

Towards Quantification of Neurophysiological Intraoperative Monitoring variables, intraoperative analysis and post-surgical predictive importance.

Raúl Roberto Valdés Sedeño

Department of Hospital Clínico Quirúrgico Hermanos Ameijeiras, Medical and Surgical Investigation Hospital, Havana 10400, Cuba.

Corresponding Author: Raúl Roberto Valdés Sedeño Department of Hospital Clínico Quirúrgico Hermanos Ameijeiras, Medical and Surgical Investigation Hospital, Havana 10400, Cuba.

E-mail: rrvaldessa@infomed.sld.cu

Received date: **August 29, 2019**; Accepted date: **September 13, 2019**; Published date: **September 18, 2019**

Citation: Valdés Sedeño, RR. (2019) Towards Quantification of Neurophysiological Intraoperative Monitoring variables, intraoperative analysis and post-surgical predictive importance. *J. Neuroscience and Neurological Surgery*. 4(4);

DOI: [10.31579/2578-8868/087](https://doi.org/10.31579/2578-8868/087)

Copyright: © 2019 Valdés Sedeño. This is an open-access article distributed under the terms of The Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Due to the existence of papers that propose quantitative techniques [1-5] for Intraoperative Neurophysiologic Monitoring (IONM), the lack of concern about which could be right to refine the work of Neurophysiologist and Neurosurgeons and their great importance during and after surgical intervention, we decide to analyze this subject. Intraoperative neurophysiological monitoring variables are the most promptly interpreted amongst electrical signal of nervous system. Their correct interpretation can protect neural tissue of surgical damage during several types of surgeries [6]. Nevertheless inside the operation room their evaluation is done qualitative rather than quantitative. Various reasons can be named for neurophysiological monitoring variables variation inside operation room. Operating room is an antagonistic environment for electrical signals quality [7] and processing of sensory responses like averaging methods can introduce well known amplitude and latency inaccuracies [3, 5] Also non-significant deviations of intraoperative neurophysiological monitoring signals which in theory could be as important as significant changes could be missed as well if quantitative methods are not applied. New alert criteria taking into account signal stability has been proposed for IONM [8] a stable signal is judged under minor alarm threshold changes, while if signal is instable the alarm threshold rise. On the other hand quantitative methods proposed for evaluating intraoperative neurophysiological monitoring signals have shown good results [1-5]. Behind all this efforts lays the fact that nowadays a worldwide concern for neurophysiological intraoperative signals alarm is still missing. Well known criteria abnormality like latency/amplitude deviation from the norm of Evoked potentials (EP) outside operating room [9] are strong pillars where Neurophysiologists supports their daily diagnosis and electrophysiology evaluations, this classification has allowed evaluating variables more accurately [9, 10] and facilitating statistical analyses. However we do not have that opportunity inside operating room. Somatosensory evoked potentials (SEP) have been investigated and quantitative intraoperative neurophysiological monitoring (QIONM) measures like area under the curve has been tested during surgical intervention; this parameter could detect different injury strength levels and identify harm in the postoperative period in rats [1]. Moreover quantitative SEP has been capable to differentiate between good and poor neurological outcomes in rats with cardiac arrest [2]. On the other hand based on mean slope changes over SEP, it could be possible to effectively differentiate pre-injury and post-injury SEP parameters with high levels of sensitivity and specificity in spinal cord injury in rats [3]. Also applying time-frequency analysis to SEP could increase the reliability of intraoperative neurophysiological monitoring of spinal cord in human patients, peak

power variable was superior compared to amplitude variable for monitoring [4]. Furthermore using quantitative pre-operative SEP it was possible to predict post-operative recovery in human patients undergoing surgery for Cervical Spondylotic Myelopathy with worthy results [5]. Then again intra and inter individual variability for SEP outside and inside the operation room have been recognized [11]. Somatosensory evoked potentials (SEP) behave differentially considering neurophysiologic application, with latency being more stable during daily studies and amplitude being more stable in intraoperative neurophysiological monitoring [11]. This means that IONM has its own particularities but it's not impossible to quantify. Quantification of Intraoperative Neurophysiological Monitoring variables along with qualitative evaluation could allow a more accurate interpretation and postsurgical prediction. Intraoperative visual evoked potential (VEP) is a non-accurate technique with latency and amplitude variability [12] that could take benefits of quantification. Intraoperative visual monitoring techniques like optic nerve stimulation, high light emitting diodes, color stimulation effects or perhaps the utility of conventional stimulation are issues still waiting for investigation [12]. QIONM may be a solution for the recognized difficulty of protecting visual system during surgical intervention. Electroencephalogram, EP and Electromyography variables are all disposed for quantification and refine analyses. IONM software could include packages taking into account patients own clinical signs, Magnetic Resonance Images variables, Neuronavigation measures like tumor's volume and tractography, trans-operative and postoperative physiologic and neurophysiologic variables. Quantitative and qualitative analysis of physiologic and neurophysiologic variables should be done within the whole package giving some prognosis of patient's clinical evolution. Even if accuracy of these quantitative techniques needs to be measure extensively yet, Anesthesiology, Neurosurgery and Neurophysiology can be benefited with some awareness of what nervous system functions should be scrutinized post-operatively. Just to name one example, let's say that thalamus surgery is driven and during operation SEP responses deteriorate in a qualitative manner and some quantitative measures are irreversible impaired additionally. It is easier for software to make prognosis of Glasgow coma scale if quantitative measures are included in automatic processing looking for evolution. What is more quantification could involve refine analysis of well-known techniques like SEP during IONM. For example predictive post-surgical value of SEP of upper and lower limbs may perhaps be examined. This might lead to a better understanding of their particular characteristics considering that they are obtained when current is applied to different nerves [9]. Neurosurgery and Anesthesiology variables may be analyzed as well within the whole predictive package along with neurophysiology variables, combining heart rate, respiration rate, blood pressure and surgical technique difficulty. In

