Incidence of False Positive Spinal Cord Monitoring Alerts in Surgery for Early Onset Scoliosis

OM Stokes, K Bowyer, L Goodger, C Nnadi, H Mehdian

BACKGROUND

- Role for multimodal SCM established [1, 2]
  - More effective than single modality
  - Descending pathways – MEPs
  - Ascending pathways – SEPs

- SCM – Effective in EOS patients [3]

- Risk factors for neuromonitoring changes [4]
  - Cobb >90°
  - Hyperkyphosis
  - Osteotomy
- High predictive accuracy in idiopathic Pts [5]
  - False positives associated with labile MAP
- Value of SCM in non-idiopathic cases established [6, 7, 8]
  - Subject to greater variability

SCM PROTOCOL – Pre-Operative

- Pre-op SEPs
  - Check responses (MRI if delayed)
  - Assess for contra-indications to MEPs

- Contra-indications to MEPs [9]
  - Hx of seizures
  - Hx skull ♯s
  - Hx craniotomy
  - Intracranial metal
  - Cochlear implants
  - Cardiac pacemakers

SCM PROTOCOL – Peri-Operative

SEPs

- Head (corkscrew electrodes)
  - Over sensory homuniculus
  - Erb's points
- Arms (stimulating electrode)
  - Over ulnar nerve
- Legs (stimulating electrode)
  - Over tibial nerve

- Max stim. – 40mA

MEPs

- Head (stimulating corkscrew electrodes)
  - Motor cortex (C1-2)
- Arms
  - In ADM
- Legs
  - In quads, tib ant, abd hall

- Max stim. – 200mA

SCM – Significant Changes

- SEPs ≥ 50% drop from baseline

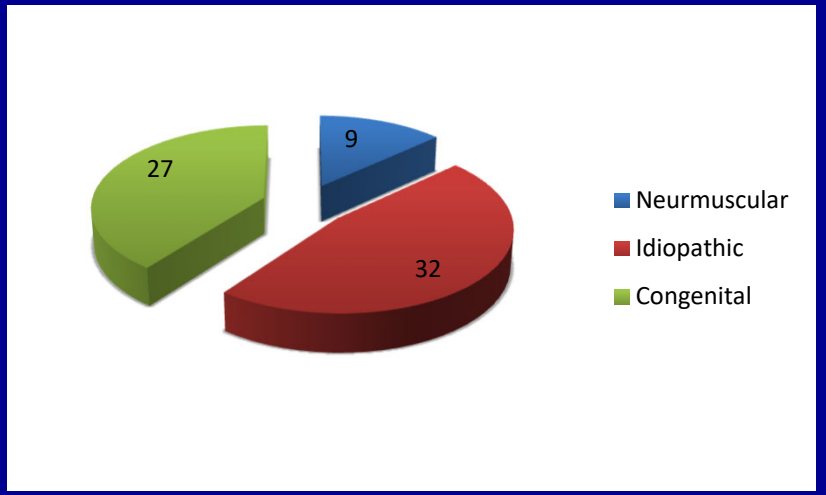
- MEPs – present Vs absent
  - Surgeon informed if ≥ 80% drop from baseline
  - Prospectively studying other thresholds

METHODS

- Prospective series of 70 consecutive operative procedures on EOS Pts
  - Jan 2003 – Dec 2012
    - All surgeons within the spine division
  - Neurophysiology database
  - Retrospective case notes review
  - Retrospective radiology review

