Preoperative ventriculostomy and rebleeding after aneurysmal subarachnoid hemorrhage

JON I. MCIVER, M.D., JONATHAN A. FRIEDMAN, M.D., EELCO F. M. WIJDICKS, M.D., DAVID G. PIEPGRAS, M.D., MARK A. PICHIELMANN, M.D., L. GERARD TOUSSAINT III, M.D., ROBYN L. MCCLELLAND, PH.D., DOUGLAS A. NICHOLS, M.D., AND JOHN L. D. ATKINSON, M.D.

Departments of Neurologic Surgery, Neurology, Biostatistics, and Radiology, Mayo Clinic, Rochester, Minnesota

Object. Despite the widespread use of ventriculostomy in the treatment of acute hydrocephalus after aneurysmal subarachnoid hemorrhage (SAH), there is no consensus regarding the risk of rebleeding associated with ventriculostomy before aneurysm repair. This present study was conducted to assess the risk of rebleeding after preoperative ventriculostomy in patients with aneurysmal SAH.

Methods. The authors reviewed the records of all patients with acute SAH who were treated at a single institution between 1990 and 1997. Thus, the records of 304 consecutive patients in whom an aneurysmal SAH source was documented on angiographic studies and who had presented to the authors’ institution within 7 days of ictus were analyzed. Rebleeding was confirmed by evidence of recurrent hemorrhage on computerized tomography scans in all cases.

Forty-five patients underwent ventriculostomy for acute hydrocephalus after aneurysmal SAH at least 24 hours before aneurysm repair. Ventriculostomy was performed within 24 hours of SAH in 38 patients, within 24 to 48 hours in three patients, and more than 48 hours after SAH in four patients. The mean time interval between SAH and surgery in patients who did not undergo ventriculostomy was no different from the mean interval between ventriculostomy and surgery in patients who underwent preoperative ventriculostomy (3.6 compared with 3.8 days, p = 0.81). Fourteen (5.4%) of the 259 patients who did not undergo ventriculostomy suffered preoperative aneurysm rebleeding, whereas two (4.4%) of the 45 patients who underwent preoperative ventriculostomy had aneurysm rebleeding.

Conclusions. No evidence was found that preoperative ventriculostomy performed after aneurysmal SAH is associated with an increased risk of aneurysm rebleeding when early aneurysm surgery is performed.

KEY WORDS • ventriculostomy • aneurysm • subarachnoid hemorrhage • hydrocephalus • rebleeding

Recurrent hemorrhage is an important source of morbidity after initial rupture of an intracranial aneurysm.1,13 Theoretically, CSF drainage in patients with an unsecured, recently ruptured cerebral aneurysm may increase transmural pressure across the aneurysm wall, thereby increasing the likelihood of recurrent hemorrhage.9 Despite the widespread use of ventriculostomy for the treatment of acute hydrocephalus after aneurysmal SAH, there is no consensus regarding the risk of rebleeding when ventriculostomy is performed before aneurysm repair. This retrospective study was conducted to assess the risk of rebleeding after preoperative ventriculostomy in patients with aneurysmal SAH.

Clinical Material and Methods

We reviewed the records of all patients with acute SAH who were treated at a single institution between 1990 and 1997. Thus, the records of 304 consecutive patients in whom an aneurysmal SAH source was documented on cerebral angiographic studies and who presented to our institution within 7 days of ictus were analyzed. Rebleeding was confirmed by evidence of recurrent hemorrhage on computerized tomography scans in all cases.

Associations between categorical variables and outcome measures were performed using chi-square tests (or the Fisher exact test when sample sizes were limited). Continuous variables were compared using two sample t-tests, or Wilcoxon rank-sum tests if the distribution appeared to be heavily skewed.

Results

Forty-five patients underwent ventriculostomy for acute hydrocephalus after aneurysmal SAH; this procedure was performed at least 24 hours before definitive aneurysm repair. Twenty-nine women (64.4%) and 16 men (35.6%) with a mean age of 57.1 years (range 36–82 years) underwent preoperative ventriculostomy, whereas 162 women (62.5%) and 97 men (37.5%) with a mean age of 52.9 years (range 17–85 years) did not receive preoperative ventriculostomy. Admission Hunt and Hess grades are shown in Table 1. Ventriculostomy was performed within 24 hours of SAH in 38 patients, within 24 to 48 hours in three patients, and more than 48 hours after SAH in four patients.

Abbreviations used in this paper: CSF = cerebrospinal fluid; EVD = extraventricular drain; SAH = subarachnoid hemorrhage.
Rebleeding with ventriculostomy after subarachnoid hemorrhage

Two (4.4%) of the 45 patients who underwent preoperative ventriculostomy suffered aneurysm rebleeding, whereas 14 (5.4%) of the 259 patients who did not undergo ventriculostomy suffered preoperative aneurysm rebleeding. Thus, there is no statistical evidence that preoperative ventriculostomy is associated with increased risk of rebleeding after aneurysmal SAH (Fig. 1). The mean time interval between SAH and surgery in patients who did not undergo ventriculostomy was different from the mean interval between this procedure and surgery in patients who underwent preoperative ventriculostomy (3.6 compared with 3.8 days, p = 0.81).

In the two patients who suffered aneurysm rebleeding after ventriculostomy, the initial level of ventricular drainage was 0 cm H2 O in one patient and 5 cm H2 O in the second. Rehemorrhage occurred immediately after EVD placement in the first patient and roughly 8 hours after EVD placement in the second. The mean initial level of ventricular drainage for 30 patients who underwent preoperative ventriculostomy and who did not suffer rebleeding was 14 cm H2 O (range 0–20 cm H2 O, p = 0.02). For 13 patients the initial level of drainage could not be ascertained. The mean Hunt and Hess grade in patients who rebled after undergoing ventriculostomy was 3.5, compared with 2.3 in patients without ventricular drainage who rebled.

