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Endovascular Management of Poor-Grade Aneurysmal Subarachnoid Hemorrhage in the Geriatric Population

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BACKGROUND AND PURPOSE: **The incidence of poor-grade (Hunt and Hess grade IV and V) subarachnoid hemorrhage (SAH) is higher in elderly patients (>70 years) than in younger groups. The aim of this retrospective study was to analyze the outcome of these poor grade elderly patients after endovascular treatment.**

METHODS: **We retrospectively reviewed the clinical records of 27 patients older than 70 years who underwent endovascular treatment for aneurysmal SAH between January 1996 and July 2002. Thirteen patients with SAH and a poor Hunt and Hess grade at initial presentation had been treated by endovascular means. Their outcomes were assessed by the using the Glasgow Outcome Scale (GOS).**

RESULTS: **Two patients (15%) had a good outcome according to the GOS. Three patients (23%) were moderately disabled, two (15%) were severely disabled at the time of discharge from the hospital, and six (47%) died. Five patients (38%) developed clinical vasospasm and underwent balloon angioplasty. Three procedure-related deaths occurred (23%).**

CONCLUSION: **Endovascular treatment has modified the management of poor-grade SAH in elderly patients, most of whom are high-risk surgical candidates. Endovascular treatment can be administered early after the initial ictus, reducing the risk of rebleeding and providing an option to pursue aggressive triple-H therapy. Symptomatic vasospasm can also be treated by endovascular means in the initial setting.**

In patients aged 70–88 years, the incidence of aneurysmal subarachnoid hemorrhage (SAH) is as high as 78 cases per 100,000 population, as compared with 15 cases per 100,000 in those aged 30–59 years (1, 2). The management of SAH in elderly patients has been mostly conservative. Studies have shown no major advantage with surgery over conservative management (3, 4). However, other studies have advocated early aggressive management in elderly patients (5–7) or patients with a poor clinical grade (8). More importantly, a poor clinical grade (Hunt and Hess grade IV and V) at initial presentation is more common in elderly patients than in younger groups (5). Therefore, the morbidity and mortality associated with surgery is increased in the elderly. In addition, many of these patients have associated medical problems, such as poor cardiac status, deranged pulmonary function, and hypertension that make them poor surgical candidates. Improvements in endovascular techniques have shown encouraging results in the management of intracranial aneurysms in elderly patients, particularly those with a poor clinical grade (8–10). We retrospectively analyzed the endovascular management of poor-grade aneurysmal SAH in elderly patients (>70 years) at the University of Michigan hospital.

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Methods

We retrospectively reviewed the clinical records of 27 patients older than 70 years who underwent endovascular treatment for aneurysmal SAH between January 1996 and July 2002. The data were collected according to a protocol approved by our institutional review board to ensure patient privacy. Among them, 13 patients (48%) had a Hunt and Hess grade of IV or V after resuscitation (Table). None of the patients had a parenchymal hematoma that would have necessitated surgical evacuation.

Endovascular coiling had been done by using Guglielmi detachable coils (GDCs; Boston Scientific/Target, Fremont, CA) for 13 aneurysms in 12 patients. One patient had four aneurysms of the posterior inferior cerebellar artery and was treated by occlusion of the parent artery with *N*-butyl 2-cyanoacrylate glue (Cordis Endovascular, Miami, FL). Endovascular treatment was administered within 48 hours of the initial ictus in all patients. All patients were treated under general anes-

Clinical data for the study patients

Age/Sex	Aneurysm Location	Aneurysm Size, mm	Hunt and Hess Grade	Symptomatic Vasospasm	GOS Status after Initial Event
72/M	Acom	10	IV	No	Good
77/M	Pcom	6	V	No	Died
75/F	Acom	5	V	Yes	Died
	MCA*	2			
80/F	Acom	7	V	No	Died
73/F	Sup Hypo	25	IV	Yes	Good
79/F	PICA†	3	IV	No	Moderately disabled
75/M	Acom	7	IV	Yes	Moderately disabled
71/F	Basilar	18	V	No	Moderately disabled
72/M	Pcallosal	6	V	Yes	Died
77/F	Pcallosal	3	V	No	Severely disabled
	Cav caro*	2			
89/F	Acom	4	IV	No	Died
	Pcom	4			
75/F	Pcom	7	V	Yes	Severely disabled
73/F	PICA	5	V	Yes	Died

