

# Ruptured Middle Cerebral Artery Aneurysm with Intracerebral Hemorrhage in Younger Patients Appearing Moribund: Emergency Operation?

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Four women, aged 39 to 46 years, were urgently admitted to our neurosurgical unit after strokes. On admission, all appeared moribund, presenting with deep coma, pupils bilaterally dilated and fixed, decerebrate posture, and markedly abnormal respiratory patterns. Computed tomography revealed subarachnoid hemorrhage with an associated large intracerebral hematoma and pronounced shift of midline structures in all four cases. Because of the clinical appearance, the patients were given urea and were operated without preceding angiography. The origin of the hemorrhage was identified as a middle cerebral artery (MCA) bifurcation berry aneurysm in one patient and giant MCA aneurysms in the other three. The hematomas were evacuated, and the aneurysms were occluded. All four patients received intravenous nimodipine, none showed any sign of delayed ischemic deterioration, and all regained full consciousness within a few days. One patient died 3 weeks later from a pulmonary embolus. Three patients are presently at home with moderate focal neurological deficits and moderate to marked cognitive impairment. The psychosocial readjustment was very good in a patient with a left giant aneurysm, satisfactory in a patient with a right giant aneurysm, and unsatisfactory in a patient with a right berry aneurysm. The indications, ethical considerations, and technical aspects of operating on seemingly moribund patients who probably harbor a ruptured MCA aneurysm are discussed. (*Neurosurgery* 20:925-929, 1987)

**Key words:** Aneurysm, Emergency operation, Intracerebral hematoma, Moribund appearance, Subarachnoid hemorrhage

## INTRODUCTION

There is now increasing evidence that early aneurysm operation improves overall management results (2, 3, 6). Whether individuals in poor condition may benefit from early operative intervention remains controversial irrespective of the patient's age and the location of the aneurysm. However, it is generally agreed that certain poor grade patients with a significant intracerebral hematoma (ICH) should be operated upon immediately. The management of moribund patients arriving soon after a hemorrhage in deep coma with decerebrate posturing, bilateral fixed dilated pupils, and severely affected ventilation has usually been expectant; most aneurysm surgeons refrain from intervening in such cases. Immediate operation in patients with computed tomography (CT)-visualized large intraparenchymatous hematomas highly suggestive of middle cerebral artery (MCA) aneurysm origin may be life-saving if performed as an ultraemergency procedure without preceding angiography, which requires additional delay that can be fatal. It is obvious that such patients can never make a complete functional recovery, but can a satisfactory result be achieved when cognitive status and psychosocial adjustment are integrated in the final outcome assessment? The present study presents our experience with four female patients subjected to such emergency operation without preceding angiography.

## GENERAL PROCEDURES

Our general anesthetic and surgical procedures are described elsewhere (6-8). All four patients received intra- and postoperative nimodipine treatment. After clipping the aneurysm, we irrigated the exposed arterial segments with a nimodipine solution of  $2.5 \times 10^{-5}$  M. An intravenous infusion of 0.5 µg of nimodipine/kg of body weight/minute (at ap-

proximately 2 mg/hour) was started and continued for at least 9 days (7). There was no instance of any secondary delayed neurological deterioration. The time course for each of the patients is shown in Figure 1.

## CASE REPORTS

### Case 1

This 42-year-old normotensive woman had a history of headache for 1 year before the abrupt onset of very intense headache and left side weakness on January 21, 1985. On admission to a community hospital, she was drowsy, vomited, and demonstrated a left hemiparesis. During ambulance transportation to the Department of Neurosurgery in Lund, she suddenly became deeply comatose with decerebrate rigidity and showed a maximally dilated right pupil. Upon arrival, she was intubated, ventilated, and given 100 ml of urea intravenously. CT showed subarachnoid hemorrhage (SAH) and large ICHs in the right frontal and temporal regions (Fig. 2). During CT, both pupils became dilated and fixed.

She was promptly taken to the operating room, where a right frontotemporal craniectomy was made and a large ICH was evacuated. During further dissection in a search for a suspected MCA aneurysm, a massive arterial hemorrhage occurred. Temporary clipping of the proximal MCA trunk stopped the bleeding. Further dissection revealed a MCA bifurcation berry aneurysm, which was occluded. The temporary clip was removed after 9 minutes.

