Blink Reflex and Laryngeal Adductor Reflex for Posterior Fossa Intraoperative Neuromonitoring in Children: Challenges and Advantages

Santa-Cruz, D. ; Morales-Sánchez, A.; Sánchez Roldán, M.A.; Rahnama, K.; Mora, F.; Moncho, D.

Clinical Neurophysiology, Hospital Universitari Vall d'Hebron, Barcelona, Spain

Introduction

The posterior fossa surgery is especially difficult due to the interconnected anatomy located in a small space, with neural pathways that usually lacks redundancy, and hence a major probability of important neurologic injuries.

In IONM, as a novel part of the multimodal approach, brainstem reflexes offer a continuous vigilance to the integrity of some cranial nerves and their pathways.

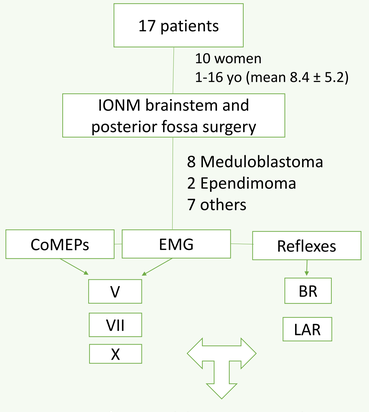
In children who underwent fourth ventricle surgery, the risk of a permanent lower cranial nerve injury is 15% (1). Even though overall IONM techniques in children, does not differ significantly from adults, they present challenges.

Our aim

To describe the technical parameters and findings of blink reflex (BR) (2,3) or trigemino-facial reflex and laryngeal adductor reflex (LAR) (4,5) in children during the IONM of brainstem and posterior fossa surgery.

Methods and Materials

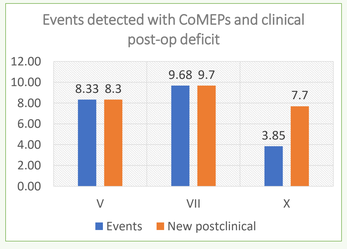
Retrospective study

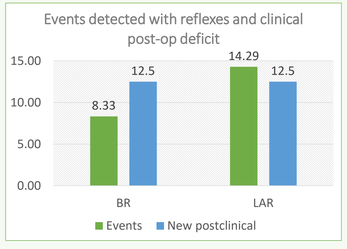


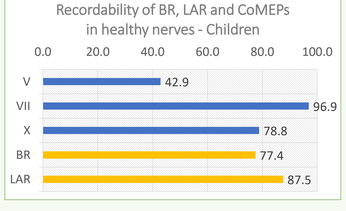
- ✓ 1st modality to raise an alert
- ✓ Elicitability
- ✓ Outcome and events
- ✓ Technical difficulties
- ✓ Latencies and amplitudes: BR, LAR

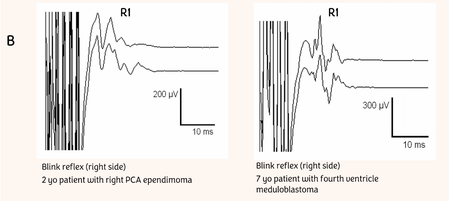
Results

4 IONM events were detected, with reflexes and free-running EMG being the first to raise the alarm (complete loss or >50 % amplitude decrement) before the CoMEPs.









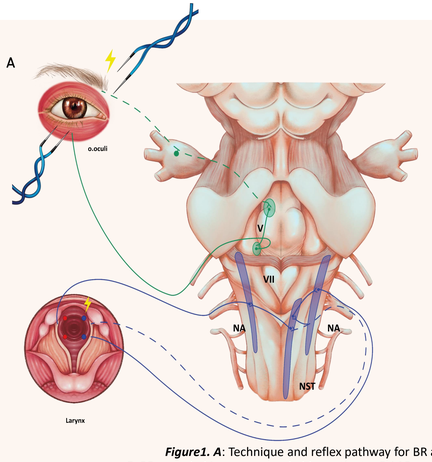
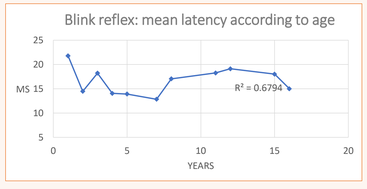
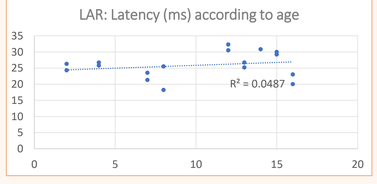
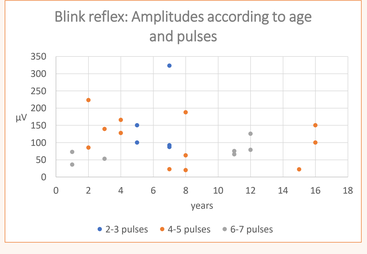
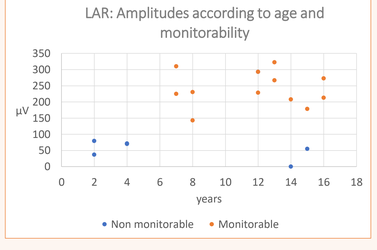


