

CEREBRAL ANEURYSMS

ASSESSMENT OF 377 CASES (1956-1982)

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SUMMARY — A review of 177 patients with cerebral aneurysms is made, out of whom 106 with ruptured aneurysms were examined, whose operational timing and prognostic chances were well documented (group B, 1979-1982) and in part updated to 1984. Furthermore, relevant data of a previous series of 200 cases of cerebral aneurysm, treated between 1956-1978 were used (group A). The patients were graded according to Hunt and Hess, assessing the risks involved. The percentages of recurrent bleeding were in group A 36.5% and 28% in group B. The incidence of vasospasm (as seen in angiography) was in group B 39.6% (42/106 patients). The highest rate of vasospasm in the spasm group division B was found to occur in the second and third week after subarachnoid haemorrhage and amounted to 64.7% and 62.5%. A pre-operatively present vasospasm had no negative effects on the mortality rate, but influenced the outcome for the survivors effectively. The total mortality in group A was 22.5% and in group B 11.7%. Timing of the operation among patients in Hunt and Hess-grades I and II needs to discussion. The surgical position of patients in grade V is also certain. What remains to be discussed and needs attention is grade III and patients in grade IVa. Here the time of operative intervention must be planned individually depending on the course of the neurological status.

Aneurismas cerebrais: conduta em 377 casos (1956-1982).

RESUMO — Os autores apresentam revisão de 177 pacientes com aneurisma observados durante o período de 1979 a 1982 (Grupo B) e dos quais 106 sofreram ruptura aneurismática. É feita comparação com série prévia tratada de 1956 a 1978 (Grupo A), com 200 pacientes. Observou-se a classificação de Hunt e Hess. No Grupo A, 36,5% sofreram ressangramento; no Grupo B, 28%. Vasoespasmo foi observado (angiograficamente) em 42 de 106 pacientes do Grupo B (39,6%). Observou-se ainda que o vasoespasmo ocorreu preponderantemente na segunda e na terceira semanas após o sangramento inicial (64,7% — 62,5%). A presença de vasoespasmo pré-operatório não mostrou efeito negativo quando relacionada ao índice de mortalidade, embora tenha influenciado no prognóstico e na recuperação do paciente. A mortalidade do grupo A foi 22,5% e no grupo B, 11,7%. O «timing» cirúrgico para os pacientes classificados em grau I e grau II (Hunt e Hess) merece ainda discussão. Pacientes em grau III e grau IV merecem atenção especial: a indicação cirúrgica deve ser planejada individualmente, dependendo da evolução do quadro clínico-neurológico.

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Cerebral aneurysm as a disease poses a challenge to the patient and the neurosurgeon alike. For the patient the course of the disease is fateful. Subarachnoid haemorrhage (SAH) from a ruptured aneurysm is an even more serious variation of this disease. The time involved from rupture and onset of bleeding until its closure is of absolute importance to the patient as far as prognosis is concerned. The word «timing» in relationship to surgery of aneurysms was coined in order to strategically determine the best appropriate time for surgery in which the least possible damage and complications would occur and not add to already existing ones. During the course of finding suitable protective measures, Norlen and Olivecrona⁵ in 1953 showed that excellent results could be expected in grade I and II patients if operations were performed 2-3 weeks after SAH. When Hunt and Hess¹ provided grading consisting of neurological deficits, meningeal irritation and state of consciousness a useful parameter of grading was established for clinical use (Table 1). Recently Yasargil¹¹ has presented a modification of this grading to add aneurysms which have not yet bled as grade 0 and further added subgrading of «a» and «b» for the sake of better differentiation.

| | |
|----------------|--|
| I | Asymptomatic, or minimal headache |
| I _A | Awake, no acute meningeal or brain reaction, with fixed neurological deficit |
| II | Awake, moderate to severe headache, stiff neck, no neurological deficit |
| III | Drowsiness or confusion; no or mild neurological deficit |
| IV | Semicomatose, responding to pain but not to voice, vegetative disturbances |
| V | Deep coma, decerebrate rigidity, moribund appearance |

Table 1 -- Hunt and Hess grading.

