Changes in Intervention and Outcome in Elderly Patients With Subarachnoid Hemorrhage

Mats Johansson; Kristina Giuliana Cesarini, MD, PhD; Charles F. Contant, PhD; Lennart Persson, MD, PhD; Per Enblad, MD, PhD

Background and Purpose—The elderly constitute a significant and increasing proportion of the population. The aim of this investigation was to study time trends in clinical management and outcome in elderly patients with subarachnoid hemorrhage.

Methods—Two hundred eighty-one patients \( \geq 65 \) years of age with aneurysmal subarachnoid hemorrhage who were accepted for treatment at the Uppsala University Hospital neurosurgery clinic during 1981 to 1998 were included. Hunt and Hess grades on admission, specific management components, and clinical outcomes were recorded. Three periods were compared: A, 1981 to 1986 (before neurointensive care); B, 1987 to 1992; and C, 1993 to 1998.

Results—The volume of elderly patients \( \geq 65 \) years of age increased with time, especially patients \( \geq 70 \) years of age. Furthermore the proportion of patients with more severe clinical conditions increased. A greater proportion of patients had a favorable outcome (A, 45%; B, 61%; C, 58%) despite older ages and more severe neurological and clinical conditions. In period C, Hunt and Hess I to II patients had a favorable outcome in 85% of cases compared with 64% in period A. This was achieved without any increase in the number of severely disabled patients.

Conclusions—Elderly patients with subarachnoid hemorrhage can be treated successfully, and results are still improving. The introduction of neurointensive care may have contributed to the improved outcome without increasing the proportion of severely disabled patients. A defeatist attitude toward elderly patients with this otherwise devastating disease is not justified. (Stroke. 2001;32:2845-2949.)

Key Words: aged ■ intracranial aneurysm ■ neuropsychological test ■ subarachnoid hemorrhage

As lifespans increase, the elderly have come to constitute a significant proportion of our population. Thus, as the number of elderly patients admitted to our hospitals increases, special regard must be paid to the management of potentially life-threatening diseases and diseases with a high risk of morbidity in this age group. Subarachnoid hemorrhage (SAH) still carries a high risk of mortality and morbidity, despite improved outcome resulting from a more active management established in the last decade. Elderly with SAH have been reported to have an even higher risk of an unfavorable outcome than younger patients because of less active management and conservative referral patterns, poorer clinical grades on admission, and a higher frequency of comorbidity. Other factors such as a higher prevalence of hypertension and arteriosclerosis may also be responsible for the observed less favorable outcomes. (For review, see Elliot and LeRoux.)

The management of SAH in the elderly has changed considerably in the last 2 decades. Twenty years ago, elderly patients were as a rule treated conservatively on the basis of their advanced age alone and therefore suffered a poor outcome. However, some authors argued that certain elderly patients might benefit from surgical repair of their aneurysm. This view was gradually accepted, and today surgery is considered even in patients \( \geq 80 \) years of age. Along with the changing treatment policy for elderly patients, new management regimes, such as early surgery, neurointensive care (NIC), nimodipine, “3H” therapy, and interventional neuroradiology have also affected the treatment of SAH.

The neurosurgical department at the Uppsala University hospital gradually adopted the principles of NIC in the mid-1980s, and a special unit was inaugurated in 1990. Improved survival after aneurysmal SAH in patients regardless of age has recently been presented. The present study was undertaken to look at the elderly patients specifically, before and after the establishment of a modern NIC unit. Its main aims were to evaluate whether the patient population admitted to the neurosurgical clinic had changed with time and to study whether altered management principles had also improved the neurological outcome after SAH in this age group.

Received February 21, 2001; final revision received July 26, 2001; accepted August 22, 2001.

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Subjects and Methods

Patients
The neurosurgical department in Uppsala provides neurosurgical services for a defined population of 1.7 million inhabitants in central Sweden. Patients are referred from >20 county or local hospitals up to 600 km away. All patients with aneurysmal SAH who were ≥65 years of age and admitted to the neurosurgical department with an intention to treat between 1981 and 1998 were included in this study. In this context, “intention to treat” means that the patients’ overall neurological and physical conditions, regardless of age, were such that active treatment was deemed appropriate.