During the following days, the patient slowly regained consciousness and obeyed commands. She had a pronounced left side hemiparesis with paralysis of the hand. On Day 16 posthemorrhage, while she was eating by herself under observation, she suddenly became unconscious and a few minutes later her heart stopped beating. Resuscitation failed. Autopsy revealed a large bilateral pulmonary embolus.

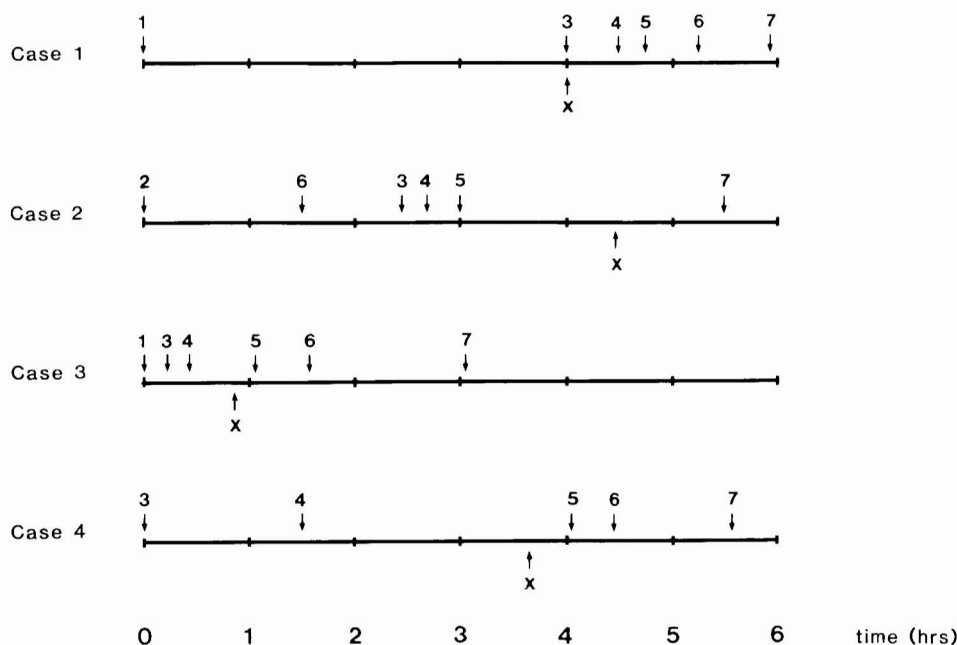


FIG. 1. Time course of the events from onset of headache to craniotomy. 1, onset of headache; 2, stuporous; 3, deeply comatose; 4, intubation; 5, urea/mannitol; 6, CT; 7, craniotomy; X, arrival in neurosurgical unit.

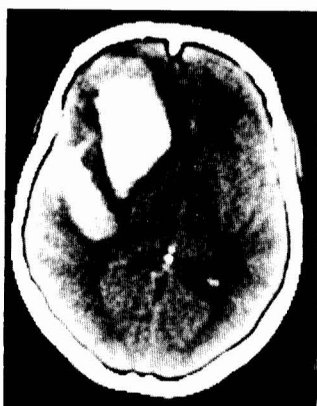


FIG. 2. Case 1, 42-year-old woman. CT on admission.

#### Case 2

This 44-year-old woman had a collagen vascular disease (scleroderma) and a history of psychiatric problems. On March 9, 1985, she experienced the sudden onset of severe headache. Within minutes, she developed generalized convulsions. On admission to a community hospital, she was somnolent and had a left side arm paralysis. CT revealed SAH and a right side temporal ICH. A few minutes after CT was completed, the patient suddenly deteriorated. She was intubated and, during ambulance transportation to Lund, she was given 200 ml of mannitol intravenously.

On arrival, she was deeply comatose with decerebrate rigidity and bilaterally dilated and fixed pupils. She was given 100 ml of urea and was immediately transferred to the operating room. During evacuation of the ICH, a giant right side MCA aneurysm was disclosed and clipped. Postoperative CT revealed considerable remaining hematoma, which was evacuated 4 days later.

