Life-Threatening Cerebral Hematoma Owing to Aneurysm Rupture

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■ OBJECTIVE: **To refine the surgical indications of surgery for life-threatening cerebral hematomas caused by aneurysm rupture, through the analysis of possible outcome predictors.**

■ METHODS: **Forty-nine consecutive patients requiring prompt clot evacuation were retrospectively reviewed. In all cases, the hematoma was equal to or greater than 60 mL. The bleeding aneurysm was located on the middle cerebral artery in 26 cases, on the internal carotid artery in 10 cases, and on the anterior cerebral artery in 13 cases; four aneurysms were giant. Six patients underwent aneurysm coiling followed by clot removal, whereas 43 patients were managed by concomitant clot evacuation and aneurysm clipping. The main clinical and radiologic features, the management paths and the treatment modalities were correlated with the outcomes. A statistical analysis was conducted.**

■ RESULTS: **Overall mortality was 32.6%, severe morbidity was 22.4% and 22 patients (44.8%) achieved favorable results. The short-term results were more significantly influenced by the radiological parameters than by the initial clinical conditions. The prognostic weight of the radiologic findings was partially lost for six-month results, whereby management factors gained in importance.**

■ CONCLUSIONS: **The bleeding severity was strongly determinant for early mortality. However, if patients can survive the initial crucial phase, their chances of a favorable outcome are not negligible. Further improvement may be possible through better patient selection and the identification of nonsalvageable subjects.**

INTRODUCTION

Development of endovascular techniques has led to a significant general improvement in the outcome of patients with cerebral aneurysms. Nevertheless, when the aneurysms are responsible for intracerebral hematomas (ICHs), the advantages of endovascular treatment become less evident. In the case of life-threatening aneurysmal ICH, emergency clot evacuation may represent the sole chance of survival, but indications and the modalities of aneurysm treatment are still debated.[1–10] Emergency clot evacuation with concomitant aneurysm clipping represents the classical treatment option. It has even been attempted without any preoperative angiography to shorten the time for brain decompression,[1] but modern computed tomographic angiography (CTA) usually provides prompt and adequate management information. Some authors[3,8] think that immediate coiling followed by clot evacuation is time efficient and may be advantageous over immediate clot evacuation and clipping.

There are several articles regarding the management of aneurysmal ICHs, but many concern just the middle cerebral artery[2,5,7,9,11] or include clots of any size and patients with a wide range of neurologic conditions.[4,5,8–12]

Key words
- Intracerebral hemorrhage
- Intracranial aneurysms
- Microsurgical clipping
- Predictors
- Subarachnoid hemorrhage

Abbreviations and Acronyms
ACoA: Anterior communicating artery
CSF: Cerebrospinal fluid
CT: Computed tomography
CTA: Computed tomographic angiography
DA: Digital angiography
ED: Emergency department
GCS: Glasgow Coma Scale
GOS: Glasgow Outcome Score
ICA: Internal carotid artery
ICH: Intracerebral hematoma
ICP: Intracranial pressure
MCA: Middle cerebral artery
OR: Operating room
SAH: Subarachnoid hemorrhage

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In this article, we report our personal series of 49 consecutive moribund patients with life-threatening ICHs caused by aneurysm rupture. All patients required emergency ICH evacuation and concomitant aneurysm securing.

MATERIAL AND METHODS

The charts and the radiologic documentation of all patients undergoing emergency clot evacuation (1998–2013) were retrospectively reviewed. Forty-nine consecutive patients with aneurysmal ICH were found. Patients without life-threatening ICHs, patients with spontaneous subdural hematomas, and those with vital brain destructions or concomitant diseases that could potentially influence the clinical situation or outcome (e.g., arteriovenous malformations, cerebral tumors, coagulation disturbances) are not included in this series. Patients with posterior circulation aneurysms are not included either.

Patient Population

There were 18 men and 31 women (male:female ratio = 3:5), and age ranged from 39 to 71 years (mean = 53.9 years). Thirty-three patients experienced sudden loss of consciousness with immediate comatose state, and 16 patients were initially described as more or less alert with subsequent early preadmission deterioration. Nevertheless, clear early rebleeding was documented in only 6 cases. All patients but 3 of these patients were referred to our emergency department (ED) within 1 hour of hemorrhage. On admission, all patients but one scored 8 or less on the Glasgow Coma Scale (GCS), and there were 4 Grade IVs and 45 Grade Vs according to the Hunt and Hess Grading System.[13] Normal pupils were described in just 9 patients, whereas dilated pupils ipsilateral to the ICH were reported in 32 patients; the remaining 7 patients were admitted with bilaterally fixed and dilated pupils but the presence of the other brain stem reflexes. All patients underwent aggressive resuscitation including intubation, ventilation, fluid administration, correction of any cardiocirculatory or electrolytic anomalies. The main clinical parameters are summarized in Table 1.

