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Surgical Management and Case-Fatality Rates of Intracerebral Hemorrhage in 1988 and 2005

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Abstract

Objective—To compare surgical management and case-fatality rates of intracerebral hemorrhage (ICH) in 1988 and 2005.

Methods—We identified all adult residents (age ≥ 18) from the five-county Greater Cincinnati region hospitalized with ICH in 1988 and 2005. Demographics, severity of illness, ICH volume, ICH location, rates and timing of surgery, and 30-day case-fatality were compared between the 1988 and 2005 groups.

Results—In 1988, 171 ICH patients met study criteria (67 lobar, 80 deep cerebral, 10 brainstem, 14 cerebellar), and in 2005, 259 ICH patients met criteria in (91 lobar, 123 deep cerebral, 19 brainstem, and 26 cerebellar). In 1988, 16% of the patients had surgical removal of their ICH versus 7% in 2005 ($p=0.003$). In both 1988 and 2005, patients treated with surgery were younger ($p<0.001$) and had a higher percentage of cerebellar hemorrhages than non-surgical patients. Timing of surgery was similar in 1988 and 2005. In 1988, 30-day case fatality was 32% in surgical patients versus 50% in non-surgical patients ($p=0.06$). In 2005, 30-day case-fatality was 16% (surgical) versus 45% (non-surgical) ($p=0.02$).

Conclusion—The frequency of surgery for ICH was lower in 2005 than in 1988, which may reflect recent clinical trial data showing no benefit for surgery over medical management. ICH case-fatality was essentially the same in 1988 and 2005. Innovative clinical trials to improve ICH outcomes are warranted.

Keywords

Intracerebral hemorrhage; neurosurgery; surgery; outcome

Introduction

Spontaneous intracerebral hemorrhage (ICH) occurs in about 67,000 persons annually in the United States (US), with a 30-day case-fatality rate of 40–50% (3,9). No proven medical or surgical treatments exist for ICH. Population-based studies and small randomized trials of surgery suggest that some patients may benefit from surgery following ICH (1,13,15,19). However, a large phase III international randomized clinical trial, the Surgical Trial in

Intracerebral Hemorrhage (STICH), published in January, 2005, raised questions about the benefit of surgery for ICH (12).

The STICH trial randomized 1,033 patients with ICH to conservative medical management versus hematoma evacuation within 96 hours of symptom onset. The primary outcome measure was the Glasgow Outcome Scale (GOS) score at 6 months. No overall benefit from surgery was found when compared with initial medical management (26% versus 24% favorable outcome, $p=0.41$) (12). However, subgroup analyses in STICH suggested that some patients may benefit from surgery, and the current American Heart Association (AHA) guidelines for management of ICH reflect this possibility with Class II recommendations for surgery in lobar ICH patients when the hematoma is within 1 cm of the cortical surface and care providers believe evacuation would be beneficial. In cases of cerebellar hemorrhage, surgical evacuation may be life saving with good functional outcome, prompting a Class I recommendation from the AHA (3). In this report, we compare recent and historical surgical management of ICH within our population, and we compare ICH case-fatality rates in our population in 1988 and 2005.

Methods

This report compares two groups of ICH patients. The methodology of patient identification for both groups has been previously described (2,5). Briefly, we attempted to identify all residents ≥ 18 years of age from the five-county Greater Cincinnati/Northern Kentucky (GCNK) area who were hospitalized with spontaneous ICH between 1/1/1988 and 12/31/1988 and again between 1/1/2005 and 12/31/2005. The 1988 group was identified as part of a population-based study of intracerebral hemorrhage in Greater Cincinnati and Northern Kentucky (2), while the 2005 group was identified as part of the Genetic and Environmental Risk Factors for Hemorrhagic Stroke (GERFHS) study that was also population-based (5). Cases were identified by retrospective review of primary and secondary ICD-9 codes 430, 431, 432.9, 436, 437.3 and 747.81 for 1988, while ICD-9 codes 430–438.9 were utilized for 2005. In 2005, study nurses also maintained active surveillance (“hot pursuit”) at several hospitals that treat most ICH in the area by reviewing neurosurgery logs and patient rosters several times each week. All potential cases were abstracted by study nurses and reviewed by study physicians. Data were not collected for ICH cases in patients living outside the five counties (as determined by zip code of residence), or for cases of traumatic ICH, hemorrhagic cerebral infarction, hemorrhage associated with brain tumor or encephalitis, or hemorrhage associated with thrombolytic treatment of ischemic stroke. In addition, cases of hemorrhage due to known structural etiology (such as aneurysms, arterio-venous malformations (AVM), or cavernomas), ICH cases of undetermined location, and cases of pure IVH were excluded from the current analysis.

