ASNM Monitor

American Society of Neurophysiological Monitoring • Volume Seventeen • Number Six • NOVEMBER 2009

Presidential Comments. . .

Dear fellow ASNM members,

Literally on the heels of what was a very successful Chicago Symposium, I received a phone call just a day later from a person representing a group of private equity partners who were exploring investment possibilities and wanted my impressions regarding the future of IOM. I thought about how, just the day before, our Society pursued its mission of providing education and training in order to address the shortage of people who, based on their credentials, knowledge, training, and experience, are qualified to provide monitoring services and/or professional oversight. I thought about other professional societies involved in IOM which have also recognized the qualified personnel shortage and have expanded their educational components to address it as well. I wondered how much impact these efforts were making and how they will affect the future of monitoring. Nevertheless, despite the shortage of qualified personnel, monitoring companies have continued to form, the amount of monitoring has continued to increase, and knowledge of this apparently did not escape my caller. This growth has largely been due to the implementation of remote monitoring where there is seemingly no technical limitation to the number of surgeries that a person can be providing "oversight" for and therefore its use's inherent potential for abuse, fraud, and poor quality monitoring. Up to now, third party payers have continued to support this model but have become both increasingly concerned about its efficacy and also sensitive to the money drain associated with its widespread use. As a result, they have approached the AMA to establish a set of rules to cover these practices and the AMA CPT Editorial Panel has in turn, relied on its AMA membership involved in IOM practices to make recommendations in this regard.

As part of the "bridge building" that has taken place over the past few months, a number of ASNM members including myself have been invited to take part in discussions with some of these AMA members regarding remote monitoring and other IOM issues. Like health care reform, it seems likely that some degree of monitoring reform will also occur perhaps as a result of changes in reimbursement policies. This is not entirely surprising considering the reform climate in which we are currently engaged. The real question is whether patient care will be affected as a result and if so, to what degree.

Rich Toleikis

Rich Toleikis, ASNM President

In this issue:

VISION

The Society serves as the leading organization for the field of interventional neurophysiological assessment and monitoring.

MISSION

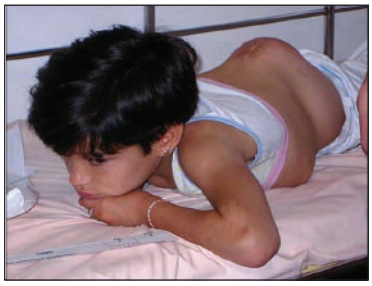
Quality neurophysiological monitoring benefits patient outcomes. The Society:

- ★ Fosters the growth and stature of neurophysiological monitoring as a profession;
- ★ Represents and advocates within the medical community on behalf of members;
- ★ Provides a forum of education and dissemination of knowledge in the field;
- ★ Develops quality standards for practice and training;
- ★ Promotes the highest standards of neurophysiological monitoring through research;
- ★ Builds partnerships and coalitions with allied professionals.

Have Mon.  Will Travel.

The Scoliosis Research Society (SRS) periodically sends teams of orthopedic surgeons to second- and third-world countries to perform state-of-the-art surgical procedures on patients that do not have the resources to obtain surgery. These are often very seriously compromised patients with advanced conditions, unlike the cases that we typically see in America. Neurophysiologic monitoring can play a pivotal role in such cases. The ASNM has therefore partnered with the SRS to develop an outreach program to provide monitorists to accompany these teams. The ASNM Global Outreach committee, chaired by Kiara Ebinger, Ph.D., will be coordinating monitorists who have interest in becoming involved in these philanthropic international neural monitoring efforts.

There are surgical teams who regularly provide services in countries such as China, Bulgaria, Ghana, Nicaragua, Trinidad, India, etc. Currently, it is challenging to staff all of these programs with experienced and qualified monitorists. Qualified participants would have several years of experience in neural monitoring, a minimum of the CNIM certification, and demonstrated experience monitoring complex spinal deformity surgeries. The teams typically stay in-country a week or more.



For those who cannot directly participate in these activities, financial support is also essential to develop and maintain this program. We need monitoring equipment donated or loaned, and supplies.

Support for round-trip airfare and baggage is needed as well. In-country costs are supported by the host or the SRS. If you seek an intense and rewarding professional experience, pack your bags for a life-changing adventure. Alternatively, if you or your company would like to contribute equipment or financial support for these philanthropic efforts, contact Dr. Ebinger at kiara_ebinger@comcast.net or Leo Towle at towle@uchicago.edu.

IN APPRECIATION

On behalf of the American Society of Neurophysiological Monitoring, I would like to thank Weaver and Company for their generous donation which will be used to support the educational mission of the Society.

WEAVER and company

J. Richard Toleikis, Ph.D.
President, ASNM

Total Intravenous Anesthesia (TIVA) Alternatives in the Face of a Propofol Shortage

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The importance of total intravenous anesthesia (TIVA) is being highlighted currently by a shortage of propofol from the three major manufacturers, Hospira, Teva and APP. In July, Teva announced a recall of propofol following investigations by the FDA and CDC relative to reported cases of nonrespiratory febrile reactions among patients undergoing endoscopy. Apparently, the recalled lots of propofol tested positive for elevated levels of endotoxins. Hospira, notified suppliers and customers in October that they too were recalling batches of propofol after discovering metal fragments in the product due to a machine malfunction. APP, the maker of Diprivan (propofol brand-name) did not have a recall, however, they are a much smaller volume supplier compared to Teva or Hospira; therefore, regular APP customers most likely will get preference.

Accordingly, alternative or adjunctive techniques to conserve available propofol reserves become important choices when TIVA is needed to facilitate uncompromised intraoperative neurophysiologic monitoring both for transcranial electric motor (tceMEP) and cortical somatosensory evoked potential (CSSEP) recordings. The neuromonitoring provider should be aware that anesthesiologists and/or nurse anesthetists may be neither familiar nor entirely comfortable in using some of the propofol alternatives, owing in part to reported potential side-effects. Hence, it behooves those responsible for the neuromonitoring plan to work closely with the anesthesiologist to achieve everyone's goal. To this end, we present a brief synopsis of available options to conserve or replace propofol as the primary TIVA agent, as well as some early clinical experiences. A longer version of this paper will be published elsewhere at a later date.

