

척수 수술중신경계감시에서 유의할 점



윤 병 남

인하대병원 신경과

Pitfalls of INM for spinal surgery

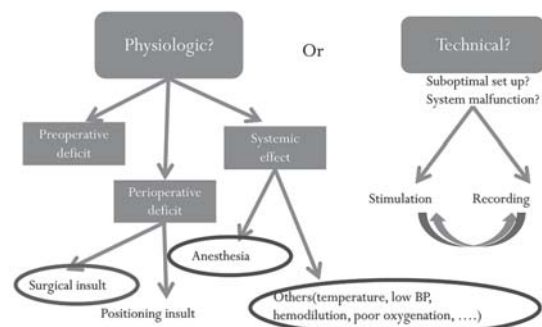
Byung-Nam Yoon

Department of Neurology, Inha University Hospital, Incheon, Korea

Applied surgery

- Spinal fusion
unstable, over 3 segments, compressive myelopathy, infective spondylitis, scoliosis
→ MNSEP, PTSEP, TOF, MEP, spontEMG
- Removal of Spinal cord tumor
→ MNSEP, PTSEP, TOF, MEP, spontEMG
- And so on...

문제 발생!! Is the problem???



수술중 IONM 의 변화

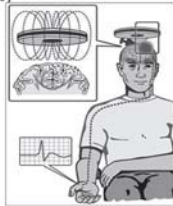
- Perioperative deficit 을 구별해내야한다.
Surgical insult or Positional insult
- 그 외 혼란스럽게 하는 것들...
Anesthesia
Systemic effect (temperature, lower BP, poor oxygenation)
Technical problem
Misinterpretation

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Anesthesia 마취제의 영향

- Near field potentials > Far field potentials
- MEP > SSEP
- Magnetic stimulation MEP > electrical stimulation MEP (sensitive to the effects of inhalational anesthetics)
- Transcortical motor stimulation
 1. direct activation of pyramidal cells, producing D or direct waves, a series of I
 2. indirect activation waves from interneuronal connections premotor cortex
- Lower motor neuron (alpha motor neuron)



Anesthesia 마취제의 영향(MEP)

- 마취제로 인한 synaptic connection 의 영향
 - the alpha motor neuron through these synaptic connections significant inhibitory impact !!
- Interneuronal synapses
- Synapse at the alpha motor neuron
- Synapse at the neuromuscular junction
- D wave(recorded from the epidural space)
 - resistant to the effects of most anesthetic agents, including the halogenated agents even at high concentrations

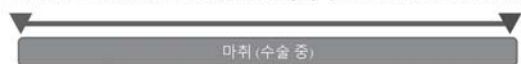
Anesthesia

- 무통, 의식소실, 마비 (analgesia, loss of consciousness, paralysis)
- Total intravenous anesthesia (TIVA)
- 의식 소실+ 무통 (analgesia, loss of consciousness): Propofol + remifentanyl
마비 paralysis: rocuronium

The use of N-M blocker in general surgery (bolus and bolus)



The use of N-M blocker in INM applied surgery (bolus and controlled infusion)



Agent	SEPs	MEPs	BAEP	EMG
Halogenated agent				
Opioid	-	-	-	-
Paralytic agent	-		-	-
Intravenous anesthetic high dose			-	-

마취제에 가장 sensitive 한 EP ?
Transcranial electrical stimulation MEP

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Case presentation

- Male / 55 years old
- Diagnosis: schwannoma at right S1 nerve root.

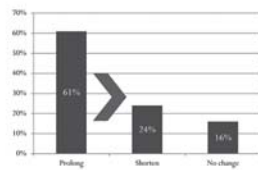


The SSEP latencies were commonly prolonged.

- compared the SEP latency of the pre-OP baseline to end-OP,
- In our hospital, last for 6 months spinal op case: 58 the total procedure of SEP: 201

compare the SEP latency of baseline and end of OP

the change of SEP latency
 - prolong: 121 (61%)
 - shorten: 48 (24%)
 - No change: 32 (15%)



Prolong of SEP latencies

- Systemic factor
Hypothermia? Hypotension? Hypoxia? Anesthesia?
- Positional change
excessive stretching or compression of the plexus or peripheral nerve.
- Neuronal dysfunction due to surgical events.

Temperature effects on the SEP

- Intraoperative decrease in core temperature decrease in neural conduction velocity
→ increased SEP latency
- Hypothermia results in increased latency of the spinal and cortical component of the SSEP
- Hyperthermia results in reduced latency
- Core body temperature and limb temperature may decrease by more than 1 °C during surgery.

Temperature effects on the SEP

- For every 1°C decline in temperature, median nerve SSEP latencies increase by 0.61 (N10), 1.15 (P14), and 1.56 (N19) msec (Markand et al., 1990a).
- Amplitudes of SSEP components correlate poorly with temperature.
- Room temperature, length of the surgery, surgical exposure
- Diminished body temperature → metabolism of the anesthesia drugs

In case of our hospital,

- The setting air temperature of Operation room 21~24°C
- Measurement of temperature nasopharyngeal thermometer



To escape the effects of temperature changes

- Maintain the patient's body temperature heating blanket type device
 - Adjust to.
(roughly 0.75-1.0msec increase in latency of the N20 for every 1°C decrease in nasopharyngeal temperature)
 - Second baseline?
To reduce the false positive rate, a baseline SSEPs recorded after exposure of the spine rather than the preoperative SSEP recorded after anesthesia and positioning of the patient.
- 1st baseline: after anesthesia and positioning of the patient.
 2nd baseline: after exposure of the spine.

Systemic effect

- 일정하게 유지해야 좋은 집중 감시
- 이러한 변화의 특징
Generalized and Gradual , Parallel four limb
- Temperature
35°C 이하면 EEG 감시에서 서파 증가 및 진폭 감소
SSEP 감시에서 중심제온 1°C 감소에 SSEP 진폭의 7% 감소, 잠복기의 3% 증가
- Blood pressure
EEG 감시에서 서파의 증가 및 진폭의 감소
평균동맥압 60 mmHg 이하시 SSEP 파형 소실

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Artifacts

- Electrical noise contamination of the IONM electrophysiologic potentials
- 많은 기계들..
electrocautery, surgery drills, C-arm, overhead lighting, surgical microscope, monitor, IV pump, blood warmer.....



Artifacts

- Electrical interference
- Power line (60Hz or 50Hz)
- 의심이 되는 기계를 찾는다. 의심이 되는 기계 전원을 뽑아 본다.
- 접지

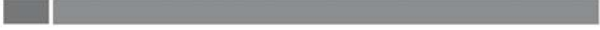
Technical problem

- Electrode 위치 변경, 탈락
Position change, contact of surgeon, fluid leakage
- Needle electrodes vs surface electrodes
- Decrease the electrical interference

Technical problem을 줄이려면

- KISS (keep it simple, stupid)
- Thinking ahead : 수술전 예상 가능한 변화에 대비.
- Check list 작성
- Unexpected events
- Equipment malfunction Neurological exam
- Optimal stimulus (repetition rate, strength)
- Optimal filtering
- Optimal placement of electrodes



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