For patients in both groups, demographics and clinical information were determined by chart review. The Glasgow Coma Scale (GCS) score recorded upon admission to the hospital was used as a measure of severity of illness. ICH location was determined by review of available imaging. In 1988, ICH volume was determined by computerized image analysis, while the 2005 ICH volume was determined using the abc/2 method, which tends to slightly overestimate volume compared to the computerized image analysis (10). Timing of surgical management was dichotomized as occurring less than versus greater than 12 hours from symptom onset. Survival after symptom onset, used to determine 30-day case-fatality, was ascertained from study records and the Social Security Death Index.

For comparisons between the 1988 and 2005 groups, the Student’s t-test was used for age and the chi-square test was used for gender, race, surgical management, surgical timing, and ICH location. GCS was considered an ordinal variable and was compared using a Wilcoxon two

sample test. ICH volumes were log transformed to approximate normality and compared using the Student's t-test. Survival after ICH was compared with a log rank test.

Results

The 1988 group included 171 ICH patients (67 lobar, 80 deep cerebral, 10 brainstem, 14 cerebellar,) after excluding 1 case caused by aneurysm, 5 by AVM, 3 cases with undetermined location, and 5 cases of pure IVH. The 2005 group included 259 ICH patients (91 lobar, 123 deep cerebral, 19 brainstem, 26 cerebellar) after excluding 3 cases due to aneurysm, 9 due to AVM, 9 due to cavernoma, and 6 cases of pure IVH. Table 1 compares patient demographics for both groups. No significant age or gender differences existed between groups. There was a higher proportion of white patients in the 1988 group ($p=.03$); all non-white patients were African American except for 3 Asians in the 2005 group. Admission GCS, location of ICH, and hemorrhage volumes were similar between the 1988 and 2005 groups.

In 1988, 16% of patients had surgical removal of their ICH versus 7% in 2005 ($p=0.002$). All surgical patients in 1988 and 2005 had removal of hematoma by open craniotomy. Intraventricular catheters were used for management of 13% of patients in 1988 and 8% in 2005 ($p=0.08$). Among patients with cerebellar hemorrhage, 36% had surgery in 1988 compared with 27% in 2005 ($p=0.56$).

In both 1988 and 2005, surgical patients were younger than non-surgical patients ($p=0.02$). Timing of surgery did not differ significantly between 1988 and 2005. The 30-day case-fatality rate among surgical patients in 1988 was 32% versus 50% in non-surgical patients ($p=0.06$). Among surgical patients in 2005, 30-day case-fatality rate was 16% versus 45% in non-surgical patients ($p=0.02$). Overall 30-day case-fatality rate for lobar and deep cerebral ICH patients was similar in 1988 and 2005 (46% vs. 42%, $p=0.80$). Table 2 compares surgical treatment of supratentorial hemorrhage in 1988 and 2005.

Discussion

Neurosurgeons in the five-county GCNK region performed fewer surgeries for lobar and deep cerebral ICH in 2005 compared with 1988, while the frequency of surgery for cerebellar hemorrhages remained unchanged. The lower frequency of surgery for supratentorial ICH may reflect the findings from the STICH study suggesting no overall benefit for surgery over conservative medical management (12) and the increased understanding that patients with massive ($>100\text{cc}$) ICH at presentation generally have poor outcomes despite maximal surgical and medical efforts. Similar to 1988, neurosurgeons in our community tended to operate on younger patients with larger hemorrhage volumes in 2005. This finding is not surprising since younger patients likely have the best chance of recovery and those with large hemorrhage volumes may be at risk of death if emergent craniotomy is not performed.

