Frameless navigation-guided stereotactic catheterization in patients with borderline basal ganglia hemorrhage volume

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Introduction

Frameless navigation-guided stereotactic catheterization (FNSC) of spontaneous supratentorial hematoma is easier, less invasive, and safer than conventional craniotomy. However, choosing between catheterization of hematoma and medical treatment is controversial in case of borderline volume of basal ganglia hemorrhage. The purpose of this study was to evaluate the benefits of FNSC in patients with borderline volume of spontaneous basal ganglia hematoma without intraventricular hemorrhage (IVH) extension.

Methods

Medical records from 238 patients who were diagnosed with spontaneous intracerebral hematoma (ICH) between January 2008 and December 2012 were reviewed. Sixty-three patients met inclusion criteria and divided into two groups; the best medical treatment group (group A, n = 29) and the catheterization group (group B, n = 34). Borderline hematoma volume was defined as 20 to 50 cm3 measured with computed tomography (CT). Frameless navigation-guided stereotactic catheterization was performed within 24 hours post- ictus. Pre- and post-operative modified Rankin Scale (mRS), recovery of motor weakness, period in intensive care unit (ICU), and total hospitalization period were evaluated and compared between the two groups.

Results

Group B showed earlier recovery of motor weakness and improvement of mRS compared to group A ($p < 0.0001$ and 0.001, respectively). Final mRS at 12 months was more favorable in group B ($p=0.006$). Both period in ICU and total hospitalization period were shorter in group B than in group A ($p = 0.001$ and $p = 0.006$, respectively). Predisposing factors for good outcome were hematoma volume less than 30? (OR = 6.158, 95% CI 1.221 to 31.053; $p = 0.028$), initial GCS score of =13 (OR = 6.331, 95% CI 1.129 to 35.507; $p = 0.036$), and absence of internal capsule involvement (OR = 4.680, 95% CI 1.152 to 19.010; $p = 0.031$). Especially, frameless navigation-guided stereotactic catheterization had significant effect on favorable outcome in regression analysis (OR = 13.376, 95% CI 2.423 to 73.842; $p = 0.003$).

Conclusions

Although the efficacy of surgery is doubtful in spontaneous basal ganglia hemorrhage, FNSC may result in beneficial effects for selected patients. Among patients with borderline volume of basal ganglia hematoma without IVH, FNSC may have beneficial effects early recovery of motor weakness, and functional status compared to conservative treatment, especially in patients with good initial GCS score, hematoma volume of 20 to 30 mL, and no involvement of the internal capsule.

Limitations

There are several limitations to this study. First, this is a retrospective study without randomization, which is the biggest limitation of this study due to the significant potential for selection bias. It may be possible that the best surgical candidates, or the patients with the best prognosis, were selected for the surgical group. In order to overcome this limitation, we would have recruited patients prospectively with equally matched control group.

Second, the number of patients is too small to generalize our results. In other words, the small number of patients raises the possibility of bias which may not bear out if a larger group of patients was studied. In this study, we have tried to find out the potential benefits of FNSC in selected patients so that we applied narrow indications for recruiting patients because previously reported large trials failed to prove the surgical benefit in generally assembled patients with ICH under broad indications in order to increase sample sizes. Recruiting a greater number of patients with ICH under certain indications is very difficult

