Neurosurgery
Issue: Volume 38(5), May 1996, pp 887-895

Publication Type: [Clinical Studies]
ISSN: 0148-396X
Accession: 00006123-199605000-00006
Keywords: Cerebral aneurysm, Subarachnoid hemorrhage, Surgical technique

[Clinical Studies]

The Incidence of Surgical Complications Is Similar in Good and Poor Grade Patients Undergoing Repair of Ruptured Anterior Circulation Aneurysms: A Retrospective Review of 355 Patients

Le Roux, Peter D. MB., ChB., M.D.; Elliott, J. Paul M.D.; Newell, David W. M.D.; Grady, M. Sean M.D.; Winn, H. Richard M.D.

Author Information

Department of Neurosurgery, University of Washington, Seattle, Washington
Received, September 14, 1995. **Accepted,** November 7, 1995.
Reprint requests: H. Richard Winn, M.D., Professor and Chairman, Department of Neurosurgery, Harborview Medical Center, Box 359766, 325 Ninth Avenue, Seattle, WA 98104.

Abstract

TO DETERMINE HOW clinical grade after subarachnoid hemorrhage impacts operative characteristics and the incidence of intra- and postoperative surgical complications, we retrospectively compared the surgical management of all good grade (n = 224) and poor grade (n = 131) patients who suffered ruptured anterior circulation aneurysms between 1983 and 1993. The majority of good grade (74.2%) and poor grade (89.8%) patients underwent surgery <3 days after subarachnoid hemorrhage. The results in this series demonstrate that severe cerebral swelling, often secondary to intracerebral hemorrhage, was significantly more frequent in poor grade patients. The incidence of complications, such as failure to occlude the aneurysm, major vessel occlusion, intraoperative aneurysm rupture, or surgical contusion, however, was similar in poor grade and good grade patients. We conclude, therefore, that except for severe cerebral swelling associated with intracerebral hemorrhage, the risk of surgical complications is similar in good and poor grade patients undergoing surgical repair of ruptured anterior circulation aneurysms.

Patients in poor clinical condition constitute nearly one-third of the patients presenting to the hospital after subarachnoid hemorrhage (SAH)(25, 28, 31, 47, 57). Neurosurgeons, however, are often reluctant to operate acutely on these patients, because they fear swollen brain and consequent technical difficulties (34). By contrast, most surgeons advocate early surgery for patients who are in good clinical grade, particularly those who harbor anterior circulation aneurysms (17, 47). In the Cooperative Study evaluating timing of surgery, technical complications were found not to be associated with the incidence of cerebral swelling encountered during surgery or with the timing of surgery (17, 24, 25). Whether clinical grade impacts the incidence of surgical complications, such as intraoperative aneurysm rupture, inability to occlude an aneurysm, or development of brain contusion, however, is unclear. Consequently, we undertook this retrospective study, comparing poor grade and good grade patients after rupture of anterior circulation aneurysms, to determine operative characteristics and the incidence of intra- and postoperative surgical complications. During the 10-year review period, 224 patients in good clinical grade (Hunt and Hess Grades I-III) (20) and 131 patients in poor clinical grade (Hunt and Hess Grades IV and V) were treated for ruptured anterior circulation aneurysms. The majority of these patients underwent early surgery(<3 days from SAH). Our observations suggest that good and poor grade patients share similar risk of surgical complications.

CLINICAL MATERIALS AND METHODS

Patient population

We retrospectively evaluated all patients admitted to Harborview Medical Center, University of Washington, who underwent treatment for ruptured anterior circulation aneurysms between September 1983 and August 1993. Information was obtained from patient charts, a review of the radiological investigations, including computed tomographic (CT) scans and angiographic films, and operative reports. The severity of SAH was graded clinically, according to the Hunt and Hess Scale (20). SAH was confirmed by computed tomography (GE, 9800) and the presence of an aneurysm diagnosed by four-vessel angiography or, in moribund patients, by infusion CT scan (29).

Management protocol

Harborview Medical Center is the major Level 1 acute care facility for Seattle, WA, and the surrounding area. All patients presenting to the emergency room were considered surgical candidates, irrespective of their clinical status. Patients were managed according to a standardized policy (28, 30, 31) that included the following: 1) aggressive preoperative resuscitation; 2) surgery within 72 hours of aneurysm rupture; 3) comprehensive intensive care; 4) invasive hemodynamic and intracranial pressure monitoring; and 5) aggressive prevention and management of vasospasm, including prophylactic hypervolemia, administration of calcium channel blockers, transcranial doppler evaluation, and angioplasty.

