Communication and collaboration in spine neuromonitoring: time to expect more, a lot more, from the neurophysiologists

Stan Skinner, MD,1 and Francesco Sala, MD2
1Abbott Northwestern Hospital, Minneapolis, Minnesota
2Institute of Neurosurgery, University Hospital, Verona, Italy

This commentary is addressed to surgeons who order intraoperative neuromonitoring (IONM). In the US, and in some other countries, a certified technologist is commonly supervised by an expert neurophysiologist physician.40 US neurophysiologist physicians are often positioned off-site while monitoring several or many cases simultaneously.41 As an example of a contrary view that is also held elsewhere in the world, a leading Canadian authority argues, “The vast majority of those involved in IONM in Canada believe, for best practice, the IONM expert should be in the operating room (OR) doing the neurophysiology” (personal communication, David Houlden, University of Ottawa, 2016).

Similarly, the joint guidelines between the Italian Neurosurgical and Clinical Neurophysiology Societies clearly state that the supervising physician should be in the OR or available in-house whenever summoned to the OR. This model is quite popular in other European countries (such as Germany), but other models exist. In Spain, only clinical neurophysiologists are present in the OR and they perform IONM without the support of certified technologists.

Keeping these dissonant approaches in mind, we will: 1) review scholarship that indicates that improved collaboration in the OR is associated with better patient outcomes; 2) demonstrate how IONM injury prevention is predicated on trust-based communication of test results; and 3) propose practical IONM solutions that might better achieve the trusted “expert in the OR” vision.

Communication and the IONM Interventional Cascade

IONM is a team effort. The technologist and neurophysiologist form the diagnostic testing contingent of the team. The responsible neuromonitorist reports alerts to the surgeon and the anesthesiologist, who decide whether to alter the course of their procedural plan. The intraoperative team as a whole, therefore, participates in a generalized model of test-treatment pathways that affect patient health.11 For IONM, this model can be summarized as an interventional cascade: test, interpretation, communication, intervention, and outcome.21 With few exceptions, surgeons are imperfectly fluent with the clinical neurophysiology body of knowledge (tests and their interpretation). Neurophysiologists do not independently execute an intraoperative intervention. Therefore, in the event of signal loss, effective neurophysiologist-initiated communication is pivotal to the surgeon’s (or anesthesiologist’s) decision to act. Favorable patient outcomes must depend on effective communications among co-practicing specialists (surgeon, anesthesiologist, and neurophysiologist). Implicit in this schema is scholarship showing that diagnostic test accuracy per se (within the neurophysiologist’s control) is an insufficient basis for clinical effectiveness.11,50

Barriers to good decisions and effective patient outcomes exist on either side of the IONM interventional cascade. Surgeons are understandably burdened by a cognitive bias to see their carefully conceived surgical plan through to the end. During IONM reporting, this bias may manifest as a tendency both to construe what is heard in a way that affirms preconceived notions and/or downgrade information that conflicts with “normal” expectations. One of us has summarized this confirmation/expectation bias:45 “Neurophysiological feedback was generally welcome as long as it reassured the neurosurgeon that everything was going well (‘Am I doing OK? Are your evoked potentials stable?’), but was not so well-received whenever there was a change in the evoked potentials that would imply the need to halt or even abandon surgery.” And, “The idea of a different professional figure (namely
a neurologist or clinical neurophysiologist) working hand in hand with the neurosurgeon in the operating room and advising him whether or not his surgical strategy was impairing the well-being of the nervous system was (and still is) something not readily acceptable to neurosurgeons.” How much more difficult is the communication task if the neurophysiologist is an unseen, unknown remotely sited “colleague”?

Unfortunately, some supervising neurophysiologists hold themselves above the exigencies of meaningful relationships with their in-room surgeon and anesthesiologist colleagues. They persist in the insular position that IONM amounts to no more than a strictly dispassionate interpretation of waveforms, not unlike a pathologist or radiologist reading a static image. This is an unfortunate posture by some neurophysiologist physicians. IONM is not the static reading of a test at one point in time, rather it is the ongoing analysis of a data stream over time within a constantly changing surgical context. Furthermore, to presume that an absentee/remote neurologist’s opinion may easily sidetrack the surgical plan is naïve and, potentially, dangerously misguided.