Twenty-seven (60%) of the 45 patients who underwent preoperative ventricular drainage demonstrated immediate clinical improvement after ventriculostomy, whereas 13 patients demonstrated no improvement, and no patient worsened. Information on the immediate response to ventriculostomy, including infection, were identified.

Discussion

Cessation of cerebral aneurysmal hemorrhage is thought to occur when the intracranial pressure approaches the mean arterial blood pressure after rupture. The increased intracranial pressure allows diastolic arrest of hemorrhage and platelet aggregation at the rupture site. Lowering of the intracranial pressure during the period following aneurysm rupture has been proposed to increase transmural pressure across the aneurysm sac. Therefore, ventricular drainage for acute hydrocephalus after aneurysmal SAH may result in a higher risk of rebleeding.

Studies of the risk of rebleeding after ventriculostomy in patients with aneurysmal SAH have yielded conflicting results. Voldby and Enevoldsen performed continuous monitoring of intraventricular pressure during aneurysmal rehemorrhage, and concluded that active drainage contributed to rerupture. Paré, et al., found that ventricular drainage for hydrocephalus following SAH was associated with a higher risk of rebleeding compared with no ventricular drainage: 30% compared with 8.3% rebleeding rates, respectively. These authors believed that hydrocephalus corresponded with larger aneurysm tears, which were more likely to rerupture during increases in the transmural pressure gradient, and cautioned that the need for ventricular drainage might reflect a more severely disrupted aneurysm more prone to rebleeding. Hasan, et al., also reported a significant increase in the risk of rebleeding after ventricular drainage despite conservative CSF drainage pressures (43% in patients with ventricular drainage compared with 15% in patients without ventricular drainage). They recommended a trial period of 24 hours, after which an EVD would be considered if there was no spontaneous improvement in results on the patient’s clinical examination, or earlier if there was deterioration attributable to hydrocephalus alone.

In contrast, Rajshekhar and Harbaugh reported a rebleeding rate of 14% in patients who underwent ventriculostomy after SAH. These authors compared their results only with historical controls. Of the seven patients who suffered rebleeding in that study, six rebled after the initial 24 hours of ventriculostomy placement and received either delayed or no surgery. Roitberg, et al., reported no rebleeding after ventriculostomy for acute hydrocephalus after SAH; their study also had no control group for comparison. These authors attributed the zero risk of rebleeding to early aneurysm surgery, and also to the predominantly referral-based nature of their patient population.

The findings in our study indicate no statistically significantly increased risk of rebleeding in patients who undergo ventriculostomy for hydrocephalus after SAH. Our study...
differs from those of Rajsekhar, et al., 10 and Roitberg, et al., 11 in that it is a consecutive series, with direct comparisons made with patients who did not undergo ventriculostomy. Although the reports of Hasan, et al., 3 and Paré, et al., 9 represent consecutive series, delayed surgery was used in the former study, whereas in the latter study the timing of surgery was not reported. Our practice is to treat the aneurysm early and definitively with surgery or endovascular means, and this is reflected in our low overall rebleeding rate. Our findings for rebleeding after ventriculostomy may not apply when delayed surgery is planned. It is important to note that ventriculostomy was performed early (within 24 hours of SAH, corresponding to the highest risk period for rebleeding) in 38 (84%) of 45 patients. Additionally, the interval between ventriculostomy and aneurysm repair was similar to the time interval between SAH and aneurysm repair in patients who did not undergo ventriculostomy, so that in both groups the interval during which rebleeding may have taken place was the same.

Our study is subject to referral bias, in which the sickest patients may have been selected out of our population by early death or a decision made by family or healthcare workers not to transfer them for treatment. All patients in the study presented to our institution within 7 days of ictus, however, and the majority (84%) of preoperative EVDs were placed within 24 hours of the time of SAH.

In cases in which rebleeding did occur after EVD placement, the mean initial level of drainage was 2.5 cm H2O compared with 14 cm H2O in patients in whom rebleeding did not occur after preoperative placement of an EVD. Rapid CSF drainage has previously been implicated in rebleeding, 8 and our data indicate that a mild increase in transmural pressure is tolerated, whereas aggressive drainage may increase the risk of rebleeding. We suggest that when a ventriculostomy is performed, the drainage must be carefully monitored and moderate initial levels of CSF drainage should be implemented. Despite the small sample size, the temporal association between ventriculostomy and rebleeding and the aggressive CSF drainage in two patients indicates that ventriculostomy may be related to rebleeding in certain cases, even though this association is not significant when all patients who undergo ventriculostomy are considered.

The value of prompt ventricular drainage in patients with acute hydrocephalus after SAH is well established. 2,7,10,12 In our study, 60% of the patients demonstrated immediate improvement in clinical grade that was temporally related to EVD placement. Given the observed clinical improvement, low rebleeding risk, and minimal morbidity, we continue to advocate early ventriculostomy in patients with hydrocephalus and depressed levels of consciousness after aneurysmal SAH.

Conclusions

We found no evidence that preoperative ventriculostomy after aneurysmal SAH is associated with an increased risk of aneurysm rebleeding when early aneurysm surgery is performed. Moderate ventricular drainage pressures may be safer than more aggressive drainage. Prompt ventriculostomy for acute hydrocephalus following aneurysmal SAH should not be withheld.

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References