Figure1. A: Technique and reflex pathway for BR and LAR. ***B.*** BR recorded in younger and older patients. ***C***: LAR recordeD in younger and older patients.









BR: Elicitability of 77.4 %. A short train of 3-7 pulses, 200-1000 ms duration, 2 ISI and 8-30 mA intensity range was used for stimulation. The mean latency was 16.44 ms (±3.05). **The technical limitations included stimulation needle set-up and the administration of intravenous boluses of sedative anesthetics.**

LAR: Not monitorable in patients younger than 7 years due to **lack of two-channel adhesive electrodes** for endotracheal tubes < 5 mm diameter. A single pulse, 200-1000 ms duration, and intensities between 9-30 mA were used for stimulation. **The cR1 was recordable in 87.5%** (mean latency 24.3 ms, ± 5.5).

Discussion

Challenges

- **Maturation**: Immaturity of the developing nervous system in younger children. But seems that LAR and BR (only R1 recorded under anesthesia) are vital reflexes that sooner assemble to parameters found in adults. (6,7)
- The capability of detecting events depends on good technique and **appropriate material. For tube-based LAR methodology**, there is a lack of adequate electrodes for smaller tube diameters. Especially in hospitals where ENT surgeons cannot help with the placement of hook wires in vocal cords. (5).

Advantages

- Overall, **similar to the findings described in adults**.
- BR and LAR, **combined with CoMEPs** monitoring of VII and X, have **better functional preservation rates** (1,5).
- Gives a **better understanding** of functionality and maturation of the nervous system.

There are just a few studies in literature that describes IONM modalities according to age, to our knowledge this is the first series of children who underwent for posterior fossa surgery, that describes the combination of BR and LAR. As always, more studies are needed with larger samples and prospective design.

Conclusion

Blink and laryngeal adductor reflexes can be elicitable in children and allow real-time monitoring of cranial nerves during posterior fossa surgery. However, they present more technical challenges than in adults, mostly due to endotracheal tube size and the effect of the anesthetic boluses.

References

1. Sala, F., Coppola, A. & Tramontano, V. Intraoperative neurophysiology in posterior fossa tumor surgery in children. *Child's Nervous System* **31**, 1791–1806 (2015).
2. Deletis, V. *et al.* The feasibility of recording blink reflexes under general anesthesia. *Muscle Nerve* **39**, 642–646 (2009).
3. Deletis, V., Shils, J. L., Sala, F. & Seidel, K. *Neurophysiology in neurosurgery : a modern approach*.
4. Téllez, M. J. *et al.* Neurophysiological monitoring of the laryngeal adductor reflex during cerebellar-pontine angle and brainstem surgery. *Clinical Neurophysiology* **132**, 622–631 (2021).
5. Costa, P., Gaglini, P. P., Tavormina, P., Ricci, F. & Peretta, P. A method for intraoperative recording of the laryngeal adductor reflex during lower brainstem surgery in children. *Clinical Neurophysiology* vol. 129 2497–2498 Preprint at https://doi.org/10.1016/j.clinph.2018.08.028 (2018).
6. Hatanaka, T., Yasuhara, A. & Kobayashi, Y. *Electrically and mechanically elicited blink reflexes in infants and children-maturation and recovery curves of blink reflex*. *Electroencephalography and clinical Neurophysiology* vol. 76 (1990).
7. Tomita, Y., Shichida, K. ichi, Takeshita, K. & Takashima, S. Maturation of blink reflex in children. *Brain Dev* **11**, 389–393 (1989).

Contact
danielaisabel.santacruz@vallhebron.cat
Daniela I. Santa Cruz