

The contribution of Brainstem Reflexes in multimodal IONM.

A case series experience in a teaching hospital

Morales-Sánchez, A.* ; Santa-Cruz, D.* ; Sánchez Roldán, M.A.; Rahnama, K.; Mora, F.; Moncho, D.
Clinical Neurophysiology Department, Hospital Universitari Vall d'Hebron, Barcelona (Spain). *Both authors contributed equally

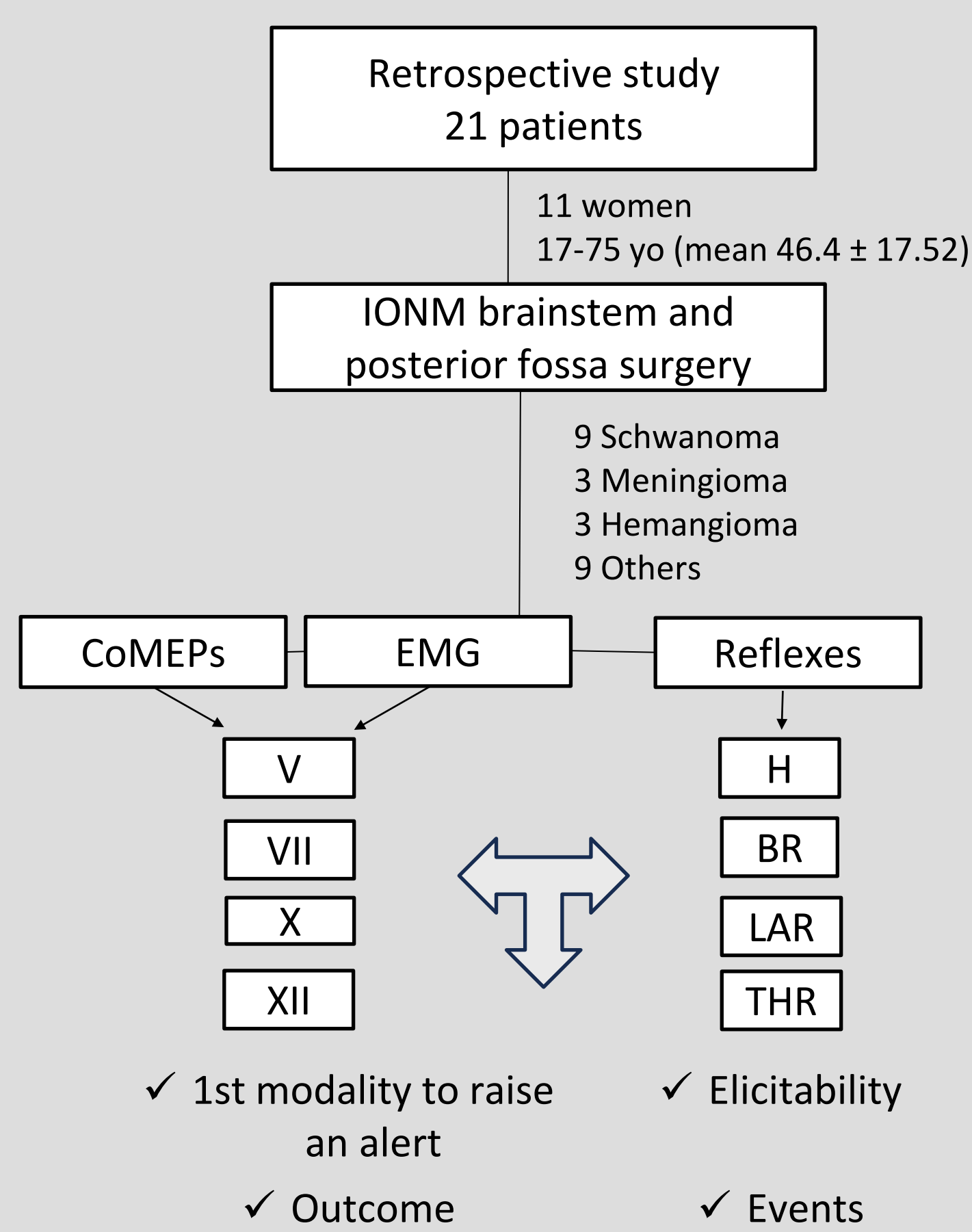
INTRODUCTION

Studying **brainstem reflexes** has allowed us to understand the functionality and interconnections of some cranial nerves and brainstem structures. Additionally, they can **evaluate sensory fibers** in the afferent arch of cranial nerve reflexes. Brainstem reflexes and other intraoperative neurophysiological monitoring techniques may provide a **more complete assessment to preserve function** after interventions *Figure 1*.

