British Journal of Medicine & Medical Research
3(1): 182-188, 2013

SCIENCEDOMAIN *international*
www.sciencedomain.org

Long Term Outcome after Hemorrhagic Stroke Surgery (LOMSS) in Hong Kong Chinese

George Kwok Chu Wong[1*], Sandy Wai Lam[1] and Wai Sang Poon[1]

[1]Division of Neurosurgery, Department of Surgery, Prince of Wales Hospital, The Chinese University of Hong Kong, Hong Kong.

Authors' contributions

This work was carried out in collaboration between all authors. Author GKCW designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Author SWL carried out the data collection and data archive. Author WSP supervised the study. All authors read and approved the final manuscript.

Research Article

Received 4th July 2012
Accepted 1st December 2012
Published 28th December 2012

ABSTRACT

Introduction: The benefits of surgical treatment to reduce ischemic penumbra and raised intracranial pressure have been challenged by results of randomized controlled clinical trial. With the lack of level I evidence, decision of whether to evacuate spontaneous intracerebral hematoma (ICH) surgically would be based on discussion with patients and families regarding long term surgical outcome.
Aim: We aimed to assess the long-term functional and cognitive outcome of ICH surgery in Hong Kong Chinese in Hong Kong, and to determine a simple prognostication scoring system for clinical application.
Methods: The study was carried out retrospectively in a regional neurosurgical center in Hong Kong. We identified 191 patients with ICH surgery performed between January 1999 and December 2008. 152(80%) patients had long-term neurological outcome data available for analyses. The study was registered at ClinicalTrials.gov (NCT01409252).
Results: Long-term favorable neurological outcome (mRS 0-3) was reported in 27%. Favorable neurological outcome negatively correlated with age, male sex, medical co-morbidities, and positively correlated with admission Glasgow Coma Scale. Long-term favorable cognitive outcome was negatively correlated with age.
Conclusion: In ICH patients, functional outcome was influenced by age, admission GCS, medical co-morbidities, and male gender, but cognitive outcome was

**Corresponding author: Email: georgewong@surgery.cuhk.edu.hk;*

independently associated with age alone.

Keywords: Intracranial hemorrhage; outcome; stroke; surgery.

1. INTRODUCTION

Hemorrhagic stroke is associated twice the mortality of ischemic stroke and is unfortunately commoner among Chinese than westerners [1,2,3]. Possible etiologies included genetic, clinical, environmental, and lifestyle factors. Majority of the population in Hong Kong is Chinese. The burden of hemorrhagic stroke resulting from associated disability poses a challenge to the health care system.

Since Bagley's description of successful surgical treatment of spontaneous intracerebral hematoma (ICH) [4], successful surgical evacuation for ICH had been reported among different neurosurgical centers [5,6,7]. Hypertension and age-related atherosclerosis were thought to be the culprit in about 75% of intracerebral hematoma. Putaminal and cerebellar hematomas were the commonest type of surgical target.

The benefits of surgical treatment to reduce ischemic penumbra and raised intracranial pressure have been challenged by results of randomized controlled clinical trial [8,9]. The recent Cochrane Database Systemic Review eventually concluded that in patients with CT-proven primary supratentorial intracerebral hematoma, surgery added to neurointensive medical management reduces the odds of being dead or dependent compared with medical management alone, but the results is not very robust [10]. The post-hoc analysis of first International Surgical Trial in Intracerebral Haemorrhage (STICH): formed the basis of the Surgical trial in lobar intracerebral haemorrhage (STICH II) [11], with a primary outcome of Extended (8 point) Glasgow Outcome Scale at six months.

With the lack of level I evidence, decision of whether to evacuate ICH surgically depends on the conjoint decision between the patient's family and neurosurgical team in many stroke centers. The foundation of decision would be based on long term outcome, both functional and cognitive. Age, conscious level, and ICH volume were the established prognostic factors for mortality. Ages larger than 50 to 65 years were associated with higher mortality rate in ICH treated surgically as compared to younger ages [6]. Deep coma before surgical evacuation also carried a poor prognosis for neurological outcome [5]. These primary ICH were associated with a 30-day mortality rate of over 30% and only half of the survivors were independent for basic activity of living at one year [12]. Few reported on long-term follow up. With these gaps in knowledge to fill, we designed the current study [13].