The scholarship on communication during high-risk events (such as an IONM alert) indicates: “The need to establish trust … is fundamental to the effectiveness of risk communication messages and strategies… Trust, therefore, must be established well in advance of an actual crisis event [italics added].” Vincent Covello, a leading scholar in the risk communication literature, has captured this idea with the apothegm: “They want to know that you care before they care what you know.”

**Spine IONM Evidence: Moving From Prediction to Prevention**

Although the evidence supporting IONM to prevent spinal cord and/or nerve root injury remains mixed, we believe the preponderance of the evidence justifies IONM in many of the varied settings of spine surgery. Several evidential limitations persist, among them: few controlled trials, paradox or bias in the categorization of recovered signal loss in observational studies, unsettled motor evoked potential alert criteria, and the unknowable confounders within and disagreement among recent supersized retrospective data sets. Notwithstanding these limitations, the reliability of any future IONM outcome trials is threatened when the neurophysiologist’s role is diminished or neglected. As already described within the interventional cascade, the surgeon’s decision to change the course of surgery after an alert crucially depends on the credibility of the interpreter/communicator. In fact, trusted communication determines the efficiency of the link between IONM test accuracy (prediction) and reduced intraoperative injuries (prevention).

A major systematic review has established that IONM can predict neurological injuries. The combined positive predictive value (PPV) for serious neurological injury was 0.30. This PPV may seem low until one realizes that in a low prevalence context (risk ≤ 1% in extradural spine surgery, for example) the PPV will look low even when the test is very accurate. Among the reviewed Class I studies, no false-negative reports were made. However, a prediction analysis that looks at differences in outcomes (no injuries with negative testing, 30% risk of serious injury with positive testing) incompletely informs us about the role IONM might play in injury prevention. We are left to hope that surgeons—understanding these data when acknowledging an IONM alert—will intervene appropriately. But there is no guarantee of that.

Surgeons’ responses to IONM alerts have been studied. Decisions to respond (or not) to an alert were usually based on context: a recent surgical manipulation, for example, or coincident report from the anesthesiologist (low blood pressure, for example). Only about 50% of alerts were followed by an intervention. Within the category “true-positive findings without intervention… The surgeon did not react to the information obtained from the IOM, and the patient suffered from a new neurological deficit corresponding to the target of monitoring.” listed reasons for inaction included anticipated injury with operative step, manipulation not reversible, and no identifiable reason for IONM change.

A likely factor woven into the surgeons’ inability or hesitance to intervene is cognitive bias, predispositions that restrain the surgeon from changing the course of surgery. We have already discussed one of these, i.e., confirmation/expectation bias. In the event of an alert, deeply instilled beliefs, bias, and previously learned rules of thumb (heuristics) come to mind first. When well-trained professionals (airline pilots and surgeons, for example) are confronted by routine challenges, heuristics permit quick and usually correct decisions. Overreliance on heuristics may limit options during the stress of crisis decision-making.23,49,58 At the point of an IONM alarm, the surgeon/decision-maker may also be subject to cognitive errors. Checklists may close this decision-making gap during crisis management. Two compelling before/after surgical safety checklist trials convinced both neurosurgical and orthopedic spine groups to generate checklists for IONM alarms. The orthopedic spine surgery checklist includes a call to “summon” the “senior neurologist or neurophysiologist” after an IONM alarm. Within many of the surgeon authors’ institutions, a trusted in-house neurologist/neurophysiologist is available to be summoned. But an at-hand IONM colleague is not the general rule in the US.

The Scoliosis Research Society has reviewed the use of IONM in 108,419 surgeon-reported cases. The sensitivity for postoperative spinal cord deficit when both somatosensory and motor evoked potentials were recorded was 0.43. The authors’ explanations for poorer than expected IONM sensitivity included variations in “… how [signal changes] are reported to the operating surgeon…”

This particular explanation by Hamilton (“… how [signal changes] are reported …”) gets to the crux of the need to urgently consider and improve the culture of communication between the neurophysiologist and surgeon. In the midst of an IONM alert, it takes a trusted neurophysiologist colleague to resist the surgeon’s understandable cognitive bias to complete the surgery as planned. Breaking through this bias demands that the neurophysiologist introduce both crucial neuropathophysiological concepts as well as a coherent probability analysis of context-wedded IONM results. In the absence of trusted communication