



# Prevention of Progressive Deterioration of Motor Evoked Potentials During General Anesthesia

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## Introduction

The increasing frequency and complexity of spinal column corrective procedures have aided the advancement of evoked potential monitoring (1). The effectiveness of somatosensory evoked potentials (SSEPs) and motor evoked potentials (MEPs) to detect iatrogenic cord ischemia during surgical manipulation has been well established (2, 3). Detection followed by corrective measures can limit and/or prevent iatrogenic injuries associated with instrumentation during these corrective surgical procedures.

While SSEPs and MEPs individually have limitations in detection and prediction (4, 5), the combination of evoked potentials (EPs), or multimodal intraoperative modalities (MIOM), increases the efficacy and predictive value during spinal column corrective procedures (6, 7).

The routine use of EPs necessitates anesthetic regimens that provide analgesia, hypnosis, anesthesia and immobility, while preserving the quality of EPs. The evidence that anesthetic duration and concentration, effects and/or deteriorates EPs (1, 7) has led to anesthetic regimens developed to limit the effects of anesthetics on evoked potentials.

The observed effects of general anesthesia causing deterioration of evoked potentials has been described (1, 7), and this "anesthetic fade" has been quantified per anesthetic hour (9).

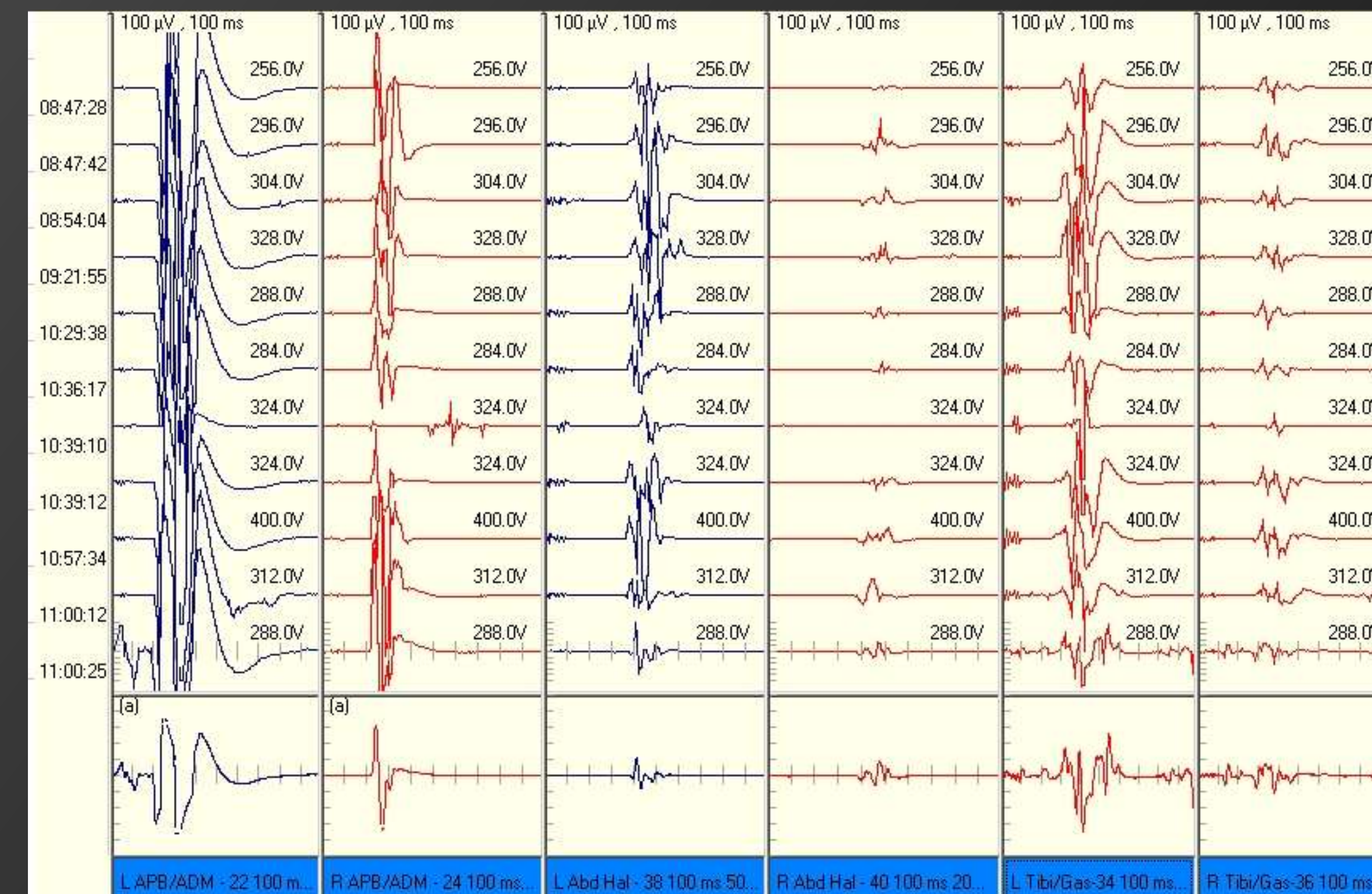
At our institution the use of total intravenous anesthesia (TIVA), propofol and remifentanyl infusions, or combined with 0.4 MAC or less of a volatile agent has been the mainstay of our anesthetic technique with good success in maintaining the efficacy of EPs.

