

DEPARTMENT OF NEUROSURGERY AT
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MINIMALLY INVASIVE PARAFASCICULAR SURGERY (MIPS) IN ICH: ECONOMIC ARGUMENT FOR EARLY SURGERY

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SUMMARY

Intracerebral hemorrhage (ICH) is a leading cause of death and long-term disability in the United States. The economic costs related to ICH have increased in the last decade when ICH was approached surgically through standard craniotomies. The last few years have shown enthusiasm in approaching ICH with minimally invasive approaches but the timing of surgery remains very variable. We have approached ICH surgically at our institution with minimally invasive parafascicular surgery (MIPS) since 2015. As our experience grew, we have adopted changes in channeling our patients from the emergency room to imaging areas in order to improve efficiency. This has translated into patients being operated on sooner from their last known normal (LKN) with a goal of surgery within 8 hours of LKN. Patients with early MIPS surgery (<8h LKN) have shorter hospital stays, less need for imaging and shorter amount of time of ventilator dependency. Significant economic cost savings were obtained.

BACKGROUND

In 2017, there were 795,000 strokes in the United States. Stroke is the 5th leading cause of death and the leading cause of serious long-term disability¹. The estimated cost of stroke is \$34 billion per year².

Spontaneous ICH accounts for 10% of all strokes and is known to have a significantly higher rate of mortality and disability than ischemic stroke. A slight trend in decreasing in-hospital deaths has been reported for ICH from 2006 to 2014, probably due to improved supportive care (23.9% vs 20.4%)^{3,6}. Economically, the costs of ICH care has increased considerably during that time from \$63,831 per patient to \$112,833 per patient³ while the average length of stay (LOS) has remained unchanged from 8.9 days to 8.3 days³.

National data from 1993 to 2002 suggests that 6.9% of ICHs are treated surgically⁹. High volume surgical centers, which operated on a higher percentage of their overall ICHs, have decreased mortality of up to 20% compared to low volume centers⁹. The presence of a postoperative complication lengthens the mean LOS by 5 days and nearly doubles the mortality rate. Each postoperative complication also increases costs. The mean LOS for surgically treated patients is higher^{3,9}.

The standard surgical approach to treat spontaneous supratentorial ICH at our institution has been MIPS since 2015. Timing of surgery in this patient population has not been well defined. We have modified some of the patient flow between the emergency room and imaging suites in order to decrease times from LKN to surgery in this patient population with the belief that a goal of surgery within 8 hours of LKN is feasible and may provide significant economic benefits. Our approach has been to mimic some of the lessons learned in the treatment of ischemic stroke for large vessel occlusion.

Rationalization for Early Surgery in ICH:

ED Length of Stay and its Impact on ICH patients

Patients with ICH who have a prolonged stay in the ED tend to have worsened functional outcomes⁴ compared to similar cohorts with a shorter stay. The rate of patients requiring intubation and mechanical ventilation in the ED is high (32.3%)⁴; which suggests a high rate of patients who deteriorate in the first few hours after onset of their ICH.

Burden of Medical Complications in ICH

Up to 50% of stroke related mortality is due to medical complications⁵. Any medical complication increases LOS and costs in ICH and decreases the chance of home disposition^{6,7}. Mechanically ventilated patients have a higher in-house mortality, as well as longer LOS⁷. They also have higher rates of medical complications⁶.

Economic Costs in ICH

Hospital costs in ICH continue to be a source of concern seen by their increase of 75% from 2006 to 2014³. Hospital costs increase as LOS increases but its relationship is not linear. The rate of change in cost per day is the most significant in the first 3 weeks of admission⁸. This is felt to be related to a higher concentration of use of laboratory and imaging studies as well as procedures in that time frame in addition to the standard daily ICU cost.

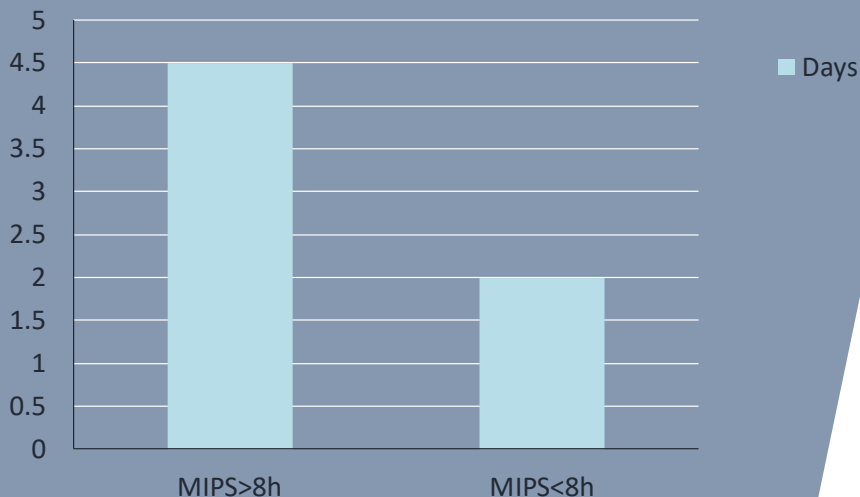
OBJECTIVES

Study the impact of early (<8h) versus late (8 to 24h) MIPS surgery on LOS, number of days of mechanical ventilation and total need for CT head imaging performed.