First, it is essential for those responsible for neuromonitoring to consider that patient safety must always come first. This over-riding factor may underlie reluctance by the anesthesiologist to deviate from the norm on any given patient. Regardless of which drug combinations are selected, the end goal of any anesthetic plan is to achieve 1) loss of consciousness, 2) amnesia, 3) blocking of painful and noxious stimuli (i.e. analgesia), 4) movement prevention and 5) hemodynamic stability. These goals are relatively easy to achieve under conventional inhalational anesthesia protocols in combination with nitrous oxide, opioid and neuromuscular blocking agents. While propofol-based TIVA in combination with an opioid also has proven highly successful toward meeting these four cardinal anesthesia requirements, there is need for greater vigilance particularly under the additional constraint of eliminating muscle relaxants so as not to compromise EMG or tceMEP recordings.[i-ii]

When propofol was first introduced in the early 1990's, most anesthesiologists were unaccustomed to using TIVA and demonstrated reluctance to alter the time-honored balanced nitrous-narcotic or low- concentration volatile (the ubiquitous half-MAC approach) anesthesia regimens to help optimize cortical somatosensory evoked potential amplitudes. Ironically, one of us (TBS) began reporting CSSEP amplitude enhancement under total intravenous anesthesia with one of the drugs described herein more than two decades ago.[iii] The introduction of propofol in 1992 broadened the anesthetic landscape yet further due to its favorable pharmacokinetic properties. Early TIVA experience by another of us (DMS) soon after release of propofol demonstrated clearly the dramatic improvements in signal quality and amplitude of lower extremity CSSEPs, and by mid-1996 tceMEPs when compared to either low-concentration volatile gas or balanced nitrous-narcotic anesthesia. Since that time we have been strong advocates for optimization of CSSEPs and tceMEPs with propofol based TIVA.[1, 2, iv, v, vi,viii]

As propofol use increased over the past decade, both as an induction agent in the operating room and sedative in outpatient endoscopy centers, familiarity and comfort in its use for optimized intraoperative neuromonitoring has grown substantially among anesthesiologists and nurse anesthetists. With the sudden propofol supply shortage, anesthesiologists are

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again faced with having to use alternative intravenous drugs for which they may have either less familiarity or only limited experience. Adding to their reluctance are reports of complications with some of these drugs that may have important implications for appropriate patient care.

The supply conservation strategy presented herein is to augment or substitute propofol with ketamine, etomidate and/or dexmedetomidine. In general, anesthesiologists trained between the 1980's-1990's, as well as those with specialty training in pediatric or neuro-anesthesia, are likely to be more comfortable in using these drugs and it might be wise to engage them in discussion prior to implementation of a new protocol.

Ketamine Infusion

Among the various intravenous anesthetics considered a suitable replacement or adjunct to propofol, and one used commonly in pediatric anesthesia or in emergency situations with hemodynamically unstable patients, ketamine has proven particularly beneficial for enhancing CSSEP and tceMEP amplitudes owing to its potent cerebral stimulant properties. When used as a propofol substitute, ketamine based TIVA meets the anesthesia requirements of loss of consciousness and analgesia, thereby reducing or eliminating the need for an opioid infusion. An added benefit of ketamine's excellent analgesic qualities is to help reduce pain in the immediate post-operative period.

Because ketamine is known to elevate cerebral blood flow (CBF), it is contraindicated in patients with increased intracranial pressure. As a result, ketamine is not a preferred drug of choice for many intracranial procedures. Another side-effect familiar to anesthesiologists is the potential for post-operative hallucinations, more common in adults then in pediatric or geriatric patients. A close chemical relative of PCP, ketamine is often referred to as a dissociative anesthetic since it effectively disconnects the cortex from the rest of the body. As a result, patients can present with emergence delirium appearing as having eyes wide open, but completely disassociated from the surrounding environment (i.e. "deer-in-the headlights"). For this reason, it is important to administer an accompanying sedative such as low-dose propofol infusion or premedication and intermittent low dose midazolam boluses during surgery.

Table 1 presents an initial suggested protocol for a ketamine infusion as a substitute for propofol during spine surgery. Here, midazolam is used to reduce the potential for hallucinations or emergence delirium as described previously. Constant communication between the neuromonitoring specialist and the anesthesia team is of paramount importance for achieving the goal of an acceptable anesthetic and optimal neurophysiological monitoring data. It is best to titrate any changes in the proposed concentration levels to tceMEP amplitude changes, lowering the infusion rate if amplitudes fall more than 10% from baseline.

Because ketamine has a relatively long half-life, it is prudent to begin tapering the drug one-hour prior ending the procedure. This will facilitate a smoother and more rapid emergence. Tapering is particularly important for longer spine surgeries such as posterior spinal fusion for scoliosis correction due to increased ketamine serum levels after prolonged use. Likewise, midazolam is much preferred over Valium as a benzodiazepine because of its shorter duration of action.

Table 1. Initial guideline for Ketamine infusion during spine surgery.

Drug	Administration	Infusion	Bolus Dose
Midazolam	Premed		2-4 mg
Ketamine	Induction		1-2 mg/kg
Ketamine	Maintenance	0.5-1.0 mg/kg/hr	
Midazolam	Maintenance	1-2 mg per hr.	

Transcranial electric motor and cortical somatosensory evoked potential amplitudes are markedly enhanced with ketamine compared to the highly compromised amplitudes noted with 0.5 MAC volatile agents. This amplitude amplification reduces ambiguity in the detection of intraoperative change, thus diminishing the potential for a false-negative consequent to rendering a clinical interpretation based on small and variable tceMEP amplitudes common with inhalational anesthesia. tceMEP responses tend also to be less fluctuant with ketamine versus propofol-based TIVA owing to improved hemodynamic stability. [**Note:** CSSEP and tceMEP amplitudes may begin to decline toward the end of the case as ketamine is tapered].

Because of ketamine's potent cerebral stimulant properties, EEG will often be characterized by heightened beta activity. It is not uncommon for BIS values to be in the 60's even though the patient is adequately anesthetized. Constant vigilance to the EEG to ensure a stable anesthetic plane, and EMG to identify early signs of unprovoked myogenic activity indicating that the patient may be "light" is recommended.

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TIVA Alternatives *Continued from page 4*

In addition to serving as a substitute primary TIVA agent, ketamine can also play an adjunctive role to conserve on propofol usage. This polypharmacy capitalizes on the sedative/hypnotic properties of both drugs, the analgesic effects of ketamine, and the amnesic qualities of propofol. The addition of a low-level opioid infusion supplement, such as remifentanil, also can help ensure maximal analgesia.

Ketamine can be either mixed directly into the propofol or administered as a separate infusion to conserve on both drugs. If mixed, many practitioners begin with 50 cc propofol and 2-mg/cc ketamine (e.g. 100 mg ketamine in 50 cc). This is reduced to 1- 1-1/2 mg/cc for the next 50 cc and so on, such that no ketamine is administered in the final hour or longer of surgery, as described previously. The rate of propofol infusion should be set to a low sedative level (50-75 ug/kg/min). If an adjunctive opioid is used, the infusion rate also should be lowered relative to conventional practice. Recall that CSSEP and tceMEP amplitudes may be noted to decrease as the ketamine is tapered downward.

Our initial experience with this approach shows that adding propofol to the mix at low infusion rates does not cause remarkable reductions in tceMEP amplitudes; however, responses appear slightly less stable than with ketamine alone. Perhaps this is the result of altered hemodynamics from propofol acting as a hypotensive agent.

The advantage of mixing in propofol is that it replaces intraoperative midazolam for inhibiting ketamine-induced psychomimetic effects by inhibiting ketamine-induced c-foss expression. BIS values can also be lowered using propofol in combination versus ketamine as the sole anesthetic.

Etomidate Infusion

Etomidate is a valuable ultra-short acting intravenous agent with a favorable pharmacokinetic and pharmacodynamic profile. Although etomidate has essentially no structural relationship to other IV anesthetics, its mechanisms of action are similar to propofol. Like ketamine, it produces minimal, if any, cardiac depression making it well suited for use in patients with poor myocardial reserve. With minimal respiratory depressive effects, it also has value in patients with obstructive pulmonary disease (OPD).