**Immediate postoperative course.** The patient regained consciousness and subsequently showed steady and continuous improvement. Postoperative angiography 9 days after operation showed satisfactory occlusion of the aneurysm and also

revealed a nonruptured left MCA aneurysm (Fig. 3). The patient was discharged to a local hospital 3 weeks after the hemorrhage.

**Neurosurgical follow-up.** Seven months after bleeding, the patient's mental status and her speech seemed unaffected, but she demonstrated a residual left hemiparesis and was assessed as showing a fair recovery. At a second neurosurgical follow-up 1 year after SAH, evidence of a mental change as compared to her premorbid personality was disclosed by her near relatives.

**Neuropsychological assessment.** The assessment was performed 13 months after SAH. Upon investigation, the patient seems unaffected in her language functions. Her verbal learning and memory is normal, although not quite in agreement with her premorbid verbal intellectual capacity. She has minor visuospatial problems; her spatial-perceptual functions are slightly impaired, and evidence of concrete thinking can be discerned in more complex problem-posing situations. Her nonverbal memory functions, however, are completely normal.

Concept formation seems quite unaffected, but her perceptual abilities and her reviewing capacity are mildly impaired. She is somewhat slow in her perception, but has no problem paying attention to multiple aspects of a given task simultaneously.

After the hemorrhage, a notable change in personality characteristics took place. Before her illness, she was shy, uncertain, and reserved, but she now airs her opinions in an uncurbed manner. The previous expressions of her neurotic problems are gradually changing character. Her lack of self-confidence, shyness, and formal appearance have given way to outspokenness and candid behavior. She is less inhibited and restrained and also thinks that her social relations are improving. But she is also easily fatigued, more vulnerable, and to some extent emotionally incontinent. She also has a tendency to overreact; she frequently gets possessed by her ideas and carries her arguments beyond the point of social tolerance.

To the investigator, the patient bears the stamp of an underlying encephalopathy. She seems persevering and sticky in emotional contact. She is also incessantly talkative, repeti-