Our aim:

To analyze the **contribution of brainstem reflexes in multimodal intraoperative neuromonitoring (IONM)**, including the **blink reflex (BR)**, **H masseter reflex (H)**, **trigeminal hypoglossal reflex (THR)**, and **laryngeal adductor reflex (LAR)**, during the monitoring of brainstem and posterior fossa surgeries.

METHODS AND MATERIALS



	Warning Criteria
CoMEP BR LAR	Loss of signal or ≥ 50% of amplitude decrement
THR H	Loss of signal
Free-EMG	Neurotonic discharges

	Technical parameters	
	Stimulation	Recording
CoMEP	Transcranial stimulation (C3-C4/Cz) with a short train of 3-5 pulses, duration 0.5 ms, ISI 2 ms	Masseter, facial, styloglossus muscle and vocal cords
BR	Supraorbital foramen, short train 3-5 st, ISI 2 ms, 20-40 mA	O. oculi muscle
LAR	A pair of electrodes attached to the ET Single pulse, 9-30 mA	Contralateral pair of ET electrodes
THR	Under the zygomatic arch, 0.5 cm anterior to the temporo-mandibular joint. Short train, ISI 2 ms	Styloglossus muscle
H	Similar location to THR, single pulse	Masseter muscle

RESULTS

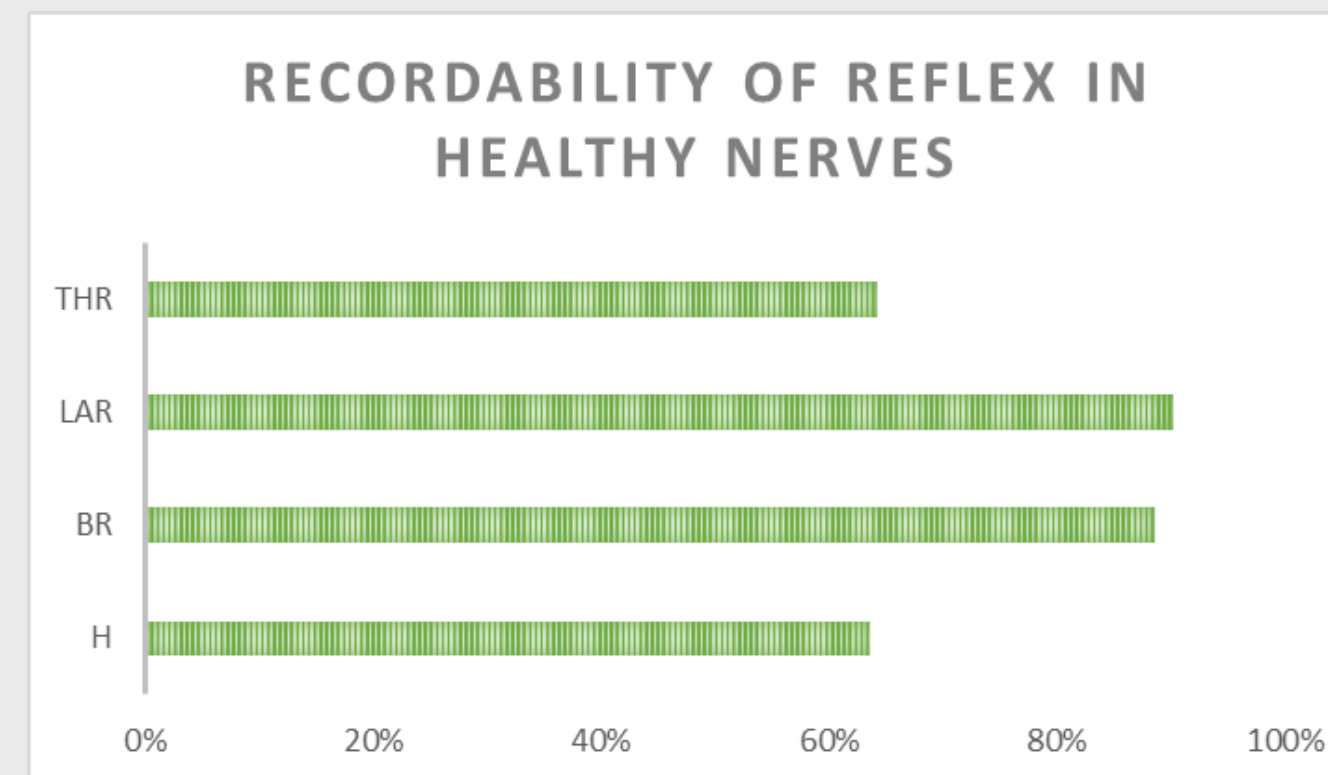


Chart 1.
Recordability of brainstem reflexes

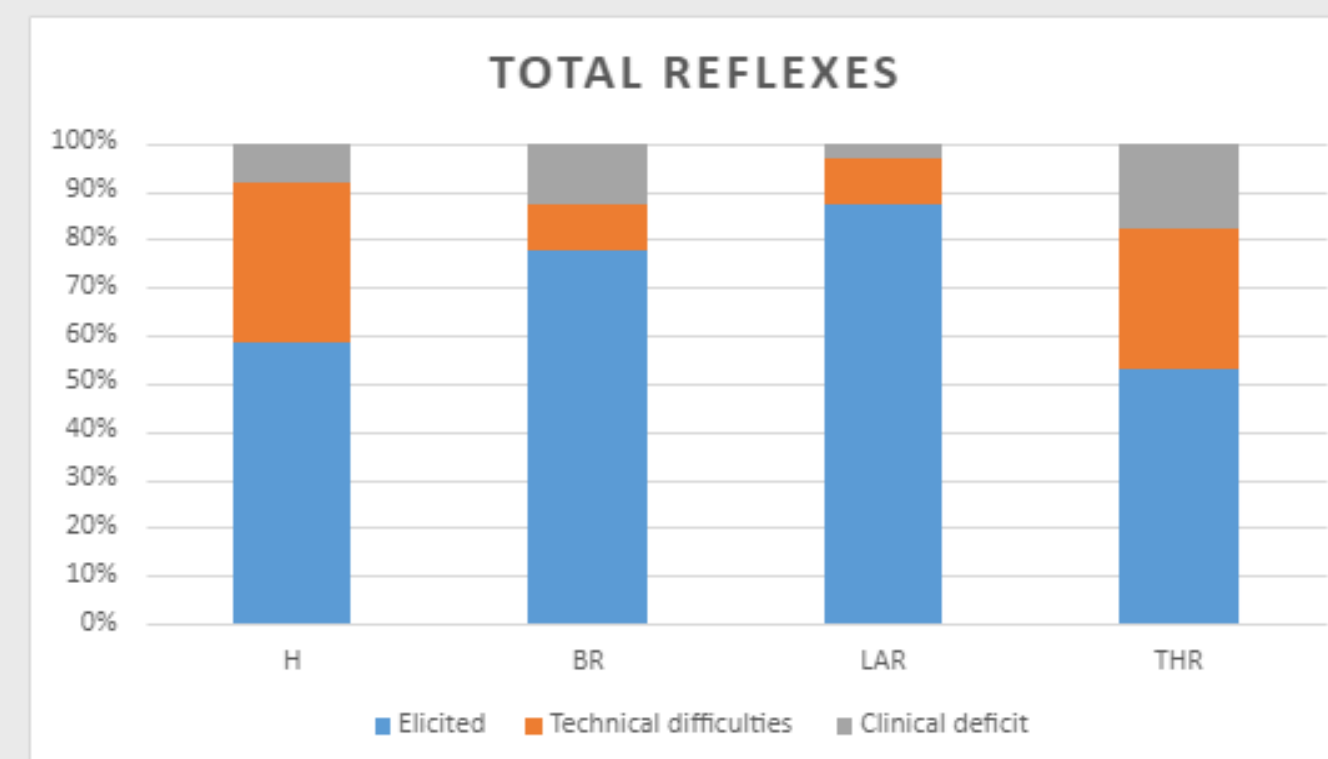


Chart 3.
Acquisition of brainstem reflexes

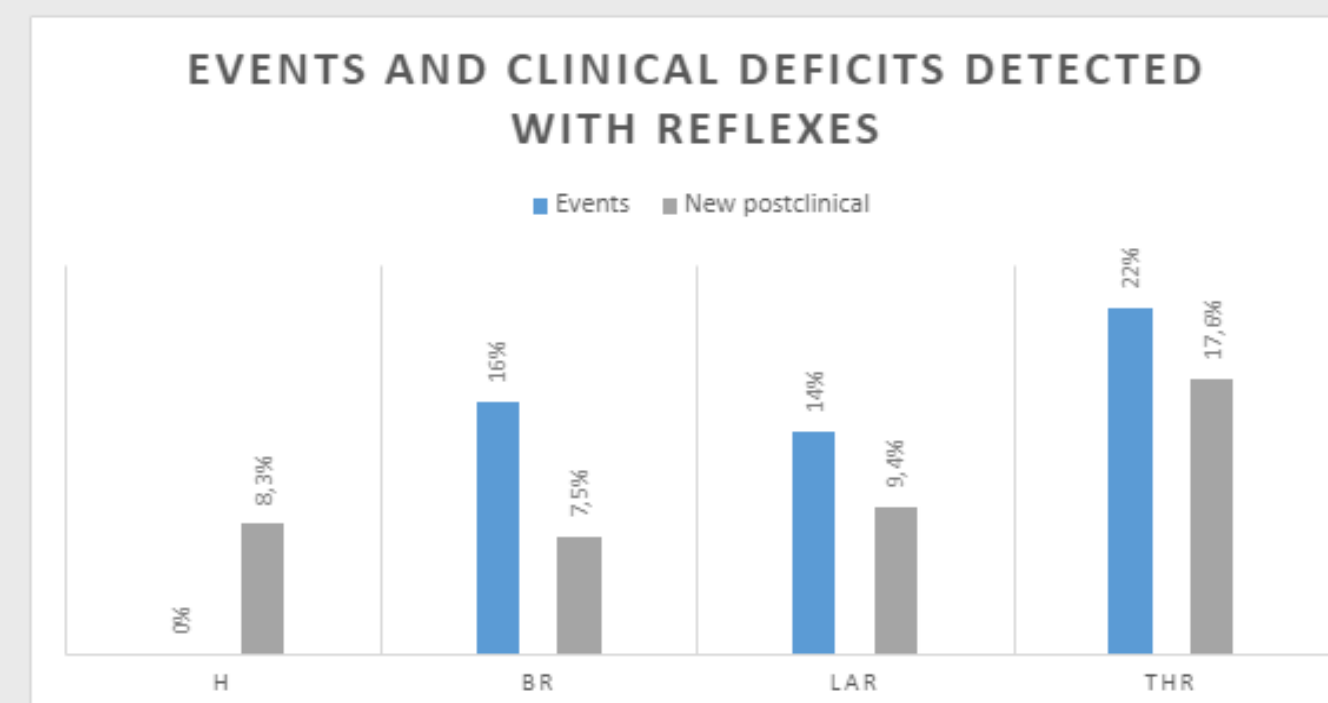


Chart 5.
Event detection using brainstem reflexes

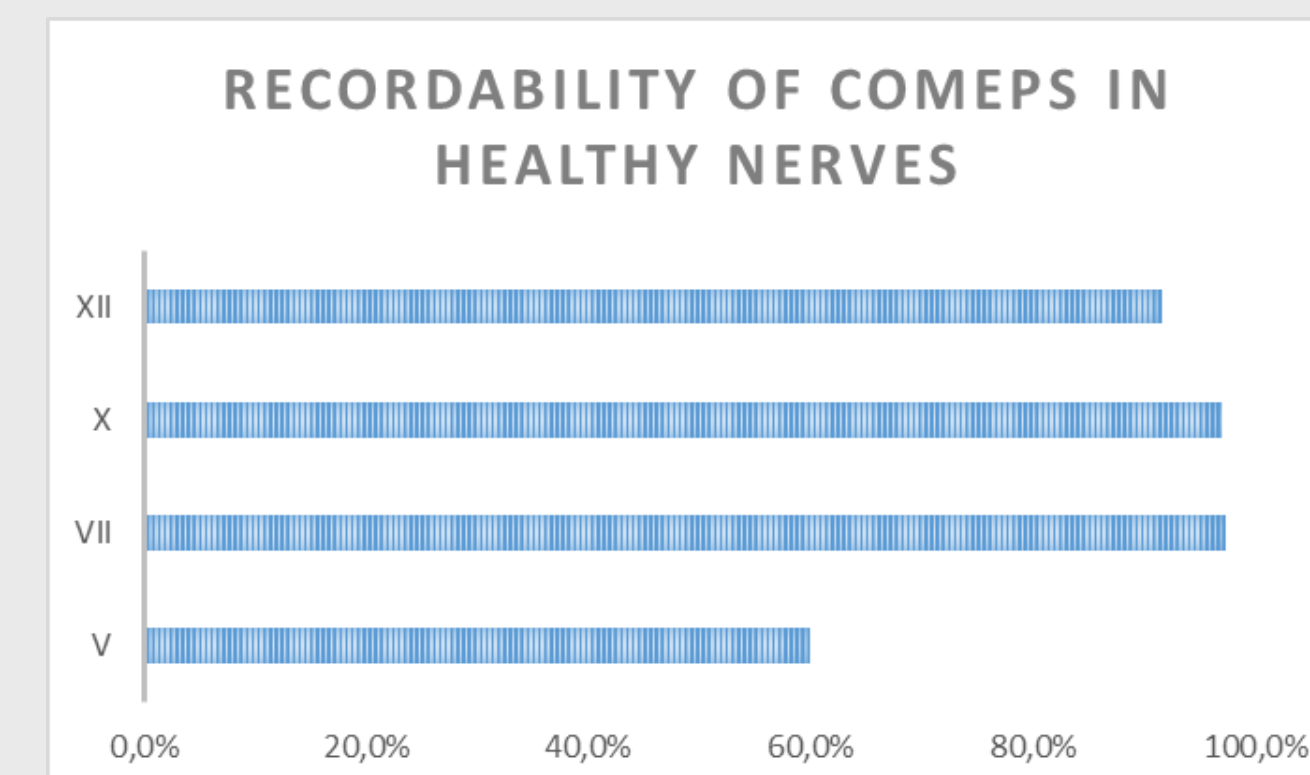


Chart 2.
Recordability of CoMEPs

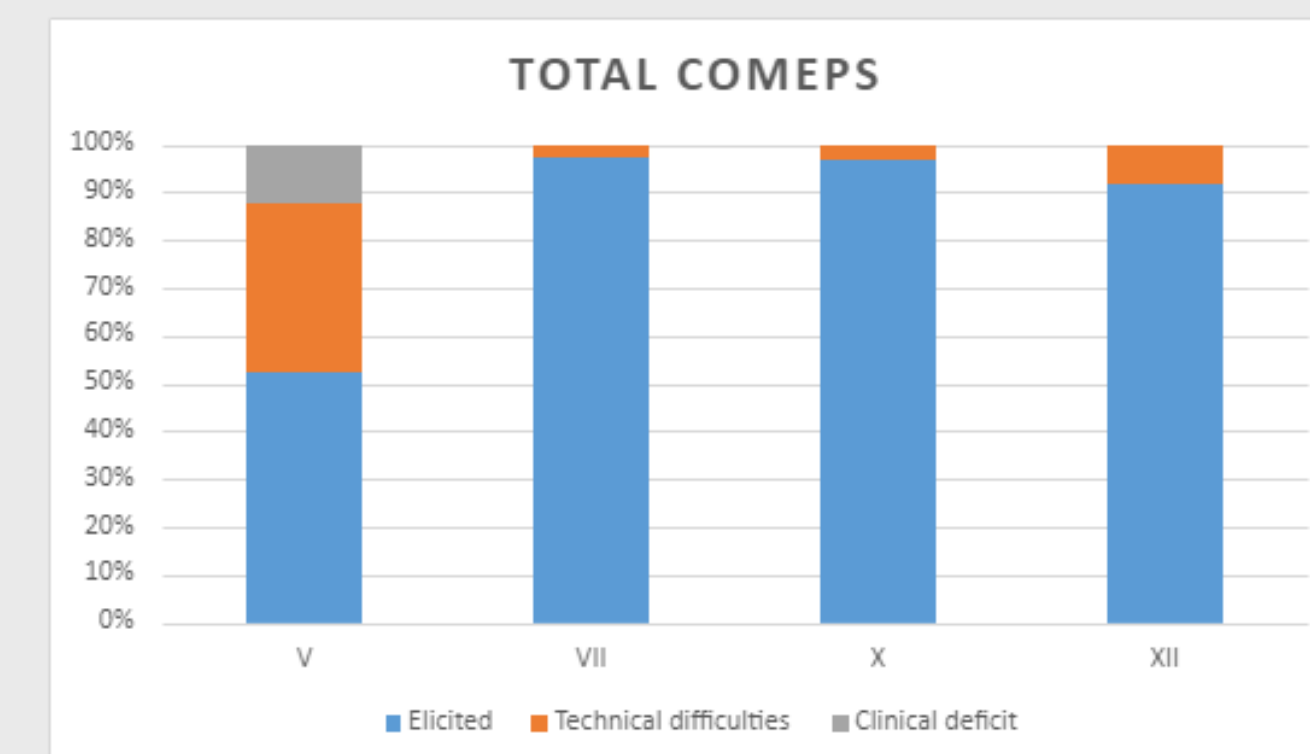


Chart 4.
Acquisition of CoMEPs

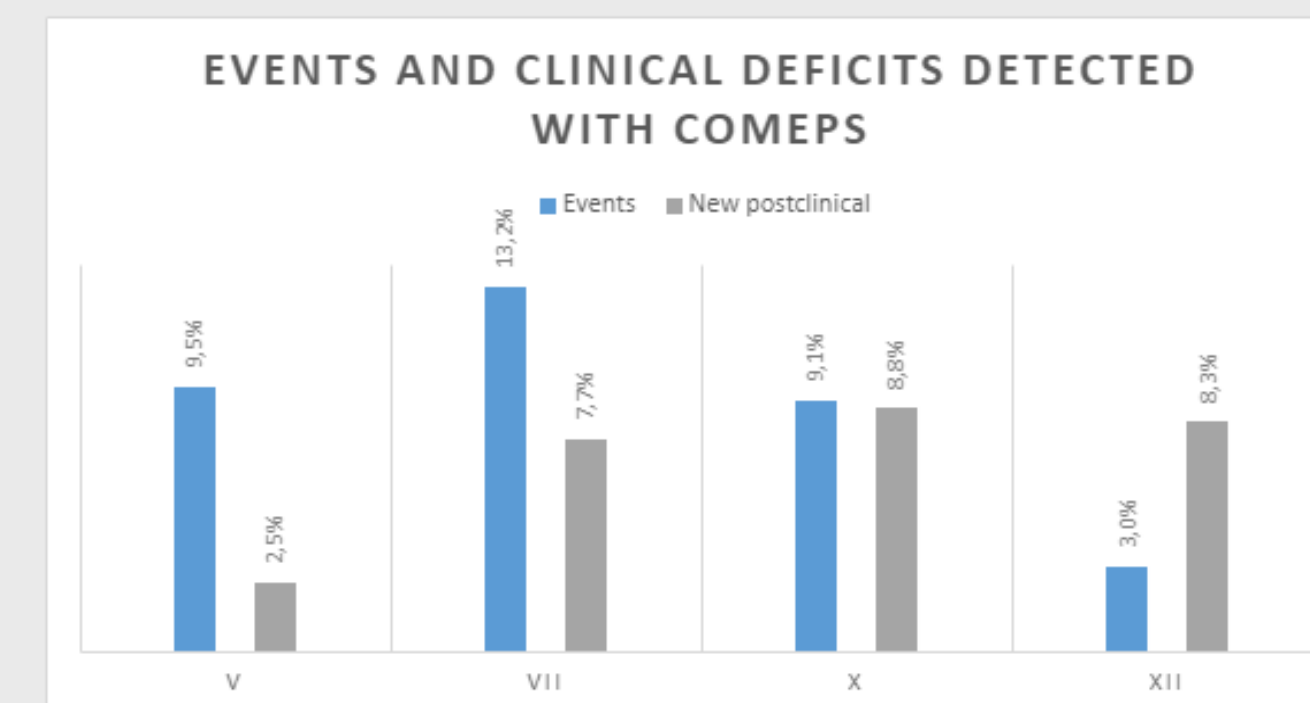


Chart 6.
Event detection using CoMEPs

