


Resource utilisation among patients transferred for intracerebral haemorrhage

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ABSTRACT

Background Patients with intracerebral haemorrhage (ICH) are frequently transferred between hospitals for higher level of care. We aimed to identify factors associated with resource utilisation among patients with ICH admitted to a single academic hospital.

Methods We used a prospectively collected registry of consecutive patients with primary ICH at an urban academic hospital between 1 January 2005 and 31 December 2015. The primary outcome was use of either intensive care unit (ICU) admission or surgical intervention. Logistic regression examined factors associated with the outcome, controlling for age, sex, Glasgow coma score (GCS) and ICH score.

Results Of the 2008 patients included, 887 (44.2%) received ICU stay or surgical intervention. These patients were younger (71 vs 74 years, $p < 0.001$), less often white (83.9% vs 89.3%, $p < 0.001$), had lower baseline GCS (12 vs 14, $p < 0.001$) and more frequently had intraventricular haemorrhage (58.6% vs 43.4%, $p < 0.001$). Factors independently associated with ICU stay or surgical intervention were age > 65 years (OR 0.38, 95% CI 0.21 to 0.69), GCS < 15 (1.23, 95% CI 1.01 to 1.52) and ICH score > 0 (OR 2.23, 95% CI 1.70 to 2.91).

Conclusion Among this cohort of primary patients with ICH, GCS of 15 and ICH score of 0 were associated with less frequent use of ICU or intervention. These results should be validated in a larger sample but may be valuable for hospitals considering which patients with ICH could safely remain at the referring facility.

INTRODUCTION

Patients with intracerebral haemorrhage (ICH) are frequently transferred between hospitals in order to access a higher level of care.¹ Many transfers are necessary to bring patients to the required resources and access the appropriate level of care for their clinical condition.² However, transfers are costly to the healthcare system, as well as to patients and families that must travel farther from their home to the location of care. While many transfers are likely cost-effective from the societal perspective overall,³ data on the cost-effectiveness of ICH patient transfer are limited and conflicting.⁴ One study reported

large differences in costs for gains in quality-adjusted life years depending on patient scenarios,³ and another failed to demonstrate the cost-effectiveness of transfer for these patients.⁵ In this context of large healthcare costs and patient and family preferences, there may be a subset of patients with ICH in whom transfer could appropriately be avoided.^{1,5}

With the growth of regionalisation and policy changes such as those encouraging formation of Accountable Care Organisations, and incentivising higher-value care and more efficient care delivery, interhospital transfers may be a target. If safe, identification of patients for whom transfer could be avoided would be satisfying to patients and their families, as well as to payers and the healthcare system as a whole. In order to achieve such efficiency, we must consider how to identify the subset of patients for whom transfer could be avoided—there is currently little evidence to inform this decision.⁴ Our primary objective was to identify factors associated with resource utilisation among patients admitted for ICH. We presumed that the use of neurocritical care or surgical procedures marked those receiving specialty services, while patients receiving neither service may potentially be safely cared for at a local facility.

METHODS

We performed a secondary analysis of prospectively collected data on consecutive patients with primary ICH admitted to an academic comprehensive stroke centre (CSC) hospital between 1 January 2005 and 31 December 2015. Details of the data collection have been previously reported.⁶ Baseline clinical data were systematically recorded for each patient. Diagnosis of acute ICH was based on axial non-contrast CT images. We excluded patients with trauma, aneurysm, tumour or other types of secondary ICH.

Our primary outcome of interest was receipt of care that may not be available at a sending hospital. This was defined as the use of either intensive care unit (ICU) admission or surgical intervention. Our secondary outcome of interest was Glasgow outcome score at time of discharge, which is a measure of patient recovery after brain injury (stratified as poor (1–3) vs good (4–5)).⁷ Our primary predictor of interest was ICH score on presentation to our hospital. We use descriptive statistics to characterise the cohort, and used t-tests and χ^2 tests as appropriate for bivariate comparisons. We used multivariable logistic regression to examine characteristics associated with our outcomes of interest. Model covariates were determined a priori based on previous literature and clinical reasoning, and included age, sex, Glasgow coma score (GCS; stratified as 15 vs less than 15) and ICH score (stratified as 0 vs greater than 0). While ICH score does include GCS in its calculation, the score groups patients with GCS 13–15 together. We therefore decided to have an additional variable examining patients with GCS 15 versus GCS less than 15 with the aim of identifying the lowest risk cohort.

