Aneurysmal subarachnoid hemorrhage case series

2020

Patients were trichotomized into a young cohort (<60 years [n= 268]) and two elderly cohorts (60-65 years [n=60] and ≥65 years [n=77]). The elderly cohorts were analyzed by poor or good scores at presentation (Hunt and Hess [HH] score >3 vs. ≤3, respectively) and poor functional outcome (modified Rankin Scale [mRS] score >2).

Of 137 elderly patients, 121 had a 6-year follow-up. The >65-year-olds (75% [52/69]) were more likely to have poor functional outcomes than the 60-65-year-olds (48% [25/52]) (OR 3.3, 95% CI 1.5-7.1; P=0.002). Among those with an HH score ≤3 at presentation (n=90), the >65-year-old cohort had poorer outcomes than the 60-65-year-old cohort at 6-year follow-up (69% [35/51] vs. 36% [14/39], respectively; OR 3.9, 95% CI 1.6-9.4; P=0.003). Among patients with an HH score >3, no statistically significant differences in functional outcome were observed between the >65-year-old (n=18) and 60-65-year-old (n=13) cohorts.

Aneurysmal subarachnoid hemorrhage outcome in elderly patients are at high risk for poor functional outcomes. However, among those presenting with good HH scores, younger-elderly patients (ages 60-65 years) tend to fare better than older-elderly patients (ages >65 years). Elderly patients presenting with high-grade aSAH fare poorly regardless of age, which can inform clinical decision-making and prognostication.

Analysis of 164 aneurysmal subarachnoid hemorrhage survivors (until discharge from intensive care) with the aim to detect factors that influence the length of stay (LOS) in intensive care with multiple linear regression methods. Moreover, binary logistic regression methods were used to examine whether the time in intensive care is a predictor of outcome after 1 year. The clinical 1-year outcome was measured prospectively in a 12-month follow-up by telephone interview and categorized by the modified Rankin Scale (mRS). Patients who died during their stay in intensive care were excluded. Complications like pneumonia (β = 5.11; 95% CI = 1.75-8.46; p = 0.0031), sepsis (β = 9.54; 95% CI = 3.27-15.82; p = 0.0031), hydrocephalus (β = 4.63; 95% CI = 1.82-7.45; p = 0.0014), and delayed cerebral ischemia (DCI) (β = 3.38; 95% CI = 0.19-6.56; p = 0.038) were critical factors depending on the LOS in intensive care as well as decompressive craniectomy (β = 5.02; 95% CI = 1.35-8.70; p = 0.0077). All analyzed comorbidities such as hypertension, diabetes, hypothyroidism, cholesterolemia, and smoking history had no significant impact on the LOS in intensive care. LOS in intensive care (OR = 1.09; 95% CI = 1.03-1.15; p = 0.0023), as well as WFNS grade (OR = 3.72; 95% CI = 2.23-6.21; p < 0.0001) and age (OR = 1.06; 95% CI = 1.02-1.10; p = 0.0061), were significant factors that had an impact on the outcome after 1 year. Complications in intensive care but not comorbidities are associated with higher LOS in intensive care. LOS in intensive care is a modest but significant predictor of outcomes after subarachnoid hemorrhage.

2019

Patients with aneurysmal subarachnoid hemorrhage (aSAH) admitted from August 2015 through August 2017 were retrospectively analyzed for EVD placement. Cerebrospinal fluid (CSF) samples were obtained twice weekly for culture and routine studies. Ventriculostomy related infection was
defined as the growth of CSF cultures.

During the 2-year study period, 122 patients presented with an aSAH, with 91 (74.6%) having EVD placement. In patients with EVDs, the mean age was 57.9 years (68% female); 88% of aSAHs were Fischer grade III-IV. Mean duration of EVD was 14 days, and 13% of patients required EVD replacement. Endovascular coiling and surgical clipping were performed in 34 (37%) and 53 (58%) patients with EVD, respectively. A total of 347 CSF studies were performed with no EVD-associated infections. There were 3 CSF samples with false-positive Gram stain results but no growth on concurrent or multiple repeat cultures.

Using a standardized protocol for placement and management of EVDs in patients with aSAH is associated with low risk of CSF infection. The study demonstrates that occlusive EVD dressings are not necessary and that routine CSF sampling in patients with EVD may lead to false-positive findings and unnecessary antibiotic administration.