MATERIAL AND METHODS

Preoperative management — The diagnosis of SAH was based on a lumbar puncture and computer tomography (CT). The evidence of aneurysm was eventually proved by angiography.

The results of the treatment were placed into two categories: A and B (Table 2). Category A comprises patients operated on during the period 1956-1973 with observation on 200 patients. The second group (B) with 177 patients was studied retrospectively from 1979-1982, later updated to 1984. The results of the treatment in group A are based on the principles for a late operation, waiting as a rule for three weeks or more after the last haemorrhage. However in the cases of group B an early operation was aimed at, if the various factors involved permitted this.

| Grades of risk | Number of patients | |
|----------------|--------------------|-------------|
| | Group A | Group B |
| I | 103 (51.5%) | 84 (47.5%) |
| II | 73 (36.5%) | 84 (31.6%) |
| III | 14 (7.0%) | 26 (14.7%) |
| IV, V | 10 (5.0%) | 11 (6.2%) |
| Total | 200 (100 %) | 177 (100 %) |

Table 2 — Distribution of risk grading after Hunt and Hess at the time of operation in 377 cases of aneurysm.

Pre-operative vasospasm — The rate of the pre-operative vasospasm of group A accounted for 32.5% and in group B to 39.6% (Table 3). The vasospasm rate within three days after SAH was registered in 27.3%, within the fourth week 20% and after the fourth week 20%. The highest rate of vasospasm occurs in the second and third week with 76% and 72.7% respectively.

| Angiographic findings | Number of patients | |
|-----------------------|--------------------|--------------|
| | Group A | Group B |
| No vasospasm | 135 (67.5%) | 64 (60.4%) |
| Vasospasm | 65 (32.5%) | 42 (39.6%) |
| Total | 200 (100 %)** | 106 (100 %)* |

Table 3 — Pre-operative rate of vasospasm after SAH at time of angiography in 306 cases of aneurysm, group A (1956-1978) and group B (1979-1982): *, only cases of SAH; **, includes cases of aneurysm without SAH.

RESULTS

The review of the survivors revealed that a total of 74.8% patients fulfilled the criteria for being classified «capable to work». Grade I and II patients present with 88.5% a significantly better prognosis than those graded in III, IV and V (Table 4); 55% of grade III patients had serious neurological deficits; 88.8% of grade IV-V patients were classified to be vegetative-like survivors. Table 5 illustrates the results of the relationship between timing of operation and mortality in relation to risk grading among 166 patients with ruptured aneurysms in group B (1978-1984).

| Grade at operation | Number of patients | Number of «able to work» | Number of «not able to work» | Number of deaths |
|--------------------|--------------------|--------------------------|------------------------------|------------------|
| I, II | 140 | 116 (88.5%) | 15 (11.4%) | 3 (6.4%) |
| III | 26 | 9 (45.0%) | 11 (55.0%) | 6 (23.0%) |
| IV, V | 11 | 0 (0.0%) | 8 (88.8%) | 3 (27.0%) |
| Total | 177 | 125 (78.6%) | 34 (21.3%) | 18 (10.2%) |

Table 4 — Post-operative quality of life in survivors (outcome) and mortality in 177 cases of aneurysm, group B (1979-1984) in relationship to pre-operative Hunt and Hess grading.

COMMENTS

It is generally known and supported by the literature that the general mortality rate of cerebral aneurysms could be estimated to 50-60% and morbidity of 20-30%⁷. If untreated, ruptured aneurysms could have a total mortality of as high as 80-90%. Fact is that the highest rate of rebleed occurs or would occur between the end of the first week and the beginning of the second (Fig. 1)^{7,8,11}. When a rebleed occurs, the mortality is rated at 80%. Jane et al.² and Kassel and Torner⁴ reported rebleed that occurs within this period to be 20% and 19% respectively. Within the first 24 hours Kassel and Torner⁴ reported that the rate of the second SAH could be as high as 4.1%. This finding provided a strong argument for an early surgical intervention among certain groups of neurosurgeons, even though other authors have found this incident to be relatively low: 0.8%⁷. The tendency however is relatively high that patients in poorer conditions with higher grading are likely to suffer a rebleed. Suzuki and coworkers⁸ argue further that removal of blood in the subarachnoid space would reduce the risk of vasospasm. Yasargil¹¹ states that «it is