Operative technique

Surgery was performed as soon as possible during the 24 hours after admission and after careful radiological evaluation. Brain relaxation was achieved by a combination of osmotic diuresis (1-2 mg/kg mannitol and 20-40 mg of furosemide) and judicious cerebrospinal fluid drainage. The majority of aneurysms were exposed through a pterional approach. Large frontotemporal craniotomies, rather than the standard pterional approach, were usually performed in poor grade patients, particularly if intracerebral hematomas(ICHs) were present (28, 31). Aneurysms located in the paraclinoid region were exposed through a partial cavernous sinus approach and pericallosal aneurysms through a frontal approach. Standard microvascular techniques and magnification were used in all cases to obliterate the aneurysm. If cerebral swelling persisted during closure, a duralplasty was performed using temporalis fascia and the bone flap was not replaced (12).

Statistical analysis

Data analyses for this report include several bivariate techniques that were selected for their appropriateness to the distribution of the data. Data are summarized as the mean ± the standard deviation or as the median at which samples depart substantially from normal distributions. The Mann-Whitney U procedure was used to examine the two-sample significance of data that departed from a normal distribution and rank-order variables. Spearman rank-order correlations were used to relate ordered variables to one another. Student's *t* test was used to test for differences among groups in which the samples were normally distributed. Subsample differences of categorical variables were tested by Pearson [chi]^2 statistics or by Fisher's exact test for two-by-two tables with expected frequencies less than 5. All univariate and bivariate statistical analyses were performed using SPSS/PC+, Version 4.0 (Marija J. Norusis/SPSS Inc., Chicago, IL).

RESULTS

Clinical data

During 10 years, 355 patients were admitted to Harborview Medical Center after rupture of anterior circulation aneurysms; 224 patients, including 87 male and 137 female patients with a median age of 48 years, were in good clinical grade (Hunt and Hess Grade I, II, or III), and 131 patients, including 47 male and 84 female patients with a median age of 54 years, were in poor clinical grade (Hunt and Hess Grades IV and V). The neurological grade at admission is illustrated in Figure 1.

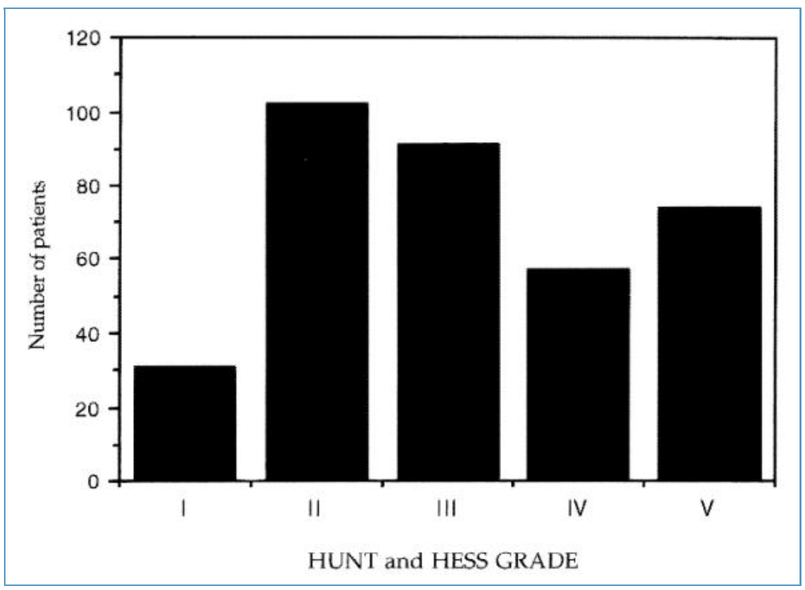

FIGURE 1. Hunt and Hess (20) clinical grades at admission.

Preoperative diagnostic studies

All patients underwent preoperative CT scans. The CT characteristics are summarized in Table 1 and Figure 2. Preoperative four-vessel angiography was performed in all patients, except 29(22.1%) moribund poor grade patients who underwent immediate operation for aneurysmal ICHs based on CT infusion scans alone (29). The distribution of ruptured aneurysms, based on the infusion scans or angiograms, is summarized in Table 2. Among good grade patients, the median aneurysm size was 8 mm; five aneurysms were >25 mm in diameter. Among poor grade patients, the median aneurysm size was 10 mm; two aneurysms were >25 mm in diameter.