our opinion intraoperative neurophysiology monitoring variables are in need of quantification and it is necessary to go beyond investigation applying previously programmed techniques [1-5] in routine labor operation room. Vision should take us to search for post-surgical predictive power of qualitative and QIONM encompassing physiologic and neurophysiologic variables along with clinical, imaging and surgical measures, leading us to a better prognosis and understanding of the whole patient's situation. In conclusion despite the efforts of scientists, QIONM is not yet routine software inside the operation room. During surgical intervention their application must be complementary to qualitative analysis, and could refine neural injury detection. Prediction of post-surgical evolution is a field which might be also explored and enriched taking into account various classes of pre-surgical, trans-surgical and post-surgical variables.

Author Contributions

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

Funding

This research has not acquired funding from any source.

Conflicts of Interest

Corresponding author declares that there is no conflict of interest.

References

1. A Jorge, J Zhou, EC Dixon, KD Hamilton, J Balzer. (2019) Area Under the Curve of Somatosensory Evoked Potentials Detects Spinal Cord Injury. *J Clin Neurophysiol.* 36 (2):155-160.
2. Madhok J, Maybhate A, Xiong W, Koenig M A, G. Geocadin R, et al. (2010) Quantitative assessment of somatosensory-evoked potentials after cardiac arrest in rats: Prognostication of functional outcomes. *Crit Care Med.* 38 (8):1709–1717.
3. Agrawal G, Sherman D, Maybhate A, Gorelik M, Kerr D A, et al. (2010) Laboratory Study. Slope analysis of somatosensory evoked potentials in spinal cord injury for detecting contusion injury and focal demyelination. *Journal of Clinical Neuroscience.*
4. Y Hu, K D K Luk, W W Lu, J C Y Leong. (2003) Application of time–frequency analysis to Somatosensory evoked potential for intraoperative spinal cord monitoring. *J Neurol Neurosurg Psychiatry* 74: 82–87.
5. Hongyan C, Yazhou W, Xiang L, Xiaobo X, Shengpu X. et al. (2015) Trial-to-trial latency variability of Somatosensory evoked potentials as a prognostic indicator for surgical management of cervical spondylotic myelopathy. *Journal of Neuro Engineering and Rehabilitation* 12:49.
6. Vedran Deletis, Isabel Fernández-Conejero. (2016) Intraoperative Monitoring and Mapping of the Functional Integrity of the Brainstem. *J Clin Neurol.* 12 (3):262-273 .
7. Møller A R: Intraoperative Neurophysiological Monitoring Second Edition. *Monitoring Auditory Evoked Potentials.* 2006 Humana Press Inc. eISBN: 1-59745-018-019.
8. Marc R. Nuwer. New alert criteria for intraoperative somatosensory evoked potential monitoring. *Clinical Neurophysiology* 130 (2019) 155–156.
9. Toleikis J. R. (2010) Intraoperative monitoring using somatosensory evoked potentials a position statement by the American Society of Neurophysiological Monitoring. Published by the American Society of Neurophysiological Monitoring.
10. Niedermeyer E. *The Normal EEG of the Waking Adult. Electroencephalography: Basic principles, clinical applications, and related fields.* Lippincott Williams & Wilkins; p. 167.
11. Muengtawepongsa S. (2019) *General Principles of Somatosensory Evoked Potentials.*
12. Sharika R, Mirela VS, Dinesh GN. (2016) Intraoperative Visual Evoked Potentials: There is More to it than Meets the Eye. Intraoperative Neuromonitoring Division, Department of Neurology, Massachusetts General Hospital, St. Boston, MA, USA.