INNOVATION IN HEMORRHAGIC STROKE MANAGEMENT USING MINIMALLY INVASIVE PARAFASCICULAR SURGERY

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SUMMARY

Intracerebral hemorrhage (ICH) has a higher prevalence in Eastern Asian countries compared to Western countries. The standard surgical approach at our institution for the management of ICH is to perform a decompressive craniectomy (DC) with intra-parenchymal clot evacuation. In patients who have favorable functional recovery, a cranioplasty is performed usually after three months.

Based on our first year experience, the adoption of minimally invasive parafascicular surgery (MIPS) has led to significant reduction in the mean operating time (19% shorter than DC alone).

The mean length of stay (LOS) was significantly reduced with MIPS in the neurointensive care unit (50% shorter than DC alone) and total acute hospital stay (52% shorter than DC alone, 61% shorter than DC with delayed cranioplasty). The shorter LOS with MIPS resulted in a smaller room bill in the acute hospital stay (42% lower than DC alone, 51% lower than DC with delayed cranioplasty).

INTRO

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BACKGROUND

Intracerebral hemorrhage (ICH) is the most common type of hemorrhagic stroke and has a higher prevalence in Eastern Asian countries (18-24% of all strokes, 19% in Singapore) compared to Western countries such as the USA, UK and Australia (8-15%)¹⁻⁵. In addition, the age-standardized incidence rates of hemorrhagic stroke among Singaporeans have shown an increasing trend in the last decade from 64.3 per 100,000 to 65.5 per 100,000¹.

The standard surgical approach at our institution for the management of ICH is to perform a decompressive craniectomy (DC) followed by delayed cranioplasty. DC has been found to significantly reduce mortality by 18% compared to medical management in our patient cohort, although benefit for functional outcomes with DC was not observed⁶. A recent meta-analysis of randomized controlled trials demonstrated that select patients with supratentorial ICH benefited from minimally invasive surgery over conventional treatment and craniotomy⁷.

OBJECTIVES

We aim to assess the impact of minimally invasive parafascicular surgery (MIPS) on the length of acute hospital stay and model its economic impact.

METHODOLOGY

Historical cohorts of patients with supratentorial ICH who underwent surgery with clot evacuation were analyzed as three groups, namely DC (n=11), DC with delayed cranioplasty (n=5), and MIPS (n=12). Non-survivors were excluded. All groups had comparable baseline ICH-GS score, which has been validated as a prognostic model for ICH in our patient cohort^{8,9}. The median ICH-GS score in all three groups was 9, corresponding to a predicted mortality of 57% in hospital and 71% at 30 days. Patients' mean LOS in neurointensive care unit, high dependence and intermediate care units, as well as the total acute hospital stay, were reviewed. The actual costs of the procedures were calculated based on the estimated costs normalized to hospital rates for the year 2018. Surgical costs were estimated and all costs were converted to USD (1 USD=1.4 SGD).

INNOVATION IN HEMORRHAGIC STROKE MANAGEMENT USING MINIMALLY INVASIVE PARAFASCICULAR SURGERY

RESULTS



The mean surgery-related cost* was **42% lower** for DC with cranioplasty (USD 21,300 \pm 4,600) compared to MIPS (USD 12,300 \pm 3,100).

However, the cost of MIPS was **48% higher** compared to DC alone (USD 8,300 ± 1,700).



*Composite cost estimation for the surgical procedure.

In the figures (top and bottom), the dots represent the overall means and the whiskers, standard deviations.

INNOVATION IN HEMORRHAGIC STROKE MANAGEMENT USING MINIMALLY INVASIVE PARAFASCICULAR SURGERY

RESULTS



* Modeled room costs excludes medication, imaging, additional therapies and other miscellaneous costs.

only

Cranioplasty

In the figures, the dots represent the overall means and the whiskers, standard deviations (top figure) or 95% upper confidence limit (bottom figure).

INNOVATION IN HEMORRHAGIC STROKE MANAGEMENT USING MINIMALLY INVASIVE PARAFASCICULAR SURGERY

CONCLUSION

The standard surgical approach at our institution for the management of ICH is to perform a DC with intra-parenchymal clot evacuation. In patients who have favorable functional recovery a cranioplasty is performed usually after three months.

Based on our first year experience, compared to DC with delayed cranioplasty, MIPS has resulted in shorter operation time, neurointensive care unit LOS, and total acute hospital LOS, leading to cost savings.

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INNOVATION IN HEMORRHAGIC STROKE MANAGEMENT USING MINIMALLY INVASIVE PARAFASCICULAR SURGERY

REFERENCES

- 1. Trends in Stroke in Singapore 2005-2013. National Registry of Diseases Office, Ministry of Health Singapore. 2015. <u>https://www.nrdo.gov.sg/docs/librariesprovider3/default-document-library/stroke-monograph-2015_final.pdf</u>?sfvrsn=0. Accessed November 4, 2018.
- 2. Kannel WB, Wolf PA, Verter J, McNamara PM. Epidemiologic assessment of the role of blood pressure in stroke: The Framingham study. Jama. 1970; 214:301-310
- 3. Broderick J, Connolly S, Feldmann E, Hanley D, KaseC, Krieger D, et al. Guidelines for the management of spontaneo us intracerebral hemorrhage in adults: 2007 update: a guideline from the American Heart Association/American Stroke Association Stroke Council, High Blood Pressure Research Council, and the Quality of Care and Outcomes in Research Interdisciplinary Working Group. Circulation. 2007; 116:e391-e413.
- Hong KS, Bang OY, Kang DW, Yu KH, Bae HJ, Lee JS, et al. Stroke statistics in Korea part I: Epidemiology and risk factors – a report from the Korean stroke society and clinical research center for stroke. J Stroke. 2013; 15:2-20.
- 5. Toyoda K. Epidemiology and registry studies of stroke in Japan. J Stroke. 2013; 15:21-26.
- 6. Lo YT, See AA, King NK. Decompressive craniectomy in spontaneous intracerebral hemorrhage: a case-control study. World Neurosurg. 2017; 103:815-820.
- 7. Scaggiante J, Zhang X, Mocco J, Kellner CP. Minimally invasive surgery for intracerebral hemorrhage. Stroke. 2018; 49(11):2612-2620.
- 8. Ruiz-Sandoval JL, Chiquete E, Romero-Vargas S, Padilla-Martinez JJ, Gonzalez-Cornejo S. Grading scale for prediction of outcome in primary intracerebral hemorrhages. Stroke. 2007; 38(5):1641-1644.
- Han JX, See AA, King NK. Validation of prognostic models to predict early mortality in spontaneous intracerebral hemorrhage: a cross-sectional evaluation of a Singapore stroke database. World Neurosurg. 2018; 109:e601-e608.