Among etomidates other advantages is that it penetrates the blood-brain barrier quickly, reaching peak levels after only 30-60 seconds following bolus injection, or 1-2 minutes post-IV administration; therefore, time from initial infusion to loss of consciousness is dramatically short. It also redistributes quickly about the brain and entire body, similar to both propofol and thiopental and metabolizes rapidly.

Like propofol, etomidate is presumed to facilitate the inhibitory effects of GABA, however, it differs in that small doses can cause a cortical excitatory reaction which can present as EEG spikes at induction, increased CSSEP and tceMEP amplitudes, or epileptiform activity on EEG in patients with seizure history.

Anesthesiologists may recognize etomidate's single biggest advantage over propofol as hemodynamic and overall cardiovascular stability. Etomidate's ability to lower cerebral blood flow, cerebral metabolic rate for oxygen ($CMRO_2$) and intracranial pressure (ICP), make it a popular choice among neuroanesthesiologists for achieving rapid-onset burst suppression prior to intracranial aneurysm clipping, in contradistinction to ketamine.

Etomidate has not been explored as a means to conserve propofol, but it has been used to replace propofol as the sedative amnestic agent in TIVA. Clinical experience with etomidate infusion as a primary anesthetic, augmented by an opioid such as remifentanil for analgesia (etomidate has no analgesic properties) has demonstrated remarkably stable and amplitude-enhanced tceMEPs and CSSEPs when compared to those traditionally noted with propofol and significantly greater than with the proverbial potent inhalational agents.

Perhaps its primary advantage over propofol is that etomidate does not cause hypotension. This minimizes or eliminates the oft-noted tceMEP amplitude variability with propofol as blood pressure waxes and wanes throughout surgery, thereby requiring constant vigilance. EEG patterns shows marked delta waves, higher theta than with propofol, prominent alpha activity and minimal beta. As such, it is much easier to monitor anesthetic depth with etomidate than with ketamine.

Table 2 presents an initial guideline for etomidate use. Because it has no analgesic or amnesic properties, etomidate must be supplemented with an opioid. Remifental is an excellent adjunctive opioid to etomidate because it too has a very short half-life. Note that after the induction dose, and because of its rapid redistribution and elimination, an additional slow bolus dose of etomidate should be given over 10-15 minutes to a total of 0.5 mg/kg so that blood levels are sufficient for the infusion to maintain adequate sedation and

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amnesia. Some also prefer to supplement it with a benzodiazepine (preferably midazolam) to reduce the myoclonic activity due to etomidate's inhibitory effect on subcortical structures that may resemble seizure activity (especially on induction). Once closing commences termination of IV anesthetics and changeover to an inhalational agent may assist in a smooth emergence, particularly for longer spine surgeries.

Table 2. Initial guideline for etomidate infusion during spine surgery.

Drug	Administration	Infusion	Bolus
Midazolam	Premed		2-4 mg
Etomidate	Induction		0.2-0.3 mg/kg
Etomidate	Additional Load		Total 0.5 mg/kg
Etomidate	Maintenance	0.6 mg/kg/hr	
Midazolam	Maintenance	1-2 mg per hr.	
Remifentanil	Maintenance	0.2-0.3 µg/kg/min	
Decadron	Loading Dose		10 mg

Given the seminal report of Sloan and co-workers[3] on the CSSEP amplitude enhancing effects of etomidate more than two decades ago, it would be reasonable to question why it has not enjoyed widespread use for optimized neuromonitoring. Like ketamine, however, etomidate is not without its drawbacks. These include: 1) pain at the injection site similar to propofol, due mostly to its solubilizing agent propylene glycol; 2) immediate or delayed myoclonus which can mimic a seizure, sometimes lasting several minutes; 3) excitation of epileptiform activity in patients with history of epilepsy; 4) occasional emergence delirium and 5) nausea and vomiting in the immediate post-operative period. The advent of propofol and its mechanisms of action similar to etomidate with very few limitations made it much more appealing for total intravenous anesthesia.

The aforementioned precautions notwithstanding, the most concerning complication associated with etomidate is depressed cortisol production (adrenal suppression for 24 hours) following a single dose or short-term infusion.[ix, x, xi] This has been reported to increase mortality in intensive care patients with sepsis and multi-system organ failure. The possibility of adrenal suppression has raised concerns among many anesthesiologists, especially in Europe who have been reluctant to use etomidate. Like many practitioners in the USA, we have found it prudent to administer prophylactic decadron routinely among the usual population of intraoperative patients. Similar to its use in treating vasogenic edema in the CNS, and as part of an anti-emetic protocol, decadron appears to circumvent the potential for etomidate induced adrenal suppression.

On the horizon is a new formulation of etomidate in lipid emulsion, rather than propylene glycol which is the conventional vehicle for etomidate as a water-insoluble drug and the medium most likely responsible for its limiting side-effects, including adrenal cortical depression. This new lipofundin medium which is already available in Europe, promises to retain etomidate's positive profile while minimizing or eliminating its side-effects. Upon FDA approval, the new etomidate formulation should be viewed as a "back to the future" IV anesthetic for optimal neuromonitoring and anesthesia care.

Dexmedetomidine as a Supplement to Propofol

The newest FDA approved supplement to minimize propofol use while facilitating effective sedation and hypnosis during TIVA is dexmedetomidine, a central alpha-2 stimulator resulting in inhibition of catecholamine release and reduced sympathetic tone. Because its mechanism of action mimics natural sleep, dexmedetomidine has been used most extensively for sedation of patients in the intensive care unit with preserved neurologic examination on arousal. Side effects of hypotension and bradycardia relate to its sympatholytic properties and limit the drug to a role as a supplement to other anesthetic agents. Dexmedetomidine is contraindicated in patients with poor cardiac reserve or who are heavily dependent on an intact sympathetic system for survival.

The experience with dexmeditomidine in the published literature is markedly less than with ketamine or etomidate and its use continues to evolve. Ongoing investigational and clinical experience by several of us has shown that when administered at suggested therapeutic levels (0.5-0.7 µg/kg/hr), dexmedetomidine has a compromising effect on tceMEP, but not CSSEP amplitudes when combined with low- dose propofol (50 -75 µg/kg/min). - When used at presumptively sub-therapeutic levels, however, (< 0.35 µg/kg/hr) dexmeditomidine does not seem to degrade tceMEP amplitudes.

If dexmeditomidine is being used as an alternative to propofol, it will require midazolam as described above for ketamine and etomidate. Moreover, although studies suggest it has an "opioid sparing effect" for intensive care unit patients, its use for anesthesia will require an opioid

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infusion, albeit at lower infusion rates, for complete TIVA. An additional opioid is particularly necessary since dexmeditomidine will need to be administered at sub-therapeutic levels so as not to effect tceMEP amplitudes.

It is important to keep in mind that our greater experience with dexmeditomidine relates only to its use as a supplement to propofol. Protocols with dexmeditomidine and opioid infusions with an amnestic supplement (e.g. midazolam) continue to evolve. Our initial and somewhat limited observation with dexmeditomidine as a supplement to etomidate or ketamine suggests a more favorable outcome, than when combined with propofol.

One of the limiting factors to exploring more widespread use of etomidate and dexmedetomidine during neuromonitoring is its somewhat prohibitive cost, as was noted with propofol in its early years. Continued evolvement as a more commonly available agent presents a timely opportunity for further investigation as a propofol alternative.