Paľa et al., performed a 2-center, retrospective, clinical database analysis of 732 SAH patients treated between 2008 and 2016. Demographic and clinical data such as age, sex, World Federation of Neurosurgical Societies (WFNS) grade, BMI, Fisher grade, history of arterial hypertension and smoking, aneurysm location, C-reactive protein (CRP) level, and detailed dosage of vasopressors and nimodipine during the treatment period were evaluated. Clinical outcome was analyzed using the modified Rankin Scale (mRS) 6 months after treatment. Univariate and multivariate regression analyses were performed. Additionally, mean arterial pressure (MAP), age, nimodipine, and vasopressor dose cutoff were evaluated with regard to outcome. The level of significance was set at ≤ 0.05.

Follow-up was assessed for 397 patients, 260 (65.5%) of whom achieved a good outcome (defined as an mRS score of 0-3). Univariate and multivariate analyses confirmed that nimodipine (p = 0.049), age (p = 0.049), and CRP level (p = 0.002) are independent predictors of good outcome. WFNS grade, Fisher score, hypertension, initial hydrocephalus, and total vasopressor dose showed significant influence on outcome in univariate analysis, and patient sex, smoking status, BMI, and MAP showed no significant association with outcome. A subgroup analysis of patients with milder initial SAH (WFNS grades I-III) revealed that initial hydrocephalus (p = 0.003) and CRP levels (p = 0.001) had significant influence on further outcome. When evaluating only patients with WFNS grade IV or V, age, CRP level (p = 0.011), vasopressor dose (p = 0.030), and nimodipine dose (p = 0.049) were independent predictors of patient outcome. Patients with an MAP < 93 mm Hg, a nimodipine cutoff dose of 241.8 mg, and cutoff total vasopressor dose of 523 mg had better outcomes.

According to the results, higher doses of vasopressors can safely provide a situation in which the maximum dose of nimodipine could be administered. Cutoff values of the total vasopressor dose were more than 3 times higher in patients with severe SAH (WFNS grade IV or V), while the nimodipine cutoff remained similar in patients with mild and severe SAH. Hence, it seems encouraging that a maximum nimodipine dosage can be achieved despite the need for a higher vasopressor dose in patients with SAH.

2018

Gas chromatography time-of-flight mass spectrometry was applied to CSF samples collected from 15 consecutive high-grade aSAH patients (modified Fisher grade 3 or 4). Collected CSF samples were
analyzed at two time points (admission and the anticipated vasospasm timeframe). Metabolite levels at both time points were compared and correlated with vasospasm status and Glasgow Outcome Scale (GOS) of patients at 1 year post-aSAH. Significance level was defined as $p < 0.05$ with false discovery rate correction for multiple comparisons.

Of 97 metabolites identified, 16 metabolites, primarily free amino acids, significantly changed between the two time points. These changes were magnified in modified Fisher grade 4 compared with grade 3. Six metabolites (2-hydroxyglutarate, tryptophan, glycine, proline, isoleucine, and alanine) correlated with GOS at 1 year post-aSAH independent of vasospasm status. When predicting patients who had low disability (GOS 5 vs. GOS $\leq 4$), 2-hydroxyglutarate had a sensitivity and specificity of 0.89 and 0.83 respectively.

This preliminary study suggests that specific metabolite changes occur in the brain during the course of aSAH and that quantification of specific CSF metabolites may be used to predict long-term outcome in patients with aSAH. This is the first study to implicate 2-hydroxyglutarate, a known marker of tissue hypoxia, in aneurysmal subarachnoid hemorrhage pathogenesis \cite{3}.

Thomas et al., from the Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, Massachusetts, hypothesized that the modified Fisher scale is independently associated with cerebrospinal fluid (CSF) macrophage CD163 expression on postictal day 1, and that CSF macrophage CD163 expression is associated with 1-month neurological outcome.

CSF macrophages from 21 SAH and 28 unruptured aneurysm patients (control) were analyzed for CD163 expression using flow cytometry and confocal microscopy on postictal day 1. Significant associations with modified Fisher scale grades or modified Rankin Scale scores were determined using linear regression and a matched case control study.

CSF macrophage CD163 expression was significantly increased in SAH patients compared with controls ($p < 0.001$). The modified Fisher scale (mF) grades ($\beta = 0.407, p = 0.005$) and CSF bilirubin concentrations ($\beta = 0.311, p = 0.015$) were positively and independently associated with CSF macrophage CD163 expression when the analysis was controlled for age and sex. CSF macrophages from an SAH patient with a high mF grade had increased co-localization of CD163 and glycoporphin A (CD235a, an erythrocyte marker) compared with those from an SAH patient with a low mF grade. The controls had no co-localization. CSF macrophage CD163 expression ($p = 0.003$) was inversely associated with 1-month neurological outcome, when SAH patients were matched based on mF grade.