Feature	Good Grade (%) (n = 224)	Poor Grade (%) (n = 131)
Subarachnoid hemorrhage	93.3	96.2
Intraventricular hemorrhage	45.1	75.6
Ventricular enlargement	44.2	49.6
Intracerebral hemorrhage <3 cm	13.8	19.1
Intracerebral hemorrhage ≥3 cm	3.1	34.4
Low density changes	0	5.3
Herniation (compressed or obliterated perimesencephalic cisterns)	0	36.6

TABLE 1. Features in Patients Suffering Ruptured Anterior Circulation Aneurysms As Revealed by Computed Tomography

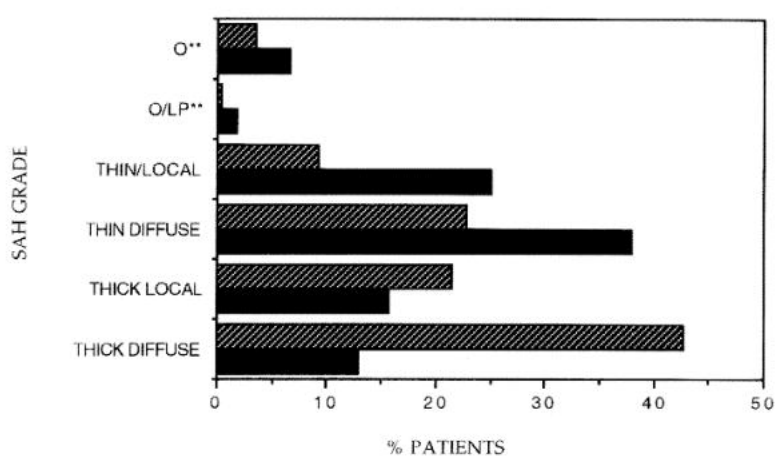

FIGURE 2. SAH grades at admission, as revealed by computed tomography. *Striped bar*, poor grade. *Solid bar*, good grade. *, SAH not visible on CT scan at admission (only ICH or intraventricular hemorrhage was present). **, SAH not visible on CT scan at admission (diagnosed by lumbar puncture).

Location	Good Grade (%) (n = 224)	Poor Grade (%) (n = 131)
Pericallosal	3.6	3.1
Anterior cerebral or communicating artery	38.3	27.5
Middle cerebral artery bifurcation or trunk	21	31.3
Posterior communicating artery	25.4	23.7
Internal carotid artery	8.5	9.9
Cavernous carotid or carotid ophthalmic artery	4	4.6

[a] Aneurysm distribution is based on preoperative four-vessel angiography (n = 326) or computed tomographic infusion scans (n = 29) (31).

TABLE 2. Locations of Ruptured Anterior Circulation Aneurysms*a*

Preoperative course

Aneurysm subsequent bleeding, confirmed by CT scans of the head, was observed in 20 (15.3%) Grade IV or V patients. This rate of subsequent bleeding was three times the rate observed among good grade patients (4.9%) treated during the same review period ($[chi]^2$ = 10.8, *P* < 0.001). Ventricular catheters were inserted into 21 (9.4%) good grade patients and 40 (30.5%) poor grade patients because of significant ventricular enlargement or intraventricular hemorrhage.

Surgical findings

Four poor grade and two good grade patients died before aneurysm obliteration could be attempted; the remaining patients underwent surgery for repair of their ruptured aneurysms. The timing of aneurysm surgery after SAH is illustrated in Figure 3. Surgery within 3 days of SAH was achieved in 74.2% of good grade and 89.8% of poor grade patients. Immediate surgery, without angiography, for massive aneurysmal ICHs was performed in 29 moribund patients (29). During surgery, moderate hypotension (systolic blood pressure = 80 mm Hg) was used in one poor grade patient and 47 (21.3%) good grade patients. To obtain temporary vascular occlusion, temporary clips were applied in 39 (29.8%) poor grade and 42 (19%) good grade patients. The median duration of arterial occlusion was 7 minutes.