Conclusions

The current shortage of propofol in the United States can be viewed from two competing perspectives. On the one hand, it represents a crisis that has significant implications for recording uncompromised tceMEP and CSSEP amplitudes available with propofol-based TIVA; on the other, it presents an opportunity for exploring alternative anesthetics that facilitate even larger amplitude, more stable responses. The alternatives presented herein will allow anesthesiologists to explore ways to conserve propofol and facilitate the development of alternatives that may prove to be valuable adjuncts for future patients. In addition, they may also serve to allow methods useful in patients, mostly pediatric, where the concern for fatal lactic acidosis from the propofol infusion syndrome is of concern.

Certainly in this time of propofol shortage there will be a tendency by some to take the path of least resistance and elect to use potent inhalational agents (isoflurane, desflurane, sevoflurane) or nitrous oxide in low doses or infusions of muscle relaxants for partial paralysis, as advocated by a minority of individuals. It is imperative to recognize that these volatile anesthetics, nitrous oxide and muscle relaxants are poor alternatives to TIVA due to their compromising effect on both tceMEP and CSSEP amplitudes. Attempts to detect significant intraoperative neurophysiologic change based on highly variable and compromised signal amplitudes only serves to create a situation of ambiguous decision-making, thereby increasing the possibility of false-positive and false-negative interpretation.[xiv] This is especially problematic in patients with pre-exisiting neuro-pathology where the risk of iatrogenic injury is greatest, and pre-operative baseline responses already amplitude depressed. All too often, volatile anesthetics, nitrous oxide and partial neuromuscular blockade preclude the ability to record a tceMEP when TIVA and no muscle relaxant would have facilitated a reliable neuromonitoring.

In the end, both the anesthesiologist and neuromonitoring provider must share a common goal; namely, to provide the very best care available for any given patient. Constant communication between the neuromonitoring specialist and the anesthesia team is paramount to achieving the goal of an acceptable anesthetic and uncompromised neurophysiological monitoring data.

[**Note and Disclaimer:** The drug suggestions and doses outlined in this paper represent those of the authors and not of the ASNM. The stated doses are ranges that may require individualization. Although some of the drug contraindications are mentioned, the list is not to be viewed as exhaustive. Clearly, the advantages of any specific drug combination need to be weighed against the potential benefits, as well is the effect of one or more drugs on neurophysiological signal amplitudes. The authors encourage sharing and updating of individual experiences. Anesthesiologists or neuromonitoring providers should feel free to communicate with the authors about their experiences.]

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Neurophysiology Research and Education Consortium

The Neurophysiology Research and Education Consortium (NREC) is a non-profit corporation that is primarily interested in improving the field of intra-operative neurophysiologic monitoring through collection of multicenter outcomes data. The NREC has worked for the last 2 years to create a HIPAA compliant website that can be used to collect data regarding intra-operative neurophysiologic monitoring. This site is now ready for data entry.

Why Should I Participate?

There are many benefits to participation in the NREC process. First, the field of IONM as a whole will benefit from the information that the NREC will produce. The NREC will generate information on the interpretative criteria used by different practitioners along with the incidence of significant intra-operative changes in the recorded neurophysiologic signals. This will lead to information about how the interpretative criteria influence IONM. It will also provide information on the frequency with which changes are seen in various monitored variables in different surgical procedures. Collecting outcomes information may, especially if significant data on cases where monitoring was aborted is entered, provide information on the overall utility of various monitoring modalities. All of this information will be of vital importance as a tool to support the use of IONM to insurance companies, hospitals and surgeons. As information on the skills of the practitioner involved in the case are acquired as well, information on the how the credentials and education of practitioners affect the surgical outcome will be also available. This will be important not only to practitioners themselves but to educational programs in the field. The data will be made available to the public through publications at regular intervals as the size of

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the database grows to significant numbers to analyze statistics and trends.

Second, individuals who submit more than 50 cases in a year may request that the NREC provide them with comparisons between their practice and that of the average practitioner in the NREC database. This information will be extremely valuable for confidential internal quality assessment/quality improvement purposes, although no information derived from the NREC can be released for publication in any form whatsoever without prior written approval of the NREC.

Third, individuals who submit more than 50 cases in a year may submit a request to add or modify questions used in the study.

How Do I Enter Data?

In order to enter data, first find out from your local institutional review board (IRB) whether they will require an application prior to entering data. If you need to submit such an application, contact Mark Stecker (mmstecker@gmail.com) and the NREC can provide you with information about our approval status with the University of Texas and can provide more details about the database. If IRB approval is required, typically only expedited approval would be required, however; this decision is made by the local IRB.

The address of the website is **https://www.nrec.info**. If you are new to the site, you may create a user name and password. It is important that as a part of that registration process, you enter information about the way that you practice IONM and that you enter contact information. The contact information CANNOT be seen by any of the investigators and can only be seen by a third party who cannot see any of the patient data. This third party can be contacted by the investigators to verify data integrity with the person who entered the data. No patient data should ever be given to any representative of the NREC by email or by voice, only by entry onto the secure database. The investigators will regularly check the database for problems and completeness.

As part of the registration questionnaire, you must acknowledge that you have read and understand the information in this document.

Is the Data I Enter Secure?

Protecting patient information and preventing information about specific hospitals and practitioners from being inadvertently released is of vital importance to the NREC process.

The NREC data collection process has been approved by the University of Texas at Dallas Institutional Review Board and great care has been taken to minimize the possibility of releasing any identified confidential patient information. First, the site is accessible only through a secure, encrypted, hypertext transfer protocol ("https") that is commonly used when critical personal information such as credit card information is entered in order to prevent inadvertently revealing the information sent to the website. Second the NREC web site and the NREC have undergone extensive evaluations by Digicert to obtain the extended validation certificate that turns the address bar green when connecting to the NREC site as an additional indication of security. Always make sure that you do see the address bar turn green prior to entering any data.

Third, the only patient identifier entered is a code number known only to the data collector. The investigators cannot see this identifier and as an additional level of security, the investigators cannot see or access either the name of the person who collected and entered the data, or any of their contact information. A third party who is not one of the investigators can access the contact information and the patient identifier but cannot access any of the patient data. This third party called the "honest broker", may be contacted by the investigators when they note that data is incomplete or inconsistent so they can request that the data collector update or check information related to a patient associated with a given identifier. Thus, neither the investigators nor the third party can access identified patient information. It is important to be aware of the fact that although the data collector may be contacted by the "honest broker" if the investigators note a problem with the entered data, the NREC will NEVER contact the data collector to obtain any information about a patient over the phone or by email. Data collectors MUST NOT communicate patient information to the NREC except through the web site.

When data from the NREC database are reported in publications, no specific information regarding the identity, affiliation, or location of the collector will be mentioned. However, data may be segregated by broad categories such as the experience, training and credentials of the data collector.

What If I Have Questions?

Please feel free to contact Mark Stecker (**mmstecker@gmail.com**) with any questions.

