Actualization of treatment options in poor-grade subarachnoid hemorrhage patients.

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Introduction

Since Botterell in 1956 and later Hunt and Hess in 1968 presented a scheme for preoperative grading of subarachnoid hemorrhage (SAH) patients, it became clear that a poor preoperative clinical condition is related to increased mortality and morbidity. The criteria used to decide which poor-grade patients with SAH are irreparably brain-damaged and which autoregulation disorders are irreversible are not clear. Predicting outcome, based only on clinical and diagnostic data found at the time of the admission, may have resulted in withholding treatment from several of the patients who subsequently experienced favorable outcomes. The mortality rate among nonoperatively treated patients with Grade IV and V SAH has been reported to be 90% to 98%. Delayed surgery, in the 1970's to middle 80's, was reported to reduce mortality without increasing the number of survivors in poor condition. These results increased confidence in surgical treatment and many centers changed management practices and introduced selective early surgery. At this time, as well as in the following years, early surgery with selective management criteria reduced mortality considerably, from about 19% to 33%. The present article analyzes four recently published studies on the actual possibilities and limitations in the treatment of these patients.

1) OUTCOME AFTER URGENT SURGERY FOR GRADE IV SUBARACHNOID HEMORRHAGE DUKE B, KINDT GW, BREEZE RE SURG NEUROL (1998) 50:169-73

Information

This study presents a consecutive series, during a 3-year period, of 27 patients with acute (less than 24 h since clinical onset) grade IV SAH-patients treated with early surgery. All patients were treated with immediate ventricular drainage, rigid hemodynamic control, early angiography and surgery. Patients were followed for a minimum of 6 months and their outcomes categorized using a four-tiered scale: 1) independent and working, 2) impaired but independent, 3) severely impaired and dependent, and 4) dead. Despite seven patients death within 48 h of admission and two patients death in the latter follow up, the remaining 18 patients survived to discharge. Their latter outcome was, seven patients were independent and working, six were impaired but independent, five were severely impaired and dependent. The authors conclude that urgent surgery for poor-grade SAH can produce quality survival for a higher percentage of patients than is historically reported with delayed surgery.

Analysis

The study population consist of all patients who were judged to be grade IV on initial evaluation and remained so until surgery, plus those judged to be grade V but who improved to grade IV with resuscitation and those grade III or less but who deteriorated to grade IV before surgery. This observation confirms, how variable can be the neurological state of these patients and the possibility to revert partial or complete deficits by administrating the correct sequential therapeutic options. Taking this into account, and considering that rebleeding is more frequent in poor-grade than in good-grade patients (3, 48, 57, 88), the incidence and the severity of vasospasm are not increased by early surgery (5) but the risk of rebleeding is reduced (51), early aneurysm occlusion is then advisable.

2) INTRACRANIAL ANEURYSMS AND SUBARACHNOID HEMORRHAGE. MANAGEMENT OF THE POOR-GRADE PATIENT LE ROUX PD, WINN HR. ACTA NEUROCHIR 1999; [SUPPL] 72: 7-26.

