

# Somatosensory Evoked Potentials (SSEP)

## Anesthetic Pearls: Anesthetic Implications and Management of SSEP Pathways

### I. Indications for Monitoring SSEP and Anesthetic Considerations

SSEP Indications	Anesthetic Considerations
<ol style="list-style-type: none"> <li>1. Spinal cord decompression</li> <li>2. Scoliosis surgery</li> <li>3. Resection of spinal cord tumor</li> <li>4. Brachial plexus exploration</li> <li>5. Surgery where spinal cord structure / function are in jeopardy (aortic cross-clamp)</li> <li>6. Carotid endarterectomy</li> <li>7. Intracranial aneurysms</li> </ol>	<ol style="list-style-type: none"> <li>A. Subcortically generated responses are more resistant to non-surgical factors such as anesthetic depth / hypothermia than cortical responses</li> <li>B. Example anesthetic: Narcotic infusion + Isoflurane 0.5-1.0 MAC with NMB +/- N<sub>2</sub>O</li> <li>C. Useful and non-investigational</li> </ol>

### II. SSEP Pathways

Somatosensory signals travel along the posterior and lateral sensory tracts of the spinal cord and the lateral portions of the brainstem.

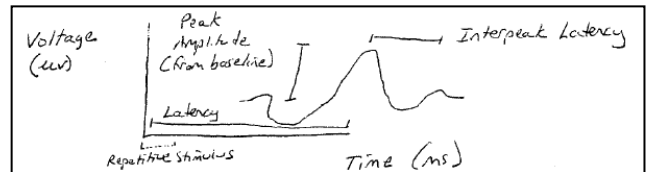
Therefore, injury to other regions of the cord like the motor tracts (anterior cord) or brainstem during surgery may be missed by SSEP monitoring. A wake-up test (or motor evoked potentials) during surgery with the patient moving upper and lower extremities would be required to test the motor tracts. Unlike the EEG which records spontaneous electrical activity produced by the CNS, sensory evoked potentials (SEP's) are "small shocks" to peripheral nerves followed by recordings at various sites along the transmission of the impulse to the CNS [peripheral nerve, spinal cord, brainstem (subcortical), or scalp / head (cortical)].

Type	Stimulus	Site of Stimulus	Recorded	Monitors
SSEP	Electrical	Lower extremity Common Peroneal n. Posterior Tibial n. Upper Extremity Median n. Ulnar n.	Peripheral nerve Spine (lumbar) Brachial plexus Cervical spine Scalp (cortical)	Ascending sensory pathways

**STIMULATION --> Peripheral n. --> Posterior Columns --> Brainstem --> Somatosensory Cortex**

The sensory evoked potential waveform obtained is displayed as a plot of voltage versus time and described in terms of amplitude and latency.

**Amplitude** is defined as the voltage difference between two peaks of opposite polarity or between an evoked potential (EP) peak and a reference level representing zero potential. **Latency** is the time in milliseconds (msec) measured from the application of the stimulus to the point of maximum amplitude (microvolts, mV) of the EP.



The wave recorded may be described by its polarity (N = negative, P = positive), its post-stimulus latency (msec), and / or its peak-to-peak amplitude (mV or nV). A wave named P-10 would be a positive deflection 10 msec after the stimulus. In some cases, the subscript may refer to the order of the peak. N-2 might indicate the second negative peak in a series. Intra-operative changes in EPs (such as decreased amplitude, increased latency, or complete loss of waveform) are considered to be indications of surgical trespass or ischemia despite stable anesthetic and physiologic parameters. Detection of these changes may allow alterations in care which may alter outcome, such as increasing mean arterial pressure, administration of brain protective drugs, release of spinal cord or brainstem distraction, changing to another region of the operative field, replacing a spinal plate / rod, or using a carotid shunt during carotid endarterectomy.

AGENT	SSEP
<b>Inhalational Agents</b>	
Nitrous Oxide	↓ Amplitude
Isoflurane	↓ Amplitude, ↑ Latency
Enflurane	↓ Amplitude, ↑ Latency
Halothane	↓ Amplitude, ↑ Latency
Desflurane	↓ Amplitude, ↑ Latency
<b>Intravenous Agents</b>	
Barbiturates	Minimal
Benzodiazepines	Minimal
Opioids	Minimal
Propofol	Minimal
Etomidate	↑ Amplitude, ↑ Latency
Droperidol	Depressed
Ketamine	↑ Amplitude, ↑ Latency
Muscle Relaxants	None
<b>Physiologic Factors</b>	
Hypothermia	↓ Amplitude, ↑ Latency
Hypotension	↓ Amplitude, ↑ Latency
Hypocarbica	Minimal
Hypercarbica	↓ Amplitude, ↑ Latency

### III. Anesthetic Effects on the SSEP