Intracerebral hemorrhage case series

2023

Lee et al. retrospectively enrolled 458 patients with supratentorial intracerebral hemorrhage who underwent surgical hematoma evacuation between April 2005 and December 2021 at two independent stroke centers. Multivariate analyses were performed to characterize risk factors for postoperative shunt-dependent hydrocephalus. Propensity score matching (1:2) was undertaken to compensate for group-wise imbalances based on probable factors that were suspected to affect the development of hydrocephalus, and the clinical impact of craniectomy on shunt-dependent hydrocephalus was evaluated by the matched analysis.

Overall, 43 of the 458 participants (9.4%) underwent shunt procedures as part of the management of hydrocephalus after ICH. Multivariate analysis revealed that intraventricular hemorrhage (IVH) and craniectomy were associated with shunt-dependent hydrocephalus after surgery for ICH. After propensity score matching, there were no statistically significant intergroup differences in participant age, sex, hypertension status, diabetes mellitus status, lesion location, ICH volume, IVH occurrence, or IVH severity. The craniectomy group had a significantly higher incidence of shunt-dependent hydrocephalus than the non-craniectomy group (28.9% vs. 4.3%, $p < 0.001$; OR 9.1, 95% CI 3.7-22.7), craniotomy group (23.2% vs. 4.3%, $p < 0.001$; OR 6.6, 95% CI 2.5-17.1), and catheterization group (20.0% vs. 4.0%, $p = 0.012$; OR 6.0, 95% CI 1.7-21.3).

Decompressive craniectomy seems to increase shunt-dependent hydrocephalus among patients undergoing surgical intracerebral hemorrhage evacuation. The decision to perform a craniectomy for patients with intracerebral hemorrhage should be carefully individualized while considering the risk of hydrocephalus [1)].

Reznik et al enrolled 40 patients with intracerebral hemorrhage (ICH) who had daily DSM-5-based delirium assessments. Continuous activity measurements were captured using bilateral wrist actigraphs throughout each patient's admission. Activity data were collected in 1-minute intervals, with “rest” defined as periods with zero activity. They compared differences in activity based on delirium status across multiple time intervals using multivariable models adjusted for age, ICH severity, and mechanical ventilation.

There were 279 days of actigraphy monitoring, of which 199 (71%) were rated as days with delirium. In multivariable analyses, delirium was associated with 98.4 (95% CI 10.4-186.4) fewer daily minutes of rest, including 5.3% (95% CI -0.1-10.1%) fewer minutes during daytime periods (06:00-21:59) and 10.2% (95% CI 1.9-18.4%) fewer minutes during nocturnal periods (22:00-5:59), with higher levels of activity across multiple individual hourly intervals (18:00-21:00, 23:00-03:00, and 04:00-08:00). These differences were even more pronounced in hyperactive or mixed delirium, although even hypoactive delirium was associated with more activity during multiple time periods.

Post-stroke delirium is associated with less rest and higher overall levels of activity, especially during nocturnal periods [2)].

The study presented in the abstract investigates the impact of delirium on activity patterns in patients with intracerebral hemorrhage (ICH). Delirium, characterized by acute cognitive disturbances, is a crucial factor in the post-stroke period. This critical review aims to assess the methodology, results, and implications of the research.

Methodologically, the study is commendable for its relatively large cohort of 40 ICH patients who underwent daily DSM-5-based delirium assessments. Continuous activity data were collected using wrist actigraphs, which provided a detailed and objective measurement of patient activity. The inclusion of multivariable models adjusted for age, ICH severity, and mechanical ventilation strengthens the analysis.

The study's findings reveal several important insights. The association between delirium and reduced daily minutes of rest is a crucial observation, as adequate rest is essential for post-stroke recovery. Moreover, the increased activity levels during both daytime and nocturnal periods in delirious patients highlight the substantial impact of delirium on sleep-wake cycles. The identification of specific hourly intervals with higher activity levels provides valuable information for clinicians.

However, there are some limitations in the study. The sample size is relatively small, and the focus on patients with ICH may limit the generalizability of the findings to a broader stroke population. Furthermore, the study does not delve into the potential underlying mechanisms causing increased activity in delirious patients, which could be a valuable avenue for future research.