| Grade at operation | Interval between last SAH and operation (days) | | | | Total | |
|--------------------|--|--------|---------|---------|---------|---------------|
| | 1-3 | 4-7 | 8-15 | > 15 | | |
| I, II | 26 | 17 | 15 | 72 | 130 | Nr. of cases |
| | 1 | 1 | 1 | 6 | 9 | Nr. of deaths |
| | (3.8%) | (5.9%) | (6.7%) | (8.3%) | (6.9%) | Mortality (%) |
| III | 4 | 2 | 2 | 17 | 25 | Nr. of cases |
| | 3 | — | 2 | 1 | 6 | Nr. of deaths |
| | (75%) | (0%) | (100%) | (5.9%) | (24%) | Mortality (%) |
| IV, V | 5 | — | — | 6 | 11 | Nr. of cases |
| | 2 | — | — | 1 | 3 | Nr. of deaths |
| | (40%) | — | — | (16.6%) | (27.3%) | Mortality (%) |
| Total | 35 | 19 | 17 | 95 | 166 | Nr. of cases |
| | 6 | 1 | 3 | 8 | 18 | Nr. of deaths |
| | (17%) | (5.3%) | (17.6%) | (8.4%) | (10.8%) | Mortality (%) |

Table 5 — Timing of operation and mortality in relation to riskgrading in 166 cases of ruptured aneurysm, group B.

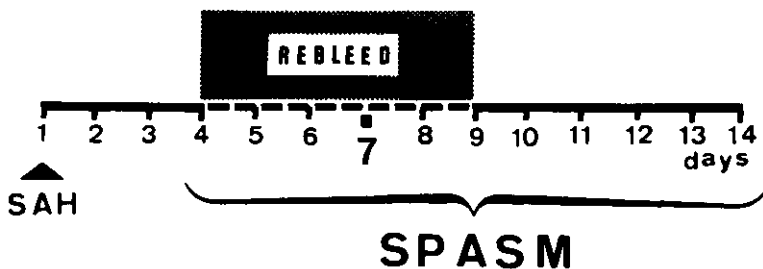


Fig. 1 — Likely pattern of behaviour of aneurysms after first bleeding.

unlikely that factors which increase the risk of operation also significantly protect the patient from the rerupture during the waiting period». This implies that the quickest possible period must be found to operate in order to reduce the risk of rerupture to an absolute minimum. It provides a strong argument for an early operation.

Which risks and complications should be considered? Grading however viewed, provides general guidelines reflecting only a rough estimation of the extension of brain damage after aneurysm rupture. Any grading system presents certain difficulties of a kind. Referring Yasargil¹¹ «each proposed grade includes a spectrum of patients grouped together regardless of (1) age, (2) general medical state and basic physical condition, (3) vasospasm, (4) state of intracranial pressure (ICP), (5) alteration of the cerebral perfusion (CBF), and (6) SAH and intracerebral haematomas»:

I. Age — Younger patients in general have better chances of survival than older ones of the same grading.

II. Medical condition — An alert patient without neurological deficit must be in a medically and physically good condition to reduce the risk of morbidity after operation.

III. Vasospasm — Vasospasm and alteration of cerebral perfusion indicate a warning to surgical intervention especially in early stages of bleeding. The course of vasospasm could be traced indirectly either angiographically or by means of non-invasive CBF and Doppler examinations. Persistent vasospasms without neurological worsening

after a certain period of time must be interpreted carefully. They could be anything else but not reactive vasospasm, for example: (a) arteritis, (b) intima proliferation of the vessel, (c) intravascular oedema, (d) calcification (plaques)^{9,10}.

IV. ICP — Whereas increase of ICP in general should be considered to be a factor which would not favour surgery, there seems to be a difference in perspective in the literature concerning ICP. Nornes⁶ thinks an increased ICP provides a support for the aneurysm wall and therefore lowers the incidence of rebleeding, whereas Suzuki prefers cerebrospinal fluid (CSF) drainage which he is convinced benefits a decrease of ICP^{8,11}.

