



Somatosensory Evoked Potential Changes in Neuroendovascular Procedures: Incidence and Association with Clinical Outcome in 873 Patients.

Jessica L. H. Phillips BA; Nohra Chalouhi MD; Pascal Jabbour MD; Robert M. Starke MD; Cory D. Bovenzi BS; Robert H. Roseenwasser MD; W. Bryan Wilent PhD; Victor M. Romo MD; Stavropoula I. Tjoumakaris MD

Department of Neurological Surgery, Thomas Jefferson University and Jefferson Hospital for Neurosciences, Philadelphia,



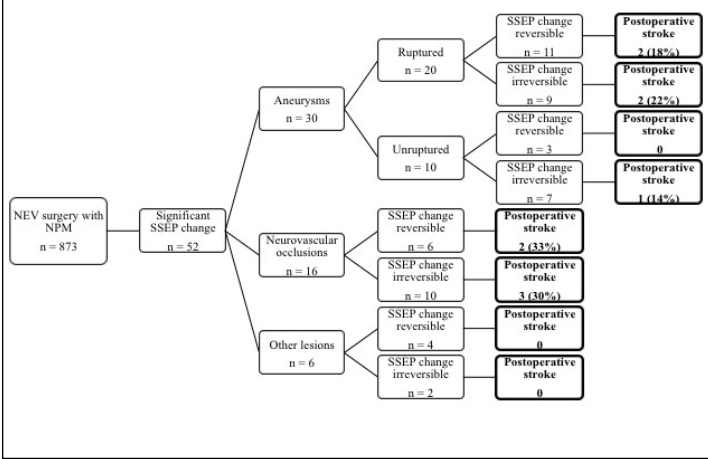
Introduction

Neurophysiological monitoring (NPM) is routinely employed during neurosurgical procedures. Use of NPM has extended to neuroendovascular procedures but evidence of its impact on clinical outcome in this arena is limited. There have been three previous studies of SSEP changes in neuroendovascular surgery and sample sizes were 9 [1], 3 [2], and 11 [3], respectively. Here we report on the incidence of intraoperative SSEP changes during 873 consecutive neuroendovascular procedures and correlate SSEP changes with clinical outcomes.

Methods

Patients who underwent neuroendovascular surgery at our institution between 2011 and 2013 were included in the analysis. Medical charts and imaging studies were retrospectively reviewed for demographics, clinical presentation, lesion type and size, type of endovascular procedure, duration of SSEP change, reversibility of SSEP change, incidence of intraoperative complications, presence of new infarction within 72 hours of intervention, and discharge outcome.

Patient distribution by lesion, reversibility of SSEP change, and presence of postoperative infarction.



Factors predicting favorable clinical outcome (GOS 4 or 5) in patients with SSEP changes.

| Factor | Univariate | | | Multivariable | | |
|-----------------------|-------------------|------------|---------|-------------------|--------------|---------|
| | Odds Ratio | 95% CI | p Value | Odds Ratio | 95% CI | p Value |
| Age | 0.94 | 0.90-0.98 | 0.006 | 0.95 | 0.90-0.99 | 0.04 |
| Gender | 2.0 | 0.65-6.20 | 0.23 | — | — | — |
| Aneurysm size >10 mm | 4.50 | 0.41-49.10 | 0.22 | 8.11 | 0.39-167.8 | 0.18 |
| Posterior location | 4.0 | 0.92-17.40 | 0.07 | 39.17 | 0.13-11383.4 | 0.21 |
| Rupture | Perfect predictor | | | Perfect predictor | | |
| Decreased duration | 0.96 | 0.93-0.98 | 0.001 | 0.96 | 0.94-0.99 | 0.002 |
| Reversed in 60 min | 8.75 | 2.10-36.49 | 0.003 | 1.63 | 0.18-15.07 | 0.67 |
| Reversed at all | 3.96 | 1.23-12.73 | 0.02 | 0.76 | 0.13-4.41 | 0.76 |
| Infarct within 72 hrs | 0.41 | 0.09-1.80 | 0.24 | Perfect predictor | | |