Diagnoses and Definitions
SAH was defined as the bleeding that caused the patient to seek medical attention. The diagnosis of SAH was based on the results of CT or occasionally lumbar puncture. The diagnosis of an aneurysm was based on cerebral angiography. Rebleeding was defined as the recurrence of sudden severe headache or abrupt impaired neurological condition accompanied by typical intracranial pressure elevation and/or CT-ensigaged evidence.

Data Collection
Data were recorded from the medical records according to a predefined protocol. Neurological grade on admission was classified according to Hunt and Hess (H&H).20 The amount and distribution of subarachnoid blood were assessed according to Fisher’s scale.21

Follow-up review was conducted 1 to 10 years (mean, 3.6 years) after SAH, and according to the Glasgow Outcome Scale,22 categorized into favorable outcome (good recovery and moderate disability), severe disability, or poor outcome (vegetative state or dead). The neurological outcome in patients alive at follow-up was based on written interviews with the patients or their relatives. Mortality figures and causes of deaths were gathered from the Swedish National Death Register. So that the disease-specific mortality was not underestimated, SAH was considered to be the cause of death in all patients who died within 3 months after the hemorrhage and in those who died later when death was related to the SAH. In patients who were considered to have died of unrelated causes, the neurological outcome was based on their preexisting physical and neurological status.

Statistical Analysis
The 18-year period was divided into 3 periods of 6 years: period A, 1981 to 1986 (before the introduction of NIC); period B, 1987 to 1992 (early after the introduction of NIC); and period C, 1993 to 1998 (when NIC was firmly established). Univariate statistical analyses of changes over time were made to compare periods A and C with the use of commercially available software (JMP version 3.1.6.2, SAS Institute Inc). Nonparametric methods were used, and a value of P<0.05 was considered statistically significant.

A multivariable logistic regression model was fit for each of 2 outcomes: poor and favorable outcome. The method implemented in S-Plus (Insightful Corp) was used. The initial model fit contained admission variables (sex, age, and H&H grade) and treatment variables (ventriculostomy and timing of aneurysm repair) as explanatory variables. The final model included all admission variables, treatment variables (ventriculostomy and timing of aneurysm repair) as explanatory variables. The final model included all admission variables, treatment variables, and time period, and treatment variables that reached statistical significance. All explanatory variables were categorized.

Results

Patients
Between January 1981 and December 1998, a total of 281 elderly patients with aneurysmal SAH were admitted with an intention to treat (77% women; mean age, 69.2 years; range, 65 to 80 years; the Figure).

In Table 1, some characteristics of the patients admitted during the 3 time periods are presented. With time, the volume of elderly patients (≥65 years of age) increased, and the proportion of patients 70 to 74 years and ≥75 years of age increased markedly (70 to 74 years: A, 11%; B, 23%; C, 47%; P<0.001; ≥75 years: A, 0%; B, 4%; C, 14%; P<0.01; the Figure). More patients were admitted within 24 hours after hemorrhage in period C than in period A (admission day 0: A, 23%; B, 47%; C, 61%; P<0.001; Table 1).

Altogether, the neurological grade on admission was H&H I to II in 109 patients (39%), H&H III in 112 (40%), and H&H IV to V in 60 (21%). With time, the proportion of patients in H&H IV to V increased (H&H IV to V: A, 11%; B, 18%; C, 26%; P<0.05), and the proportion of patients in H&H I to II decreased (H&H I to II: A, 50%; B, 43%; C, 33%; P<0.05; Table 1 and the Figure).

On diagnostic CT, the distribution of blood according to Fisher was grade 1 to 2 in 42 patients (15%) and grade 3 to 4 in 231 patients (85%), with no significant change over time. The detection of ventricular dilatation increased over the years (ventricular dilatation: A, 24%; B, 38%; C, 58%; P<0.001). With time, the proportion of patients with posterior circulation aneurysms tended to increase (posterior circulation: A, 0%; B, 9%; C, 12%; Table 1).