Comprehensive Intraoperative Neuromonitoring Data Interpretation and Report Writing

A Physician & Advanced Practitioner Interactive Symposium

February 6th and 7th 2010 at the

Laguna Cliffs Resort & Spa ❦ Dana Point, CA

ASNM Laguna Cliffs Meeting Committee

Directors:

Vernon Leo Towle, Ph.D., FASNM and Jay Shils, Ph.D., DABNM, FASNM

Committee:

Jeffrey Balzer, Ph.D., DABNM, FASNM
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Leah Hanson, R. EEG/EP T., CNIM
Shawn Regan, B.S., CNIM
Jay Shils, Ph.D., DABNM, FASNM
Cathleen Zippay, R. EEG/EPT., R.EDT., CNIM

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Adjunct Faculty Member
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Lincolnshire, IL

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Medical Director, Baptist Neuroscience Center
Chief, Neurological Surgery
Miami, FL

Accreditation and Credits

Accreditation and Credits

This activity has been planned and implemented in accordance with the essential areas and policies of the Accreditation Council for Continuing Medical Education through the joint sponsorship of University of Chicago Pritzker School of Medicine and the American Society of Neurophysiological Monitoring.

University of Chicago Pritzker School of Medicine is accredited by the ACCME to provide continuing medical education for physicians.

University of Chicago Pritzker School of Medicine designates this educational activity for a maximum of ***8.75 AMA PRA Category 1 Credits™***. Physicians should only claim credit commensurate with the extent of their participation in the activity.

The American Society of Electroneurodiagnostic Technologists has granted 9 ASET Continuing Education [ACE] credits for this program. Such crediting, however, should not be construed by program participants as an endorsement of any type of instruments or supplies mentioned or involved in these presentations.

Continuing Education Credits shall be applied for through the American Academy of Audiology.

Continued on Page 12 ☞

Comprehensive Intraoperative Neuromonitoring Data Interpretation and Report Writing

Target Audience

Neurosurgeons, Neurologists, Physiatrists, Orthopedists, ENT Surgeons, Anesthesiologists, Nurses, Neurophysiologists (doctorate and masters level), Neuropsychologists, Audiologists and medical practitioners credentialed in D.ABNM or CNIM and involved in interventional intraoperative neuromonitoring of evoked potentials, EMG and EEG during surgical procedures.

Course Description

This symposium provides an important update for neurological physicians and advanced practitioners who collaborate on the neuromonitoring team, as well as surgeons and anesthesiologists who require intraoperative neuromonitoring (IONM) during procedures. Experts in IONM education will examine common and important methods, including:

- Somatosensory and transcranial motor evoked potentials and EMG for complex spine surgery.
- Auditory evoked potentials and cranial nerve monitoring for craniotomy and skull-based monitoring.
- Didactic sessions and interactive panel debates will focus on pre-existing conditions, data analysis, anesthetic considerations, complications and troubleshooting, reporting changes to the surgical team and report writing. A session on essential CPT coding and billing guidelines for IONM will examine recent changes in coding LCD and implications of Stark and Stark 3.

Conference Objectives

Upon completion of this conference, participants should be better able to:

- Interpret anatomic correlates of intraoperative neuromonitoring (IONM) data to facilitate surgical intervention.
- Effectively analyze data and report change.
- Formulate appropriate plan of action when presented with challenging data results.
- Write effective IONM reports.
- Review essential CPT coding and billing guidelines for intraoperative neuromonitoring based on modality, and examine recent changes in coding LCD and implications of Stark and Stark 3.

Disclosures and Conflict of Interest Resolutions

University of Chicago Pritzker School of Medicine requires disclosure and resolution of all conflicts of interest to ensure balance, independence, objectivity and scientific rigor in all CME programming. Conflicts of interest of all individuals who control CME content will be identified and resolved prior to this educational activity. Full disclosure will be made in the syllabus.

Presenters will also disclose discussion of off-label uses.

Continued on Page 13 ☞

Symposium Schedule • Sat., Feb. 6th & Sun., Feb. 7th

Saturday, February 6, 2010 — SESSION I

8:00 a.m. **Registration, Continental Breakfast and Exhibits**

8:45 a.m. **Welcome, Introductions and Announcements**
Jay Shils Ph.D., D.ABNM, F. ASNM

9:00 a.m. **CPT Coding and Billing in Intraoperative Neuromonitoring**
Rebecca J. Clark-Bash, R. EEG/EP T., CNIM, CLTM, F.ASNM

10:00 a.m. ***Break and Exhibits***

10:15 a.m. **Complex Spine Surgery: Somatosensory Evoked Potentials**
(Method, Pre-existing Conditions, Data Analysis, Anesthetic Considerations, Complications and Troubleshooting, Reporting Changes to the Surgical Team and Report Writing)
John G. Atwater, M.D.

11:30 a.m. **Complex Spine Surgery: EMG in Upper and Lower Limbs**
(Method, Pre-existing Conditions, Data Analysis, Anesthetic Considerations, Complications and Troubleshooting, Reporting Changes to the Surgical Team and Report Writing)
John G. Atwater, M.D.

12:15 p.m. ***Lunch (on your own)***

SESSION II

1:30 p.m. **Interactive SSEP Data Interpretation in Complex Spine Surgery**
(Method, Pre-existing Conditions, Data Analysis, Anesthetic Considerations, Complications and Troubleshooting, Reporting Changes to the Surgical Team and Report Writing)
Rebecca J. Clark-Bash, R. EEG/EP T., CNIM, CLTM, F.ASNM

3:00 p.m. ***Break***

3:15 p.m. **Complex Spine Surgery: Transcranial Motor Evoked Potentials**
(Method, Pre-existing Conditions, Data Analysis, Anesthetic Considerations, Complications and Troubleshooting, Reporting Changes to the Surgical Team and Report Writing)
Jay Shils, Ph.D., D.ABNM, F.ASNM

4:30 p.m. **Utility of TceMEP and Alarm Criteria Panel Debate**
All Faculty Panel

5:30 p.m. ***Welcome and Networking Reception***

Sunday, February 7 — SESSION III

8:30 a.m. **Registration, Continental Breakfast and Exhibits**

8:55 a.m. **Welcome**

9:00 am **Craniotomy and Skull-based Monitoring: Auditory Evoked Potentials**
(Method, Pre-existing Conditions, Data Analysis, Anesthetic Considerations, Complications and Troubleshooting, Reporting Changes to the Surgical Team and Report Writing)
Tracy E. Mishler, Au.D., CCC-A

10:00 a.m. ***Break***

10:15 a.m. **Craniotomy and Skull-based Monitoring: Cranial Nerve Monitoring**
(Method, Pre-existing Conditions, Data Analysis, Anesthetic Considerations, Complications and Troubleshooting, Reporting Changes to the Surgical Team and Report Writing)
Tracy E. Mishler, Au.D., CCC-A

11:00 a.m. **Carotid Endarterectomy and Aneurysm Monitoring: EEG and MSEP**
(Method, Pre-existing Conditions, Data Analysis, Anesthetic Considerations, Complications and Troubleshooting, Reporting Changes to the Surgical Team and Report Writing)
Jay Shils, Ph.D., D.ABNM, F.ASNM

12:00 noon **Adjourn**

REGISTRATION FORM

PLEASE PRINT CLEARLY!