Information

In this article the authors review the epidemiology, pathophysiology, clinical features and treatments of patients in poor clinical condition after SAH, summarizing their own experience of 159 previously published patients and from other authors collected data. Early aggressive surgery resulted in 38.4% of the poor-grade patients experiencing a favorable outcome. This management was not associated with more survivors in poor condition. The authors analyses the importance of concomitant aggravating factors such as intracerebral hemorrhage (ICH) which complicates between 5 and 40% of all SAH and is most prevalent in poor-grade patients. They advise space-occupying intracerebral or subdural hematomas to be removed and emergency aneurysm clipping to be performed in all of these patients based on the CT angiograms alone. External ventricle drainage without aneurysm clipping was found to increase the risk of rebleeding and resulted in poor outcomes. In addition they remark that the decision about which patients receive further care should not only be based on the response to ventricular drainage. The authors did not find a clear relationship between advanced age and the risk of poor outcome, but the simultaneous occurrence of intraventricular hemorrhage and arteriosclerosis following a multivariate analysis were considered as comorbidity factors. Additionally, they recommend in poor-grade patients a strict intensive care unit (ICU) with monitoring (cardiopulmonary and intracranial), supplemented with frequent head CT scans and SPECT scans and daily transcranial Doppler examinations in order to control hypervolemic therapy and reduce the incidence of delayed ischemia. Analysis. The present article is based on one of the largest series published in recent years. It also demonstrates that even comatose patients who have pupil abnormalities and large ICH can experience a favorable outcome if they are rapidly resuscitated and operated. The authors make an excellent detailed analysis of therapeutic options including the experience and results from other series. Clinical improvement after insertion of an external cerebra-spinal fluid (CSF) drainage in cases of secondary dilatation of the ventricle system was reported previously in 25% (97) to 45% of cases (4) by other authors. Likewise

in elderly patients amenable to treatment but for whom surgery was deferred solely because of the age, the late outcome was catastrophic (31). However, the presence of both packed intraventricular hemorrhage (IVH) and ventriculomegaly (69, 93), remains a strong predictive factor of unfavorable outcome. Unfortunately, the progression of neurological abnormalities, failure to improve after surgery, development of intractable intracranial hypertension, and follow-up CTs demonstrating low density changes were used in this study to determine if therapy should be pursued or discontinued. Usually, a significant number of these patients start to improve after the first two weeks from surgery. Additionally, the chemical mediator-depletion an the inappropriate balance of neurotransmitters (49, 56, 106) are also related to profound weakness, which of course, is a sign of critical illness, neuropathy and myopathy (2, 23, 41) and makes the clinical evaluation difficult during this period of transitional change.

3) OUTCOME FROM POOR-GRADE ANEURYSMAL SUBARACHNOID HEMORRHAGE-WHICH POOR-GRADE SAH PATIENTS BENEFIT FORM ANEURYSM CLIPPING? HUTCHINSON PJ, POWER DM, TRIPATHI P, KIRKPATRICK PJ BRITISH JOURNAL OF NEUROSURGERY (2000);14 (2):105-109

Information

The objective of this study was to attempt to identify a subgroup of poor-grade ventilated SAH patients in whom the prognosis following surgery or interventional radiology is more favorable. After 24 h of resuscitation and ventricular drainage, the sedation and paralysis was reversed allowing clinical assessment. Those patients showing a purposeful flexion response to a painful stimulus were selected for angiography with a view to clip or coil potential ruptured aneurysms. Patients with an intracerebral hematoma causing mass effects underwent immediate surgery and were excluded from the data analysis as well as those patients who improved after the clinical grade were no longer considered "true" poor-grade categorists. Of 102 ventilated cases, 55 satisfied the clinical criteria for angiography. Forty of the 48 diagnosed patients with aneurysms were treated, 37 by surgery and three by interventional radiology. The outcome at 6 months in this subgroup was favorable to 53% with a mortality of 28%.

Analysis

This study demonstrates the potential value of selecting a subgroup of ventilated poor-grade SAH patients according to a simple clinical assessment after suitable neurosurgical resuscitation. However, some points need to be considered before adopting this protocol for the management of all patients with poor-grade SAH. The authors refer eight patients suffering rebleeding with a 100% mortality. Four of these patients had undergone angiography and were awaiting definitive aneurysm treatment. Urgent management may have prevented this complication. Despite the fact that secondary brain insults can be avoided through adequate neuro-intensive care management (14, 26), the employ of osmotic therapy (57), mechanical ventilation, and even short-acting barbiturates, these measures alone often fail to prevent from herniation and brain death (84). Hyperventilation has to be administrated carefully. Patients with increased ICP