The use of DSM-5 criteria for delirium assessments is a strength, as it provides a standardized approach. However, delirium can be challenging to diagnose, and the subjectivity inherent in psychiatric assessments may have affected the results. The study's inability to provide an in-depth exploration of the causes and consequences of delirium is a notable limitation. Understanding the mechanisms driving these activity changes could be invaluable for developing effective interventions.

In conclusion, the study sheds light on the impact of delirium in post-stroke patients with ICH. It demonstrates that delirium is associated with disrupted activity patterns, reduced rest, and increased activity levels, particularly during nocturnal periods. While the research presents valuable insights, it is imperative to conduct further investigations to understand the underlying mechanisms, broaden the sample size, and include a more diverse stroke population to enhance the generalizability of the findings. Ultimately, this research contributes to our understanding of post-stroke delirium and highlights the need for tailored interventions to address its adverse effects on patients' recovery.

2022

A total of 89 patients with intracerebral hemorrhage (ICH) were recruited. Of these, 68 and 21 patients were categorized into screening cohort and validation cohorts, respectively. In the screening cohort, patients were categorized into three groups, according to the serum anion gap levels at admission. Shen et al. dynamically recorded AG levels. Neurological and cognitive functions were assessed using the Glasgow coma scale (GCS), Glasgow outcome scale (GOS), and mini-mental state examination (MMSE) scale at different time points. Furthermore, in the validation cohort, 9 patients with increased AG levels underwent interventions to rectify the electrolyte imbalance.

In the screening cohort, statistical differences were observed for respiratory diseases (p=0.029) among the three groups. The number of patients in the ≥16 mmol/L group (59.3%) was higher than that in the other groups. The mean scores of GCS in the ≥16 mmol/L group were lower than those in the other groups. The AG levels at admission had significant associations with 180-day GOS (p=0.043) and 180-day MMSE (p=0.001). Among them, the mean scores of the 180-day GOS and 180-day MMSE were lower in the ≥16 mmol/L group than in the other groups. In the validation cohort, AG intervention promoted recoveries of neurological and cognitive functions when compared to those without AG interventions.

AG is a potential predictive biomarker for the long-term outcomes of ICH patients, and rectifying AG at admission improves the Intracerebral hemorrhage outcomes [3].

2021

Gousias et al. analyzed 135 consecutive patients with traumatic Intracerebral hemorrhage(n = 90) or spontaneous intracerebral hemorrhage (n = 45) undergoing treatment at a surgical intensive care unit of an urban university hospital. They documented their differences before and after adjustment for age in terms of demographics, the therapies applied, their radiologic (i.e., volume and rate of ICH expansion [HE]) and clinical (patients' outcome at 30 days) course, the length of hospital and ICU stay, as well as the hospital costs.

Patients with traumatic Intracerebral hemorrhage demonstrated more favorable clinical and radiologic characteristics at admission, that is, higher Glasgow Coma Scale score (p < 0.001), less frequently dilated pupil (p = 0.028), lower Charlson Comorbidity Index (p < 0.001), smaller intracerebral hemorrhage volume (p < 0.001), noneloquent (p < 0.001) or nonintraventricular (p = 0.003) ICH locations, as well as underwent fewer neurosurgical interventions (p < 0.001) and showed a better outcome (p = 0.041), defined as Glasgow Outcome Scale 4 and 5. After adjustment for age, no different outcomes were observed. Of note, elderly patients on novel oral anticoagulants (NOACs) were more likely to develop an HE compared with those on vitamin K antagonists (VKAs, p = 0.05) after traumatic brain injury (TBI) but not after spontaneous ICH.

This data reveal a significant heterogeneity within the traumatic series. Whereas younger patients show an excellent outcome, the elderly population of the traumatic cases demonstrates a poor outcome similar to that of the nontraumatic cohort. Intracerebral hemorrhage expansion under novel oral anticoagulants (NOACs) rather than under vitamin K antagonists (VKAs) is more likely in the elderly after TBI. Larger prospective trials are warranted to elucidate the potential individual underlying molecular mechanisms for the development of an ICH and HE in these diseases [4].