Note.—Acom = anterior communicating artery, Cav caro = cavernous carotid artery, GOS = Glasgow outcome scale, MCA = middle cerebral artery, Pcallosal = pericallosal artery, Pcom = posterior communicating artery, PICA = posterior inferior cerebellar artery, and Sup Hypo = superior hypophyseal artery.

* Untreated aneurysm.

† This patient had four small aneurysms arising from PICA.

thesia and received intravenous heparin for at least 24 hours after placement of the first endovascular coil. During the procedure, anticoagulation was monitored to a target activated clotting time of around 300 seconds. Postprocedural anticoagulation was monitored to a target activated partial thromboplastin time of more than twice the baseline. Patients also received oral aspirin (325 mg/d administered through a nasogastric tube) if they could tolerate it. Nimodipine was given to all patients to reduce the effects of vasospasm. Triple-H (hypervolemia, hemodilution, and hypertension) therapy was administered to treat or prevent vasospasm. Pulmonary wedge pressures were closely monitored to prevent fluid overload in patients with compromised cardiac and pulmonary status. Balloon angioplasty was done to treat vasospasm in five patients. Intracranial hypertension was appropriately treated in all patients with sedation, CSF drainage, and administration of mannitol or barbiturates. Patient outcome was assessed by the using the Glasgow Outcome Scale (GOS). The on-call neurosurgical team completed the initial assessment, and the ward neurosurgery attending physician (B.G.T.) assessed the final outcome. Patients with good GOS status or moderate disability were classified as having a favorable outcome. Patients who were severely disabled, those in a persistent vegetative state, and those who died were classified as having an unfavorable outcome.

Results

Five (38%) of 13 patients had a Hunt and Hess grade of IV, and eight (62%) had a grade of V at presentation. Twelve patients had a Fischer grade of IV, and one had grade III SAH, as shown on the initial CT scan. The oldest patient was aged 89 years (mean age of all patients, 76 years). Female patients outnumbered male patients nine to four. A total of 19 aneurysms were detected. Four of 13 patients with ruptured aneurysms also had six incidental unruptured aneurysms. Three patients had one additional incidental aneurysm, and one had three additional aneurysms. Thirteen aneurysms were in the anterior circulation, and the remaining six were in the posterior circulation (Table).

Eleven aneurysms were small (<5 mm), six were medium (6–10 mm), one was large (11–25 mm), and one was giant (>25 mm). Endovascular treatment was administered for 17 aneurysms. Two small incidental aneurysms in the anterior circulation were not treated. Four small incidental aneurysms were treated with the ruptured aneurysms. Thirteen aneurysms were managed by using GDCs. Total occlusion was possible in eight lesions (62%) after the first procedure. Subtotal occlusion was achieved in three (23%), and partial occlusion, in two (15%). Three patients underwent repeat coiling because of a residual neck at the first procedure or later compaction of the coils. One patient required stent-assisted coiling for a wide-necked aneurysm during the repeat procedure.

Five (38%) patients had a favorable outcome according to GOS status, two (15%) had a good outcome, and three (23%) were moderately disabled at the time of their discharge from the hospital after the initial episode. Two (15%) were severely disabled, and six (47%) died. Hence, eight patients (62%) had an unfavorable outcome according to GOS status.

Of five patients who presented with a Hunt and Hess grade of IV, four (80%) were alive at discharge. One patient (20%) died from complications related to vasospasm and increased intracranial pressure. Two patients (40%) had a good outcome, and two (40%) were moderately disabled. Eight patients with a Hunt and Hess grade of V underwent endovascular treatment. Three patients were alive at discharge, two (25%) were severely disabled, and one (12.5%) was moderately disabled. Five patients (62.5%) died during their hospital admission. Among them, one patient was actively bleeding at the time of diagnostic

angiography, as indicated by pulsatile blood flowing from the ventriculostomy and free extravasation of contrast material from the dome of the aneurysm.