DISCUSSION

- First series that evaluates the role of all brainstem reflexes in posterior fossa surgery together.
- Real-time monitoring: The main finding of this study was that **brainstem reflexes had more probability to raise an alert than CoMEPs**.
- The brainstem reflexes presented **more technical difficulties than CoMEPs as a group**. THR and H-reflex were the most challenging to obtain, meanwhile LAR and BR showed a high elicibility.
- Comparing this study to previous reports, the recordability of BR and LAR was similar^{2,3}, but it was lower for the THR⁴ and H reflex⁵.
- Improving techniques will increase the capability of detecting events, although elicibility of reflexes does not only rely on technique, but also on **appropriate material**. For instance, in the trigeminal reflex, most of stimulations in our sample were not elicited using insulated needle electrodes, as it is recommended in other studies for the H and THR.
- A larger sample and prospective studies are needed to standardize a homogenous technique, which would help us to evaluate the diagnostic power of these IONM modalities, study them as biomarkers and create a suitable alert criteria.

CONCLUSIONS

Brainstem reflexes represent a useful tool for monitoring cranial nerves during brainstem and posterior fossa surgeries, as they can be the first to raise an IONM alert and present good correlation with postoperative outcome. Like CoMEPs, they might not always be recordable and depend on proper technical development and training.

REFERENCES