2020

Sakuta et al. retrospectively reviewed 142 consecutive primaries intracerebral hemorrhage patients admitted to a hospital between September 2016 and December 2018. The NAG scale consists of three factors: National Institute of Health Stroke Scale (NIHSS) score ≥ 10, anticoagulant use, and glucose ≥133 mg/dl (1 point each). Patients underwent non-contrast computed tomography (CT) within 24 h of symptom onset and follow-up CT 6 h, 24 h, and 7 days after admission. They defined hematoma expansion (HE) as increased hemorrhage volume > 33% or an absolute increase of >6 mL on follow-up CT. Poor prognosis was defined as a modified Rankin scale score of 4-6 at discharge. We performed logistic regression analysis and created receiver operating characteristic curves to determine the discrimination ability of the NAG score.

Patients constituted 96 men and 46 women (median age: 64 years; median NIHSS: 11), and HE was observed in 38/142 patients (27%). Higher NAG sores were associated with HE (P < .001), poor prognosis (P < .001), and in-hospital death (P < .001). The C statistic was 0.72 (95% confidence interval [CI]: 0.63-0.82) for HE, 0.67 (95% CI: 0.58-0.76) for poor prognosis, and 0.85 (95% CI: 0.74-0.95) for in-hospital death. Multivariate logistic regression analysis with known risk factors showed that NAG scale score was an independent risk factor for HE (odds ratio: 2.95; 95% CI: 1.57-5.52; P = .001)

The NAG scale showed good discrimination in a multi-institutional validation. [5].

In a cohort (n=1094), there were 306 deaths (per 100 patient-years: absolute event rate 11.7, 95% CI 10.5 to 13.1); 156 were "early" and 150 "late". In multivariable analyses, early death was independently associated with age (per year increase, HR 1.05, p=0.003), history of hypertension (HR 1.89, p=0.038), pre-event mRS (per point increase, HR 1.41, p<0.0001), admission NIHSS (per point increase, HR 1.11, p<0.0001), and hemorrhage volume > 60ml (HR 4.08, p<0.0001). Late death showed independent associations with age (per year increase, HR 1.04, p=0.003), pre-event mRS (per point increase, HR 1.42, p=0.001), prior anticoagulant use (HR 2.13, p=0.028) and the presence of intraventricular hemorrhage (HR 1.73, p=0.033) in multivariable analyses. In further analyses where time was treated as continuous (rather than dichotomized), the hazard ratio of previous cerebral ischaemic events increased with time, whilst those for GCS, NIHSS and ICH volume decreased over time.

They provided new evidence that not all baseline factors associated with early mortality after intracerebral hemorrhage are associated with mortality after 6 months, and that the effects of baseline variables change over time. The findings could help design better prognostic scores for later death after intracerebral hemorrhage [6].

Xu et al., reviewed the medical records of patients treated with minimally invasive surgery plus local thrombolysis for intracerebral hemorrhage between November 2013 to December 2015 in an intensive care unit of a tertiary care hospital. Depending upon the vascular images, unruptured intracranial aneurysms were identified. The primary outcome was any of postoperative intracranial rebleeding. The second outcome included the 30-day death and 6-month follow up graded by Modified Rank Scale. Blind abstractors reviewed the medical data and binary logistic regression was performed to investigate the risk factors of poor prognosis.

They identified a cohort of consecutive 188 patients, of whom 23 (12.2%) harbored unruptured intracranial aneurysms. There were 28 aneurysms documented in this study, among which 3 were in the posterior circulation. And in total, 20 (11.3%) cases suffered from postoperative hematoma growth, of which 4 were with aneurysms. Additionally,the 30-day mortality after stroke in patients with aneurysms was 8.69% (2/23), comparable to 13.33% in without (22/165,p = 0.744). The proportion of the favorable outcome at 6-month follow-up in patients with aneurysms was comparable to that in without (47.8% versus 48.5%,p = 1.000) Insignificant associations were demonstrated between the unruptured intracranial aneurysms and postoperative intracranial rehemorrhage (p = 0.092), 30-day death(p = 0.588) and poor long-term prognosis (p = 0.332), respectively.

The findings suggest that unruptured intracranial aneurysms seem to represent no increased risks of poor outcome after local thrombolysis for intracerebral hematomas [7].