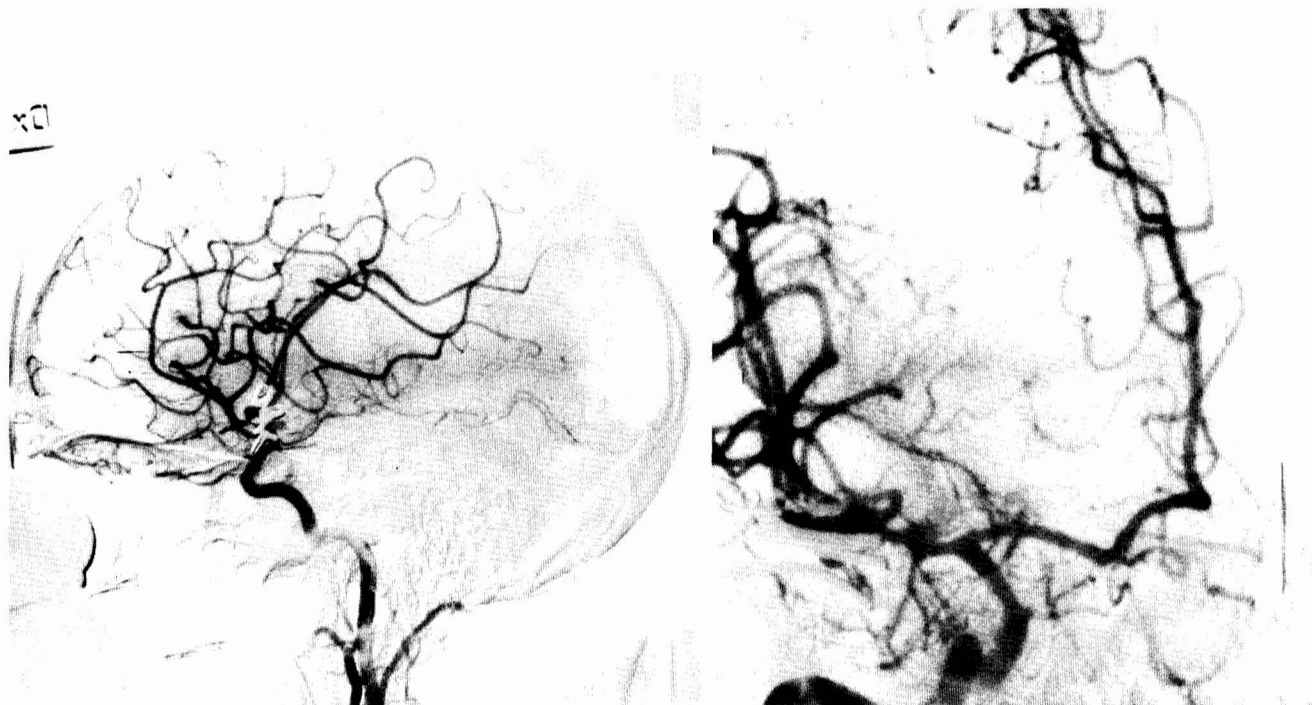


FIG. 3. Case 2. Angiography 9 days after operation (see text).

tively pursuing specific lines of thought, and she has to be resolutely diverted. Her emotional rapport is characterized by a shallow wittiness alternating with a plaintive attitude. Altogether, her emotional appearance is illustrative of a personality change associated with brain damage.

Her daughter certifies this change in her mother's personality. Although she often finds her overreactive behavior burdensome, she still regards the personality change as a turn for the better. She has also assumed full responsibility for the care of her mother, the former mother-daughter relation now being reversed. Since the SAH, the patient has never given up her ambitions for recovery. Practical problems put a restraint on her activities, but with inventiveness and persistence she is gradually coping. She is also making progress in the rehabilitation program, where her tenacity and present self-confidence are an asset.

### Case 3

On March 10, 1985, a 39-year-old woman was transferred directly to our unit after having suddenly become deeply unconscious while working in her kitchen. On admission 1 hour later, she was profoundly comatose with decerebrate rigidity. The right pupil was dilated, and both pupils were fixed. CT revealed a SAH and a large left side ICH. The patient was given 100 ml of urea and was brought to the operating theater, where a left frontotemporal flap was raised. The ICH was evacuated, and a giant MCA aneurysm was occluded.

*Immediate postoperative course.* During the subsequent days, the patient slowly regained consciousness, but demonstrated a pronounced right side hemiparesis and was severely dysphasic. Angiography on Day 8 post-SAH was unremarkable. She improved continuously and was discharged 2 weeks after the hemorrhage.

*Neurosurgical follow-up.* Seven months after operation, she lives at home and takes part in most daily activities. She has no obvious mental impairment, and her speech is continu-

ously improving. She walks with the help of one cane, but has residual paralysis of her right hand. She requires no help in attending to her personal needs.

*Neuropsychological assessment.* At neuropsychological assessment 13 months after the SAH, the patient reported that she takes active part in domestic work, many times with the aid of ingeniously invented gadgets, and she even manages knitting. Her verbal functions are largely characterized by her dysphasia. To her family, she has no striking mental impairment and her speech is continuously improving. She is able to read part of the daily papers with some effort. She has substantial problems in communicating spoken language, but can make herself understood reasonably well with paper and pencil, gestures, etc. Her visual receptive verbal functions are moderately impaired, she has some trouble comprehending written material, but she is fully able to understand oral communications.

Because of the dynamics of her dysphasia, her verbal learning and memory are severely hampered, partly due to genuine amnesic problems and partly due to the communicative aspects of her dysphasia. Her spatial-perceptual functions and logical and visuoconstructive abilities are completely unaffected. She performs at a high level, presumably in accordance with her premorbid capacity (former high school graduate). Simplified spatial learning and reproduction is quite equivalent with what is seen in healthy subjects, but shortcomings are evident when more extensive material is at hand.

Her perceptual flexibility, the ability to shift between various aspects of any given situation, is only moderately affected and borders on normality. Her perceptual reviewing ability and the tempo of her perceptual functions are somewhat reduced but, on the other hand, she performs with a precision and accuracy rarely seen in normal individuals. She knowingly substitutes accuracy for speed.

