

**Clinical and radiographic outcomes following
intracerebral hematoma evacuation via BrainPath-
assisted minimally invasive craniotomy**

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Introduction: Spontaneous intracerebral hemorrhage (ICH) comprises 10-15% of strokes with a high mortality rate (40%) and low rates of functional independence within 6 months (25%). Minimally invasive surgeries (MIS) emerging in recent years may offer a safer option of ICH management with decreased collateral tissue damage and shortened anesthesia time. However, no clinical trials have been performed to evaluate the effectiveness and safety of MIS compared to craniotomy. We present our experience with minimally invasive hematoma evacuation using the BrainPath endoport tubular retractor system in a series of 25 patients, with a particular focus on pre- and postoperative radiographic and clinical parameters.

Methods: Twenty-five patients underwent channel-based ICH evacuation. Retrospectively collected data on demographics (gender, age), clinical presentation, neuro-imaging characteristics (hydrocephalus, IVH), presenting Rankin score (MRS) and Glasgow coma score (GCS), comorbidities, use of anticoagulation and disposition. Postoperative MRS and GCS were assigned upon discharge, and then again at the time of their last known encounter. Clot size was assessed volumetrically using the formula for an ellipsoid ($ABC/2$), performed both pre- and postoperatively to assess percentage clot reduction. Chi-square and T-tests were performed.

Results: With mean age of 52, patients were 16 male (64%) and 9 female (36%). There were 4 frontal, 1 occipital, and 20 basal ganglia hemorrhages; 15 (60%) showed intraventricular extension. Seventeen (68%) ICHs and 6 of 7 (86%) patient deaths were left sided. The mean volume was 46 cm³ (range 13.1-101.2 cm³), while the mean clot reduction was 92%. Left sided ICH (p =0.014) and the presence of IVH (p = 0.038) was associated with worsened postoperative GCS score. Larger hemorrhages were associated with mortality (66 cm³ versus 38 cm³) p < 0.005). Increased clot removal is associated with increased survival (p = 0.092). With mean follow up time of 5 months, the median follow-up MRS was 3.5 (v. 4 preoperative), and median follow-up GCS was 15 (v. 10

preoperative). Patients with higher postoperative MRS scores and lower postoperative GCS were more likely to expire.

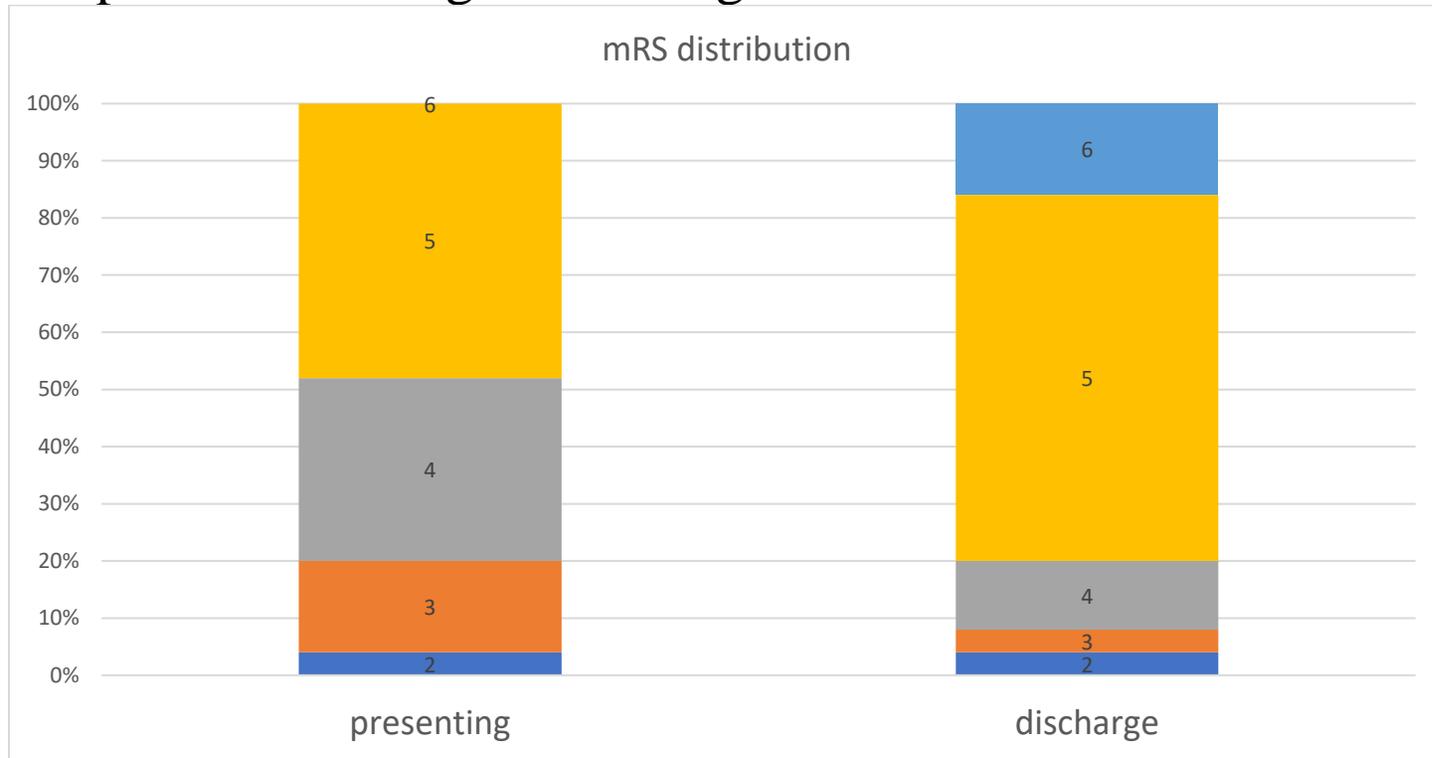
Table 1: left v. right sided clinical outcome

mean score	Left	Right
GCS pre	9.5	11.4
GCS post	9.1	13.6
mRS pre	4.5	3.8
mRS post	5.1	4.4

Table 2: survival v. expiration patient presentation

	survived	expired
gender: M	12	4
gender: F	9	0
median age	61.5	54
ICH score	1.6	2.4
hemorrhage size	38	66
% clot evacuation	96%	81%
L BG ICH	6	0
L BG ICH+IVH	4	4
L frontal ICH	1	0
L frontal ICH+IVH	2	0
R BG ICH	2	0
R BG ICH+IVH	5	0
R occipital ICH	1	0

Graph 1: Presenting v. discharge mRS distribution



Discussion: Ongoing clinical trials for minimally invasive ICH evacuation have suggested a morbidity and mortality benefit for carefully selected patients, and initial results with BrainPath mediated transsulcal approaches suggest functional and survival benefits as evidenced by lower postoperative GCS and MRS scores. When standardized, we believe the approach offers an effective means of clot evacuation with acceptable complication rates and low rates of residual hematoma. Further data are needed to determine the relative importance of hemorrhage location and size, timing of surgical intervention, and long term patient outcomes.

Summary Points:

- Minimally invasive parafascicular surgery (MIPS) has emerged in recent years as a potentially safer option for ICH management.
- Investigate whether MIPS ICH evacuation offer an effective means of substantial clot removal with improved postoperative outcomes
- Twenty-five patients underwent channel-based ICH evacuation were retrospectively collected data
- Improved postoperative GCS and MRS scores suggest that judicious use of MIPS may benefit well-selected patients.