RESULTS

Our sample included 2008 patients admitted to our hospital with primary ICH from 2005 to 2015, of which 71% were transfers from another hospital (see [table 1](#)). Mean age was 72.5 years, 46.1% were female and 87% white. Many patients were on anticoagulation (warfarin: 21.3%; direct oral anticoagulants: 0.6%) and had history of stroke (15% ischaemic, 5.3% ICH). Mean GCS on arrival was 11.1 (SD 4.6), mean ICH volume was 32.4 mL (SD 38.0 mL) and 50.1% had intraventricular haemorrhage.

In bivariate comparisons, patients receiving ICU stay or surgical intervention were younger, more often male, and less often white than those without ICU stay or surgical intervention. They also had lower GCS on presentation, higher ICH score, and more often had cerebellar ICH or intraventricular haemorrhage ([table 1](#)). Of the 2008 patients in our sample, 334 (16.6%) had a GCS of 15 and ICH score of 0 on presentation. Of these 334 patients, 86 had an ICU stay (25.7%) and 4 received surgery (1.1%).

In our multivariable model, the factors associated with ICU stay or surgical intervention were age greater than 65 years (OR 0.38, 95% CI 0.21 to 0.69), GCS less than 15 on arrival (OR 1.23, 95% CI 1.01 to 1.52) and ICH score greater than 0 (OR 2.23, 95% CI 1.70 to 2.91). Patients with GCS <15 and ICH score >0 were also less likely to have moderate or good recovery on Glasgow outcome score (GCS <15, OR 0.14, 95% CI 0.10 to 0.20; and ICH score >0, OR 0.25, 95% CI 0.19 to 0.33).

DISCUSSION

In this analysis, we studied 11 years of consecutive patients with primary ICH admitted to an academic CSC hospital, the majority of whom were transferred from a referring hospital. We found that patients with mild severity (GCS

of 15 and ICH score of 0) on CSC arrival were less likely to receive ICU admission or surgical intervention during admission. Our findings are similar to results published by Nakagawa and colleagues in which the use of neurosurgical procedure among patients transferred for ICH was also associated with initial GCS and characteristics of the ICH.⁵

We found that approximately a quarter of patients with ICH score of 0 and GCS of 15 on arrival still received ICU stay or surgery during admission. However, the majority of these patients were for ICU admission only, and very few actually underwent surgical intervention. It remains unclear whether all of these ICU admissions were necessary. Most community hospitals do have access to ICU resources for strict blood pressure control and close monitoring. As technologies such as telemedicine enable monitoring of patients and expert consultation for patients in remote locations, this may extend our ability to keep patients closer to home in their local hospitals unless a change in examination or imaging results in need for transfer. This supports the argument that with technology extending resources into the community, there is potential for more complex patients to be managed at lower cost and closer to their local support systems. Of course, many factors in the transfer decision depend on local resource availability, and the use of these variables as a screening tool for triage decision-making would be a function of local capabilities. Further work is necessary to determine which subset of patients with ICH would optimally benefit from transfer to centres with higher level of care, and how these decisions are related to patient-centred outcomes such as functional outcome and mortality.

Our study has the usual limitations of a single-centre observational study, and findings may not be generalisable to other care settings. As we consider transferred patients with ICH, who composed over three quarters of our sample, ICH score in our analysis was based on patients' score on CSC presentation. Because we did not have CT scans from the transferring hospitals, we are unable to determine ICH scores at the originating facility, characteristics of the ICH that would have been present at the time of transfer decision-making, or subsequent haematoma expansion. Likewise, we did not have consistent access to blood pressure at the transferring hospital. We also were not able to determine whether ICU admissions among our cohort were necessary; however, future work will explore ICU length of stay to better understand this. Finally, this study only included patients admitted to our academic CSC, thus we do not know specific transfer conditions or criteria or the extent of triage that occurred at transferring hospitals, and whether any very low-risk patients were admitted locally or transferred elsewhere. Nevertheless, we believe that these findings are helpful in further identifying characteristics of patients with primary ICH who may not require CSC-level resources.

