# Safety of intraoperative monitoring in pregnant patient: literature review and brainstem case study

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## INTRODUCTION

**Intraoperative neurophysiological monitoring (IONM) refers to techniques used to assess neural pathways in multiple surgical fields.**

**IONM does not avoid harm but helps to alert the surgeons when there is a certain level of impairment before it becomes complete or irreversible [(1)].**

**These methods have been explored in the general population and there are limited reports of adverse effects. There are limits and relative contraindication to reduce the risk from these techniques.**

**One area which has limited evidence is the use of IONM in patients who are pregnant, the theoretical risk that electrical stimulation can induce contractions of the uterus or have adverse effects on the foetus [(2)]. This poster explores the current literature and presents our experience of IOM in pregnant patient undergoing brainstem surgery with IONM.**

## METHODS AND MATERIALS

**An exhaustive search was done in PubMed and Google Scholar for the literature review. Studies retrieved from the search were imported into Zotero, and duplicates were eliminated. After removing duplicates, records were scanned by title, abstract, or both to determine which studies should be evaluated further by full-text screening according to the pre-established inclusion criteria.**

### Multimodal IONM included:

- **Transcranial motor evoked potentials (TcMEPs)**
- **Corticobulbar motor evoked potentials (CoMEPs)**
- **Somatosensory evoked potentials (SSEPs)**
- **Free-run electromyography (frEMG)**
- **Brainstem auditory evoked potentials (BAEPs)**
- **Electroencephalography (EEG)**
- **Blink reflex (BR)**
- **Laryngeal adductor reflex (LAR)**

## RESULTS

The search strategy retrieved 121 studies. Duplicates were removed, and after screening by title and abstract, five studies were left, of which four were case reports, and one was a case report and literature review. Three investigated IONM in pregnant patients with brain tumours and two in pregnant patients with spinal cord disease. In all studies, multiple IONM modalities have been performed and no adverse effects were reported to the mother or child intraoperatively nor postoperatively.

**Modalities and techniques [(3)]:**

- **TcMEPs** to monitor the functional integrity of corticospinal tract and its potential compromise, either as a result of ischaemia or direct trauma
- **CoMEPs** to monitor the functional integrity of the corticobulbar tracts, cranial nuclei and nerve efferent pathways
- **SSEPs** to monitor the integrity of the ascending medial lemniscus pathway and may detect vascular compromise etc.
- **frEMG** to detect direct trauma to the cranial nerves and their nuclei caused by surgical manipulation throughout the procedure
- **BAEPS** to monitor the integrity of the auditory portion of cranial nerve VIII and to detect brainstem ischaemia/injury
- **EEG** to monitor depth of anaesthesia and cerebral perfusion, as well as potential seizure activity
- **Blink reflex (BR)** to assess the functional integrity of the anatomical structures involved in the reflex arc in real time
- **Laryngeal adductor reflex (LAR)** to assess the functional integrity of the sensory and motor fibers/nuclei of vagus nerve and reflexive medullary pathways

## CASE STUDY

Our case study presents a 31yo pregnant women in 20th week (+/-6 days) of pregnancy with an extra-axial brainstem tumour who presented with nausea and vomiting with use of multimodal IONM monitoring.

After extensive discussion about potential risks of procedure and IONM with surgical, anaesthetic and OBY-GYN teams it was agreed for IONM plan to be consisted of TcMEPs, CoMEPs (CNs V-XII bilaterally), SSEPs, frEMG, BAEPs, blink reflex, LAR and EEG throughout the intraoperative period as the tumour was adherent and potentially invading the brainstem (Figure 1).

It was decided not to perform triggered EMG if tumour was not invading the brainstem (Figure 2.). Surgical team decided foetal heart rate monitoring will not be performed as foetus of 20+/-6days of gestational age is not considered viable. Important to note, discussion was also had with the patient about potential risks and complications prior proceeding with the procedure.

**General anaesthesia** consisted of injection of Atracurium (0.5mg/kg) to facilitate intubation followed by titration of propofol (3.5mg/kg/hr) and fentanyl (1.5mcg/kg/hr) with BIS maintained between 30 and 45, with monitoring of arterial blood pressure (BP), electrocardiogram (ECG), SpO2, BIS, TOF and temperature

Intraoperatively, TcMEPs and CoMEPs were run throughout the procedure counting in total 56 (TcMEPs) and 64 (CoMEPs) traces with no post-stimulation heart rate changes observed in patient throughout the procedure. Spontaneous activity due surgical manipulation was observed during resection on frEMG from cranial nerve motor nuclei X and XII, but it settled each time shortly after surgical pause.
Postoperatively, patient presented with no new neurological deficits, nausea and vomiting issues were resolved and no foetal complications was observed.

- **TcMEPs**
  *(5 pulses, pulse duration 0.5-1ms, 2Hz, 2-4ISI, intensity 40-200mA)*
- **CoMEPs**
  *(3-5 pulses, pulse duration 0.3-0.5ms, 2-3Hz, ITI 60-90ms, 50-150mA)*
- **SSEPs**
  *(1 pulse, 200-500pulse duration, 2.1-5.1 Hz, intensity 30-45mA)*
- **Blink reflex**
  *(1-7 pulses, ISI 2, 0.4Hz, pulse duration 0.3-0.5ms, intensity 20-40mA)*
- **LAR**
  *(1-3 pulses, ISI 1-2, pulse duration 0.5-1ms, intensity 3-20mA)*
- ***FrEMG, BAEPs, EEG***

**Figure 1. IONM modalities and parameters performed**

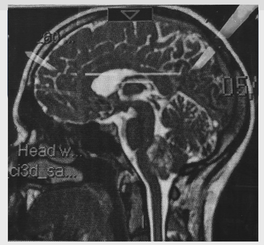


**Figure 2. MRI scan (sagittal)**

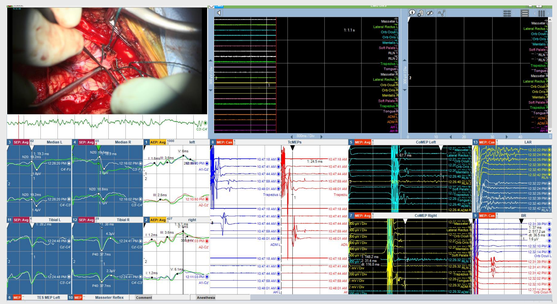

**Figure 3. Baseline responses**

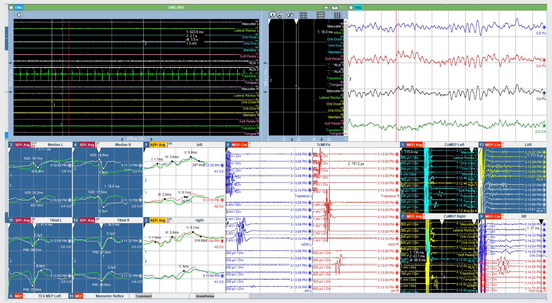

**Figure 4. Final responses**

## CONCLUSIONS

This review summaries techniques which have been shown to have no adverse effects on pregnant patients and our case study adds to the current literature showing that additional highly specialised techniques can also be performed.

Optimising stimulation parameters and avoiding unnecessary excessive stimulation during the procedure are some of the strategies to be considered in similar cases.

The evidence is still very limited, and more research is needed into the effects of IONM in pregnant patients. It would be recommended by the authors that until there is sufficient evidence foetal HR should be performed to optimise the detection of adverse effects.

## REFERENCES

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