and with hypocapnic vasoconstriction, secondary to hyperventilation, are at risk for increasing the preexisting ischemia. Clinical studies on the use of hyperdynamic therapy with colloidal volume expansion in cerebral vasospasm (27, 50), as well as experimental stroke studies (17, 75, 102), have demonstrated that blood volume expansion is effective in the treatment of focal cerebral ischemia. This therapeutic advantage can only be restrictively employed in many of the Grade IV and V patients due to the elevated ICP (6, 57, 76, 108) with secondary brain swelling , damaged autoregulation with impaired carbon dioxide (CO2) reactivity (20, 47, 55), and after excluding the aneurysm from the circulation. Early aneurysm occlusion, dehydration therapy (74) and decompressive craniectomy in these cases should be helpful (12, 29) and need to be considered before waiting and seeking optional managements.

4) OUTCOME AFTER ENDOVASCULAR TREATMENT OF HUNT AND HESS GRADE IV AND V ANEURYSMS. COMPARISON OF ANTERIOR VERSUS POSTERIOR CIRCULATION KREMER C, GRODEN C, HANSEN HC, GRZYSKA U, ZEUMER H STROKE (1999); 30: 2617-2622

Information

This article analyzes a series of 40 poor-grade patients treated by endovascular approach within 23 days after aneurysm rupture. Eighteen had aneurysms in the anterior circulation (AC), 22 in the posterior circulation (PC). Mean treatment delay was 4 days after rupture. In 36 cases, aneurysms were occluded by Guglielmi detachable coils; in 4 cases, by parent vessel balloon occlusion. At 6 months follow-up, the result was good in 5 patients and poor in 13 in the AC group and good in 11 patients and poor in 11 in the PC group. The authors compare these results with those from some surgical series and conclude that the endovascular treatment of poor-grade patients after SAH is effective and offers results similar to those from surgical reports. Analysis. Endovascular techniques (EVT) in poor-grade patients became an additional solution to decrease the risk of early rebleeding (7, 96). There is not doubt that aneurysms with extremely increased operative risk (deep located giants, wide-necked dissecting or those of difficult surgical access) should be first treated via the endovascular route even on poor-grade patients. However, taking into account that between 20% and 30% of the patients who suffer from SAH can be classified as Grade IV to V, an unexpected small number of these patients are represented in endovascular reports (13, 16, 38, 58, 62). The explanation for this disparity could be selective treatment criteria or results not related to the expectancies. Malisch et al (62) treated nine poor-grade patients using coils with rather disappointing results. Casasco et al (13) treated nine Grade IV patients with microcoils, of whom four made a good recovery, one was moderately disabled, and four died. It is notable that there were no patients in a severe disabled or vegetative state in this study, which might suggest a selection bias that could also contribute to the difference in outcome (83). Leber et al (58) found excellent patient outcome in 33.3% (grade IV) and 50% (grade V) for operative treatment and 16.7% (grade IV) and 0% (grade V) for endovascular treatment. In the endovascular group the mortality rate was three times higher. Kremer et. al. remarked that no attempt was made to select cases, but taking into account a mean treatment delay of 4 days, with 10 patients undergoing the

