Efficacy and pitfalls of intra-operative spinal cord monitoring with Br-MsEP


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Purpose

- To prevent paralysis after spine and spinal cord surgeries, it's necessary to perform intra-operative spinal cord monitoring.

- To assess both motor and sensory pathway, multimodality monitoring makes sense.

- Actually, multimodality monitoring is difficult regarding problems in manpower and/or facilities.

- What is efficacy and pitfalls on intra-operative spinal cord monitoring accomplished with only Muscle-evoked potential after electrical stimulation to the brain (Br-MsEP)
Materials

- 44 cases
  - 12 female and 32 male
  - Mean age 61.6 years

Diagnosis
- Cervical spondylosis (CS) 9 cases
- Ossification of the longitudinal ligament (OPLL) in the cervical spine 8 cases
- Cervical disc herniation (CDH) 5 cases
- Cervical spondylotic amyotrophy (CSA) 3 cases
- Spinal cord tumor 13 cases
  - Intra-medullary 1 case
  - Intra-dural extradural 12 cases
- Others 6 cases
  - Ossification of the ligamentum flavum (2 cases), Atrantaxial subluxation, Syringomyelia, Arachnoidal cyst, Fracture dislocation in the lumbar spine
## Methods

**Intra-operative spinal cord monitoring**

- **Muscle-evoked potential after electrical stimulation to the brain (Br-MsEP)**
  - **Stimulation and Recording procedure**
    - **Stimulus count**: 4~5 times
    - **Stimulus interval**: 2ms
    - **Stimulus voltage**: 450~630V
    - **Recording time**: 100ms
    - **Summation**: 20 times
    - **Frequency**: 0.7~0.9Hz
    - **Filtering**: 20~500Hz

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Recommended conditions by
The Japanese Society for Spine Surgery and Related research (JSSR)
Monitoring muscles
- Deltoid muscle
- Abductor digiti minimi (ADH)
- Abductor hallucis (AH)
- Other muscles
  - Biceps brachii
  - Quadriceps femoris
  - Biceps femoris
  - Tibialis anterior
  - Gastrocnemius
  - External anal sphincter

Warning sign
- More than 70% amplitude loss
Evaluations

- Rate of recordable muscles
- Incidence rate of motor paralysis
- Clinical findings of cases with motor paralysis
  - Pre-operative diagnosis
  - Type of motor paralysis
  - Clinical course of motor paralysis
- Sensitivity and specificity
  - Each pre-operative diagnosis
Results

- The number of monitored muscles (rate)
  - 219/236 muscles (92.8%)

- Incidence (rate) of post-operative paralysis
  - 5 cases (11.4%)
    - All cases
      - Transient incomplete monoplegia of upper extremity
    - Two of 5 cases
      - Just after surgery
      - Spinal cord tumor
      - “true positive”
    - Three of 5 cases
      - A few days after surgery
      - OPLL; 2 cases and CS; 1 case
      - “false negative” 2 cases, “true positive” 1 case
Sensitivity 80.0%, Specificity 79.5%

Sensitivity and Specificity for each disease

A trend that sensitivity and specificity in OPLL were lower than spinal cord tumor and CS.
Discussion

Br-MsEP

- Advent in the mid-1990s
- Assess the functional integrity of motor pathways during intra-operative spine and spinal cord surgery
- The most appropriate monitor the functional integrity of motor pathways

**Merits**
- Less invasive
- Sensitive monitor
- Multi-channel

**Demerits**
- Anesthesia-sensitive
- Impossible to monitor dorsal funiculus
Incidence of post-operative motor paralysis: 5 cases

- Paralysis just after surgery: 2 cases
  - True positive
- Paralysis in a few days after surgery: 3 cases
  - False negative: 2 cases, true positive: 1 case

**Br-MsEP is a appropriate monitor for motor paralysis just after surgery**

- Br-MsEP have great promise for intra-operative injury
- Post-operative injury, such as C5 palsy, couldn’t be detected on Br-MsEP

D. Fan, *et al.* *Spine* 2002
N. Tanaka, *et al.* *Spine* 2006
Br-MsEP as intra-operative monitoring

**Efficacy**
- Less invasive
- Sensitive monitor
- Multi-Channel
- Suitable for spinal cord tumor, cervical spondylosis (CS)
- Capable of monitoring paralysis just after surgery

**Pitfalls**
- Anesthesia-sensitive
- Impossible to monitor dorsal funiculus
- NOT suitable for ossification of the posterior longitudinal ligament (OPLL)
Intra-operative spinal cord monitoring in 44 cases were recorded using Br-MsEP.

There was a trend that sensitivity and specificity in OPLL were lower than spinal cord tumor and CS.

Br-MsEP is a appropriate monitor for motor paralysis just after surgery.