Patients with deep seated spontaneous ICH who were admitted to the Golestan Hospital, of Ahvaz, from November 2014 to February 2016, were prospectively enrolled in this study. A prospective clinical trial where 30 patients diagnosed having large hypertensive ICH was randomly allocated to either group A or B using permuted-block randomization. These patients (n = 30), who all had large deep seated supratentorial ICH with surgery indications, were randomly divided to two groups. ultimately, in one group (n = 13), large DHC was performed without clot evacuation, while in the other (n = 17), craniotomy with clot evacuation was done. Data pertaining to the patients' characteristics and treatment outcomes were prospectively collected.

There was no statistically significant difference between two treatment groups (P > 0.05). No significant difference was observed between the two groups in terms of mortality and GOS at 6 months (P > 0.05); nevertheless, the good outcome (Glasgow Outcome Scale = 4-5) for patients with hematoma evacuation was slightly higher (35.3%) as compared to the DHC patients without clot evacuation (30.7%).

Decompresive craniectomy without clot evacuation in deep seated ICH can be accomplished with identical mortality and outcome in comparison to patient that undergone clot evacuation [8].

A multicentre cohort study was conducted in all consecutive patients with ICH admitted to the ICUs of three hospitals with a neurosurgery department between 2009 and 2012 in Andalusia, Spain. Data collected included ICH, Glasgow Coma Scale (GCS) and Acute Physiology and Chronic Health Evaluation II (APACHE-II) scores. Demographic data, location and volume of haematoma and 30-day mortality rate were also collated.

A total of 336 patients were included. 105 of whom underwent surgery. Median (IQR) age: 62 (50-70) years.

APACHE-II: 21(15-26) points, GCS: 7 (4-11) points, ICH score: 2 (2-3) points. 11.1% presented with bilateral mydriasis on admission (mortality rate=100%). Intraventricular hemorrhage was observed in 58.9% of patients. In-hospital mortality was 54.17% while the APACHE-II predicted mortality was 57.22% with a standardised mortality ratio (SMR) of 0.95 (95% CI 0.81 to 1.09) and a Hosmer-Lemenshow test value (H) of 3.62 (no significant statistical difference, n.s.). 30-day mortality was 52.38% compared with the ICH score predicted mortality of 48.79%, SMR: 1.07 (95% CI 0.91 to 1.23), n.s. Mortality was higher than predicted at the lowest scores and lower than predicted in the more severe patients, (H=55.89, p<0.001), Gruppo Italiano per la Valutazione degli Interventi in Terapia Intensiva calibration belt (p<0.001). The area under a receiver operating characteristic (ROC) curve was 0.74 (95% CI 0.69 to 0.79).

ICH score shows an acceptable discrimination as a tool to predict mortality rates in patients with spontaneous ICH admitted to the ICU, but its calibration is suboptimal [9].

A retrospective study aimed to evaluate the effectiveness and safety of 3 surgical procedures for Spontaneous Supratentorial Intracerebral Hemorrhage (SICH).A total of 63 patients with SICH were randomized into 3 groups. Group A (n=21) underwent craniotomy surgery, group B (n=22) underwent burr hole, urokinase infusion and catheter drainage, and group C (n = 20) underwent neuroendoscopic surgery. The hematoma evacuation rate of the operation was analyzed by 3D Slice software and the average surgery time, visualization during operation, decompressive effect, mortality, Glasgow Coma Scale (GCS) improvement, complications include rebleeding, pneumonia, intracranial infection were also compared among 3 groups.All procedures were successfully completed and the hematoma evacuation rate was significant differences among 3 groups which were 79.8%, 43.1%, 89.3% respectively ($P < .01$), and group C was the highest group. Group B was smallest traumatic one and shared the shortest operation time, but for the lack of hemostasis, it also the highest rebleeding group ($P = .03$). Although there were different in complications, but there was no significant in pneumonia, intracranial infection, GCS improvement and mortality rate.All these 3 methods had its own advantages and shortcomings, and every approach had its indications for SICH. Although for neuroendoscopic technical's minimal invasive, direct vision, effectively hematoma evacuation rate, and the relatively optimistic result, it might be a more promising approach for SICH [10].

