Open Cerebrovascular Neurosurgery: Studying the Learning Curve in the Endovascular era

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Introduction

Endovascular techniques have resulted in diminishing case volumes for open cerebrovascular neurosurgeons.[1,2,3] Straightforward cases are progressively substituted with technically demanding complex lesions, frequently failures and recurrences of endovascular treatment. The value of open cerebrovascular fellowship training in comprehensive, high volume centers has increased.[3] Nevertheless, the impact of fellowship training on the learning curve steepness reflecting the ability to graduate proficient open cerebrovascular surgeons remains unclear.

Table 1. Descriptive results

Variable	Surgeon 1 (total n=89)	Surgeon 2 (total n=81)	p value
Preoperative Rupture	54 (45.76%)	64 (54.24%)	<0.01
Hunt-Hess grade	2.3±1.02	2.5±1.13	0.4
Fisher score	3.04±0.92	3.28±0.72	0.19
Clinical vasospasm	10 (22.22%)	35 (77.78%)	<0.01
Radiographic vasospasm	11 (25%)	33 (75%)	<0.01
Temporary clip application	23 (25.84%)	44 (54.32%)	
Duration (min)	11.57±7.28	19.8±14.38	0.02
GCS	13.81±2.76	13.27±3.2	0.09
GOS			
Discharge	4.26±1.06	4.28±0.95	0.79
Follow-up	4.6±0.72	4.85±0.5	<0.01
mRS			
Discharge	1.63±1.61	1.96±1.47	0.02
Follow-up	1.06±1.21	0.86±1.2	0.24
Presence of complications	23 (65.71%)	12 (34.29%)	0.19

Table 2. Adjusted outcomes

Outcome measure	Surgeon 1 (total n=89) Rate	Surgeon 2 (total n=81) Rate	Adjusted results: Ratio (Surgeon 2/Surgeon 1)	Adjusted results: 95% CI	Adjusted results: p value
Post-surgical complications	25.84%	17.14%	0.7	0.32 - 1.55	0.38
GOS improved at follow-up	8.99%	28.40%	2.24	0.89 - 5.64	0.09
mRS improved at follow-up	41.57%	69.14%	1.35	0.84 - 2.16	0.22
GOS change from discharge at follow-up	0.14	0.38	0.09	(-0.1) - 0.27	0.35
mRS change from discharge at follow-up	-0.25	-0.85	-0.38	(-0.68) - (-0.08)	0.01

Adjustment factors: pre-operative rupture status, Hunt-Hess grade, Fisher score, GCS

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Methods

Intracranial aneurysm cases treated by a neurosurgeon with a 30+ year experience (Surgeon 1) and an immediate fellowship graduate (Surgeon 2) were retrospectively reviewed. The last 100 and first 100 consecutive aneurysms treated by Surgeon 1 and Surgeon 2, respectively, were selected. After excluding cases with incomplete data, n=89 cases for Surgeon 1 and n=81 cases for Surgeon 2 were included. Aneurysm rupture status, presenting subarachnoid hemorrhage grades, temporary clip time, vasospasm status, modified Rankin Scale (mRS), and Glasgow outcome scale (GOS) scores at discharge and follow-up were analyzed.

Results

The initial analysis revealed more patients with preoperative rupture, higher vasospasm rates and longer temporary occlusion time for Surgeon 2 (Table 1). After adjustment for pre-operative rupture status, Hunt-Hess, Fisher and Glasgow coma scale scores, no significant differences in complication rate and outcomes at follow-up were found (Table 2). There were no significant differences in the numbers of patients with outcome improvement at follow-up, vasospasm and complication rates between both surgeons. Nevertheless, the change in mRS scores from discharge at follow-up was significantly larger for Surgeon 2 (Table 2, Figures 1-2). Stratification based on rupture status, Hunt-Hess and Fisher scores, revealed a significantly larger decrease in mRS score at follow-up for patients with Fisher score 4 for Surgeon 2.

Results Cont'd

There was no significant change in mRS and GOS scores at discharge and follow-up over time after fellowship graduation for Surgeon 2 (Figure 3), while a steady downtrend in the number of complications over time was evident (Figure 4).

Figure 1. Surgeon 1 modified Rankin scale scores

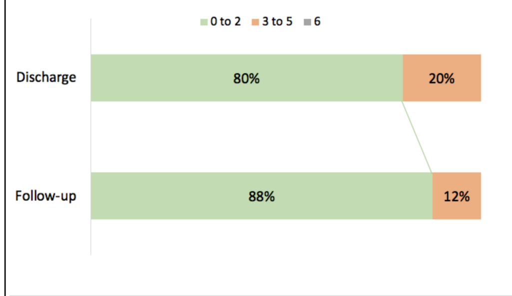
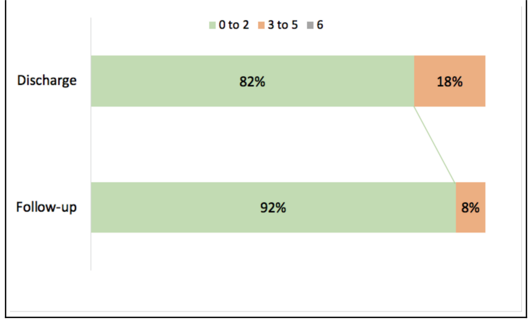


Figure 2. Surgeon 2 modified Rankin scale scores



Conclusions

Future graduating open cerebrovascular surgeons will likely face more complex cases than prior to the endovascular era. Current accredited fellowship training has the potential to meet the training demands. As with endovascular training, more rigorous accreditation standards will likely improve training results.

Learning Objectives

By the end of this session, participants should be able to:

-Describe challenges open cerebrovascular surgeons are increasingly facing in the endovascular era;

- Understand the current state of open cerebrovascular neurosurgeon training;

-Understand the role of accredited open cerebrovascular fellowship training.

References

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Figure 3. Surgeon 2 outcomes over time

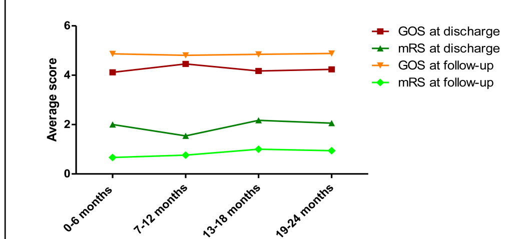

Figure 4. Surgeon 2 complications over time