V. SAH and intracerebral haematomas — According to Jellinger³, aneurysms account for 22% of all hemispheric intracerebral bleedings. The localisation of such bleeding would give rise to suspicion when they are typical and close to areas of the cerebral vessels where aneurysms could be expected, for example in the temporal lobe in the vicinity of the sylvian fissure typical for median trifurcation aneurysms or frontal region, typical for the anterior communicating aneurysm. Angiography must be performed to rule out the existence of a malformation.

Our general concept of management — In general we base the concept of management along the guidelines of the Hunt and Hess-grading. Our Neurosurgical Department in Mainz maintains an interdisciplinary 24-hour-service in cooperation with the Departments of Neuroradiology and Anaesthesiology.

Patients admitted in Hunt and Hess I, when they meet medical conditions suitable for operation, undergo a CT examination and angiography immediately. When the diagnosis of an aneurysm is made, a basic Xenon-CBF measurement is quickly performed which is manned also 24 hours in service, either with the standard CBF installation or a smaller mobile unit which is available in the intensive care unit. After that the operation is planned. Generally lumbar CSF drainage is made before and during the operation. Patients in Hunt and Hess II are treated along similar lines.

The problem of decision making as to when to operate arises according to our experience with patients in Grade III. Generally, we prefer «a wait and see attitude» of about 24 hours. In this stage we do not operate in the acute situation. If after 24 hours the patient's condition becomes better under observation and treatment with calcium antagonists, and be graded as II, the operation is performed. It becomes evident that patients whose conditions worsen most likely develop vasospasm. Although there are sometimes discrepancies in the proof of vasospasm by means of CBF measurement, it still gives us enough evidence and indication of the state of the cerebral perfusion. Recently we have added into our supplementary predictive diagnostic methods transcranial Doppler examinations as an additional means of obtaining information about the state of intracerebral blood flow.

Patients in Hunt and Hess-grading IV and V are never operated on acutely with the exception of patients in grades IV and V with massive intra- or extracerebral haematomas. Haematomas with space occupying effect must be evacuated. Depending on the general condition of the patient and neurological status one must make a choice between acute removal of the clot alone or perform angiogram with the intention of closing the aneurysm. In many cases it is possible to clip the aneurysm in the same sitting. In general, according to our experience most of such patients are in the group of a high Hunt- and Hess-grading of IV-V. The prognosis is generally bad with a high rate of morbidity, and neurological deficit.

Smaller haematomas without midline shifting must be treated along the lines for management of the aneurysm in the Hunt- and Hess-grading.

REFERENCES

1. Hunt WE, Hess RM — Surgical risk as related to time of intervention in the repair of intracranial aneurysms. *J Neurosurg* 28:14, 1968.
2. Jane JA, Winn HR, Richardson AE — The natural history of intracranial aneurysms: rebleeding rates during the acute and long term period and implication for surgical management. *Clin Neurosurg* 24:176, 1977.
3. Jellinger K — Pathology of intracerebral haemorrhage. *Zbl Neurochir* 38:25, 1977.

4. Kassel NF, Torner JC — Aneurysmal rebleeding: a preliminary report from the Cooperative Aneurysm Study. *Neurosurgery* 13:479, 1983.
5. Norlen G, Olivecrona H — The treatment of aneurysms of the circle of Willis. *J Neurosurg* 10:404, 1953.
6. Nornes H — The role of intracranial pressure in the arrest of hemorrhage in patients with ruptured intracranial aneurysms. *J Neurosurg* 39:226, 1973.
7. Rosenorn J, Eskesen V, Schmidt K, Ronde F — The risk of rebleeding from ruptured intracranial aneurysms. *J Neurosurg* 67:329, 1987.
8. Suzuki J, Kodama N, Fujiwara S — Surgical treatment of internal carotid-posterior communicating aneurysms: from the experience of 213 cases. In Suzuki J — *Cerebral Aneurysms*. Neuron, Tokyo, 1979, pg 256.
9. Wilkins RH — Attempted prevention of treatment of intracranial arterial spasm: a survey. *Neurosurgery* 6:198, 1980.
10. Yasargil MG — *Microneurosurgery*, Volume I. Thieme, Stuttgart, 1984, pg 343.
11. Yasargil MG — *Microneurosurgery*, Volume II. Thieme, Stuttgart, 1984, pg 7.