A multi-institutional, retrospective analysis of 563 patients with spontaneous ICH from 2010 to 2014 was performed with multivariate regression modeling. Primary outcomes were patient mortality and functional status with modified Rankin Scale score. To control for differences in patient and clinical characteristics influencing EVD utilization, a propensity score analysis was performed with patient-specific predicted probability of EVD use.

The multivariable logistic regression model showed odds of EVD use increased with younger age, lower ICH volume, ICH located outside the brainstem, increasing IVH volume, and concurrent IVH; the model showed high discriminability for EVD use (area under the receiver operating curve 0.84, R2McFadden = 0.27). The use of EVD was associated with lower 30-day mortality in patients with ICH score of 4 (odds ratio = 0.09, $P = 0.002$), greater ICH volume (>11 cc, odds ratio = 0.47, $P = 0.019$), and lower initial GCS (<13, 0.38, $P = 0.003$) in propensity score-adjusted analyses, as well as a trend toward lower mortality in patients with IVH and greater modified Graeb score. There was no benefit to morbidity in patients receiving an EVD.

Among a large, multi-institutional cohort, this statistical propensity analysis model accurately predicted EVD use in ICH. EVD use was associated with a trend towards decreased mortality but greater modified Rankin Scale score for functional outcomes [11].

Liu et al., selected 125 patients with acute cerebral hemorrhage admitted within 24 hours of symptom onset. Blood calcium levels were assessed by standard biochemical methods. Hematoma volume was measured by quantitative computed tomography. NIHSS (National Institutes of Health Stroke Scale) scores at one month, and the differences in survival rate and survival period at follow-up visits were assessed.

Hematoma volume and NIHSS scores of the hypocalcemic group were higher than those of the hypercalcemic group. Those of the normocalcemic group were the lowest, and the differences were statistically significant ($p < 0.05$). The survival rate and survival period of the normocalcemic group were higher than those of the other two groups and the differences were statistically significant ($p < 0.05$). The logistics regression analysis showed that the APACHE II score, blood calcium level upon admission and hematoma volume were independent risk factors for survival ($p < 0.05$).

If blood calcium level is too low or too high, hematoma volume and stroke severity of acute cerebral hemorrhage patients may increase and is related to long-term survival [12].

To determine whether hypodense regions, irrespective of their specific patterns, are associated with hematoma expansion in patients with ICH Boulouis et al analyzed a large cohort of 784 patients with ICH (the development cohort; 55.6% female), examined NCCT findings for any hypodensity, and replicated the findings on a different cohort of patients (the replication cohort; 52.7% female). Baseline and follow-up NCCT data from consecutive patients with ICH presenting to a tertiary care hospital between 1994 and 2015 were retrospectively analyzed. Data analyses were performed between December 2015 and January 2016.

Hypodensities were analyzed by 2 independent blinded raters. The association between hypodensities and hematoma expansion (>6 cm3 or 33% of baseline volume) was determined by multivariable logistic regression after controlling for other variables associated with hematoma expansion in univariate analyses with $P \leq .10$.

A total of 1029 patients were included in the analysis. In the development and replication cohorts, 222 of 784 patients (28.3%) and 99 of 245 patients (40.4%; 321 of 1029 patients [31.2%]), respectively, had NCCT scans that demonstrated hypodensities at baseline ($\kappa = 0.87$ for interrater reliability). In univariate analyses, hypodensities were associated with hematoma expansion (86 of 163 patients with hematoma expansion had hypodensities [52.8%], whereas 136 of 621 patients without hematoma expansion had hypodensities [21.9%]; $P < .001$). The association between hypodensities and hematoma expansion remained significant (odds ratio, 3.42 [95% CI, 2.21-5.31]; $P < .001$) in a multivariable model; other independent predictors of hematoma expansion were a CT angiography spot sign, a shorter time to CT, warfarin use, and older age. The independent predictive value of hypodensities was again demonstrated in the replication cohort (odds ratio, 4.37 [95% CI, 2.05-9.62]; $P < .001$).

Hypodensities within an acute ICH detected on an NCCT scan may predict hematoma expansion, independent of other clinical and imaging predictors. This novel marker may help clarify the mechanism of hematoma expansion and serve as a useful addition to clinical algorithms for determining the risk of and treatment stratification for hematoma expansion [13].

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