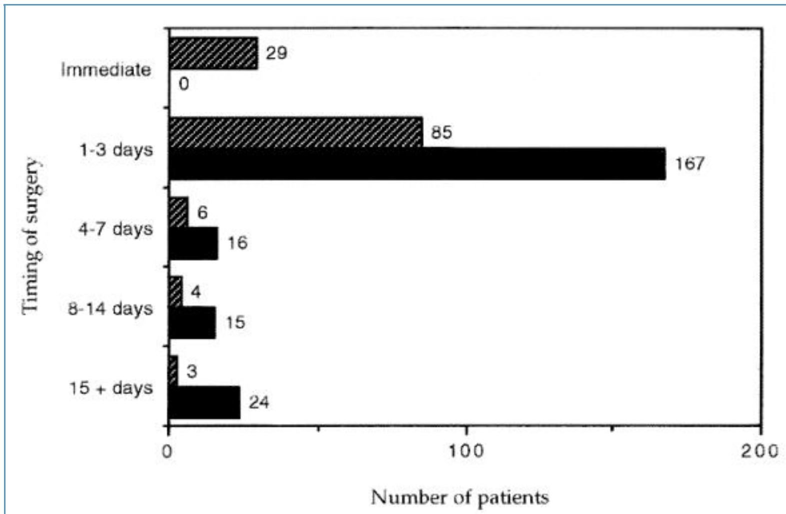

FIGURE 3. Timing of surgery. Four poor grade and two good grade patients died before surgery could be attempted. The remaining 349 patients underwent surgery. *Striped bar*, Grades IV and V.*Solid bar*, Grades I-III. Day 1 = day of hemorrhage.

Significant cerebral swelling during aneurysm exposure was judged to be present in 56 (42.7%) poor grade patients undergoing surgery; this incidence was fivefold greater than the incidence of intraoperative cerebral swelling encountered in good grade patients ($[chi]^2$ = 59, P < 0.0001). Cerebral swelling was associated with the presence of an ICH on the preoperative CT scan ($[chi]^2$ = 21.8, P < 0.0001), which was more frequently observed in poor grade (53.4%) than good grade (16.3%) patients ($[chi]^2$ = 53.9, P < 0.0001). During closure, 30(22.9%) poor grade patients demonstrated cerebral swelling, particularly if an ICH had been present ($[chi]^2$ = 4.3, P < 0.04). Cerebral swelling at closure was controlled by lobectomy, decompressive craniectomy, or both in 30 (22.9%) patients. In good grade patients, excessive cerebral swelling was not encountered during closure.

Surgical complications

In poor grade patients, surgery was abandoned in two (1.6%) patients because of severe cerebral swelling or uncontrollable aneurysm rupture. The remaining aneurysms were all successfully delineated; one aneurysm was wrapped, one was trapped, and the rest were occluded by clip application. All aneurysms in good grade patients were successfully approached; two aneurysms were wrapped, and the remaining were occluded by clip application. Despite the higher incidence of cerebral swelling in poor grade patients, intraoperative aneurysm rupture (including bleeding during clip application that was controlled by blade closure, minor leaks that did not obscure operative visibility, or major hemorrhages that required large bore suction for operative visibility) occurred with similar frequency in 53 (23.5%) good grade and 33 (25.2%) poor grade patients. The severity of intraoperative aneurysm rupture, although judged subjectively, was similar in good and poor grade patients.

The surgical complications are listed in Table 3. The development of surgical complications or new, immediate postoperative neurological abnormalities was not significantly associated with the timing of surgery in either good or poor grade patients. New, immediate postoperative cranial nerve abnormalities or motor deficits were observed in 38 (17%) and 43(19.2%) good grade patients, respectively, and in 7 (5.3%) and 18 (13.7%) poor grade patients, respectively. The majority of these deficits were transient in nature. After surgery, each patient received an immediate postoperative and at least one subsequent CT scan. The incidence of new contusions or ICHs was similar in poor and good grade patients (Table 3). For example, 10 (4.5%) new ICHs that required surgical evacuation were identified in good grade patients, whereas 5 (3.8%) poor grade patients required surgery for new postoperative ICHs. All good grade and 111 (84.7%) poor grade patients underwent postoperative angiograms. Aneurysmal remnants were identified in 16(7.1%) and 8 (7.2%) good grade patients and poor grade patients, respectively. Two good grade and three poor grade patients required subsequent surgery for incompletely occluded aneurysms. Occlusion or focal narrowing of a major vessel, in the absence of vasospasm, was observed in 16 (7.1%) good grade and 7 (6.3%) poor grade patients. Temporary arterial occlusion had been used in 16(69.6%) of these patients. An area of low density consistent with ischemia or infarction and in the distribution of the occluded vessel was documented on CT scans of five good grade and four poor grade patients, respectively.