A total of 13 endovascular procedures—12 endovascular coil embolizations and one glue embolization—were done as a primary endovascular technique in the acute phase. Five patients (38%) also underwent balloon angioplasty to treat vasospasm within 2–8 days of the initial ictus. Two procedure-related complications occurred. Both occurred in patients with a grade V status and were fatal. One patient had an embolic occlusion of the distal anterior cerebral artery branches during the procedure. Intraarterial urokinase was given, but the aneurysm ruptured, and the patient died after the procedure. In another patient, the ruptured aneurysm was partially occluded without incident, but vasospasm subsequently developed. During balloon angioplasty on the third day after coiling, vessel rupture occurred. The ruptured M2 branch was occluded by using glue and liquid coils; however, the patient died after the procedure.

Three patients underwent repeat endovascular coiling for aneurysm recanalization due to coil compaction 2–14 months after initial treatment. In two patients, repeat coiling was uneventful. However, the third patient, who underwent stent-assisted coiling for a wide-necked aneurysm 14 months after the first procedure, died 6 hours from a myocardial infarction after the second procedure.

Discussion

The percentage of elderly patients (>70 years) with aneurysmal SAH and a poor neurologic grade (Hunt and Hess grade IV or V) at presentation is significantly higher than the percentage in younger and middle-aged groups (5, 8, 11). To our knowledge, endovascular treatment of elderly patients with poor-grade disease has never been analyzed separately. This subset of patients poses a therapeutic challenge, as they also have a higher risk of rebleeding, cerebral vasospasm, and hydrocephalus. Associated preexisting medical problems, such as hypertension and poor cardiac and respiratory status, further aggravate the problem and in most cases make them poor surgical candidates. Compromised cerebral circulation and neural plasticity with advancing age may contribute to an unfavorable outcome after aneurysmal SAH (11). Most of these patients had been treated with conservative measures in the past, but this approach was usually associated with a poor outcome. Surgery is often technically difficult because of cerebral edema, increased intracranial pressure, and other associated medical problems common in the elderly. In a few studies, surgery was contraindicated in those with a poor clinical grade and in elderly patients, and investigators have suggested that those with worse grades do poorly with or without intervention (12, 13). Some authors have recommended early resuscitation, surgery, and active medical treatment in elderly patients (5–7). However, most groups have reported poor outcomes in patients with poorer clinical grades and have suggested surgery in elderly patients with a good clinical grade (5–7). Some have also suggested that advanced age alone is not a contraindication to surgery (14, 15), but International Study of Unruptured Intracranial Aneurysms (ISUIA) data clearly demonstrate a higher surgical risk in older patients (16).

Several studies have attempted to define features at admission that would allow the specific prediction of outcomes in patients in poor clinical condition after aneurysmal SAH. However, Le Roux et al (17) advised that no patient should be denied the opportunity to receive aggressive treatment. Patient selection based on admission features fails to provide treatment to many patients with a poor clinical grade who might ultimately have a favorable outcome. These authors found that 38% of patients with a poor Hunt and Hess grade had favorable outcomes, with a mortality rate of 43%. Other results confirm this view, demonstrating that 55% of patients with a World Federation of Neurosurgical Societies grade of V have a favorable outcome after early endovascular treatment (8). However, all of these patients were younger than 70 years. Few studies have been conducted to evaluate endovascular treatment in the elderly, and most have excluded poor-grade patients. In the present study, 38% of patients had a favorable outcome, with a 47% mortality rate and a 15% rate of severe disability. Grade IV patients did much better than grade V patients; 80% of the former had a favorable outcome compared with only 12.5% of the latter. Our results are comparable to those of various surgical series in elderly patients. Lan et al (5) reported a 40% favorable outcome rate in their elderly patients (>64 years) with a poor Hunt and Hess grade; their mortality rate was 45%.