- Fernández-Conejero, I. Corticobulbar motor evoked potentials in skull base surgery. In: Shiis, Deletis V. Neurophysiology in neurosurgery: A modern approach. 2a ed. Deletis V, Shiis JL, Sala F, Seidel K, editores. San Diego, CA, Estados Unidos de América: Academic Press; 2020. p.137-148.
- Téllez MJ, Mirallave-Pescador A, Seidel K, Urriaza J, Shoakazemi A, Raabe A, Ghatan S, Deletis V, Ulkatan S. Neurophysiological monitoring of the laryngeal adductor reflex during cerebellar-pontine angle and brainstem surgery. Clin Neurophysiol. 2021 Feb;132(2):622-631. doi: 10.1016/j.clinph.2020.10.021. Epub 2020 Nov 19. PMID: 33272821.
- Deletis V, Urriaza J, Ulkatan S, Fernandez-Conejero I, Lesser J, Misita D. The feasibility of recording blink reflexes under general anesthesia. Muscle Nerve. 2009 May;39(5):642-6. doi: 10.1002/mus.21257. PMID: 19347924.
- Mirallave Pescador A, Téllez MJ, Sánchez Roldán MLÁ, Samusyte G, Lawson EC, Coelho P, Lejarde A, Rathore A, Le D, Ulkatan S. Methodology for eliciting the brainstem trigeminal-hypoglossal reflex in humans under general anesthesia. Clin Neurophysiol. 2022 May;137:1-10. doi: 10.1016/j.clinph.2022.02.004. Epub 2022 Feb 16. PMID: 35231863.
- Ulkatan S, Jaramillo AM, Téllez MJ, Goodman RR, Deletis V. Feasibility of eliciting the H reflex in the masseter muscle in patients under general anesthesia. Clin Neurophysiol. 2017 Jan;128(1):123-127. doi: 10.1016/j.clinph.2016.10.092. Epub 2016 Nov 5. PMID: 27888745.

CONTACT

danielaisabel.santacruz@vallhebron.cat
anabel.morales@vallhebron.cat