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Review Article

Intraoperative Neurophysiological Monitoring closer to neurosurgeon. Perspective.

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Abstract

Intraoperative Neurophysiological Monitoring helps Neurosurgeons, Orthopedics and Anesthesiologists to achieved better post-surgical outcomes. Here I encompass some very important aspects that in my opinion Neurosurgeons should not be missed if a correct monitoring is expected. Some variables that can enrich Intraoperative Neurophysiological Monitoring are mentioned, like Communication, Video surgery, Neuronavigation, Tractography and Wave classification criteria. Particularities, strength and weakness of neurophysiologic modalities are considered. I also considered what I have learned working inside operating room.

Keywords: intraoperative neurophysiological monitoring; neurosurgeon; neurophysiologist; surgical outcomes

Introduction

Intraoperative Neurophysiological Monitoring is a well-known technique that protects nervous system during neurosurgical interventions [1,2,3,4], it basically applies electrophysiological test to peripheral and central nervous system structures to evaluate its function during surgical intervention. Therefore Anesthesia and Neurosurgery can be enriched with this modality of neurophysiology [1,5].

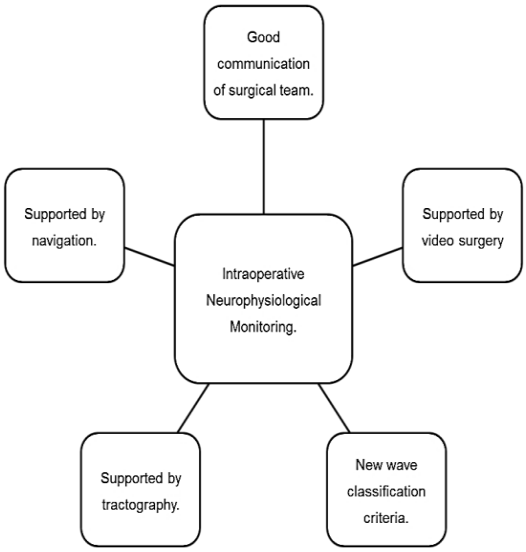

Figure 1. Relationship between Intraoperative Neurophysiological Monitoring and variables that can improve its outcome.

Paragraph: Figure 1 focuses in some aspects that could improve Intraoperative Neurophysiological Monitoring outcomes. I want to emphasize some very important points which cannot be missed if a high-quality monitoring is aimed to be made. First of all a very important encounter that involve the whole surgical team (Neurosurgeons, Neurophysiologist, Anesthesiologist) must take place before each surgery [6]. Here the Neurophysiologist would ask about tumor size because greater tumors could imply greater neural structure involvement [6].

Compression and displacement of neural structures corroborated by images can carry an already malfunctioning neural tissue [7].

Surgical corridors intended for intervention could be interested to neurophysiologist, since during tumor resection this will decide which electro physiologic responses he/she must pay more attention. Also Neurophysiologist must know the methods of each Neurosurgeon; I have learned that some Neurosurgeons prefer to be more drastic concerning tumors resection than others even when considering monitoring events. Each Anesthesiologist needs to be updated with intraoperative monitoring anesthetic technique; this preferably should be done with total intravenous anesthesia [5,8]. Once inside the operating room the anesthesiology should warn neurophysiology personal even when the littlest change is done in anesthetic technique. Inside operating room Neurophysiologist and Anesthesiologist can support each other during monitoring, cardiac rate; respiration rate and blood pressure are very important measures that's relates to neurophysiology monitoring variables [9,10]. Neurosurgeons and Neurophysiologist should function as one; some remarkable good things can be done if communication is of high quality. There are options once some nervous structure has been damage. If the cause of irritation is attended one can wait until the electro physiologic response is back to normal or improve. On the other hand neurosurgeon can think of more suitable surgical corridors if that is possible or continue surgical procedure until a consented surgical team alarm is reached which can depends on previous observations. A recent paper has indicated that classification and alarm criteria of intraoperative signals should be updated; the implication of that observation could act as a protector mostly in complicated and difficult surgeries [11]. Imaging techniques allow several ways of studying nervous system and Neuronavigation and tractography are included. Neuronavigation links real time patient's anatomy with pre and trans-surgical images [12]. Tractography studies neural tracts using calculations that with colors and intensities describe the state of corticoespinal tract, dorsal lemnisci tract etc [13]. Authors that have studied the relationship between imaging and neurophysiology in surgical field have shown good results and improved post-surgical outcomes [14,15]. Intraoperative Neurophysiologic Monitoring can be enriched with imaging techniques, since the former has high temporal resolution and the later has high spatial resolution. One aspect that I have found very useful is video guided surgery, when you are looking at the screen, you can easily relate compression and mechanic displacement to Neurophysiologic Intraoperative Monitoring variables deterioration.

Electromyography is very useful to determine whether cranial nerves are suffering during resection of tumors, but have its limitations. Neurosurgeons should realize that once a cranial nerve is damage, stimulation for evaluating function should be done as proximally to central nervous system as possible, even if disconnected distal segment of the nerve would spread current to muscles since Wallerian degeneration occurs passing seven days, and this could lead to a false sense of intact nerve function [16]. Also neurosurgeon should not always put forward the changes of neurophysiologic signals; neurophysiologic signals are very sensible but nonspecific about the stimulus [17,18]. Even surgery fields occupied by cold water can lead to irritating activity in one nerve; once the cavity is empty the nerve will stop firing.

Intraoperative electromyography monitoring of extra-ocular muscles could be necessary, and neurophysiologist should warn neurosurgeon about the difficulty to study these small muscles. Nevertheless in my opinion and according to some authors this can render worthy results [17]. Sensory evoked potentials are a very important arm of monitoring (visual, somato-sensory and auditory evoked potentials). Taking into account of their own characteristics a patient with a selar tumor could need intraoperative visual monitoring to protect vision; neurosurgeon should be warned about the inaccuracy of this particular technique inside operating room [19]. Nevertheless I have observed that if supported by video surgery this technique is useful. Somatosensory evoke potentials are valuable to protect neurovascular structures like spine and those irrigated by internal carotid artery, anterior cerebral artery and middle cerebral artery [20], but can be deceiving when evaluating motor system, during cranial surgery you should focus monitoring on somato-sensory generators like sensory cortex and thalamus. Other structures irrigated by afore mentioned arteries could be studied with somato-sensory potentials as well (basal ganglia). On the other hand auditory evoked potentials are very useful for monitoring the state of brainstem, since generators are numerous at this level and one can correlates brainstem damage levels with specific wave deterioration [21], in addition as waves are numerous you have a backup of information . In my opinion once damage has taken place several paths can lead to several prognoses, depending on intraoperative acting, post-surgical edema, post-surgical cerebral-vascular events, post-surgical infections, and of course owns patients characteristics. Finally each patient works as his own control during surgery, and constantly pre-tumor resection responses are compared with trans- tumor resection and post-tumor resection responses. However preoperative and postoperative studies are informative and should be included.

Conclusion

Intraoperative Neurophysiologic Monitoring technique is not a solution, not a substitute of surgical skill, is just a tool that in patient hands and updated brains can render good results.

Author Contributions

Valdés Sedeño RR as the first author conceptualized the idea and writes the manuscript.

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Conflicts of Interest

Corresponding author declares that there is no conflict of interes.

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