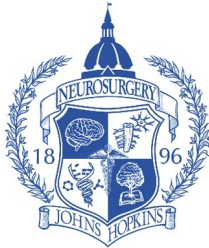




# Impact of Changes in Intraoperative Somato-sensory Evoked Potentials (SSEPs) on Stroke Rates After Clipping of Intracranial Aneurysms

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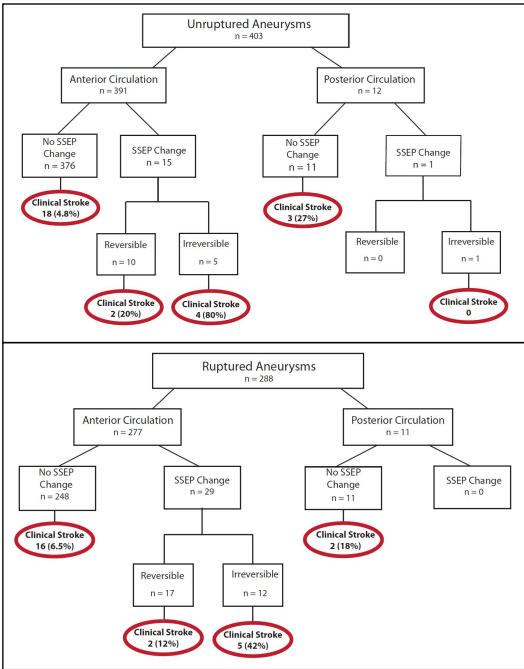


## Introduction

Somatosensory evoked potential (SSEP) monitoring is used during cerebral aneurysm surgery to track the effects of anesthesia, surgical manipulation, and temporary clipping.[1] We present the outcomes of 663 patients (691 cases) treated surgically for intracranial aneurysms who underwent intraoperative SSEP monitoring and analyze the sensitivity and specificity of significant SSEP changes in predicting post-operative stroke.

## Methods

691 consecutive aneurysm surgeries from 2004-2009 at the Johns Hopkins Hospital are analyzed. 403 (391 anterior and 12 posterior circulation) were unruptured and 288 (277 anterior and 11 posterior circulation) were ruptured aneurysms. Post-operatively, symptomatic patients underwent CT imaging to assess for ischemia. Positive predictive value(PPV), negative predictive value(NPV), sensitivity, and specificity were calculated with a Fisher’s Exact Test with two-tailed P value.



## Results

Significant SSEP changes occurred in 16 of 403 unruptured cases (4.0%) with 15 of the 16 cases in the anterior circulation. With reversible SSEP changes, the stroke rate was 20% (2 of 10 cases). With irreversible SSEP changes, the stroke rate was 80% (4 of 5 cases) in the anterior circulation. SSEP changes occurred in 29 of 288(10%) ruptured cases, all anterior circulation aneurysms. When SSEP changes were reversible, the stroke rate was 12% (2 of 17 reversible cases), and the stroke rate was 42% (5 of 12 irreversible cases) when SSEPs were irreversible. The accuracy of SSEP change in predicting post-operative stroke had an overall PPV=30%, NPV=94%, sensitivity=25%, and specificity=95%.

## Accuracy of SSEPs in All Cases

	Clinical Stroke	No Clinical Stroke	
SSEP Change	13	31	PPV: 0.30 (0.17 – 0.45)
No SSEP Change	39	608	NPV: 0.94 (0.92 – 0.96)
	Sensitivity: 0.25 (0.14 - 0.39)	Specificity: 0.95 (0.93 - 0.97)	

## Accuracy of SSEPs in Unruptured Aneurysm Cases

	Clinical Stroke	No Clinical Stroke	
SSEP Change	6	9	PPV: 0.40 (0.16 – 0.68)
No SSEP Change	21	367	NPV: 0.95 (0.92 – 0.97)
	Sensitivity: 0.22 (0.086 - 0.42)	Specificity: 0.98 (0.96 - 0.99)	

## Accuracy of SSEPs in Ruptured Cases

	Clinical Stroke	No Clinical Stroke	
SSEP Change	7	22	PPV: 0.24 (0.10 - 0.44)
No SSEP Change	18	241	NPV: 0.93 (0.89 - 0.96)
	Sensitivity: 0.28 (0.12 - 0.49)	Specificity: 0.92 (0.88 - 0.95)	

## Conclusions

In 70% of cases with significant SSEP changes, no adverse clinical outcome resulted, and in 75% of cases when post-operative stroke occurred, there was no change in SSEPs. When irreversible SSEP changes occurred in unruptured cases, the percentage of post-operative stroke was large–80%. SSEP alterations should be carefully evaluated and presence of subarachnoid hemorrhage, location of aneurysm, and reversibility of SSEP changes should be considered prior to predicting clinical significance.

## Mean GOS - Unruptured Cases

	Discharge GOS	Outpatient GOS
No SSEP Change (n=398)	4.7	4.9
Reversible SSEP Change (n=10)	3.8	4.4
Irreversible SSEP Change (n=7)	3.2	4.0

## Mean GOS - Ruptured Cases

	Discharge GOS	Outpatient GOS
No SSEP Change (n=270)	3.7	4.2
Reversible SSEP Change (n=17)	2.9	3.5
Irreversible SSEP Change (n=12)	3.1	3.1

## Learning Objectives

1) Intraoperative SSEP alterations in aneurysm surgery should be carefully evaluated prior to predicting clinical significance.

2) In our series, the majority of cases with significant SSEP changes did not result in post-operative stroke, and the majority of cases in which post-operative stroke occurred, had no changes in SSEPs.

## References

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