Complication	Good Grade (%) (n = 222)*	Poor Grade (%) (n = 127)
New intracerebral hematoma/contusion on CT scans	2.2	0.8
New intracerebral hematoma, surgery[b]	4.5	3.8
Aneurysm remnant on postop angiogram[c]	7.1	7.2
Vessel occlusion on postop angiogram	7.1	6.3
Wound dehiscence	2.2	0.8
CSF leak	1.8	0.8
Meningitis	2.2	2.3
Wound infection	0.4	1.5
Cosmetic	0	1.5

[a] At admission, 224 patients were in good grade and 131 patients were in poor grade; 2 good grade and 4 poor grade patients died before surgery could be attempted. CT, computed tomographic; postop, postoperative; CSF, cerebrospinal fluid.

[b] Intracerebral hematoma requiring surgical evacuation.

[c] All good grade and 111 poor grade patients underwent postoperative angiography.

TABLE 3. Surgical Complications after Surgery for Ruptured Anterior Circulation Aneurysms*a*

DISCUSSION

The present retrospective study describes our experience over the past decade in the treatment of 224 good grade and 131 poor grade patients who suffered ruptured anterior circulation aneurysms. Surgical obliteration of the aneurysm was achieved within 3 days of SAH in >75% of all patients. Despite the high incidence of cerebral swelling in poor grade patients, the overall incidence of surgical complications observed in poor grade patients was similar to that observed in good grade patients.

Early aneurysm surgery in poor grade patients

Whereas previous studies have demonstrated that early surgery might benefit patients in good clinical grade after SAH (17, 18, 47), there is no strong evidence favoring either late or early surgery in poor grade patients. Generally, delayed surgery is advocated for poor grade patients (34) because the incidence of cerebral swelling is expected to decrease and, thus, the incidence of surgical complications, which are thought to be greater in poor grade patients than in good grade patients, is also expected to decline. Our results suggest that these expectations might not be valid. Although the incidence of cerebral swelling was significantly greater in poor grade than in good grade patients, our results indicate that the incidence of surgical complications, such as intraoperative aneurysm rupture, inability to occlude the aneurysm, or postoperative hematoma, was similar in poor and good grade patients undergoing surgery for ruptured anterior circulation aneurysms. The results of this series, however, do not provide support favoring either early or late surgery.

There are several theoretical advantages of early surgery in poor grade patients. First, the incidence of early subsequent bleeding, as we observed, is greater in poor grade than good grade patients (2, 21, 44, 49). Second, vasospasm occurs more frequently in poor grade patients (19, 45, 49, 52); treatment of vasospasm, including hypertensive therapy and angioplasty, might be best performed after aneurysm occlusion (27, 39, 52). Third, unlike good grade patients, elevated intracranial pressure and mass lesions are more frequent in poor grade patients (28, 31, 42, 46, 56). After aneurysm rupture, intracranial hypertension evolves over time; early aneurysm surgery, when combined with hematoma evacuation or decompression, might, in some patients, provide a means to alleviate the cycle of elevated intracranial pressure and subsequent edema formation, whereas delaying surgery might subject the patient to potentially reversible insults (12, 14). Finally, cerebral blood flow (CBF) is reduced after SAH, particularly in poor grade patients. The reduction in CBF progresses in severity from the day of SAH for the next 14 days (37); surgical intervention might, therefore, be best performed soon after aneurysm rupture when the CBF is least reduced.

Technical considerations in poor grade patients

Attention to surgical technique and careful neuroanesthesia management helps minimize early surgical risk in poor grade patients (28). First, large bone flaps are preferable to prevent brain herniation and strangulation and, if an ICH is present, provide the easiest and safest access to the hemorrhage. If possible, the sphenoid bone and orbital roof should be carefully and extensively drilled down to minimize brain retraction. In patients with large ICHs, removal of the cranial base might not be possible and, thus, partial clot removal, distant from the aneurysm, might be necessary for decompression. As Samson and Batjer (46) indicate, however, aneurysm obliteration should precede complete hematoma evacuation. Second, in conjunction with careful neuroanesthetic technique, cerebral swelling can be minimized through the administration of mannitol and careful cerebrospinal fluid drainage. We do not routinely use hyperventilation, because CO_2 reactivity is frequently deficient in poor grade patients (6, 26). By monitoring middle cerebral artery blood flow velocity and jugular venous oxygen saturation, the arterial carbon dioxide pressure can be individualized to the patient, thus allowing maximal brain relaxation without reduction of CBF. Third, poor grade patients might have deficient autoregulation (6, 55); therefore, we use judicious temporary clip application, rather than systemic hypotension, to decrease the risk of aneurysm rupture and to facilitate aneurysm dissection. Fourth, if cerebral swelling remains, lobectomy, ventriculostomy, or dural-augmentation without bone replacement can be used (12).