Early surgery for patients, especially elderly patients, with a poor clinical grades can be technically difficult and contraindicated because of their poor overall health and associated medical problems. There are also concerns about inflicting further damage to an already edematous, hemorrhagic brain, as second-insult trauma may result from brain retraction and manipulation. On the other hand, endovascular treatment avoids direct mechanical trauma, though it increases the risk of ischemic insult due to intravascular thrombus formation and injury to already atherosclerotic vessels in the elderly. Our complication of embolic occlusion also emphasizes the need for adequate heparin therapy during the procedure. Endovascular treatment can be performed at any time, even during the acute phase or the vasospasm phase. Early occlusion of the aneurysm allows for the initiation of more aggressive triple-H therapy to prevent symptomatic vasospasm. In addition to the aneurysm, early vasospasm can be treated by endovascular means with balloon angioplasty during the same procedure. Another advantage of endovascular therapy is the ability to treat multiple, even incidental, aneurysms during the same procedure. This can be a significant advantage during aggressive triple-H therapy.

Five patients (38%) had clinical vasospasm that required balloon angioplasty within 2–8 days of the initial ictus. One patient underwent endovascular occlusion of the aneurysm and balloon angioplasty to treat early vasospasm during the same procedure. Two (40%) of five patients with a grade of IV, and three (37.5%) of eight patients with a grade of V had vasospasm. Symptomatic vasospasm is more common with poor clinical grades and usually detected late because of patient sedation or unconsciousness. Symptomatic vasospasm was detected in 23% patients in an endovascular series of patients with a Hunt and Hess grade of I-III (18). This rate is comparable to the 22%–25% incidence of symptomatic vasospasm in different surgical series in similar clinical conditions (19, 20). However, the incidence of symptomatic vasospasm can be as high as 43%–55% in patients of poor clinical grade (14, 21), as in the present study. Vasospasm can be difficult to manage in poor-grade elderly patients, as many of them have associated cardiac problems that may limit triple-H therapy. Hence, the role of endovascular treatment of vasospasm may be even more valuable in this particularly challenging subset of patients. Early detection of vasospasm with xenon CT, functional MR imaging, single photon emission CT, or transcranial Doppler sonography should be emphasized in patients with poor-grade SAH, as neurologic examination is less reliable for the early detection and prevention of ischemic complications. Perfusion CT has shown some promise in the detection of early vasospasm (22). This may become a valuable and easily accessible imaging technique, particularly for monitoring of vasospasm in poor-grade SAH.

Two procedure-related complications (11%) occurred in 18 endovascular procedures done in the acute phase of the treatment of aneurysms and vasospasm. In three patients, aneurysm recanalization was noted at follow-up and required repeat endovascular treatment. One of these patients died from a myocardial infarction after technically successful stent-assisted coiling of a wide-necked aneurysm. Three procedure-related deaths occurred (23%). The embolic complication that progressed to a fatal rupture after urokinase administration illustrates the fact that preventative measures for thromboembolic complications, such as heparin and antiplatelet therapy, are crucial. Moreover, thrombolytic therapy can have disastrous results in patients with ruptured aneurysms. The arterial rupture that occurred during balloon angioplasty may indicate that elderly patients with atherosclerotic vessels should be treated with extreme caution when vasospasms are dilated. The cardiac complication occurring after elective embolization of a recurrent aneurysm suggests that these elderly patients are at a higher risk for complications from general anesthesia or any invasive procedure. Our rate of complications is comparable to the 21% and 18% incidences of all procedure-related complications and the 9% and 10% rates of fatal complications reported in two series (21, 23).

Conclusions

Improvements in endovascular techniques and instrumentation have made a major impact on treatment of elderly patients with a poor clinical grade. Most of these patients can now be treated with endovascular embolization in the acute phase. Early treatment of the ruptured aneurysms improves overall outcomes by reducing the incidence and extent of associated complications such as rebleeding and vasospasm. Aggressive medical management of asymptomatic vasospasm can be pursued early. Symptomatic vasospasm can also be treated by endovascular routes during or separate from the initial treatment of the aneurysm.

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