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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.

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was stopped at the end of the procedure in most patients. In purpose of doubling the baseline ACT. Systemic heparinization – 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 neuroradiologist (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 neuroradiologist simultaneously performed a clinical examination and evaluated the intracranial vessels by using rime-of-flight (TOF) and gadolinium-enhanced angiography. A senior neuroradiologist (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-

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bid medical conditions (congestive heart failure, sep-
sis, pneumonia, pulmonary edema, gastrointestinal
bleeding). One 72-year-old woman with a ruptured
basilar tip aneurysm (SAH grade III) died 8 days af-
er uneventful embolization. Doppler study showed ma-
jor 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). Recanaliza-
tion 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 pa-
ients 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 intracra-
nial aneurysms has been described in the literature
(4–6). However, specific situations may be encoun-
tered in elderly people. Tortuosity or stenosis of the
femoral and/or supra-aortic vessels may limit intra-
cranial arterial access. In our series, six patients (9%)
could not be treated successfully via the femoral ap-
proach: the carotid and/or the femoral artery had a
tortuous course that prevented safe catheterization of
the aneurysm with the microcatheter. Common ca-
rotid artery puncture were performed to allow better
catheter pushability and stability. Endovascular treat-
ment was performed with heparinization, and the
common carotid artery was compressed for 15 min-
utes at the end of the procedure to prevent any local
complication at the puncture site.

Procedural complications may occur during en-
dosaccular 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 per-
sisting neurologic deficit in two patients. The higher
rate of embolic complication is probably related to
atheromatous degeneration and tortuosity of the in-
tracranial and/or the supra-aortic vessels that may
increase the difficulty of catheterization and the du-
ratio of treatment.

In cases of wide-necked aneurysms, the remodeling
technique (7, 17) has proved to be effective, prevent-
ing coil protrusion into the parent artery. This tech-
nique is associated with a higher rate of embolic complica-
tions (10) because of the second microcath-
eter and successive parent-artery occlusions. In the
present series, the remodeling technique was success-
fully performed in seven patients without any compli-
cations; 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 rup-
tured 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 out-
come 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 pa-
tients may explain the different results. The remain-
ing 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 treat-
ment. They were medically treated, made good clin-
ical recoveries, and were then referred to our depart-
ment 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
