:1267–1274
2. Sedat J, et al. **Endovascular treatment of ruptured intracranial aneurysms in patients aged 65 years and older: follow-up of 52 patients after one year.** *Stroke* 2002;33:2620–2625
3. Hunt W, Hess R. **Surgical risk as related to time of intervention in the repair of intracranial aneurysms.** *J Neurosurg* 1968;28:14–20
4. Gulielmi G, Vinuela F, Dion J, Duckwiler G. **Electrothrombosis of saccular aneurysms via endovascular approach, II: preliminary clinical experience.** *J Neurosurg* 1991;75:8–14
5. Guglielmi G, Vinuela F, Duckwiler G, et al. **Endovascular treatment of posterior circulation aneurysms by electrothrombosis using electrically detachable coils.** *J Neurosurg* 1992;77:515–524
6. Vinuela F, Duckwiler G, Mawad M. **Guglielmi detachable coil embolization of acute intracranial aneurysm: perioperative anatomical and clinical outcome in 403 patients.** *J Neurosurg* 1997;86:475–482
7. Moret J, et al. **"The remodeling technique" in the treatment of wide neck intracranial aneurysms: angiographic results and clinical follow-up in 56 cases.** *Interv Neuroradiol* 1997;3:21–35
8. Cottier J, et al. **Utility of balloon-assisted Guglielmi detachable coiling in the treatment of 49 cerebral aneurysms: a retrospective, multicenter study.** *AJNR Am J Neuroradiol* 2001;22:345–351
9. Jennett B, Bond M. **Assessment of outcome after severe brain damage: a practical scale.** *Lancet* 1975;1:480–484
10. Soeda A, et al. **Thromboembolic events associated with Guglielmi Detachable Coil embolization of asymptomatic cerebral aneurysms: evaluation of 66 consecutive cases with use of Diffusion-weighted MR imaging.** *AJNR Am J Neuroradiol* 2003;24:127–132
11. Kassel N, Torner J, Haley E. **The international cooperative study on the timing of aneurysm surgery, I: overall management results.** *J Neurosurg* 1990;73:18–36
12. Stachniak J, Layon A, Day A, Gallagher T. **Craniotomy for intracranial aneurysm and subarachnoid hemorrhage.** *Stroke* 1996;27:276–281
13. Lanzino G, et al. **Age and outcome after aneurysmal subarachnoid hemorrhage: why do older patients fare worst?** *J Neurosurg* 1996;85:410–418
14. Yamashita K, Kashiwagi S, Kato S, Takasago T, Ito H. **Cerebral aneurysms in the elderly in Yamaguchi, Japan: analysis of the Yamaguchi Data Bank of cerebral aneurysm from 1985 to 1995.** *Stroke* 1998;28:1926–1933
15. Kremer C, Groden C, Hansen H, Grzyska U, Zeumer H. **Outcome after endovascular treatment of Hunt and Hess grade IV or V aneurysms: comparison of anterior versus posterior circulation.** *Stroke* 1999;30:2617–2622
16. Byrne J, Sohn M, Molyneux A. **Five-year experience in using coil embolization for ruptured intracranial aneurysms: outcomes and incidence of late rebleeding.** *J Neurosurg* 1999;90:656–663
17. Bracard S, et al. **Endovascular treatment of Hunt and Hess grade IV and V aneurysms.** *AJNR Am J Neuroradiol* 2002;23:953–957
18. Weir R, Marcellus M, Do H, Steinberg G, Marks M. **Aneurysmal subarachnoid hemorrhage in patients with Hunt and Hess grade IV or V: treatment using Guglielmi detachable coil system.** *AJNR Am J Neuroradiol* 2003;24:585–590