The incidence, cause, and impact of surgical complications

Between 5 and 20% of patients undergoing aneurysm surgery awake with new neurological deficits (11, 16, 18, 32, 53). Many of these abnormalities are transient in nature; however, the development of an intraoperative technical mishap or postoperative surgical complication frequently adversely affects outcome (4, 36, 43). For example, among 670 patients undergoing surgery for repair of ruptured aneurysms, uncomplicated operations were associated with a 17% mortality, whereas if a surgical complication occurred, mortality was 32% (43). Overall, between 5 and 25% of the morbidity and mortality after SAH can be attributed to surgical complications (24, 25, 32, 40, 47, 50). For example, 1490 patients who received treatment for ruptured cerebral aneurysms in the Cooperative Study were disabled or died; surgical complications were the cause in 141 of these patients (24, 25).

The incidence of specific operative mishaps or complications in patients undergoing repair of ruptured cerebral aneurysms is not known in detail. Intraoperative aneurysm rupture, depending on how it is defined, is estimated to occur in 14 to 35% of patients (4, 15, 16, 18, 22, 43, 48). Occlusion of a major vessel is identified in 3 to 12% of patients and might be frequently associated with cerebral infarction and disabling stroke (1, 23, 24, 33, 35). The true incidence of inadvertent vessel occlusion, however, is not known, because few patients undergo routine postoperative angiography. Similarly, the true incidence of incompletely obliterated aneurysms, which carries a poor prognosis (9), is not known but might complicate between 1 and 4% of procedures (13, 18, 22, 33). Other complications that are associated with significant morbidity and mortality, such as cerebral contusion, ICH, meningitis, or would infection, are identified in 0.5 to 4% of patients (3, 18, 22, 24, 54).

Why do surgical complications occur? Many variables, which might be additive, can determine whether surgical complications occur. Factors such as inexperience or poor surgical technique might play a role (4, 35). Some series suggest that surgical complications are related to aneurysm location and occur most frequently when ruptured aneurysms at the basilar bifurcation or anterior communicating artery are repaired (15, 32, 48, 53). Other series, however, suggest that the ruptured aneurysm's size, and not location, correlates with the development of complications (10, 24, 42). Similarly, when unruptured aneurysms are repaired, size rather than location is the most important determinant of complications (51, 58). Our data suggest that the patient's clinical condition after SAH is not associated with the incidence of surgical complications. Several studies comparing cohorts of patients or historical controls suggest that although brain swelling is more common in patients undergoing early surgery after SAH, there is no significant difference in the incidence and severity of surgical complications or surgical morbidity when compared with patients undergoing delayed surgery (5, 7, 8, 24, 38). Together, these data suggest that after aneurysm rupture, it is aneurysm anatomy, rather than patient condition, that is associated with surgical complications. We believe, therefore, that with the exception of some anatomically complex aneurysms, it is reasonable for patients with aneurysmal SAH, including those in poor clinical condition, to undergo early, definitive surgery.

ACKNOWLEDGMENTS

This work was supported, in part, by a grant from the New York Academy of Medicine (to PLR). We thank Ray Baculi, Rose Fontanilla, Galen Ransom, Debbie Schneiderman, and Andrew Zweibel for assistance in data acquisition and Lois Downey for statistical analysis. The current address for Dr. Le Roux is Department of Neurosurgery, New York University Medical Center, 550 First Avenue, New York, NY 10016.

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COMMENTS

This is a good retrospective analysis of a large series of patients who generally underwent early surgery for ruptured intracranial aneurysms. The analysis addresses one of the most important questions facing the neurosurgeon who is treating a patient with an acute subarachnoid hemorrhage. It has become relatively well established as a general policy that patients in good neurological condition and without serious medical contraindications should undergo early surgery. The problem is what to do with patients in poor neurological grades. Some patients in poor neurological grades have accessible intracerebral hematomas, which are responsible for their neurological deterioration, and those patients fall into a different category and are generally operated on early, for evacuation of their hematomas and for definitive treatment of the aneurysm. Other patients in poor grades have acute hydrocephalus and respond well to ventriculostomy, with improvement in neurological condition, and those patients should be considered as having the preoperative grades that they achieved after improvement rather than the grades at the time of admission; generally, they are operated on early. There remains a significant number of patients whose poor grades cannot be accounted for by intracerebral hematomas or hydrocephalus and who generally have significant brain swelling and increased intracranial pressure. This is the group for whom the timing of surgery remains controversial. In their analysis, the authors found that the incidence of “surgical complications” is similar in poor grade patients and in patients who are in good neurological condition. This leads the authors to conclude that essentially all patients, with the exception of those who are moribund or who have technically inaccessible aneurysms, should be operated on early.