1.1 Aims

We aimed to assess the long-term functional and cognitive outcome of ICH surgery in Chinese over a ten year period in a neurosurgical center in Hong Kong and their predictive factors.

2. MATERIALS AND METHODS

2.1 Study Design and Patients

The study was carried out retrospectively in a neurosurgical center in Hong Kong. The neurosurgical service was a tertiary referral center with a population of 1.5 million. In our center, the indications for surgical evacuation of ICH included: 1) Lobar, ganglionic, or cerebellar in location; 2) mass effect with cisternal compression; 3) good rehabilitation potential, usually aged 70 years or below, with no disabling medical conditions. We identified 191 patients with ICH surgery performed between January 1999 and December 2008, and 152(80%) patients had long-term neurological outcome data available for analyses. The study was approved by the Joint CUHK-NTEC Clinical Ethics Committee and was registered at ClinicalTrials.gov (NCT01409252).

3. OUTCOMES

3.1 Modified Rankin Scale

The primary outcome was the modified Rankin Scale (mRS) [14]. A score higher than 3 was regarded as poor outcome whereas a score less than or equal to 3 was regarded as good outcome. Patients and their next-of-kins were contacted assessment of the Simplified Modified Rankin Scale Questionnaire [15] through telephone interview. The questionnaire had been shown to be valid and reliable by telephone. Given the known higher neurological morbidity and mortality of hemorrhagic stroke, favorable neurological outcome was defined as mRS 0-3 [16]. Since the duration between the date of surgery and interview varied with different patients, the aim of using mRS was used to determine the long-term functional outcomes of the patients, with a minimum duration of three years from the diagnosis of hemorrhagic stroke.

3.2 Telephone Interview of Cognitive Status

The secondary outcome was long-term cognitive outcome using theTelephone Interview of Cognitive Status (TICS) [17]. TICS was shown to correlate highly with mini-mental state examination and has the advantage of not requiring face-to-face interview. Long-term favorable cognitive outcome was defined as TICS ≥31 [17].

Clinical characteristics and 30-day mortalities were retrieved from the Computerized Medical Record System of the Hospital Authority.

3.3 Statistical Analysis

Data analyses were carried out with the aid of SPSS for Windows Version 18.0. Data were presented as mean+/-SD unless otherwise stated. Differences with a P value of less than 0.05 were considered statistically significant. Correlation between outcomes was assessed by Kendall's tau b coefficient. Pre-defined independent variables included age, sex, admission Glasgow Coma Scale (GCS), admission systolic blood pressure, admission diastolic blood pressure, medical co-morbidities (cardiac diseases, pulmonary diseases, renal diseases, hepatic diseases, and previous ischemic stroke), deep or infratentorial locations of hematoma, and use of anticoagulant upon admission.

Binary logistic regression was performed to assess the impact of pre-defined independent variables on the likelihood of long-term favorable neurological outcome using Enter method, with stepwise removal of variables with largest P value until all variables were statistically significant. The analysis had Hosmer and Lemeshow test significance values more than 0.05 and supported the fit of analysis. The Cox & Snell R Square and the Nagelkerke R Square provided the range of variation in the dependent variable explained by the model.

Linear regression was used to assess the ability of the predefined independent variables to predict favorable cognitive outcome, with stepwise removal of variables with largest P value until all variables were statistically significant. All Variable inflation factors were below 10, indicating multicollinearity was not a problem. The values for Cook's Distance were all less than 1, indicating there was no significant outlier. The total R square value indicated the unique variance explained by each variables and also that shared.

4. RESULTS

Clinical characteristics are shown in Table 1. Half were lobar hematoma and one-fifth was cerebellar hematoma. Median time from ictus to long-term assessment (Interquartile Range, IQR) was 9 years (6-12 years). Long-term favorable neurological outcome (mRS 0-3) was reported in 27%. Sixty-seven (44%) were communicable and completed the TICS assessment. Long-term favorable cognitive outcome (TICS≥31) was reported in 13%. TICS was negatively correlated with mRS (Kendall's tau b coefficient: -0.377, p<0.001).