First Name:_____ Last Name: _____

Nickname for Nametag: _____

Degree: (Check all that apply)

___M.D. ___D.O. ___Ph.D. ___R.N. ___MS/MA ___BS/BA ___B.S. ___D.C. ___AuD _____Others

Credential: (Check all that apply)

___DABNM ___FASNM ___CNIM ___CCC-A ___R.EEG T. ___R. EP T. ___AANEM _____Others

Institution Affiliation: _____

Work Address:_____

Work City: _____Work State:_____ Work Zip:_____

Home Address:_____

Home City:_____Home State:_____ Home Zip:_____

Daytime Phone_____Evening Phone:_____

Work E-mail:_____Alternate E-mail:_____

❑ **ASNM MEMBER** ❑ **NON-MEMBER**

Other organizational affiliations: (optional field)

__ AMA ___ACNS __ASHA ___AAA ___ASET ___AAEM _____(Others)

Registration Fees:	**Deadline Date**	**Members**	**Non-Members**	**Enter Amount**
	Before January 6	$425.00	$525.00	_____
	After January 6	$525.00	$625.00	_____

Method of Payment: ___ Check enclosed (***payable to ASNM***) ___VISA ___MasterCard

Card Holder Name (Please print) _____

Card Number _____Expiration Date:_____

Authorized Amount $_____ Security Code on back of card:_____

Cardholder Signature _____

NOTE: • Registration is nonrefundable & nontransferable.

NOTE: If paying by credit card on-line registration is preferred!

Three registration options

Online: www.signmeup.com/66939

Mail to:
ASNM Registration
c/o Monica Clark
827 East Briar Lane
Green Bay, WI 54301

Scan and email to:
ASNMregister@gmail.com

We regret that registration cannot be accepted by telephone.

For additional information, please call 920.362.2737 or e-mail ASNMregister@gmail.com

❑ In consideration of the Americans with Disabilities Act, please check here if you require special services, and we will contact you to determine your specific requirements. **NOTE:** Please submit this form two weeks prior to the symposium.

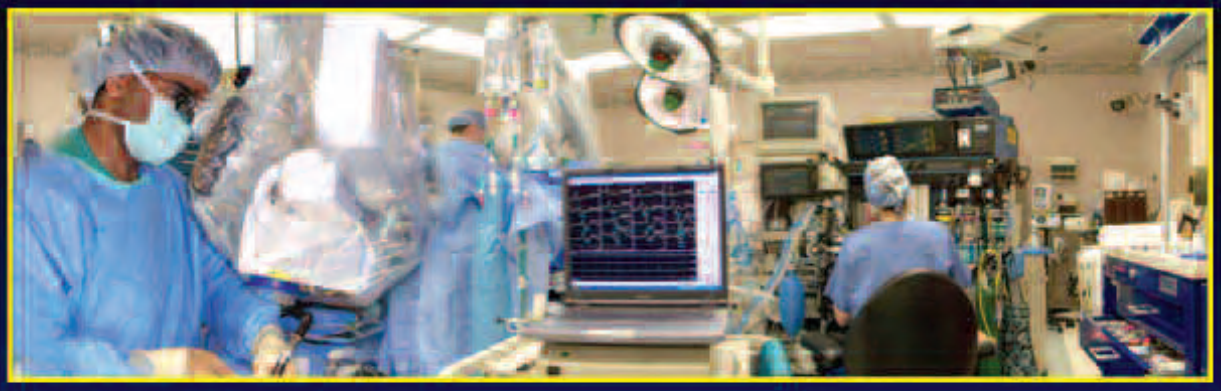
Check one:

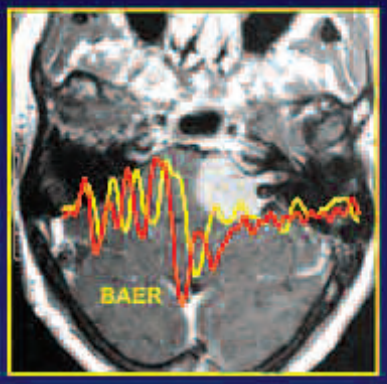
- ❑ Electronic Version of Handout/Syllabus *(no charge)*
- ❑ Electronic Version and Printed Handout/Syllabus $75 *(ONLY available if paid for prior to the meeting)*
- ❑ Printed Handout/Syllabus without meeting registration $150.00

How did you hear about this conference? ____Mail ___E-mail ___Internet ___Other _____

HOTEL REGISTRATION INFORMATION: Laguna Cliffs Resort & Spa: Click on this link, **www.lagunacliffs.com**
Make your reservations by calling **949-661-5000**.

AMERICAN SOCIETY OF NEUROPHYSIOLOGICAL MONITORING
2010 WINTER SYMPOSIUM





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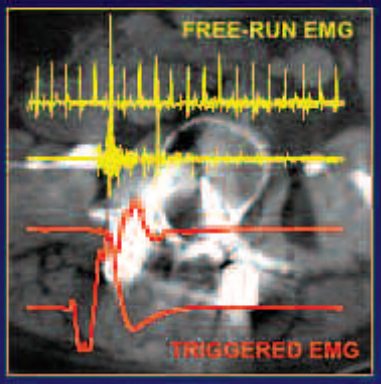

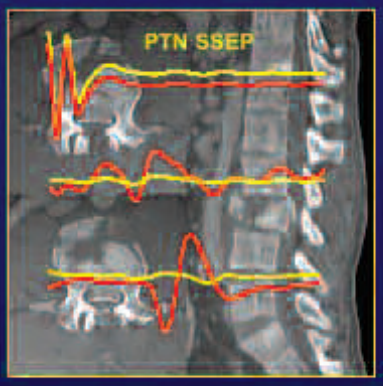

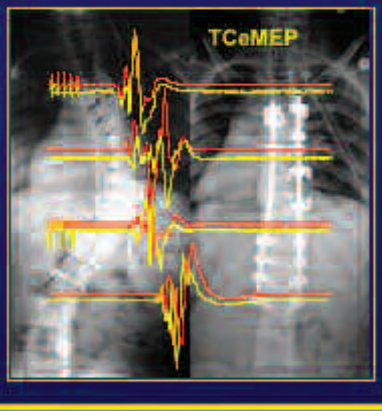

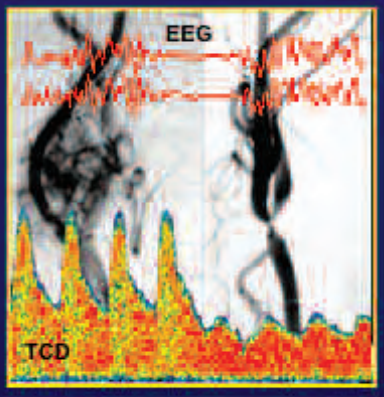

HILTON, CLEARWATER BEACH, FL 3/5-3/6, 2010

Join us in Clearwater Beach, Florida for the best of *la Florida* experiences.

Come and enjoy the 2010 Winter Symposium, sponsored jointly by the American Society of Neurophysiological Monitoring and Orlando Health in the relaxed, elegant surroundings at the Hilton Clearwater Beach Resort in Clearwater Beach, Florida. Clearwater Beach is "the best city beach on the gulf of Mexico" according to Dr. Stephen Leatherman, also known as "Dr. Beach." Clearwater Beach is only steps away from the emerald waters of the Gulf of Mexico, with some of the softest and whitest sand beaches in Florida. The surrounding area offers a never ending stream of opportunities and attractions, including boating, diving and snorkeling, relaxing on the beach, parasailing, golf, dining, and shopping. Dining options in the surrounding area are wonderfully diverse, particularly notable is the Island Way Grill which overlooks the Intercostal Waterway and is considered by many to be one of Florida's finest seafood restaurants.

