신경근육재활 및 전기진단

발표일시 및 장소 : 10 월 19 일(토) 14:10-14:20 Room C(5F)

**OP3-3-2**

## Differences of Intraoperative Monitoring during Neuromuscular and Idiopathic Scoliosis Surgery

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**Objective**

Intraoperative neurophysiological monitoring (IONM) is widely used in spine surgery to prevent the postoperative motor deterioration (PMD). Previously reported values of the sensitivity or specificity of somatosensory or motor evoked potentials (SEPs or MEPs) are various since the PMD is rare in scoliosis surgery. However, with the absence of previous comparative study of IONM between neuromuscular scoliosis (NS) and idiopathic scoliosis (IS), we made comparative analysis, especially in patients who did not show any PMD.

**Methods**

This retrospective study contains the 4 years (May, 2015~May, 2019) of medical record review in a tertiary hospital. Among 66 patients who received the scoliosis surgery, 53 (NS: 25, IS: 28) underwent the IONM. By C1/C2 interhemispheric transcranial electrical stimulation, the MEPs were obtained in the bilateral tibialis anterior and abductor halluces muscles. Bilateral tibial SEPs were obtained recording from C4'/C3'. The maximum amplitude decrement percentage of MEPs (ΔMEPampMax) and SEPs (ΔSEPampMax), and the maximum percentage of the prolonged SEPs latency (ΔSEPlatMax) compared to baseline value were analyzed. The preoperative motor score (Motorpre) of 5 key muscles of bilateral lower extremities by the International Standards for Neurological Classification of Spinal Cord Injury were calculated using the Medical Research Council scale. Cobb's angle (Cobb'spre), corrected Cobb's angle (ΔCobb's) were measured by preoperative and postoperative simple plain image of the whole spine (standing or sitting). The maximum and minimum SBP and DBP during surgery were checked.

**Results**

By independent T test, NS showed significantly lower height, weight, and Motorpre, larger Cobb'spre, longer fixation level and the operation duration, and more bleeding amount with lower SBPMin than IS. However, there were no significant differences of the ΔMEPampMax, ΔSEPampMax, or ΔSEPlatMax (Table 1). By Pearson's correlation analysis, several parameters were correlated statistically, and especially, ΔSEPampMax were

significantly correlated with operation duration (P=0.01) in NS. In addition, ΔSEPampMax were correlated with DBPMin (P=0.04) and ΔMEPampMax (P=0.01) in IS. The ΔSEPlatMax was correlated with SBPMax (P<0.01) and ΔSEPampMax (P<0.01) in NS. On the linear regression analysis, bleeding amount, SBPMax, and DBPMax were significant contributing factors for ΔSEPlatMax in NS. Other variables did not significantly contribute to intraoperative SEPs and MEPs (Table 2).

**Conclusion**

These results represent that the bleeding amount and the following hemodynamics are important factors to make the SEP latency prolonged in NS. It may result from the more bleeding amount in NS, and as already known, SEPs were more sensitively correlated with hemodynamics than MEPs. Thus, the surgeons should pay more attention in NS to reduce the bleeding amount for the safe neurophysiologic outcome under IONM especially including SEPs.

Table 1. Difference between neuromuscular and idiopathic scoliosis surgery.

| Scoliosis | NS (n=25) | IS (n=28) | *P* value |
|---|---|---|---|
| Age | 15.7 ± 2.9 | 15.9 ± 2.6 | 0.79 |
| Sex | | | < 0.01* |
| Male | 20 (80.0) | 3 (10.7) | |
| Female | 5 (20.0) | 25 (89.3) | |
| Diagnosis | | | |
| Adolescent idiopathic scoliosis | | 28 (100.0) | |
| Muscular dystrophy[a] | 16 (64.0) | | |
| Spinal muscular atrophy | 4 (16.0) | | |
| Other[b] | 5 (20.0) | | |
| Height | 148.6 ± 13.7 | 162.9 ± 8.3 | < 0.01* |
| Weight | 37.7 ± 14.9 | 56.7 ± 15.9 | < 0.01* |
| Preoperative motor score | 22.0 ± 11.5 | 50.0 ± 0.0 | < 0.01* |
| Simple plain image | | | |
| Cobb's$_{pre}$ (°) | 63.7 ± 16.5 | 21.1 ± 3.8 | < 0.01* |
| ⊿Cobb's (°) | 39.7 ± 16.8 | 50.4 ± 6.5 | 0.59 |
| Fixation level (level) | 16.0 ± 0.8 | 12.0 ± 1.8 | < 0.01* |
| Operation duration (hr) | 8.2 ± 2.0 | 7.1 ± 1.6 | 0.03* |
| Hemodynamics | | | |
| Bleeding amount (mL) | 2,705.2 ± 1,550.2 | 1,687.1 ± 819.7 | 0.004* |
| $SBP_{Max}$ | 132.0 ± 19.9 | 136.3 ± 12.6 | 0.35 |
| $SBP_{Min}$ | 76.0 ± 9.1 | 81.5 ± 5.8 | 0.01* |
| $DBP_{Max}$ | 81.6 ± 14.3 | 80.8 ± 10.1 | 0.82 |
| $DBP_{Min}$ | 39.1 ± 4.9 | 41.1 ± 4.9 | 0.15 |
| Changes in IONM | | | |
| ⊿$MEPamp_{Max}$ | 0.1 ± 158.4 | -11.4 ± 35.1 | 0.71 |
| ⊿$SEPamp_{Max}$ | -33.6 ± 22.4 | -37.7 ± 16.3 | 0.45 |
| ⊿$SEPlat_{Max}$ | 5.4 ± 8.5 | 5.5 ± 6.1 | 0.10 |