Unfortunately, overall ICH case-fatality rate did not improve in 2005, compared with 1988. This poor outlook for ICH patients, despite advances in emergency and critical care medicine, reflects the lack of effective treatments for ICH and emphasizes the need for innovative therapies and clinical trials in the care of ICH. In 1988, there was a trend toward lower 30-day case-fatality among surgical compared to non-surgical patients; in 2005, this trend reached significance with surgical patients again having lower 30-day case-fatality than non-surgical patients. These findings are difficult to interpret given the selection bias in choice of surgical candidates. In addition to our previous report on the 1988 group (1), improved mortality with surgery has been reported in various small clinical trials and studies (13–15,19), but not in the large, randomized STICH trial (12). Although STICH II is ongoing and is seeking to better

define patients who may benefit from surgery (18), poor overall ICH mortality underscores the need to develop other surgical and medical treatments for ICH.

Few population-based studies are available for comparison. In the Japan Standard Stroke Registry Study (JSSR), 20% of ICH patients entered into the registry between 1999 and 2001 had surgical treatment, including 32% of patients with cerebellar hemorrhage and 20% of patients with lobar and deep cerebral hemorrhages (8). In another Japanese study, 20% of all ICH patients were operated upon. Similar to the JSSR, 32% of patients with cerebellar hemorrhage and 21% of patients with lobar and deep cerebral hemorrhages had surgical evacuation (14). The higher surgical rates for supratentorial hemorrhage compared to our 2005 data may be due in part to the fact that patients were enrolled in these studies between 1991 and 2001, prior to the publication of the STICH trial. On the other hand, a Finnish study on 411 ICH patients identified between 1985 and 1991 reported surgery in only 6% of patients (6). Varying practice patterns in these different settings may account for the differences in treatment. To our knowledge, these studies represent the only available population-based reports examining practice patterns for surgical management of ICH.

If the frequency of surgery for ICH in our community is reflective of current practice patterns in the US, then approximately 6,000 patients in the US have operative removal of ICH annually. Based on practice in our community, about a third of these surgeries would be in patients with cerebellar hemorrhage, while the remaining two thirds would be patients with supratentorial ICH. Many surgeons will operate upon patients with good baseline medical status who are felt to be at risk of imminent herniation and death, and these patients are unlikely to be enrolled in clinical trials such as STICH.

Our study had several limitations. Because of retrospective patient identification in both groups, we were unable to evaluate the decision-making process regarding the role of surgical management of ICH. Another limitation of our study is the infrequency of stereotactic ICH evacuation in our population in 2005. It is not known how frequently these procedures are performed in the United States. Thus, the practice pattern in our community might not be reflective of practice elsewhere. We were not able to evaluate functional outcomes in the 2005 group and, thus, cannot compare outcome measures other than mortality between groups. Also, we have previously found that the International Classification of Diseases–Ninth Revision codes used in 1988 likely missed 5 to 10% of ICH cases in our community that year (4). If an additional 17 patients with supratentorial ICH were identified in 1988 and none had surgery, the frequency of surgery for ICH in 1988 would have been 14% compared with 7% in 2005. Also, if half of these additional 17 patients died, supratentorial ICH mortality would have remained 46% for 1988. Thus, we do not believe these missed cases would have had a significant impact on our findings. Finally, our findings represent 2 snapshots in time (1988 and 2005), and we are unable to state that this represents a “trend” in surgical management of ICH. We examined crude surgical rates for spontaneous ICH within our population from epidemiological data collected in 1999 and found that surgery was performed on 17 of 249 (6.8%) ICH patients, a rate similar to that in 2005. Unfortunately, we were unable to comprehensively compare surgical and nonsurgical candidates in 1999 in the same way as the 1988 and 2005 groups because hemorrhage volume data were not collected for the 1999 group. Thus, these data were not presented but do suggest that neurosurgeons were performing fewer operations before publication of the STICH trial.

In summary, the lower frequency of surgery in 2005, compared with 1988, may reflect trials that suggest no clear benefit to surgery after ICH and data indicating the poor outcome of patients with very large hemorrhages at presentation. Given similar ICH case-fatality rates in 1988 and 2005, innovative clinical trials to improve ICH patient outcomes are warranted.

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