Table 1 Patient characteristics, stratified by ICU stay or surgical intervention

	Overall n=2008	Received ICU stay or surgical intervention n=887	No ICU stay or surgical intervention n=1121	P value
Age, mean (SD)	72.5 (13)	70.7 (13.4)	74.0 (12.5)	<0.001
Female (%)	46.1	43.4	48.2	0.033
Race (%)				
White	87.0	83.9	89.3	<0.001
Black	6.3	7.2	5.6	
Asian	5.8	7.5	4.4	
Other	0.7	0.9	0.5	
Native Hawaiian/Pacific Islander	0.1	0.1	0.1	
American Indian/Alaskan native	0.1	0.1	0.1	
>1 race	0.2	0.2	0.1	
Hispanic/Latino (%)	6.1	6.8	5.5	0.249
Warfarin (%)	21.3	21.0	21.5	0.768
DOAC (%)				
None	99.5	99.0	99.9	0.003
Dabigatran	0.2	0.2	0.1	
Rivaroxaban	0.2	0.5	0.0	
Apixaban	0.1	0.2	0.0	
Other	0.1	0.1	0.0	
History of ischaemic stroke (%)	15.0	16.3	14.0	0.154
History of ICH (%)	5.3	5.3	5.4	0.901
GCS, mean (SD)	11.1 (4.6)	10.4 (4.8)	11.7 (4.4)	<0.001
Cerebellar location (%)	7.4	10.4	5.1	<0.001
ICH volume (mL), mean (SD)	32.4 (38.0)	33.8 (36.5)	31.3 (39.1)	0.142
Intraventricular haemorrhage (%)	50.10%	58.60%	43.40%	<0.001
ICH score (%)				
0	20.3	13.4	25.7	<0.001
1	26.2	24.6	27.5	
2	21.7	25.7	18.5	
3	17.2	21.3	14.0	
4	11.8	12.2	11.4	
5	2.6	2.3	2.7	
6	0.3	0.5	0.2	
EVD (%)	14.5	32.6	0.0	<0.001
Haematoma evacuation (%)	6.5	14.7	0.0	<0.001
Total LOS, mean days (SD)	8.7 (10.2)	11.1 (10.7)	6.9 (9.4)	<0.001
ICU LOS, mean days (SD)	1.6 (3.7)	3.6 (4.9)	0.0 (0.0)	<0.001
Discharge GOS (%)				
1	34.4	34.6	34.2	<0.001
2	1.2	1.5	0.9	
3	44.4	52.0	38.0	
4	14.3	8.9	19.0	
5	5.7	3.0	7.9	
30-day mortality (%)	33.9	34.8	33.1	0.413

DOAC, direct oral anticoagulant; EVD, external ventricular drain; GCS, Glasgow coma score; GOS, Glasgow outcome score; ICH, intracerebral haemorrhage; ICU, intensive care unit; LOS, length of stay.



CONCLUSION

Among this cohort of patients with primary ICH, those with age less than 65, GCS of 15 and ICH score of 0 were less likely to receive ICU stay or surgical intervention. These results should be validated in a larger sample but may be valuable for hospitals considering which patients with ICH should be transferred to a tertiary care centre.

Contributors KSZ, JNG and LHS conceived and designed the study. SM takes responsibility for the integrity of the data and the analyses. All authors participated in critical review of results and drafting and critical revisions of the manuscript, and KSZ takes responsibility for the paper as a whole.

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Competing interests KSZ reports research funding from the Agency for Healthcare Research, National Institutes of Health and CRICO, and consulting relationship with Portola Pharmaceuticals. JR reports research funding from the National Institutes of Health, and consulting relationships with Boehringer Ingelheim, Pfizer and New Beta Innovations. LHS reports research relationships with the National Institutes of Health and Genetech, and consulting relationships with the Massachusetts Department of Public Health, Medtronic and Genetech. JNG has research relationships with Portola Pharmaceuticals, Octapharma and Pfizer, and consulting relationships with CSL Behring, Octapharma, Portola and Phillips.

Patient consent for publication Not required.

Ethics approval The study was approved by the hospital's Institutional Review Board.

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