The authors' findings are important. They demonstrate that those clear-cut, easily recognizable surgical complications, such as major vessel occlusion, intraoperative aneurysmal rupture, and postoperative hematoma requiring evacuation, occur with about the same frequency in poor grade as in good grade patients. They also found that “brain contusion,” as indicated by the computed tomographic (CT) scans, occurs with the same frequency in the two groups. This latter finding is more subjective, and the value of the authors' conclusion in this respect is therefore less definitive. It is difficult to determine, by CT scan or otherwise, what is a significant “surgical contusion.”

The problem with this type of retrospective analysis based on operative notes and a review of the clinical charts from the acute hospitalization is that it neglects the long-term effects of surgical intervention. It is easy to recognize a postoperative hemiplegia or aphasia that was not present before. However, the subtle changes in long-term intellectual function and socioadaptive behavior are much more difficult to assess. It would require a properly planned prospective long-term study with late psychometric evaluations, which, of course, are extraordinarily difficult to conduct. Does retraction of a swollen brain during the early stages after subarachnoid hemorrhage result in subtle long-term neurological effects that are difficult to appreciate in the immediate postoperative period? Would these patients do better in the long run if brain swelling were allowed to subside before undertaking definitive aneurysm repair once the brain is no longer swollen, hyperemic, and friable? This study has not answered this question, and, therefore, it has not answered the important issue of whether patients in poor grade should be operated on early or whether they should be treated conservatively until such time as brain swelling subsides and the patient reaches a better neurological grade. Nevertheless, I think that this is a valuable analysis that indicates that the dreaded immediate serious“technical” complications of aneurysm surgery do not occur with significantly greater incidence in poor grade than in good grade patients. To many of us, this data will provide substantial support to a decision to, for one reason or another, operate early on a patient who is in poor grade after subarachnoid hemorrhage from a ruptured aneurysm.

Roberto C. Heros

Miami, Florida

The authors report interesting findings of similar surgical complication rates in good and poor grade patients undergoing repair of ruptured anterior circulation aneurysms. The study reflects an aggressive policy of surgical therapy in poor grade clinical patients, with 90% undergoing surgery within 72 hours and only six patients (exclusive of those with absent brain stem reflexes) not being operated on because of early death. Although the authors show that their defined surgical complications occurred at similar rates in poor and good grade patients, the frequency of major cerebral swelling despite hematoma evacuation in the poor grade as opposed to good grade patients deserves emphasis. Although this is not a surgical complication *per se*, the phenomenon itself and necessary tissue resection might have contributed to persistent neurological deficits or even to the patient's demise, though unrecognized, because of the patient's poor clinical condition preoperatively. As the authors state, this series does not provide support for either early or late surgery nor does it answer the question about the advisability of early surgery in poor grade patients.

David G. Piepgras

Rochester, Minnesota

The authors show that the operative complications of postoperative intracerebral clot, postoperative clot/contusion from retraction, inadequately clipped aneurysm, major vessel occlusion, wound problems, and aneurysm rupture were not more common in poor grade than in good grade patients treated for subarachnoid hemorrhage with early surgery. Therefore, using the concern for increased operative difficulties as a reason to delay surgery in poor grade patients does not seem justified based on the current data, especially in light of the increased propensity for recurrent hemorrhage in this group of patients.

However, importantly, the authors do not evaluate the effects of these complications on the patients. It seems reasonable to assume that a major complication, such as vessel occlusion or contusion, will be less well tolerated by a Grade IV or V patient than a better grade patient. Without this information, it is impossible to evaluate the importance of this article.

Approximately 13% percent of the patients had complications (vessel occlusion and inadequately clipped aneurysms) that could have been prevented, at least in part, by the use of intraoperative angiography. It will be interesting to learn whether other approaches, such as the use of the temporary occlusion of aneurysms in poor grade patients, using the endovascular technique, will improve the outcome of the treatment of these patients.

Charles J. Hodge

Syracuse, New York

Le Roux et al. provide us with additional information from their well-documented series of anterior circulation artery aneurysms. They present detailed data on intra- and postoperative surgical complications in 224 good grade and 131 poor grade patients. These patients were cared for using contemporary techniques. Most were operated on acutely.