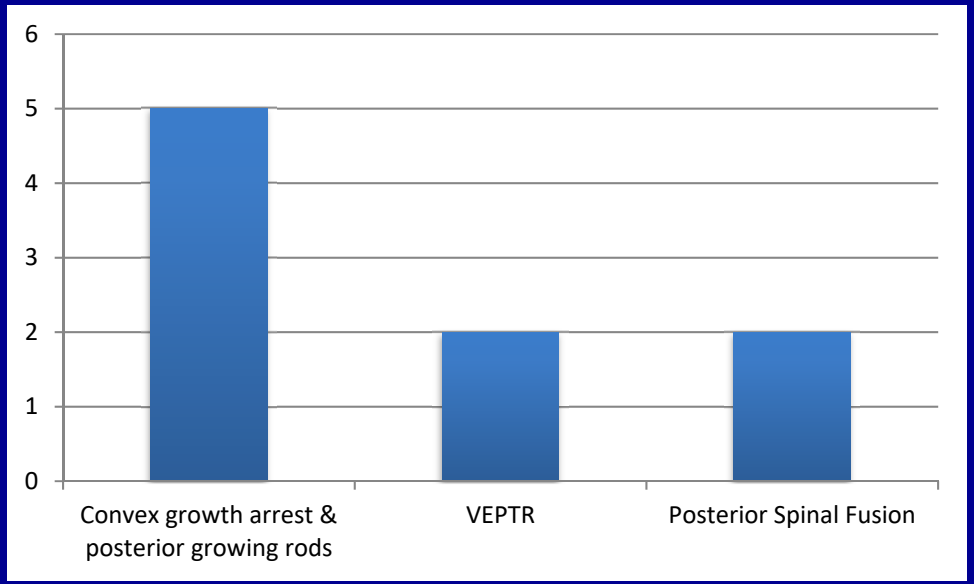
RESULTS

- 70 patients
  - 37 males, 33 females
- Mean age 4 years



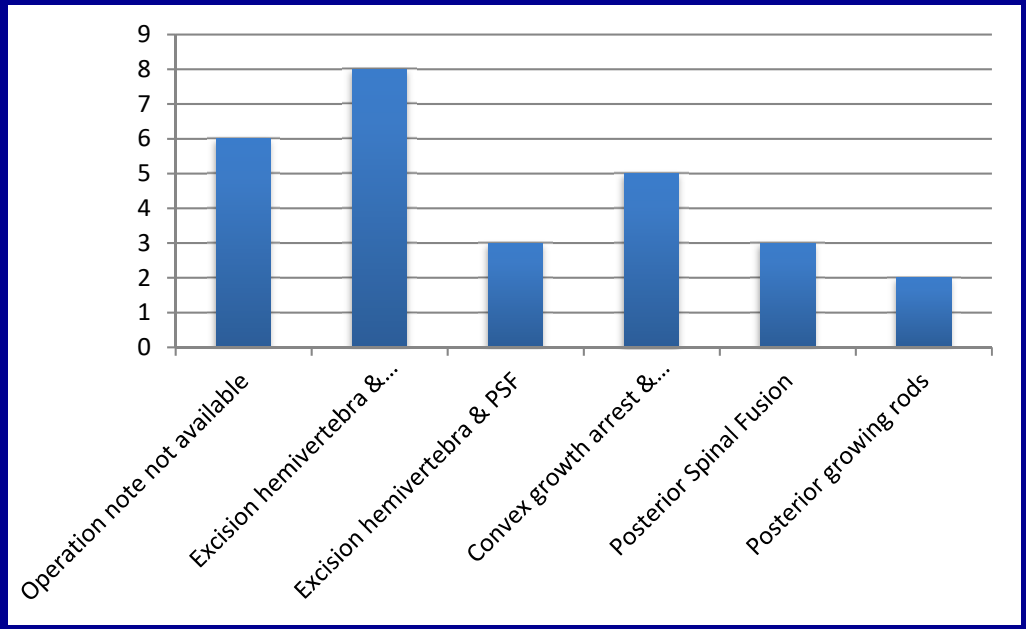
Neuromuscular Cases (n=9)

- Monitoring
  - 2 dual
  - 7 SEPs only
  - 0 alerts



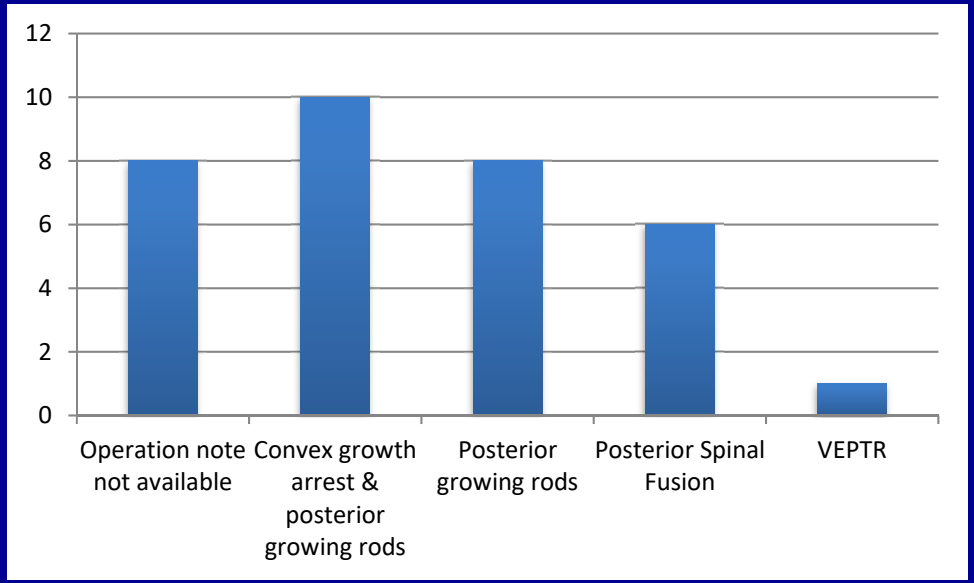
Congenital Cases (n=27)