Table 1. Patient characteristics

	Hemorrhage stroke patients underwent clot evacuation
	(n=191)
Age (mean+/-SD)	53+/-12
Male	122(64)
Hypertension	84(44)
Diabetes mellitus	23(12)
Hypercholesterolemia	7(4)
Cardiac disease	14(7)
Pulmonary disease	2(1)
Hepatic disease	6(3)
Renal disease	5(3)
Antiplatelet treatment	4(2)
Anticoagulant treatment	9(5)
Hematoma location	
Lobar	94(49)
Deep	60(32)
Cerebellar	37(19)
Intraventricular hemorrhage	20(11)
Arteriovenous malformation	20(11)
Brain tumour	4(2)
Admission GCS (median, IQR)	10(6-14)
Admission SBP (mmHg, mean+/-SD)	177+/-42
Admission DBP (mmHg, mean+/-SD)	99+/-26
Mortality at 90 day	26(17)

Data in number (percentage) unless stated, IQR: Interquartile Range, SD: Standard Deviation. GCS: Glasgow Coma Scale; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure

4.1 Long-Term Neurological Outcome

On multivariable binary logistic regression, favorable neurological outcome negatively correlated with age (OR 0.94; 95%CI, 9.1 to 9.7), male sex (OR 0.34; 95%CI, 0.17 to 0.89), medical co-morbidities (OR 0.24; 95%CI, 0.07 to 0.78), and positively correlated with admission GCS (OR 1.15; 95%CI, 1.03 to 1.27). The statistical model as a whole explained between 19% and 28% of the variance and correctly predicted 78% of cases.

4.2 Long-Term Cognitive Outcome

On linear regression, favorable cognitive outcome was correlated only with age (B coefficient, -0.30; 95%CI, -0.48 to -0.13; semipartial correlation coefficient, -0.39). Total R square value was 15%.

5. DISCUSSION

Long-term favorable neurological outcome negatively correlated with age, male sex, medical co-morbidities, and positively correlated with admission GCS, while long-term favorable cognitive outcome was correlated only with age. Today, despite treatment, only nearly a ¼ of patients had a favorable outcome, which possibly reflecting the fact that disease severity indicated surgery and the main achievement of surgery was relieving the mass effect rather than reversal of neurological injuries. Further researches should be conducted to optimize neurological recovery, such as through better understanding of brain connectivity and stem cell therapy.

There were several limitations of the current study. Surgical evacuation of ICH was based on the individual discussion between the neurosurgeons and family. Outcomes of the non-surgical ICH patients were not available for comparisons. With the retrospective nature of current study (the original CT were not available in many patients), we were not able to include radiological parameters such as hematoma volume and degree of intraventricular hemorrhage for assessments due to old policy of not keeping the CT films. These parameters should be considered in future prospective assessments for surgical outcome to adjust for the case hetereogeneity. Hemphill et al. [18,19] proposed the ICH Score to predict thirty-day mortality and twelve-month functional outcome. The ICH Score was the sum of individual points assigned as : GCS score 3 to 4 (=2 points), 5 to 12 (=1), 13 to 15 (=0); age ≥80 years yes (=1), no (=0); infratentorial origin yes (=1), no (=0); ICH volume ≥30 cm3 (=1), <30 cm3 (=0); and intraventricular hemorrhage yes (=1), no (=0).The other limitation of the current study included a non-uniform time-point for long-term assessment (cross-sectional observational study). A long time period (10 year) was included for analysis in our current study and might have induced biases. Despite these limitations, we were able to describe the long-term functional and cognitive outcome and their predictive factors. Our data suggested that adjunctive treatment should be developed in future maximize the neurological recovery in these patients.

6. CONCLUSION

In ICH patients, functional outcome was influenced by age, admission GCS, medical co-morbidities, and male gender, but cognitive outcome was independently associated with age alone.

ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

FINANCIAL DISCLOSURE AND COMPETING INTEREST

Nil.