Management
The use of artificial ventilation during transport to the neurosurgical department became more frequent with time (A, 7%; B, 20%; C, 29%; P<0.01). Moreover, the use of ventriculostomy for continuous intracranial pressure registration and cerebrospinal fluid drainage increased (A, 9%; B, 50%; C, 61%; P<0.001; Table 2).
Aneurysm repair was performed in 247 of the 281 patients (88%); 215 underwent surgical repair (aneurysm clipping, trapping, or wrapping), and 32 had endovascular aneurysm repair (Guglielmi detachable coils). All 32 patients were in period C. Early treatment (within 3 days of aneurysm rupture) was more frequent in later years (aneurysm repair day 0 to 3: A, 39%; B, 56%; C, 62%; \( P < 0.05 \)). Likewise, aneurysm repair in the “vasospasm phase” (day 4 to 10) became less frequent (aneurysm repair day 4 to 10: A, 26%; B, 18%; C, 11%; \( P < 0.05 \); Table 2).

Although all patients in this study were admitted with an intention to treat, 34 patients were conservatively treated. Reasons for conservative treatment were rebleeding in 15 patients, delayed neurological deterioration in 6, complications from other organ systems in 7, technical impossibility to treat in 5, and nonconsent in 1. In period A, 30% of the patients were treated conservatively compared with 9% in period C (\( P < 0.01 \)).

Clinical Outcome
A reliable neurological outcome could not be determined in 3 patients in period C because they were deceased >3 months after SAH and the cause of death could not be established. The outcome figures in Table 3 are based on the remaining 278 patients (99% of the patients). Twenty-four patients died of unrelated causes: cardiovascular disease (n = 11), malignancy (n = 10), and other (n = 3).

For all periods, the neurological outcome was favorable in 158 patients (57%), severe disability in 33 (12%), and poor in 87 (31%). The proportion of patients with a favorable outcome showed an increasing trend (A, 45%; B, 61%; C, 58%; \( P = \text{NS} \); Table 3). The SAH mortality rate at follow-up was 30% and did not change substantially over the 18-year period (A, 41%; B, 26%; C, 30%; \( P = \text{NS} \); Table 3).

Patients in H&H I to II on admission had a favorable outcome in 80% of the cases in the last 2 periods compared with 65% in period A (\( P = \text{NS} \); Table 3). H&H III patients
TABLE 4. Multivariate Logistic Regression With Favorable Outcome as Dependent Variable

<table>
<thead>
<tr>
<th>Variable</th>
<th>OR</th>
<th>P</th>
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<tr>
<td>Sex</td>
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<tr>
<td>Female</td>
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<tr>
<td>Male</td>
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<tr>
<td>Age</td>
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<td>Per 10-y difference in age</td>
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<td>H&amp;H grade</td>
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<td>I–II</td>
<td>1.00</td>
<td>0.01</td>
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<tr>
<td>III</td>
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<tr>
<td>IV–V</td>
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<tr>
<td>Ventriculostomy</td>
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<tr>
<td>Yes</td>
<td>0.17</td>
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<td>Time period</td>
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<td>A</td>
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<tr>
<td>B</td>
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<td>C</td>
<td>8.23</td>
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OR>1.0=increased chance of a favorable outcome; OR<1.0=decreased chance of a favorable outcome.

Discussion

Referral Patterns

This longitudinal study demonstrates an increasing volume of elderly SAH patients admitted for treatment to a neurosurgical clinic serving a defined population. Previous studies have shown that the incidence in SAH has been stable for decades. The increase has in part a more demographic cause because the total elderly population in the catchment area of the clinic increased by 18% over the period studied. However, most of the increase probably reflects an increasing propensity to refer or admit patients resulting from changes in attitude toward treatment of this group of patients.