- Monitoring
  - 14 MEPs & SEPs
  - 8 alerts
    - 5 dual monitored
    - 5 false +ves
    - 3 other cases – SCM normalized 2° to loosening instrumentation
    - No post-op deficits



Idiopathic Cases (n=32)

- Monitoring
  - 15 MEPs & SEPs
  - 4 alerts
    - 2 dual monitored
    - 0 false +ves
    - 4 cases – SCM normalized
      - 3 following correction MAP
      - 1 following surgical manoeuvre
    - No post-op deficits



DISCUSSION

- SCM is of value in surgical Tx of EOS
  - No cases of post-op deficits in this series
- SCM alerts are more common in congenital cases
  - 30% of congenital cases (Vs 12.5% idiopathic)
- False +ve alerts common in congenital cases
  - 62.5% of alerts (Vs 0% of alerts in idiopathic cases)
  - ?due to ↑frequency of neural axis / vascular abN

- Trend towards monitoring alerts in larger curves
  - SCM alerts Cobb =72° (Vs 63°)
- Sublaminar wires highly associated with monitoring alerts
  - 75% cases
- Series too small to permit
  - Further subgroup analysis
  - Sensitivity / specificity analysis

CONCLUSION

- Dual modality SCM is the standard of care in the surgical Tx of EOS
- Correction of congenital scoliosis is associated with
  - More frequent SCM alerts
  - More false +ve alerts
- SCM alerts while useful to guide surgeons
  - NOT an alternative to a wakeup test

REFERENCES

1. Sutter M, Eggspuehler A, Grob D, Jeszenszky D, Benini A, Porchet F, Mueller A, Dvorak J. The diagnostic value of multimodal intraoperative monitoring (MIOM) during spine surgery: a prospective study of 1,017 patients. Eur Spine J. 2007 Nov;16 Suppl 2:S162-70.

2. Pelosi L, Lamb J, Grevitt M, Mehdian SM, Webb JK, Blumhardt LD. Combined monitoring of motor and somatosensory evoked potentials in orthopaedic spinal surgery. Clin Neurophysiol. 2002 Jul;113(7):1082-91.

3. Gavaret M, Trébuchon A, Aubert S, Jacopin S, Blondel B, Glard Y, Jouve JL, Bollini G. Intraoperative monitoring in pediatric orthopedic spinal surgery: three hundred consecutive monitoring cases of which 10% of patients were younger than 4 years of age. Spine (Phila Pa 1976). 2011 Oct 15;36(22):1855-63.

4. Feng B, Qiu G, Shen J, Zhang J, Tian Y, Li S, Zhao H, Zhao Y. Impact of multimodal intraoperative monitoring during surgery for spine deformity and potential risk factors for neurological monitoring changes. J Spinal Disord Tech. 2012 Jun;25(4):E108-14.

5. Noonan KJ, Walker T, Feinberg JR, Nagel M, Didelot W, Lindseth R. Factors related to false- versus true-positive neuromonitoring changes in adolescent idiopathic scoliosis surgery. Spine (Phila Pa 1976). 2002 Apr 15;27(8):825-30.

6. Loder RT, Thomson GJ, LaMont RL. Spinal cord monitoring in patients with nonidiopathic spinal deformities using somatosensory evoked potentials. Spine (Phila Pa 1976). 1991 Dec;16(12):1359-64.

7. Wilson-Holden TJ, Padberg AM, Lenke LG, Larson BJ, Bridwell KH, Bassett GS. Efficacy of intraoperative monitoring for pediatric patients with spinal cord pathology undergoing spinal deformity surgery. Spine (Phila Pa 1976). 1999 Aug 15;24(16):1685-92.

8. Hammett TC, Boreham B, Quraishi NA, Mehdian SM. Intraoperative spinal cord monitoring during the surgical correction of scoliosis due to cerebral palsy and other neuromuscular disorders. Eur Spine J. 2013 Mar;22 Suppl 1:S38-41.

9. Legatt AD. Current practice of motor evoked potential monitoring: results of a survey. J Clin Neurophysiol. 2002 Oct;19(5):454-60.