REFERENCES

1. Chau PH, Woo J, Goggins WB, Tse YK, Chan KC, Lo SV, Ho SC. Trends in stroke incidence in Hong Kong differ by stroke subtype. Cerebrovasc Dis. 2011;31:138-146.
2. Liu M, Wu B, Wang WZ, Lee LM, Zhang SH, Kong, LZ. Stroke in China: epidemiology, prevention, and management strategies. Lancet Neurol. 2007;6:456-464.
3. Wei JW, Heely EL, Wang JG, Huang Y, Wong LK, Li Z, Heritier S, Arima, Anderson CS, ChinaQUEST Investigators. Comparison of recovery patterns and prognostic indicators for ischemic and hemorrhagic stroke in China. Stroke. 2010;41:1877-1883.
4. Bagley C Jr. Spontaneous cerebral hemorrhage: discussion of four types, with surgical considerations. Arch Neurol Psychiat. 1932;27:1133-1174.
5. Juvela S, Heiskanen O, Portanen A, Valtonen S, Kuurne T, Kaste M, Troupp H. The treatment of spontaneous intracerebral hemorrhage. J Neurosurg. 1989;70:755-758,
6. Maiura F, Corriero G, Passarelli F, Cirillo S, Astarita G. CT indications for surgery and evaluation of prognosis in patients with spontaneous intracerebral haematomas. Br J Neurosurg. 1990;4:155-160.
7. Fujitsu K, Muramoto M, Ikeda Y, Inada Y, Kim I, Kuwabara T. Indications for surgical treatment of putaminal hemorrhage. J Neurosurg. 1990;73;518-525.
8. McKissock W, Richardson A, Taylor J. Primary intracerebral hemorrhage: a controlled clinical trial of surgical and conservative treatment in 180 unselected cases. Lancet. 1961;2:221-226.
9. Mendelow AD, Gregson BA, Fernandes HM, Murray GD, Teasdale GM, Hope DT, Karimi A, Shaw MD, Barer DH, STICH investigators. Early surgery versus initial conservative treatment in patients with spontaneous supratentorial intracerebral haematomas in the International Surgical Trial in Intracerebral Haemorrhage (STICH): a randomised trial. Lancet. 2005;365:387-397.
10. Prasad K, Mendelow AD, Gregson B. Surgery for primary supratentorial intracerebral haemorrhage. Cochrane Database Syst Rev. 2008;4:CD000200.
11. Mendelow AD, Gregson BA, Mitchell PM, Murray GD, Rowan EN, Gholkar AR, STICH II investigators. Surgical trial in lobar intracerebral haemorrhage. Trials. 2011;12:124.
12. Bilbao G, Garibi J, Pomposo I, Pijoan JI, Carrasco A, Catalan G, Gonzalez S. A prospective study of a series of 356 patients with supratentorial spontaneous intracerebral haematomas treated in a Neurosurgical Department. Acta Neurochir. 2005;147:823-829.
13. Wong GK, Wong R, Poon WS. Cognitive outcomes and activity of daily living for neurosurgical patients with intrinsic brain lesions: a 1-year prevalence study. Hong Kong Journal of Occupational Therapy. 2011;21:27-32.
14. Banks JL, Marotta CA. Outcomes validity and reliability of the modified Rankin Scale: implications for stroke clinical trials: a literature review and synthesis. Stroke. 2007;38:1091-1096.

15. Bruno A, Akinwuntan AE, Lin C, Close B, Davis K, Baute V, Aryal T, Brooks D, Hess DC, Switzer JA, Nichols FT. Simplified Modified Rankin Scale Questionnaire: reproducibility over the telephone and validation with quality of life. Stroke. 2011;42:2276-2279.
16. Wei JW, Heely EL, Wang JG, Huang Y, Wong LK, Li Z, Heritier S, Anderson CS. ChinaQUEST Investigators. Comparison of recovery patterns and prognostic indicators for ischemic and hemorrhagic stroke in China. Stroke. 2010;41:1877-1883.
17. Brandt J, Spencer M, Folstein M. The Telephone Interview for Cognitive Status. Neuropsychiatry, Neuropsychology and Behavioural Neurology. 1988;1:111-117.
18. Hemphill JC III, Bonovich DC, Besmertis L, Manley GT, Johnson SC, Tuhrim S. The ICH Score: a simple, reliable grading scale for intracerebral hemorrhage. Stroke. 2001;32: 891-897.
19. Hemphill JC III, Farrant M, Neill TA Jr. Prospective validation of the ICH Score for 12-month functional outcome. Neurology. 2009;73:1088-1094.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sciencedomain.org/review-history.php?iid=163&id=12&aid=821