Table 1 Patient demographic characteristics

Characteristics		Group A (n= 29)	Group B (n= 34)	*p* value
Age(year)	Mean, ±SD	54.86, ±11.664	55.41, ±12.218	0.856
	Range	31-75	31-79	
Gender	Male: Female	22:7	21:13	0.234
Affected side	Right: Left	19:10	12:22	
Initial GCS	≥13	22	21	0.010
	≥9, ≤ 12	7	13	
Volume of hematoma(m^3)	Mean, ±SD	29.48, ±6.916	29.32, ±9.415	0.940
	Range	22-45	20-49	
FUNC score	10	16 (55%)	20 (59%)	
	9	1 (3%)	4 (12%)	
	8	10 (35%)	10 (29%)	
	7	2 (7%)	0 (0%)	
Hematoma location	Lateral	11	7	0.133
	posterolateral	18	27	
Internal capsule involvement	Yes	17	23	0.466
	No	12	11	
Underlying condition				
	Hypertension	16 (55.17%)	14 (41.18%)	0.275
	Diabetes mellitus	6 (20.69%)	10 (29.41%)	0.436
	Previous ischemic stroke	2 (6.90%)	5 (14.71%)	0.333
	Smoking	14 (48.28%)	15 (44.12%)	0.746
	Alcohol	19 (65.52%)	17 (50.00%)	0.221
BMI(kg/m^2)	Mean, ±SD	23.76, ±3.851	24.55, ±3.143	0.370

GCS; Glasgow Coma Scale, FUNC; a functional outcome risk stratification scale

Table 2 Comparison of outcomes between groups

Outcomes		Group A	Group B	*p*-value (<0.05)	Odds ratio (95% CI)
Total HP*		29.31(±24.097)	17.32(±5.459)	0.006	
Period in ICU*		8.93(±7.620)	4.41(±1.438)	0.001	
Δ1 month mRS*		0.38(±0.561)	1.00(±0.778)	0.001	
Δ3 month mRS*		1.00(±0.845)	2.06(±0.919)	0.000	
Δ12month mRS*		1.55(±0.736)	2.76(±0.890)	0.000	
At 12 months favorable mRS outcome†		11	25	0.006	0.220 (0.076-0.641)
Δ1month affected side Motor Power*	Upper extremity	0.55(±0.783)	1.53(±1.53)	0.000	
	Lower extremity	0.41(±0.825)	1.09(±1.164)	0.011	
Δ3month affected side Motor Power*	Upper extremity	1.10(±0.976)	2.18(±0.999)	0.000	
	Lower extremity	1.03(±0.906)	1.88(±1.149)	0.002	
Δ12month affected side Motor Power*	Upper extremity	1.79(±0.978)	2.62(±0.954)	0.001	
	Lower extremity	1.52(±1.122)	2.24(±1.257)	0.021	

* *t*-test

† Pearson Chi-square

mRS; modified Rankin Scale, HP; hospitalization period, ICU; Intensive care unit

Δ; the difference between the initial values

Favorable mRS defined as mRS 0, 1 or 2

Table 3 Binary logistic regression analysis of functional outcome estimated by modified Rankin Scale at 12 months by factor

Factors		Univariate analysis (*p*-value)	Odds ratio (95% CI)	Multivariate analysis (*p*-value)	Odds ratio (95% CI)
Age(year)	<60, ≥60	0.282	1.787 (0.620-5.154)	NA	
Gender	Male, Female	0.815	1.136 (0.390-3.310)	NA	
Location	Lateral, Posterolateral	0.688	1.257 (0.412-3.835)	NA	
Initial GCS	≥13, <12	0.018	3.847 (1.257-11.773)	0.036	6.331 (1.129-35.507)
Internal capsule involvement	Yes, No	0.045	3.132 (1.023-9.585)	0.031	4.680 (1.152-19.010)
Hematoma volume(m^3)	<30, ≥30	0.000	10.540 (3.094-35.905)	0.028	6.158 (1.221-31.053)
Treatment modality	Medical management Catheter insertion	0.006	4.545 (1.560-13.241)	0.003	13.376 (2.423-73.842)
Diabetes mellitus	Yes, No	0.505	1.474 (0.471-4.608)	NA	
Hypertension	Yes, No	0.037	3.008 (1.068-8.473)	0.043	3.919 (1.047-14.671)
Smoking	Yes, No	0.827	0.894 (0.328-2.436)	NA	
Alcohol	Yes, No	0.769	1.164 (0.424-3.197)	NA	
Previous ischemic stroke	Yes, no	0.125	3.864 (0.688-21.691)	NA	

CI; confidence interval, NA; not assessed, GCS; Glasgow coma scale