The analysis shows that the incidence of complications (failure to occlude aneurysms, major vascular occlusion, intraoperative aneurysm rupture, surgical contusions) was similar in good and poor grade patients. I do not think one can argue the point. Surprisingly, it has been infrequently specifically addressed.

Presumably, even small amounts of blood in the ventricles were defined as intraventricular hemorrhage in the analysis, because the rates are several times higher than have been reported in numerous other series. I think that the most important single technical factor in avoiding intraoperative complications is the use of a ventricular catheter. A red, swollen brain is frequently relieved on the spot by the placement of such a drain. The pressure that needs to be placed on the brain by retractors is significantly reduced by this maneuver. Visualization is improved, which reduces the chance of inadequate clip placement. Another useful adjunct to early surgery is the use of intraoperative angiography. This helps to reduce the incidence of postclipping rests on postoperative angiography (7.1% of good grade patients and 7.2% of poor grade patients in this series) or inadvertent vessel occlusion (7.1 and 6.3%, respectively, in this series). In a recent prospective study from an experienced group in Toronto, postoperative angiography revealed inadequate clipping in 8% and major vessel occlusions in 12% (1) of the patients. Surgeons who do not conduct routine studies are unaware of these hazards, because they are often asymptomatic.

I have thought, for more than 2 decades, that early surgery conferred a distinct advantage over late surgery, except in moribund patients. I have found that the relative gain was greatest in poor grade patients. An early analysis of my own cases shows that poor grade patients had a greater relative reduction in management mortality with early surgery than did good grade patients (2).

The conclusion that because poor grade patients do not have an increased surgical complication rate they can also be operated early is probably a reasonable one. In the absence of any randomized clinical trial, this type of careful, retrospective analysis from one center probably represents the best evidence available.

Bryce K.A. Weir

Chicago, Illinois

Key words: Cerebral aneurysm; Subarachnoid hemorrhage; Surgical technique

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IMAGE GALLERY

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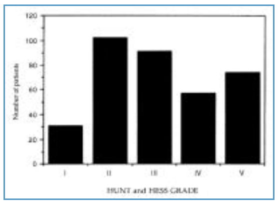

Figure 1

Feature	Good Grade (%) (n = 224)	Poor Grade (%) (n = 131)
Subarachnoid hemorrhage	93.3	96.2
Intraventricular hemorrhage	45.1	75.6
Ventricular enlargement	44.2	49.6
Intracerebral hemorrhage <3 cm	13.8	19.1
Intracerebral hemorrhage ≥3 cm	3.1	34.4
Low density changes	0	5.3
Herniation (compressed or obliterated perimesencephalic cisterns)	0	36.6

Table 1

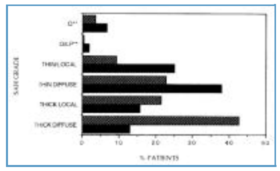

Figure 2

Location	Good Grade (%) (n = 224)	Poor Grade (%) (n = 131)
Pericallosal	3.6	3.1
Anterior cerebral or communicating artery	38.3	27.5
Middle cerebral artery bifurcation or trunk	21	31.3
Posterior communicating artery	25.4	23.7
Internal carotid artery	8.5	9.9
Cavernous carotid or carotid ophthalmic artery	4	4.6

[a] Aneurysm distribution is based on preoperative four-vessel angiography (n = 326) or computed tomographic infusion scans (n = 29) (31).

Table 2

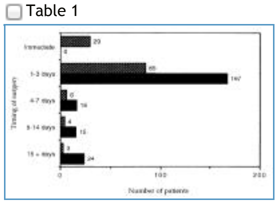

Figure 3

Complication	Good Grade (%) (n = 222)[a]	Poor Grade (%) (n = 127)
New intracerebral hematoma/contusion on CT scans	2.2	0.8
New intracerebral hematoma, surgery[b]	4.5	3.8
Aneurysm remnant on postop angiogram[c]	7.1	7.2
Vessel occlusion on postop angiogram	7.1	6.1
Wound dehiscence	2.2	0.8
CSF leak	1.8	0.8
Meningitis	2.2	2.3
Wound infection	0.4	1.5
Cosmetic	0	1.5

[a] At admission, 224 patients were in good grade and 131 patients were in poor grade; 2 good grade and 4 poor grade patients died before surgery could be attempted. CT, computed tomographic; postop, postoperative; CSF, cerebrospinal fluid.

[b] Intracerebral hematoma requiring surgical evacuation.

[c] All good grade and 111 poor grade patients underwent postoperative angiography.

Table 3

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