This symposium is designed for basic and advanced personnel performing intraoperative neuromonitoring, highlighting multimodality protocols, recent advances in the field, and future trends. Each presentation will address a current literature review, technical developments, methodologies, and clinical efficacy. Special attention will also be paid to billing and CPT codes for neuromonitoring, and patient safety. The faculty is composed of past presidents of the ASNM, past and current members of the ASNM board, and other distinguished professionals in the field.

Course Objectives

The structure of the Winter Symposium is to provide a forum for scientific and clinical presentations, special interest seminars, and didactic lectures with all accompanied by comprehensive handouts and video materials, and with ample opportunity for interaction between the faculty and audience. Special evening events will also provide a chance for the attendees to personally interact with the faculty and each other. The learning objectives are to expose the participants to materials that will allow them to achieve a comprehensive understanding of the following concepts:

- Advanced principles for neurophysiological monitoring, including instrumentation, neuromonitoring protocols, recent advances, alarm criteria and clinical efficacy.
- The appreciation and utility of using multimodality neuromonitoring techniques for variety of surgeries involving orthopedic, vascular, cardiac and neurosurgical procedures.
- Advances in remote neuromonitoring.
- The basic principles, applications, and guidelines for using transcranial and microvascular Doppler during vascular (carotid endartectomy) and cardiac (cardiopulmonary bypass) surgeries, and for clipping of cerebral aneurysms.
- New and emerging methods for monitoring spinal motor pathways.
- Exposure to problem solving in instances of pathological and nonpathological changes in neurophysiological monitoring data.
- Intraoperative neuromonitoring of cranial nerves.
- Neuromonitoring and patient safety.
- Medico-legal issues.
- Appropriate billing and CPT codes for intraoperative neuromonitoring.
- Anesthesiology concerns for spinal surgery.
- Requirements for DABNM Certification.

ORLANDO HEALTH

Continued on next page ☞

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Professor and Associate Chair for Development
Department of Anesthesiology
University of Colorado at Denver and Health Science Center
Denver, Colorado

ORLANDO HEALTH

Continued on next page ☞

Program Schedule
2010 Winter Symposium
American Society of Neurophysiological Monitoring

Friday, March 5, 2010

7:00 am Continental Breakfast

7:55 Welcome and Introduction
Michael Isley, PhD, DABNM, FASNM

8:00 Billing and CPT Codes for Neuromonitoring: An Open Forum
Marianna Hegedus, BA

9:00 Break

9:15 Current Trends in Pedicle Screw Stimulation: Cervical, Thoracic, and Lumbo-Sacral Levels
Michael Isley, PhD, DABNM, FASNM

10:30 Patient Safety During Intraoperative Neuromonitoring
Jack Kartush, MD, FASNM

11:30 Intraoperative Neuromonitoring of the Recurrent Laryngeal Nerve
Jack Kartush, MD, FASNM

Noon – 1:00 pm Lunch (Provided by the ASNM)

1:00 Blood Supply of the Spinal Cord: Are Traditional Concepts Valid?
Leo Happel, PhD, DABNM, FASNM

2:00 Current Trends in Intraoperative Motor Evoked Potentials
Jeffrey Balzer, PhD, DABNM, FASNM

3:00 Break

3:15 Intraoperative Cranial Nerve Monitoring: Methodologies and Clinical Outcomes
William Martin, PhD, FASNM

5:00 New Technical Challenges in Intraoperative Neuromonitoring: iMRI, Minimally Invasive Spine Surgery, Unsupervised Monitoring, and Other Tasty Items
William Martin, PhD, FASNM

5:30 Adjournment

5:30 Wine and Cheese

7:30 Faculty Dinner (Island Way Grill)

ORLANDO HEALTH

Continued on next page ☞

Program Schedule
2010 Winter Symposium
American Society of Neurophysiological Monitoring

Saturday, March 6, 2010

7:00 am Continental Breakfast

7:55 Welcome and Introduction
Jeffrey Balzer, PhD, DABNM, FASNM

8:00 Electromyography During Spinal Surgery
Leo Happel, PhD, DABNM, FASNM

9:00 Anesthesiology Concerns During Spinal Surgery
Tod Sloan, MD, PhD, MBA, FASNM

10:00 Break

10:15 Transcranial Doppler Ultrasound for Perioperative Neuromonitoring
Harvey Edmonds, Jr., PhD, FASNM

11:00 Strategies for Neuromonitoring
Jeffrey Balzer, PhD, DABNM, FASNM

12:00 – 1:00 pm Lunch (On Your Own)

1:00 Multimodality Neuromonitoring for Cardiac and Vascular Surgery
Harvey Edmonds, Jr., PhD, FASNM

2:00 Anesthesic Effects and Protocols for Neuromonitoring Using Sensory and Motor Evoked Potentials
Tod Sloan, MD, PhD, MBA, FASNM

3:00 Break

3:15 Practical Considerations of Physician Remote Neuromonitoring
Anne M. Guyot, MD, DABNM

4:15 ABNM and DABNM Information Workshop
Tod Sloan, MD, PhD, MBA, FASNM

5:15 Adjournment

ORLANDO HEALTH

Continued on next page ☞

AMA

This activity has been planned and implemented in accordance with the Essential Areas and Polices of the Accreditation Council for Continuing Medical Education (ACCME) through the joint sponsorship of Orlando Health and the American Society of Neurophysiological Monitoring. Orlando Health is accredited by ACCME to provide continuing medical education for physicians. Orlando Health designates this educational activity for a maximum of 15.75 AMA PRA Category 1 Credit(s)™. Physicians should only claim credit commensurate with the extent of their participation in the activity.

ASHA

Certificates of Attendance will be given for application to the Continuing Education Board of the American Speech-Language-Hearing Association (ASHA) for CEUs.

ASET

The American Society of Electroneurodiagnostic Technologists has granted 15.75 ASET Continuing Education (ACE) credits for this program. Such crediting, however, should not be constructed by program participants as an endorsement of any type of instrument or supplies mentioned or involved in these presentations.

2010 Winter Symposium
American Society of Neurophysiological Monitoring
Hilton Clearwater Beach Resort, Clearwater Beach, Florida
March 5-6, 2010

ASNM Registration Deadline: February 14, 2010
Hilton Room Registration Deadline: January 31, 2010

Name _____ Credentials _____

Affiliation _____ Department _____

Address _____
Street Address City State Zip Code

Phone (_____)_____ (_____)_____
Business (Daytime) Home

Registration Fees:

Deadline Date	Full Members	Non-Members	Enter Amount
Until 2/14/10	$425	$550	
After 2/14/10	$525	$650	
		Payment*	

***Full Registration includes all events and a hardcopy handout. (Optional CD copy for $20.00)**

Please make checks payable for registration to ASNM and include additional charge for optional CD.