NS, neuromuscular scoliosis; IS, idiopathic scoliosis; Cobb's$_{pre}$, preoperative Cobb's angle; ⊿Cobb's, corrected Cobb's angle via scoliosis surgery; $SBP_{Max}$, Maximum systolic blood pressure; $SBP_{Min}$, Minimum systolic blood pressure; $DBP_{Max}$, Maximum diastolic blood pressure; $DBP_{Min}$, Minimum diastolic blood pressure; Δ$MEPamp_{Max}$, Maximum amplitude decrement of motor evoked potential compared to baseline; Δ$SEPamp_{Max}$, Maximum amplitude decrement of somatosensory evoked potentials compared to baseline; Δ$SEPlat_{Max}$, Maximum latency delay of somatosensory evoked potential compared to baseline.

a, 9 Duchenne muscular dystrophy, 5 progressive muscular dystrophy, 1 myotonic muscular dystrophy, 1 limb girdle muscular dystrophy; b, 1 Lennox-Gastaut syndrome, 1 Dandy-Walker syndrome, 1 Cardiofaciocutaneous syndrome, 1 bacterial meningitis, 1 lipomeningomyelocele. *, *P* value < 0.05.

Table 2. Regression analysis for intraoperative MEPs and SEPs in neuromuscular and idiopathic scoliosis surgery.

| Variables | $\Delta MEP_{Max}$ | | $\Delta SEPamp_{Max}$ | | $\Delta SEPlat_{Max}$ | |
|---|---|---|---|---|---|---|
| Scoliosis | NS | IS | NS | IS | NS | IS |
| Age | 0.70 | 0.29 | 0.56 | 0.56 | 0.24 | 0.88 |
| Height | 0.37 | 0.67 | 0.50 | 0.20 | 0.26 | 0.91 |
| Weight | 0.83 | 0.66 | 0.50 | 0.98 | 0.70 | 0.66 |
| Preoperative motor score | 0.88 | | 0.48 | | 0.81 | |
| $Cobb's_{pre}$ | 0.51 | 0.10 | 0.29 | 0.78 | 0.10 | 0.05 |
| ⊿Cobb's | 0.72 | 0.86 | 0.44 | 0.33 | 0.33 | 0.13 |
| Fixation level | 0.15 | 0.08 | 0.23 | 0.54 | 0.24 | 0.75 |
| Operation duration | 0.83 | 0.15 | 0.05 | 0.27 | 0.78 | 0.41 |
| Bleeding amount | 0.52 | 0.19 | 0.13 | 0.77 | 0.04* | 0.58 |
| $SBP_{Max}$ | 0.50 | 0.83 | 0.26 | 0.66 | <0.01* | 0.50 |
| $SBP_{Min}$ | 0.72 | 0.50 | 0.75 | 0.27 | 0.84 | 0.49 |
| $DBP_{Max}$ | 0.63 | 0.54 | 0.65 | 0.59 | 0.01* | 0.33 |
| $DBP_{Min}$ | 0.44 | 0.09 | 0.94 | 0.07 | 0.21 | 0.89 |

NS, neuromuscular scoliosis; IS, idiopathic scoliosis; $Cobb's_{pre}$, preoperative Cobb's angle; ⊿Cobb's, corrected Cobb's angle via scoliosis surgery; $SBP_{Max}$, Maximum systolic blood pressure; $SBP_{Min}$, Minimum systolic blood pressure; $DBP_{Max}$, Maximum diastolic blood pressure; $DBP_{Min}$, Minimum diastolic blood pressure; $\Delta MEPamp_{Max}$, Maximum amplitude decrement of motor evoked potential compared to baseline; $\Delta SEPamp_{Max}$, Maximum amplitude decrement of somatosensory evoked potentials compared to baseline; $\Delta SEPlat_{Max}$, Maximum latency delay of somatosensory evoked potential compared to baseline. *, $P$ value < 0.05.