endovascular procedure even in the second week after SAH, a natural patient selection was carried out over time. Bavinzski et al (7) reported endovascular treatment of eight Grade IV patients with aneurysms of the basilar artery bifurcation, with two having an excellent outcome, one having a good outcome, and four having a poor outcome. All Grade V patients died. A comparison study (38) between endovascular and surgical management of basilar artery apex aneurysms showed only two real poor-grade patients treated acutely, both in Grade IV, who underwent surgical clipping. In aneurysms where the coil pack is not stable, multiple interventions can be required (39). Incomplete obliteration of the aneurysm sac after surgical clipping has been estimated at approximately 4% (22, 60). Complete endovascular aneurysm occlusion rates ranged between 21% and 84% in different series (9, 13, 16, 36, 40, 66, 73, 78, 79, 104). Its long-term efficacy remains uncertain (9). Open spaces between the coil meshwork with persisting gelatinous thrombus and lack of subsequent fibrosis were frequently seen on histological studies, despite complete occlusion on angiographic studies (70, 82). Under ideal conditions, GDC treatment adds 1 to 2 hours to the diagnostic angiographic procedure (30). The complete occlusion of the aneurysm may require a prolonged endovascular procedure (81). Different authors (61, 63, 65) found that a partially occluded aneurysm after embolization has an even greater risk of re-growth and repeated hemorrhage. On the other hand, short duration of cerebral angiographic procedures is associated with increased safety (64). Additionally aneurysm clipping after coil embolization has been reported to be a more complicated surgical procedure (15, 40) and randomized studies comparing acute surgery to acute endovascular aneurysm occlusion found only a few cases were candidates for endovascular procedures, with the majority of the patients having an advantage in open surgery (43). Taken into account that brain swelling, and elevated ICP with reduced CBF share a well-demonstrated basis of ischaemic condition in poor-grade patients (86), one question to be answered remains: How impaired are CBF and PtiO2 during endovascular procedures? The use of the lumen in flow-carrying blood vessels, sometimes over long periods, can be considered to be a more stressful factor for compromised ischaemic brain areas than the reduced brain retraction employed for aneurysm clipping after broad decompressive craniotomy and adequate cisternal opening. Perhaps the new reconstructive endovascular treatment of aneurysms with stents should introduce new possibilities in the management of these patients.

Synthesis and Comments

Aneurysm rupture is accompanied by drastic changes in the ICP and CBF (86). CBF studies in SAH patients have shown that there is a close relationship between the severity of the clinical grade and the lowering of CBF (77, 80). Since autoregulation is impaired after SAH (20, 42, 100), CBF becomes totally dependent on the CPP. Further increase of ICP causes significant CBF diminution (87). Poor-grade patients require individual evaluation of their hemodynamic situation, before the previously damaged autoregulation gets overcharged with additional treatments. Vasoparalysis of vascular smooth muscle by blocking the calcium influx, may increase CBV, edema, and ICP (33, 46). The Bayer Corporation finds no contraindications for the treatment with nimodipine oral capsules of SAH-patients with Hunt and Hess scale (H&H) Grades IV and V . The precautions for its use mention only that a lowering of the blood pressure occurs in 4.4% of the patients. However, product information for the intravenous