METHODOLOGY

Spontaneous supratentorial ICH patients treated with MIPS were analyzed as 2 groups; early (n=5) versus late (n=8) MIPS. The early surgery group arrived in the operating room with a mean of 6.9 hours and the late surgery group at 20 hours. All hospital deaths were excluded. All patients who had undergone surgery more than 24 hours from LKN were excluded. The two groups had similar preoperative GCS scores (mean of 8 in both groups) and ICH scores (mean of 2.6 in both groups). The changes made to optimize efficiency since 2017 have focused on limiting transport of patients between the emergency and imaging areas. All patients had a preoperative CTA performed prior to surgery. Since 2017, the CTA study was used for intraoperative navigation using facial registration. The patient's LOS in the ICU, as well as total LOS, was determined through retrospective chart review. Patient's number of mechanically ventilated days was recorded and included days through endotracheal intubation as well as tracheostomies as long as the patient required the presence of a ventilator. Patient's frequency of imaging with non-contrast CT scans were reviewed. The cost savings were estimated by using nominal data based on the national average cost of a non-contrast CT scan as well as the average cost of an ICU day and floor day in US dollars (\$).

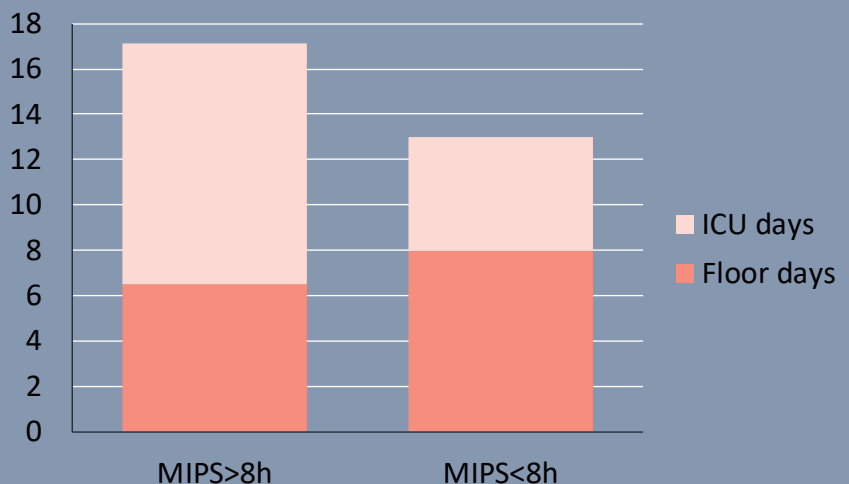
Length of Mechanical Ventilation (Days)



The median length of mechanical ventilation is **decreased from 4.5 days (SD=12.8) to 2 days (SD=3.78)**. This represents a decrease by 55%.

Median LOS is **reduced from 17 days (SD=18.09) to 14 days (SD=6.22)** which represents a decrease of 17.6%.