During the months after the hemorrhage, she reacted with depression for a short period, but has since shown an unbroken will to recover. She is full of energy and initiative, always

pushing forward. Her social interests are unchanged and, despite her dysphasic problems, she eagerly takes part in activities outside her family. She initiates visiting friends, going to the theater, shopping, etc. Her husband testifies that, in his mind, her personality is completely unchanged as compared to before her stroke. Although her ambitions reach farther than her present condition permits, "she is working hard to get on top again and progress is evident every week."

#### Case 4

This 46-year-old woman had a history of migraine. One week before admission, she had a sudden onset of severe headache, which slowly disappeared during the following days. On April 30, 1985, she suddenly became deeply comatose with rigidity in all limbs. On admission to a community hospital, she was unresponsive to pain. Her right pupil was maximally dilated and fixed. She was intubated and ventilated and, 20 minutes later, a mild extensor posturing on noxious stimulation was noted in her right arm. On admission in Lund, both pupils were fixed. CT revealed SAH and a large right side temporal ICH. She received urea and was immediately transferred to the operating room. The hematoma was evacuated, and a right giant MCA aneurysm was clipped.

*Immediate postoperative course.* This patient regained consciousness approximately 24 hours after SAH and operation. She had a left side hemiparesis, but continuous improvement was noted before discharge. Angiography on Day 8 post-SAH was normal. She stayed in our neurosurgical unit for 2 weeks.

*Neurosurgical follow-up.* At 6 months after SAH, the patient lives at home. She seems mentally unimpaired, and her speech is unaffected. She can walk with the help of one cane, but has residual paralysis of her left hand. The neurological outcome is considered fair.

*Neuropsychological assessment.* The neuropsychological assessment 1 year after operation confirms presumably unimpaired language functions (the patient is of non-Swedish extraction) and an unusually good verbal learning and short term memory capacity. Although she has slight consolidation problems, her verbal retrieval upon retesting is still well above average. A moderate spatial-perceptual impairment can be observed in dimensional structuring and visual analysis. However, this difficulty is in all likelihood aggravated by a left homonymous hemianopsia.

Her nonverbal (spatial) memory functions are affected and are quite at variance with her verbal memory. Apart from highly disproportionate structures and reproductions based on perceptual misconceptions, she also displays pure memory-related deficits, specifically in more demanding contexts.

Perceptual speed is seriously reduced and, even though she compensates for her visual neglect, her reviewing ability is marked by a particularly slow progress.

In her adjustment after the hemorrhage, she specifically emphasizes a decrease in energy and activities. She tires easily and is prone to a passive life. Her social interests, which were never plentiful, are abandoned altogether. Although she was always withdrawn and taciturn before her disease, she has become even more so. Her loss of autonomy is the greatest threat to her existence: she is inert and dysphoric and often touchy and irritable. Formerly an accountant, she is gradually trying to resume her work part-time, mostly for therapeutic reasons, but progress is slow and she is often inclined to give up her efforts.

Her husband testifies to her description of herself. With outside help, she is able to take part in some activities of daily living, but is far from independent. She also needs help in

getting dressed because she cannot perceive the appropriate fitting of her garments. Emotionally, she is irritable and frequently shows poor control over impulsive tendencies. The greatest problem, however, is posed by her inertia and passive-negative attitude. She needs constant stimulation and incitement. Left on her own, she resorts to passivity, lying on a couch leafing through magazines. She refrains from seeing people, has lost interest in her personal appearance, and has assumed an attitude of indifference. Although many of her symptoms are seemingly depressive equivalents, her husband rather relates her apathy and passivity to an obvious change in her personality characteristics after the stroke.

#### DISCUSSION

Most neurosurgeons would probably not hesitate to operate upon an individual with an epidural hematoma even if the patient appeared more or less moribund because such patients may benefit from operation and eventually return to a meaningful life.

Can the same be said for ICHs associated with aneurysm rupture? The timing of surgical intervention in patients who have suffered an aneurysmal SAH has been under debate for decades. Because results from the early days of aneurysm surgery were mostly disappointing, only patients in very good clinical condition after the hemorrhage were thought to benefit from operation. Technical advances have diminished the morbidity of aneurysm surgery, but debates regarding the timing of intervention continue. Recent data using microsurgical techniques strongly favor early operation for patients in good condition. Auer has recently suggested that patients in poorer condition may also benefit from early surgical intervention (1). In his series, the poor grade patients with a satisfactory outcome had SAH only. He concluded that operation did not seem to be indicated in patients with extensive intracerebral hemorrhage, especially from an anterior communicating artery aneurysm.