administration of nimodipine, warns about precautions during use in cases with generalized brain swelling and elevated ICP. Diffuse vasoparalysis and distal cerebral arteriolar vasodilatation seems to be responsible for tight-brain changes in a considerable number of patients. Actually, there is a conclusive evidence that acute spontaneous SAH is often followed by an intracranial circulatory arrest lasting for several minutes and causing a peak of ICP in the range of mean arterial levels. High ICP must continue for at least 2 to 4 minutes to ensure safe clot formation, and afterwards must be reduced promptly to prevent from ischemic brain damage (37, 99). Cerebral blood volume (CBV) is usually increased since the distal microcirculation may vasodilate (105). This hyperemia protects patients against rebleeding, but produces a diffuse ischemia. Actual management practices concentrate on efforts to reduce secondary worsening of the ischemic condition. There seems to be a time frame, where deleterious effects of severe SAH might be ameliorated (29) if irreparable brain-damage has not occurred. It remains unclear how long this period is, but losing additional time evaluating prognostic factors to search for selection criteria will not help the patient. Of course, an additional ischemic period, as observed by the surgical use of a temporary clip should be avoided, if possible. Samson et al (85) reported a reduced tolerance for vessel occlusion in poor-grade patients of about 4 minutes. After decompressive craniotomy in cases of uncontrollable intracranial hypertension, brain tissue oxygen tension (PtiO2) had had increased in the patients examined by several authors (11, 52, 103) along with decreased ICP, particularly in those patients where craniectomy was performed early and extensively. Most of the patients in poor condition show a tight brain, or will develop this within the following days, as a result of hypervolemic therapy-induced changes and damaged autoregulation (94). Therefore, it is important to perform the craniectomy by admission in patients where brain swelling on the CT-scan can be correlated with clinical deterioration, even without signs of compartimental herniation or in cases of untreatable rising of the ICP . A broad primary craniotomy (10) in poor-grade patients, instead of an earlier advised pterional craniotomy to approach aneurysms of the anterior circulation, makes it unnecessary to employ other drastic solutions for intractable brain swelling, such as a lobectomy (25) or additional parenchymal resections (57). Patients with primary ischaemic diffuse lesions after SAH and patients suffering from cardio-respiratory arrest, who were successfully resuscitated, should be candidates for bilateral decompressive craniotomy. These patients are all Grade V at admission and they generally demonstrate thick diffuse SAH, IVH or ICH (92). Secondary brain ischaemic lesion due to vasospasm must be prevented. Intrathecal fibrinolitic therapy with tissue plasminogen activator (TPA) (54) on Days 0 to 3 after bleeding seems to be associated with a reduced incidence of vasospasm. On the other hand, the reported incidence of vasospasm in poor-grade patients varies between 1.5% and 91% (21, 44, 57, 90, 95, 107), which reflects the non-uniform criteria used to define its occurrence. Critical increased blood flow velocities after SAH without secondary neurological deficits do not indicate vasospasm, but hyperemia (67). Solomon et al (95) demonstrated that preoperative grade was not significantly correlated with the incidence or severity of delayed cerebral ischemia during any time interval. A strict correlation between high TCD flow velocities and occurrence of delayed ischemic neurological deficits (DIND) does not exist (24). Cerebral infarction with or without vasospasm is common in poor-grade patients. The presence of hypotension and ICH increases the risk of infarction three-times (1, 18, 35). The reduction of CBF progresses in many patients within 14 days after SAH (68).

Monitoring cerebral oximetry in the intensive care unit (ICU) provides timely information regarding regional perfusion of the threatened brain area (34). As observed by Stocchetti et al. (98) and Darby et al (19), arterial hypertension capable of increasing CPP above normal values appeared useful in normalizing tissue oxygenation in ischemic areas. Holding an elevated CPP with dopamine (8, 11, 76) or dobutamine (74), minute ventilation adjusted to obtain levels of partial pressure of carbon dioxide in arterial blood (PaCO2)) between 30 and 35 mmHg, and carefully use of mannitol and dexamethasone (71) are well known successful tools to reduce the effects of the ischemia until an adequate secondary decompressive craniotomy can be performed. Optional postoperative intensive care priorities include; EEG-controlled barbiturate therapy to block pathophysiological events leading to neuronal death in some cases (12, 91). Secondary narrowing of the large conducting vessels of the circle of Willis is also suitable today for mechanical treatment with transluminal balloon angioplasty (TBA) (28, 32, 45, 72, 101). Unfortunately, TBA can only be used in selected patients (53, 109). The region of the aneurysm clipping must be excluded from dilatation to avoid accidental ruptures (59). This also means that the arterial segment should not be dilated over a 2.4 cm distance. On the other hand, the most severe and clinically-relevant vasospasms seem to occur in the vessel system containing the ruptured aneurysm (89). In summary, patients with poor-grade SAH are in a clinical condition which can be improved with selective, individual, and evolving treatment criteria. Immediate aneurysm occlusion precludes further effective anti-ischemic therapies. Temporary stabilization management practices should not prolong existent ischemic damage, which can be partially or completely reverted today by administrating the correct sequential therapeutic options. Adequate cerebral perfusion remains to be the key to save many of these patients, even over long periods of time. Further research on patients with poor-grade SAH will help all neurosurgeons to determine the true point of irreversible brain damage.

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