Length of Stay

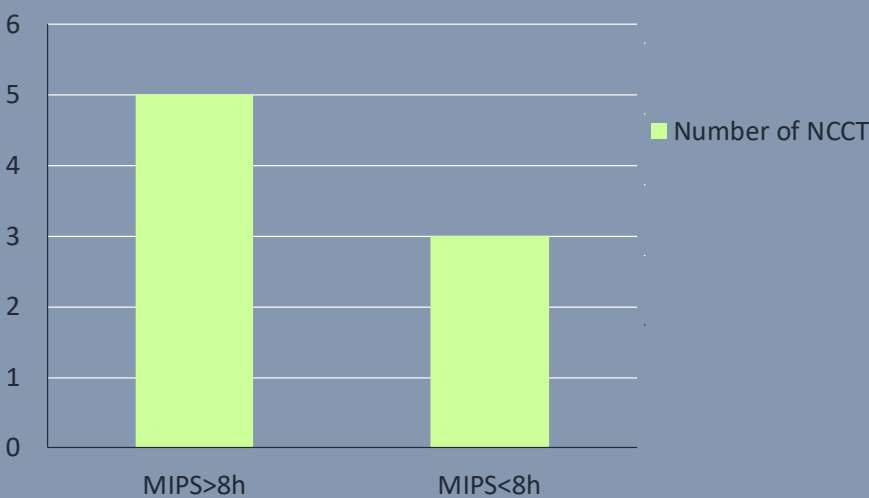


RESULTS

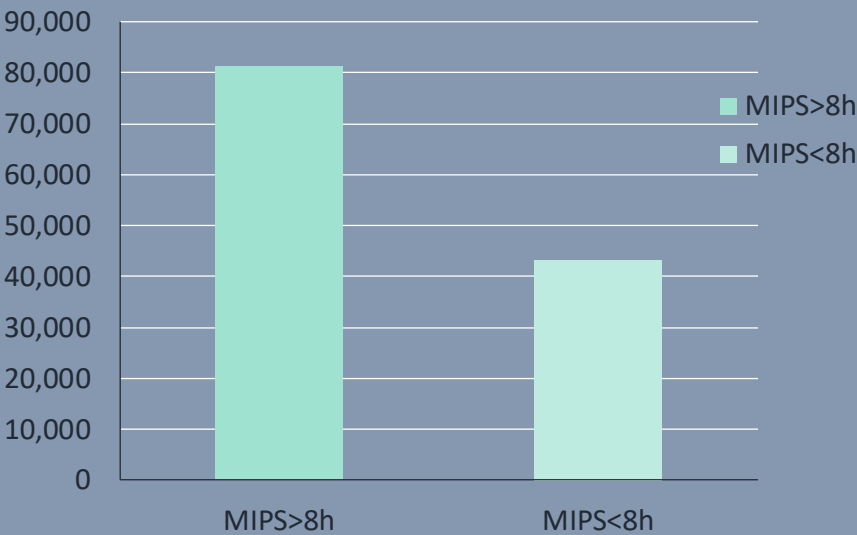
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The median number of non-contrast CTs performed is **decreased** from 5 (SD=1.28) to 3 (SD=0.7). This represents a decrease by 40%.

Number of NCCT During Hospital Course



Cost Per Patient Estimate



MIPS>8h patient cost estimate = \$81,190¹⁰⁻¹³. MIPS<8h patient cost estimate = \$43,241. This represents a decrease of 47%¹⁰⁻¹³.

CONCLUSION

Early MIPS surgery results in decreased LOS, need for mechanical ventilation, and frequency of non-contrast CT scans. Significant economic value can be added to the treatment of ICH patients. All centers are encouraged to rethink how ICH patients flow in their system in order to achieve maximum efficiency and economic savings.

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REFERENCES

1. Benjamin EJ, Blaha MJ, Chiuve SE, Cushman M, Das SR, Deo R, et al, on behalf of the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Heart disease and stroke statistics 2017 update: a report from the American Heart Association. *Circulation*. 2017; 135:e229–445.
2. Stroke Facts. Center for Disease Control and Prevention. <https://www.cdc.gov/stroke/facts.htm>. Accessed October 10, 2017.
3. Bedaiwi II, Alfaraj SZ, Pines JM. National trends in stroke and TIA care in U.S. emergency departments and inpatient hospitalizations (2006–2014). *Am J Emerg Med*. 2018; 10:1870-1873.
4. Jones EM, Boehme AK, Aysenne A, Chang T, Albright KC, Burns C, et al. Prolonged Emergency department length of stay as predictor of adverse outcomes in patients with intracranial hemorrhage. *J Crit Care Med*. 2015; 2015:526319.
5. Hemphill JC, Greenberg SM, Anderson CS, Becker K, Bendok BR, Cushman M, et al. Guidelines for the management of spontaneous intracerebral hemorrhage: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*. 2015; 46:2032–2060.
6. Otite FO, Khandelval P, Malik AM. Ten year temporal trends in medical complications after acute intracerebral hemorrhage in the United States. *Stroke*. 2017; 48:596-603.
7. Stein M, Misselwitz B, Hamann GF, Kolodziej MA, Reinges MHT, Uhl E. Defining prolonged length of acute care stay for surgically and conservatively treated patients with spontaneous intracerebral hemorrhage: A population based analysis. *BioMed Res Int*. 2016; 9095263: 6 pages.
8. Specogna AV, Turin TC, Patten SB, Hill MD. Hospital treatment costs of and length of stay associated with hypertension and multimorbidity after hemorrhagic stroke. *BMC Neurology*. 2017; 17:158.
9. Patil CG, Alexander AL, Hayden Gephart MG, Lad SP, Arrigo RT, Roakye M. A population based study of inpatient outcomes after operative management of nontraumatic intracerebral hemorrhage in the United States. *World Neurosurg*. 2012; 78(6):640-645.
10. Dasta JF, McLaughlin TP, Mody SH, Piech CT. Daily cost of an intensive care unit day: the contribution of mechanical ventilation. *Crit Care Med*. 2005; 33(6):1266-71.
11. Norton SP, Dickerson EM, Kulwin CG, Shah MV. Technology that achieves the triple aim: an economic analysis of the BrainPath approach in neurosurgery. *Clinicoecon Outcomes Res*. 2017; 9:519-523.
12. Hospital adjusted expenses per inpatient day by ownership. Kaiser Family Foundation Website. <https://www.kff.org/health-costs/state-indicator/expenses-per-inpatient-day-by-ownership/?currentTimeframe=0&sortModel=%7B%22colld%22:%22Location%22,%22sort%22:%22asc%22%7D>. Accessed December 13, 2018.
13. Non-Contrast CT procedure details. Healthcare Bluebook Website. https://www.healthcarebluebook.com/page_ProcedureDetails.aspx?cftId=130&directsearch=true. Accessed December 13, 2018.