This early study suggests that CSF macrophage CD163 expression, as measured by flow cytometry, may have some neuroprotective function given its inverse association with outcome and provides unique insights into the neuroinflammatory process after SAH \cite{6}.

2017

Thirteen patients with SAH with ICH who underwent coil embolization were retrospectively analyzed. Modified Rankin Scale (mRS) scores were compared for postoperative clinical outcomes of different hematoma locations.

All ruptured aneurysms in the present series of patients were treated using endovascular surgery. Six patients underwent additional ventricle drainage. Only one patient underwent craniotomy for evacuation of the hematoma following coil embolization. Despite ten out of thirteen patients (76.9%) having a preoperative SAH clinical grade, as evaluated using the World Federation of
Neurosurgical Societies grading system of IV or V, six (46.2%) patients had a favorable outcome (mRS=0-2).

Coil embolization for ruptured aneurysms, especially those located in the frontal lobe, with ICH and without cerebral herniation may be a feasible alternative and less invasive treatment.  

2016

Mijiti et al, retrospectively reviewed the medical records of 542 consecutive aSAH patients admitted to neurosurgery department of the First Affiliated Hospital of Xinjiang Medical University in Urumqi city of China between January 1, 2011 and December 31, 2015. AV, SV and cerebral infarction were defined based on clinical data and neuroimaging findings. Univariate and multivariate analyses were performed to identify predictors of AV, SV or cerebral infarction.

343 (63.3%) patients fulfilled the inclusion and exclusion criteria. Of them, 182 (53.1%) developed AV, 99 (28.9%) developed SV, and 87 (25.4%) developed cerebral infarction. A history of hypertension, poor modified Fisher grade (3-4) and poor Hunt-Hess grade (4-5) on admission were common risk factors for AV, SV and cerebral infarction. Patients from Uyghur ethnic group or other minorities were less likely to develop AV, SV or cerebral infarction, compared to those from Han ethnic group after adjustment of other potential confounders. Additionally, age ≥53 years, leukocyte count ≥11×10^9/L on admission and being current or former smokers were independent risk factors of cerebral infarction. Leukocyte count ≥11×10^9/L on admission and aneurysm size ≥10 mm were independent risk factors of SV. Serum glucose level ≥7.0 mmol/L on admission was an independent risk factor of AV.

Risk factors of different definitions of CVS were diverse in Chinese patients with aSAH; however, risk factors of SV and cerebral infarction seem to be similar. We recommend early and aggressive therapy in these patients at-risk of CVS.

Sasahara et al., performed plain computed tomography (CT) perfusion (CTP), and CT angiography (CTA) in all patients with aSAH on arrival. Aneurysms were surgically obliterated in patients with stable vital signs and the presence of a brain stem response. They measured the average mean transit time (aMTT) and compared it with the modified Rankin Scale (mRS) score at 1 month. Regions of interest were identified as 24 areas in the bilateral anterior, middle, and posterior cerebral artery territories and 2 areas in the basal ganglia.

A total of 57 patients were treated between 2007 and 2014. None of the 21 patients with aMTT >6.385 seconds achieved a favorable outcome, whereas 8 of the 36 patients with aMTT <6.385 seconds did achieve a favorable outcome (P = 0.015). Furthermore, comparing the number of areas showing a mean transit time (MTT) >7.0 seconds among the aforementioned 8 areas and mRS, favorable outcomes were not seen in 24 patients with more than 2 such areas (P = 0.009).

We cannot expect a favorable outcome for patients with WFNS grade V aSAH with aMTT >6.385 seconds or more than 2 of 8 areas with MTT >7.0 seconds.

In a retrospective study, from all 142 adult patients admitted to a surgical intensive care unit (ICU)
with SAH between March 2004 and November 2010.

The mean patient age was 54 ± 14 years, 62.7 % were female, and the median Hunt and Hess score was 3. The proportions of patients with poor outcome (Glasgow Outcome Score ≤3) were 58.4, 54.2, and 52.1 % at 3, 6, and 12 months, respectively, after the SAH. The ICU and hospital mortality rates were both 12.7 %, and the median lengths of stay in the ICU and the hospital were 16 (IQ 7-25) and 26 (IQ 18-34) days, respectively. In multivariable analysis, older age and greater cumulative fluid balance within the first 7 days in the ICU were independently associated with a greater risk of poor outcome.

In this cohort of patients, older age and greater cumulative fluid balance were independently associated with a greater risk of poor outcome up to 1 year after the initial insult. The data suggest that mild hypovolemia may be beneficial in the management of these patients 10).