Dose response studies have shown that the ED50 of methohexital as a supplement to 67% nitrous was 50-65 mcg/kg/min and 100mcg/kg/min when used alone. A significant preservation of MEPs was seen with methohexital compared to a propofol infusion (53% vs. 14%) (8).

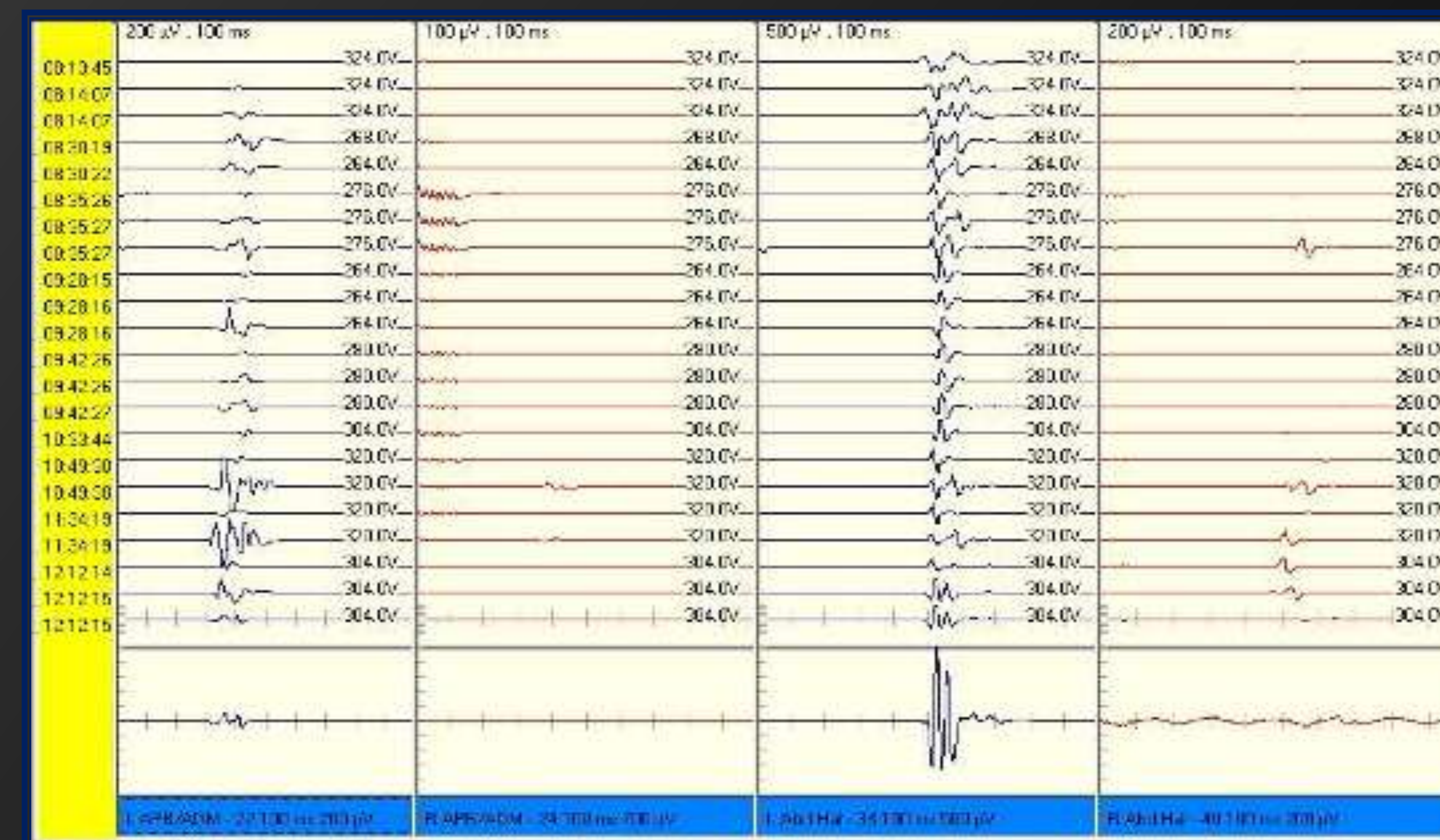
Methohexital being at least equal or a potentially superior agent, was chosen as a substitute for propofol and dexmedetomidine, secondary to the need for an alternative agent due to the shortage of both agents and the cost profile of dexmedetomidine.