Results

- Of 873 consecutive patients, 52 (6%) had clinically significant intraoperative SSEP changes. Twenty-four patients (46%) had SSEP changes that were corrected while 28 patients (54%) had changes that were not reversed before the conclusion of surgery.
- Ten patients (19%) suffered new postoperative infarction within 72 hours.
- Decreased duration and reversal of SSEP changes were both associated with more favorable clinical outcome upon discharge (p=0.001 and 0.003, respectively).
- The positive predictive value of an irreversible SSEP change for postoperative infarction in our study was 21% (95% CI, 0.09-0.41) while the negative predictive value was 83% (95% CI, 0.62-0.95).

Factors predicting postoperative infarction within 72 hours of neuroendovascular intervention in patients with SSEP changes.

| Factor | Univariate | | | Multivariable | | |
|----------------------|------------|------------|---------|---------------|--------------|---------|
| | Odds Ratio | 95% CI | p Value | Odds Ratio | 95% CI | p Value |
| Age | 1.03 | 0.98-1.08 | 0.23 | — | — | — |
| Gender | 0.94 | 0.23-3.85 | 0.93 | — | — | — |
| Aneurysm size >10 mm | 1.45 | 1.0-2.12 | 0.05 | 1.47 | 1.0-2.18 | 0.05 |
| Posterior location | 1.77 | 0.37-8.39 | 0.47 | — | — | — |
| Rupture | 2.25 | 0.22-23.32 | 0.50 | — | — | — |
| Decreased duration | 1.01 | 0.99-1.03 | 0.39 | 1.03 | 0.16-1.10 | 0.45 |
| Reversed in 60 min | 0.46 | 0.11-1.89 | 0.28 | — | — | — |
| Reversed at all | 0.77 | 0.19-3.14 | 0.72 | 505.30 | 0.06-4237708 | 0.18 |

Efficacy of irreversible SSEP changes for predicting postoperative stroke.

| | Postoperative stroke, n | | No postoperative stroke, n | |
|-----------------------------|-------------------------|----|----------------------------|--|
| <i>All cases</i> | | | | |
| Irrev SSEP change (n = 28) | 6 | 22 | PPV = 21% (0.09-0.41) | |
| Rev SSEP change (n = 24) | 4 | 20 | NPV = 83% (0.62-0.95) | |
| | Sens = 60% (0.27-0.86) | | Spec = 48% (0.32-0.63) | |
| <i>All aneurysms</i> | | | | |
| Irrev SSEP change (n = 16) | 3 | 13 | PPV = 19% (0.05-0.46) | |
| Rev SSEP change (n = 14) | 2 | 12 | NPV = 86% (0.56-0.97) | |
| | Sens = 60% (0.17-0.93) | | Spec = 48% (0.28-0.68) | |
| <i>Ruptured aneurysms</i> | | | | |
| Irrev SSEP change (n = 9) | 2 | 7 | PPV = 22% (0.04-0.60) | |
| Rev SSEP change (n = 11) | 2 | 9 | NPV = 82% (0.48-0.97) | |
| | Sens = 50% (0.09-0.91) | | Spec = 56% (0.31-0.79) | |
| <i>Unruptured aneurysms</i> | | | | |
| Irrev SSEP change (n = 7) | 1 | 6 | PPV = 14% (0.01-0.58) | |
| Rev SSEP change (n = 3) | 0 | 3 | NPV = 100% (0.31-1.0) | |
| | Sens = 100% (0.05-1.0) | | Spec = 33% (0.09-0.69) | |

Conclusions

The approximate incidence of SSEP changes is 6% during neuroendovascular procedures. Both decreased duration and reversal of SSEP changes are associated with more favorable clinical outcome. SSEP monitoring may be a valuable tool for preventing complications following neuroendovascular interventions.

Learning Objectives

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

- Discuss the value of SSEP monitoring in neuroendovascular procedures.
- Identify limitations of SSEP monitoring in the neuroendovascular setting.

References

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