Seventy-one patients were treated in two periods: 2010-2011 (32 patients; 19 clipped, 6 coiled, 7 untreated), and 2012-2013 (39 patients, 3 clipped, 34 coiled, 2 untreated). No significant differences were found in age, sex, clinical grade at admission, type and location of aneurysm, Fisher score, or in hospital mortality (28.1% vs 25.6%, P=.35), GOS (except for GOS 5: 43.37% vs 53.8%, P=.045), rate of hydrocephalus and rate of vasospasm. The second cohort obtained better results for aggregated GOS 1+2+3 (36.3% vs 43.75%, P=.034) and for GOS 4+5 (61.5% vs 56.25%, P=.078). The percentage of patients left untreated was significantly lower in the second period (5.1% vs 21.8%, P<.01), as well as the rate of re-bleeding (0% vs 9.4%, P<.01). Patients were treated earlier (2.51 vs 3.95 days), and hospital and total stay were lower (15.2 and 24.6 vs 10.3 and 18 days) in the second period, these differences not reaching statistical significance.

Endovascular therapy allowed treating more patients with aSAH, and with a lower re-bleeding rate. This led to a modest reduction in morbidity and mortality 11).

2015

Five hundred ninety patients (40.4%) reported LOC at onset of SAH. Loss of consciousness was associated with poor clinical grade, more subarachnoid and intraventricular hemorrhage seen on admission computed tomographic scan, and a higher frequency of global cerebral edema (P < .001). Loss of consciousness was also associated with more prehospital tonic-clonic activity (22.7% vs 4.2%; P < .001) and cardiopulmonary arrest (9.7% vs 0.5%, P < .001) vs patients who did not experience LOC. In multivariable analysis, death or severe disability at 12 months was independently associated with LOC after adjusting for established risk factors for poor outcome, including poor admission clinical grade (adjusted odds ratio, 1.94; 95% CI, 1.38-2.72; P < .001). There was no association between LOC at onset and delayed cerebral ischemia or aneurysm rebleeding.

Loss of consciousness at symptom onset is an important manifestation of early brain injury after SAH and a predictor of death or poor functional outcome at 12 months 12).

1992

The distribution of cisternal blood in relation to the development of acute hydrocephalus was studied in 246 consecutive patients with aneurysmal subarachnoid hemorrhage who were admitted within 72 hours. Patients with evidence on the initial computed tomograph (CT) of subarachnoid hemorrhage caused by other than a ruptured aneurysm and patients with a negative angiography were excluded. Acute hydrocephalus (defined as a bicaudate index, measured on the initial CT or on a repeat CT
within 1 week after subarachnoid hemorrhage, exceeding the 95th percentile for age) was found on the initial CT in 50 (20%) of the 246 patients and on a repeat CT in 9 other patients. Ventricular blood was found significantly more often in patients with acute hydrocephalus than in those in whom acute hydrocephalus did not develop (28 of 59 [47%] versus 58 of 187 [31%]; chi^2 = 4.634, p = 0.031). When the analysis was restricted to the 86 patients with ventricular blood, no significant differences were found in the total amount of cisternal blood and in the distribution of cisternal blood between patients with and without hydrocephalus. In contrast, among the 160 patients without ventricular blood, hydrocephalus was associated with a slightly higher total amount of cisternal blood (Wilcoxon's rank sum test, p = 0.023), and significantly more patients with acute hydrocephalus had a higher score in both ambient cisterns than patients without acute hydrocephalus (20 of 31 [65%] versus 41 of 129 [32%]; chi^2 = 10.007, p = 0.002) 13).

1985

Wijdicks et al., studied the sodium balance and changes in plasma volume by an isotope dilution technique in the first week after an aneurysmal subarachnoid hemorrhage in 21 patients. In 11 of the patients, the plasma volume decreased by more than 10%. This was accompanied by a negative sodium balance and hyponatremia in 6 patients, a negative sodium balance without hyponatremia in 4 patients, and a positive sodium balance in 1 patient. Together with a decrease in plasma volume, blood urea nitrogen content increased and body weight decreased. Three patients developed hyponatremia without a decrease in plasma volume. Serum vasopressin was measured in 14 of the 21 patients. The values were elevated on admission and declined in the first week, regardless of the presence of hyponatremia. These findings indicate that natriuresis and hyponatremia in aneurysmal subarachnoid hemorrhage reflect salt wasting and not inappropriate secretion of antidiuretic hormone and that these changes should be corrected by fluid replacement rather than by fluid restriction 14).