Amount: $_____ Authorized Signature:_____

Refund Policy: For cancellations received prior to Feb 14, 2010, fees will be refunded less a $50 service charge. Cancellation must be in writing and must include the original registration receipt. No refunds will be provided after Feb 14, 2010.

Travel Information: ASNM recommends using the shuttle service to and from the airport to the Hilton Clearwater Beach Resort.

Hotel Accommodations: Rooms are at the Hilton Clearwater Beach Resort, 400 Mandalay Ave., Clearwater Beach, FL, 33767 (Tel. 888-353-3222; Fax 727-446-1583; website: hiltonclearwaterbeachresort.com) are available at a special conference rate ($215). These rooms will be held only until January 31, 2010. Reservations will be accepted on a space available basis after this date. Take advantage of the special registration rates by booking early. Check the ASNM website for updates (ASNM.org).

Two Registration Options:

Register by credit card:
www.signmeup.com/67258

Register by check and mail to:
ASNM Registration c/o Monica Clark
827 East Briar Lane
Green Bay, WI 54301

Vendor Registration: www.signmeup.com/67260

We regret that registration cannot be accepted by telephone: For additional information, please call 920.362.2737 or email ASNMregister@gmail.com For program information, contact Dr. Michael Isley, at 407.841.5111 ext. 841.6694 or email Michael.Isley@orlandohealth.com.

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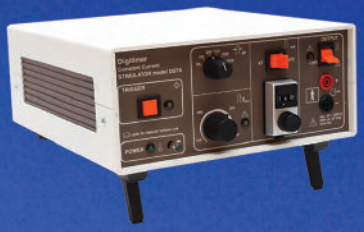

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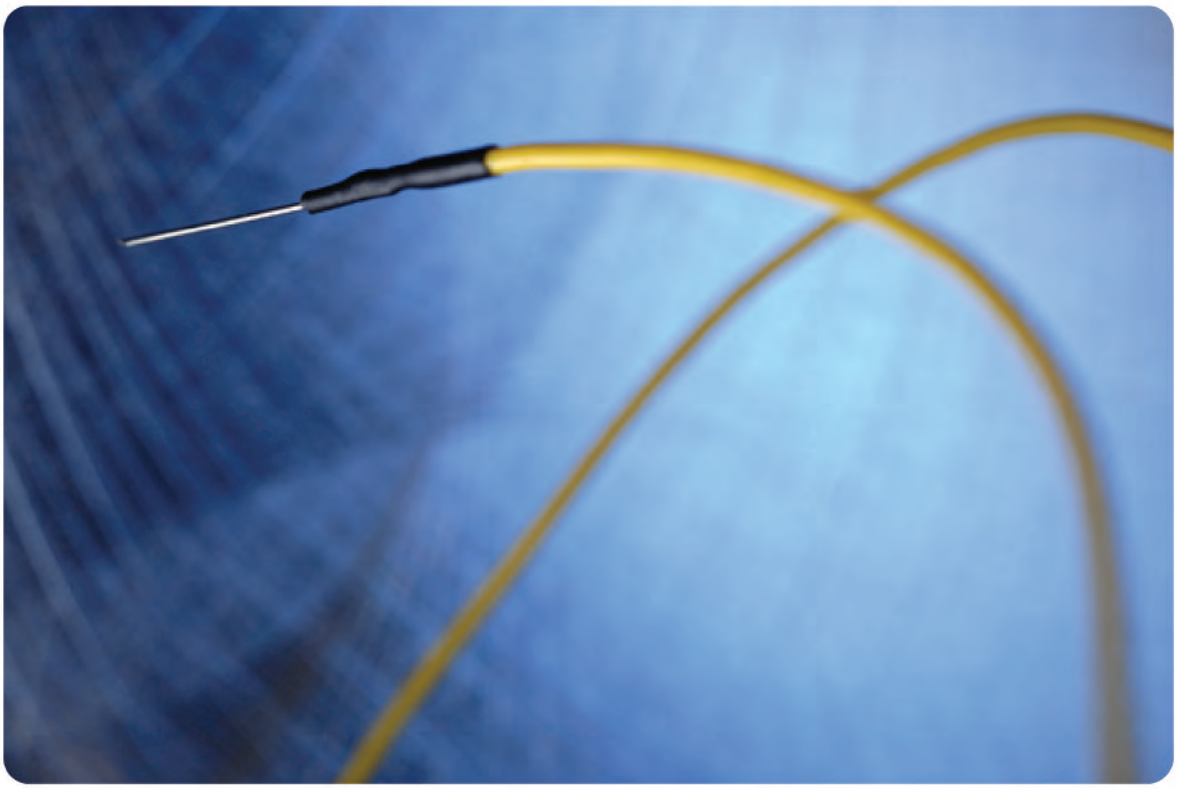

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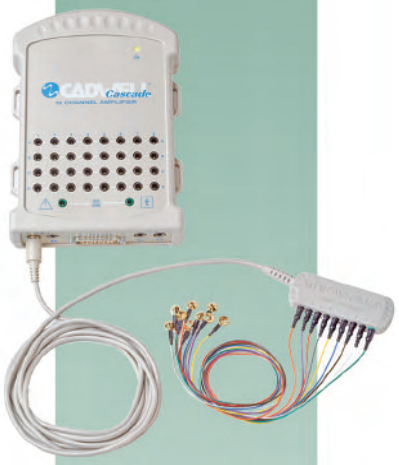

The Cadwell Cascade is a powerful, multi-modality system capable of performing EP (including SEP, TceMP, BAEP, VEP), free-run EMG, stimulated EMG, EEG, and train of four tests simultaneously. The Cascade can also be used clinically for multi-channel evoked potential testing and other applications.

The Cascade was designed with portability as a priority. The base unit weighs only 4.25 lbs. The Cascade can be configured with a laptop computer for portability or as a desktop PC-based system.

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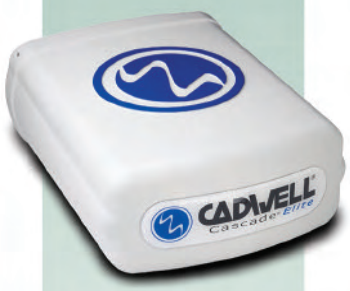

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More information will be coming soon.

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The ASNM Monitor is the Newsletter of the American Society of Neurophysiological Monitoring.
The ASNM is located at:
20 North Michigan Avenue., Suite 700, Chicago, IL
(800) 479-7979 • Fax (800) 479-7989

The ASNM Web Site address: www.asnm.org.
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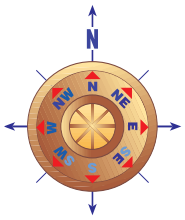

Got a problem, an interesting concept, or an issue and don't know what direction to take to get an answer or feedback on? Your ASNM Board Committees are here for you to contact and help get the answers you are seeking!

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Physician & Advanced Intraoperative Monitoring Practitioner Symposia

Laguna Cliffs Resort & Spa--California Feb. 6-7, 2010
Physician & Advanced Intraoperative Monitoring Practitioner Symposia

Winter Regional Symposia
Clearwater Hilton Beach Resort, Clearwater, FL March 5-6, 2010

21st Annual Meeting--Nashville, TN April 22 -25, 2010

22nd Annual Meeting--Orlando, FL May 13-15, 2011