Until the last period, it would appear that we were somewhat reluctant to admit patients >75 years of age, whereas in the last period, this group constitutes one sixth of the patients. The fact that this group was previously considered impossible to treat successfully and therefore was managed conservatively inevitably meant a poor outcome for most patients. It was also obvious that more patients with more severe neurological grades were accepted for treatment with time. One explanation for this gradual change toward more active treatment of elderly SAH patients may be that it became obvious that the general treatment results had improved and further that positive experiences of individual cases catalyzed the evolution toward more active treatment of the elderly. Subsequently, the management also changed at the referral hospitals, which can be illustrated by the findings that with more patients were referred earlier and artificial ventilation was more widely used during transportation. Under all circumstances, we could state that more elderly and patients in more advanced ages, and more patients in a bad H&H grade, were accepted for treatment with time. Improved or unchanged clinical outcome would therefore reflect better management and not an effect of selection of patients with better chances.

Clinical Outcome

Reviewing the overall neurological outcome, we can see more favorable outcome and less severe disability after period A, but the difference between the time periods was not significant in the univariate statistical analysis. The improvement may be underestimated because more older patients and patients in worse clinical conditions were admitted and treated with time. Taking this into account, it is reasonable to believe that management has improved substantially. This was supported in the multivariable logistic regression analysis, which revealed that the results had improved significantly. In discussions of the policy of treating elderly patients with SAH, it is important to note that elderly patients with good neurological grades in the last 2 periods had an 80% potential of having a favorable outcome and that very few in this H&H group were rendered severely disabled. The same figures for patients in H&H III were ~60% with favorable outcome and 10% with severe disability. We find these results promising for 2 reasons. First, elderly patients in H&H grade I to III have a good chance of returning to an active, independent life if treated actively. Second, the risk of becoming debilitated and dependent on others in daily life is very low. We believe that in this age group, the fear of living one’s last years in dependency is often greater than the fear of a humane death after a long life.

The reasons for the improved results may be explained by several factors. An important contribution is certainly the establishment of NIC and the fact that elderly patients were treated according to NIC principles, eg, intensive monitoring and secondary insult prevention. It is difficult to evaluate which specific parts of the management approach have had the most important impact. Surprisingly, the use of ventriculostomy was related to negative outcome according to the H&H grade patients improve and qualify for early aneurysm repair without an increased risk of rebleeding. The unexpected finding may be explained by the
fact that the indication for ventriculostomy was delayed ischemic deterioration or rebleeding in many cases. The timing of aneurysm repair did not influence outcome significantly. However, in the last 2 periods, more patients underwent repair of the ruptured aneurysms, which most likely has contributed to the improved outcome to some extent. The introduction of endovascular aneurysm repair during the last period has improved the management of patients with aneurysms in the posterior circulation in absolute terms. The overall impact of endovascular treatment remains to be elucidated (work in progress). The more efficient initial management and early referral have probably had a positive effect on the results.

Cost-Effectiveness and Ethics

The treatment of SAH in highly specialized centers with NIC units is a great monetary expense per patient for society. The cost of treating aneurysmal SAH has been reported to increase with age by and clinical grade on admission.31 With decreasing healthcare budgets and a constantly aging population, priorities must be made to ensure that money is spent in the best possible manner. If it can be shown that elderly patients can be treated for a severe disease and recover with little or no morbidity at a high yet acceptable cost, this must be commended. It must also be remembered that at 65 years of age, the expected remaining lifetime in Sweden is 16 years for men and 20 years for women.1 Thus, an elderly patient successfully treated for a ruptured aneurysm has a good chance of an independent life for >10 years after the SAH. Today, it is widely accepted in society that elderly patients with, for example, cardiovascular diseases are treated actively, and there appears to be no reason for neurovascular diseases in elderly patients to be treated less actively.

Conclusions

Elderly patients with SAH can be treated successfully, and the results are improving. The introduction of NIC may have contributed to the improved outcome without increasing the proportion of severely disabled patients. A defeatist attitude toward elderly patients with this otherwise devastating disease is not justified.

References

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Stroke. 2001;32:2845-2949
doi: 10.1161/hs1201.099416
Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
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Print ISSN: 0039-2499. Online ISSN: 1524-4628

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