The four patients in the present series were all admitted to our unit with an ICH very soon after the hemorrhage. They were all relatively young, previously healthy, and without any complicating vascular disease. They all arrived in a clinical state that, without urgent surgical intervention, would have resulted almost certainly in death. Had angiography been performed, the additional delay might have contributed to an irretrievable situation. In our experience, a preoperative angiographic investigation would not have changed or substantially facilitated the surgical approach.

After evacuation of the ICHs, the brains were slack in all four cases, and there was no secondary intraoperative brain swelling. The aneurysms were recognized and could be clipped without major technical problems. Temporary MCA trunk occlusion, a procedure that is generally well tolerated in aneurysm operations performed during the acute stage (see Ref. 8), was needed in one patient. Despite the obvious signs of severe brain stem compromise exhibited by all four patients before operation, consciousness was regained within a day or a few days.

In the decision for surgical intervention, knowing the unpredictability of the prospective outcome, ethical aspects must also be considered. Because patients with large ICHs can never be expected to achieve a complete recovery, the quality of the life that these patients are destined to live must be weighed into the final considerations before operation. Knowing the uncertain odds, it is understandable if all parties concerned, surgeon and perhaps relatives, hesitate before such a doubtful and gloomy venture. Further, if operation is per-



formed, the aneurysm surgeon, having invested his competence and skill in a surgical success, may not always be the very best judge of the final outcome (9).

The life of a surviving patient after the disaster depends on an array of factors: the concomitant neurological sequelae, the nature and degree of the cognitive impairment sustained, the strength, endurance, and understanding of family members and caretakers, and, perhaps most of all, the personality characteristics and adaptational properties of the patient, which are unknown to the surgeon (4, 5, 10). Our present experience with the three surviving patients has been encouraging in that respect. We stress the importance of a referral system that allows young patients to be referred to a neurosurgical unit with an interest and knowledge in early aneurysm operation immediately after a stroke, even if the patient seems moribund.

In conclusion, it might be justified that younger, moribund patients with large ICHs possibly originating from a ruptured MCA aneurysm not be dismissed as "surgical taboos" (1).

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#### COMMENTS

Brandt and colleagues have provided thoughtful insight into a neurosurgical dilemma. We wholeheartedly agree that the Hunt-Hess grading scale, although extremely useful in patients with diffuse subarachnoid hemorrhage, does not apply well to the patient whose brain is herniating from a focal hematoma. The substantial time delay imposed by even single vessel cerebral angiography can cost life-saving minutes for these patients. When the pattern of hemorrhage is characteristic of middle cerebral aneurysm, the stereotypic location and configuration of these aneurysms should lend considerable assurance to the surgeon of the prospective operative anatomy. After the hematoma and the bulk of the anterior temporal lobe are evacuated, the brain is typically slack and lends itself well to a reasonable sylvian dissection. In the unusual circumstance that this exploration is negative, the posterior carotid wall should also be inspected, as a laterally projecting aneurysm in this location can similarly produce a temporal hematoma. It can be argued that, once decompression is accomplished, the craniotomy should be closed and the patient's condition stabilized, allowing time for definitive angiography. However, the removal of tamponading clot and brain tissue may predispose to very early rebleeding. The authors are to be congratulated for the extensive neuropathological follow-up of these patients. Our future ethical decisions regarding which patients should and should not be treated must be based on firm data reflecting the quality of life that can be anticipated in a given situation.

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I certainly agree with the authors that an aggressive approach to the hematomas in these patients is warranted, based upon the results obtained in patients in similar clinical states after trauma. However, one should proceed to operation without angiography with caution. The presumed site of hemorrhage with large hematomas may be misleading on CT. Minutes may, at times, determine success, but a well-organized team can obtain an angiogram, limited to the appropriate hemisphere (e.g., left carotid artery only for a left fronto-temporal hemorrhage) in a matter of minutes, while the operating room team is being assembled. We have, on several occasions, been thankful that we had a preoperative angiogram.

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