## Discussion

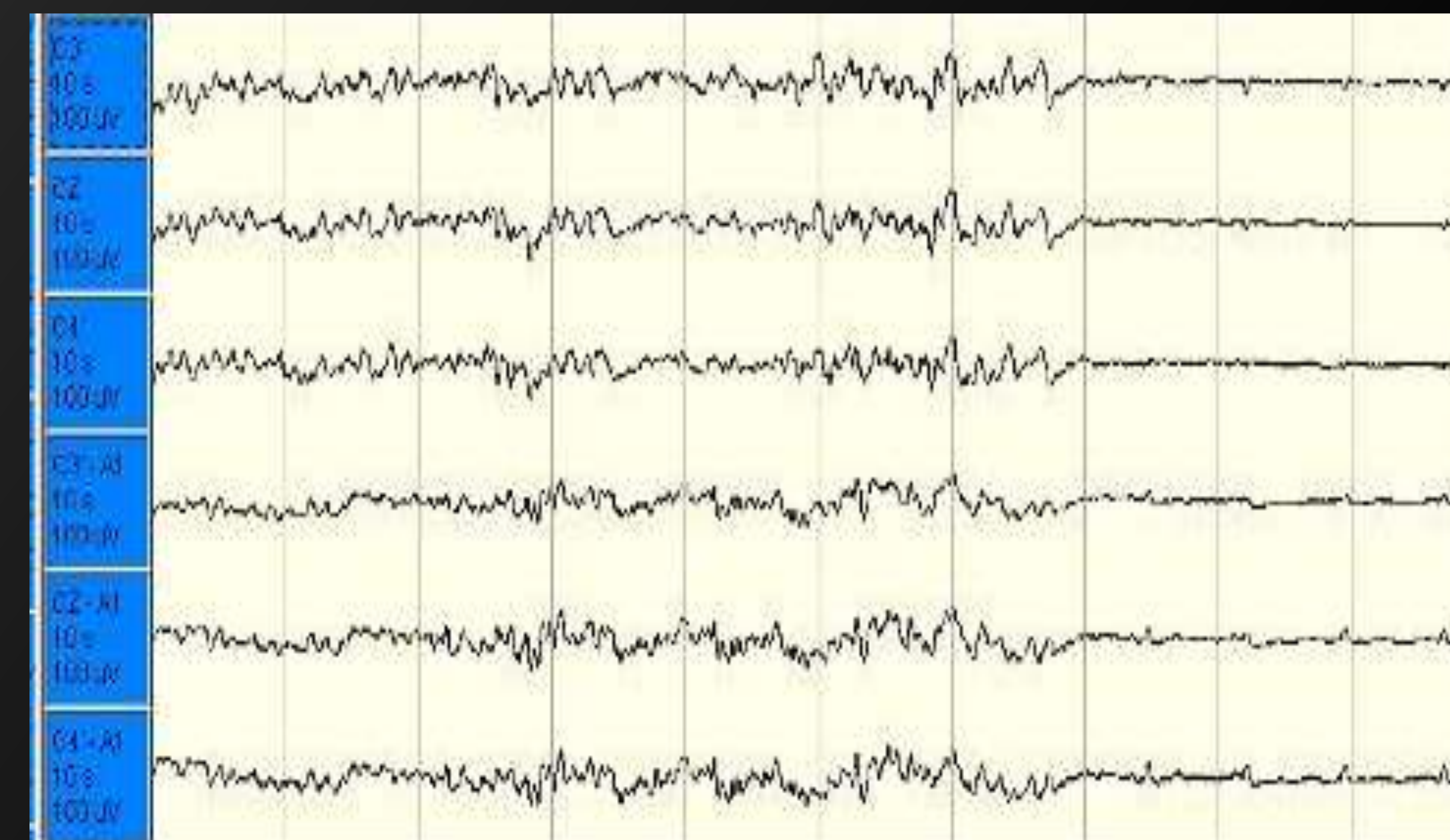
Our observations in more than 40 patients who underwent either anterior and/or posterior cervical, thoracic or lumbar spinal corrective procedures, were administered an anesthetic regimen of 0.3-0.4 MAC of volatile agent (sevoflurane or desflurane), remifentanyl infusion (0.1-0.3 mcg/kg/min) and a methohexital infusion (35-75 mcg/kg/min).



Stack panel of MEPs showing 100µV cMAPs



Stack panel of MEPs showing 100, 200 and 500µV cMAPs



EEG showing depth of anesthesia

## Discussion

The voltage stimulus needed to induce a 100microV cMAP did not significantly increase over the course of the anesthetic, even for operative times greater than 8 hours.

The quality of responses was maintained with measured cMAP responses of 200 and 500microV (see figures). The degradation of MEPs that has been described during general anesthesia, using volatile agents with infusion combinations or TIVA alone, was not present with our anesthetic regimen. Previous examples of "anesthetic fade" of MEPs used 50microV cMAPs as a minimum standard. Our minimum standard for cMAPs was 100microV.

Concomitantly measured SSEPs show similar resilience. Measured EEG activity provided monitored evidence as to the depth of anesthesia. Burst suppression was often seen with methohexital infusions rates greater than 60mcg/kg/min.

## Conclusion

Our observations suggest that the deterioration and/or the abolition of MEPs that can occur during a general anesthetic, can be prevented by administering an anesthetic regimen using remifentanyl and methohexital infusions along with sub-MAC volatile agents. Our observations additionally imply methohexital may be a preferred agent to propofol or dexmedetomidine. Its substitution for propofol or dexmedetomidine averts deterioration of MEPs during general anesthesia and measured cMAPs can be as high as 500microV.

Also of note, this regimen was effective in maintaining the integrity of SSEPs and provides an adequate depth of anesthesia, evidenced clinically and via EEG monitoring (see figure). This regimen may be superior to others that use propofol or dexmedetomidine as infusions and is promising for institutions that conduct complex spine corrective procedures, even with extended operative times.

## References

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