Radiological Assessments

Immediate computed tomography (CT) scans were performed in all cases. All patients harbored life-threatening ICHs, which were classified according to location and size. There were 3 temporal ICHs (Figure 1), 13 frontal ICHs (Figure 2), and 33 frontotemporal or frontotemporoparietal ICHs. The volume of the ICH was grossly calculated considering the clot as an ellipsoid and its three major diameters as the axes, and using the classical equation $V = 4/3\ \pi abc$ (a, b, and c = semiaxes). For example, an ICH with three major diameters of 6, 8, and 4 cm had the following estimated volume: $V = 4/3 \times 3.14 \times 3 \times 4 \times 2 = 100.4$ mL. With this method, the ICH volume ranged from 60 to 200 mL (mean = 104.3 mL). Midline shift was evident in all patients; it was considered minimal (<5 mm) in 9 patients, intermediate (6–10 mm) in 23 patients, and maximal (>10 mm) in 17 patients. More or less intraventricular blood was reported in 41 patients (83.6%), but true acute hydrocephalus was shown in 19 patients (38.7%).

Afterwards, depending on the clinical conditions, either the patients underwent preoperative neurovascular assessments or they were immediately referred to the neurosurgical operating room (OR) for emergency clot evacuation and cistern exploration: a total of 27 patients (55.1%) were studied by CTA, 8 (16.3%) underwent digital angiography (DA), and 14 (28.6%) underwent direct exploration with clot evacuation and aneurysm clipping. In the 35 patients who underwent preoperative neuroradiologic assessments, the bleeding aneurysm was located on the middle cerebral artery (MCA) in 17 cases, the internal carotid artery (ICA) in 8 cases, the anterior communicating artery (ACoA) in 8 cases, the pericallosal artery in 2 cases. The CTA was able to show the bleeding aneurysm in all patients but one (Figure 2), in whom the aneurysm was hidden by artifacts because of coils that were put in place 2 years earlier when this patient had experienced her first subarachnoid hemorrhage (SAH). The 14 patients who underwent surgery without preoperative angiography harbored bleeding aneurysms on the MCA (9 patients), the ACoA (3 patients), and the ICA (2 patients).

Giant aneurysms (larger than 2.5 cm) (Figure 3) were found in 4 patients. Multiple aneurysms were documented in 5 patients. Radiologic features are reported in Table 1.

Treatment

Among the 8 patients who underwent preoperative DA, 2 (4.1%) were managed by subsequent clot removal and aneurysm clipping, whereas 6 (12.2%) underwent aneurysm coiling at the same time. The decision regarding endovascular treatment mainly depended on the clinical conditions, the aneurysm features, and the availability of neuroradiology facilities. In all the coiled cases, the aneurysm dome could be protected, and more than 80% sac obliteration was achieved. Afterwards, all patients underwent clot removal without any cistern exploration. The remaining 41 patients (83.7%) were surgically managed immediately after computed tomography (CT) or CTA.

The mean time from the admission to the ED and the arrival at the OR (ED-OR interval) was 160 minutes (range = 120–180 minutes) for patients whose aneurysms were coiled before surgery, and 115 minutes (range = 30 minutes to 23 hours) for those patients undergoing surgical clipping.

The operation consisted of the classical surgical management of cerebral aneurysms. The approach was planned to allow complete ICH evacuation and to access the circle of Willis. Following a wide craniotomy, the ICH was tapped with a blunt Cushing needle to slacken the dural plane. Next, clot removal started distantly from the aneurysm to obtain further brain relaxation and early visualization of the proximal vessels. As soon as possible, the cisterns were dissected and the bleeding aneurysm secured by clipping. In patients undergoing cistern exploration without preoperative angiography, the presumed site of the aneurysm was explored first. Hematoma evacuation was only completed after definitive obliteration of the aneurysm.

In 13 patients (26.5%), early intraoperative aneurysm rebleeding occurred before the aneurysm was exposed; in 2 patients, this happened during the craniotomy and before any dural incision. In all these patients, the arrest of the hemorrhage could be obtained by the combination of strong suction, pad compression, brain amputation, temporary trapping, and/or

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