

Emergency Neurological Life Support (ENLS): What to Do in the First Hour of a Neurological Emergency

Wade S. Smith · Scott Weingart

Published online: 28 July 2012

© Springer Science+Business Media, LLC 2012

Abstract Emergency Neurological Life Support (ENLS) is a series of protocols, generated by experienced neurocritical care and emergency physicians that describe key steps when managing a patient within the first hours of a neurological emergency. The protocols are designed to help standardize these important early steps for several reasons: (1) patients will likely experience better outcomes, (2) they provide the essential elements to communicate to receiving physicians a patient's diagnosis and emergency treatment, (3) this approach forms the foundation for eventual consensus on neurological emergency decisions, and (4) this consensus can inform researchers about the important clinical questions that need resolution to enhance patient care. ENLS is online and free to use. Certification and training in ENLS is hosted by the Neurocritical Care Society. This document introduces the concept of ENLS, reviews the history of its creation, and enumerates future goals as ENLS becomes adopted more widely.

Keywords Protocol · Algorithm · Stroke · Resuscitation · Subarachnoid hemorrhage · Meningitis

Purpose of ENLS

ENLS emerged from the need of emergency medicine professionals to know and apply essential first steps in the initial hour of a neurological emergency. The limited number of

physicians who become clinical neuroscientists (e.g., neurologists, neurosurgeons, psychiatrists) are in high demand and, in many settings, are not readily available to manage patients acutely. This leaves those on the front line—emergency physicians, nurses, and paramedics—to deal with potential neurological catastrophes like status epilepticus, subarachnoid hemorrhage, and ischemic stroke.

Depending on their level of training and experience, these professionals have a range of comfort dealing with such emergencies. Because the first few hours of neurological emergencies are likely the most critical for defining patient outcome, adequate training for these emergencies should be available for all front line medical professionals.

ENLS is not a comprehensive set of protocols for the complete management of neurological emergencies. Rather, it is a compilation of the core issues that should be addressed within the first hours of the patient encounter. For many conditions, the list of items is simple. For example, for subarachnoid hemorrhage, one should control the airway and blood pressure, assess the patient clinically, and decide if he or she has hydrocephalus. These key elements are ultimately all that is germane to communicate when the ED physician calls the admitting physician.

By refining the checklist to a few critical items, practitioners can focus quickly and efficiently on the most important considerations rather than on more esoteric items. Upon hearing a concise presentation, the receiving neurointensivist or neurosurgeon is then immediately primed for the next steps as they assume care of the patient (e.g., ventriculostomy, imaging, scheduling an OR).

We hope that physicians will train and certify in ENLS, much like they do in Advanced Cardiac Life Support (ACLS) and Advanced Trauma Life Support (ATLS), and, in doing so, will be more comfortable dealing with neurological emergencies. By making the protocols readily

W. S. Smith (✉)

Department of Neurology, University of California,
San Francisco, CA, USA
e-mail: spambin55@gmail.com

S. Weingart

Division of Emergency Critical Care, Mount Sinai School
of Medicine, New York, NY, USA

accessible online, physicians may refer to them in real-time—if only to refresh their memories about certain elements. The online protocols are hosted on the Neurocritical Care Society website (<http://neurocriticalcare.org/ENLS>), as is the training and certification course.

ENLS has another purpose beyond streamlining patient care. Because so many of the steps involved in emergency resuscitation of the brain are lacking an evidence basis, ENLS was created as a “first draft” of what experts say should be done, drawing on any existing evidence and their own experience. Each online protocol is able to accept comments at each decision point (by clicking on the feedback link); users of the protocols can submit comments as they learn the protocols or while using them in practice. Our hope is by having the protocols available to anyone, such practical feedback will allow iteration of protocols to more universal consensus. It would be difficult to view ENLS protocols as guidelines because of this relative lack of evidence-basis for managing neurological emergencies; authors of the manuscripts contained herein have referenced their papers where references exist. ENLS should not, by itself, be considered standard-of-care, and physicians who manage patients with conditions addressed by ENLS should not be considered falling below a standard-of-care if they do not follow a particular ENLS protocol. Rather, ENLS should be considered as advisory, much like what a physician expects to learn when calling a consult. Our hope is that enterprising researchers will identify the gaps in knowledge inherent in ENLS and initiate clinical research to prove or disprove particular components. This research will inform modification of the protocols over time, increasing their potential to improve patient outcomes.

History of ENLS

The creation of ACLS and, later, ATLS helped usher protocol-driven medicine into clinical practice. Both protocols were based on a need to provide clear, simple guidelines for physicians treating patients in crisis. They also allowed for standardization of clinical vernacular, leading to better communication and understanding across broad backgrounds.

The idea of having a set of protocols for neurological emergencies is not new. Allan Ropper, MD, recalls discussions of this sort beginning in the early 1980s during the creation of the American Academy of Neurology Neurocritical Care course by Dr. David Jackson. Per Dr. Ropper, “There were ... formal and informal discussions among the small group of people interested in neurocritical care about the best ways to perform CPR. Fads of abdominal binding, resuscitation in Trendelenberg, various frequencies of chest compression and respiration, and the possible benefits of

jugular venous compression were all debated hotly. These were simply variations on cardiac CPR recommendations but, nonetheless, were beginning to be oriented much more toward brain resuscitation.” Such early discussions were clearly motivated to improve brain perfusion and outcomes. In the 1990’s, Sydney Starkman and Eelco Wijdicks directed a seminar for the American Academy of Neurology titled, *Acute Neurologic Catastrophies: the first 60 min*. However, there was still low penetrance to the clinicians that performed the majority of care to patients during their early hospital course.

Neuroscience has remained esoteric to many who specialize in fields other than neurology, neurosurgery, and psychiatry. As it is rare for neuroscientists to primarily practice in the emergency room, those who actually deal with neurological emergencies at presentation (Emergency Department or out of hospital) have typically found support only in neurosurgeons and the rare neurologist who practices critical care medicine. Neurocritical care itself began in early respiratory care units during the polio epidemics and aligned with emergency physicians and pulmonologists, primarily for the care of patients with neurological emergencies. Yet, the knowledge gap between such specialties exists even today because of the extensive training necessary in these diverse specialties: there are only a few physicians who have specialized in emergency medicine and the neurosciences, and there are very few available resources on the early care of neurological emergencies.

This motivated the creation of ENLS; euphemistically, “What do I do in the first hour of a neurological emergency?” It began in November 2009, after the Neurocritical Care Society board reviewed the suggestions of Edgar Samaniego, MD, and Greg Kapinos, MD—fellows in neurocritical care from Stanford University and Columbia University, respectively—who submitted an abstract suggesting the need for such protocols written by Neurointensivists [Neurocrit Care (2009) 11:S136]. The board deliberation concluded with the appointment of neurointensivist Wade Smith, MD, PhD, and emergency physician-intensivist Scott Weingart, MD, to chair the process.

These co-chairs selected the initial protocols based on the disorder’s emergency state, the presence of treatment decisions that can affect outcomes, and the prevalence of such disorders as the first group of ENLS topics. The dichotomy of a neurointensivist and emergency physician was kept in the overall organization, whereby two such physicians were selected to co-chair the development of each topic (Table 1). The co-chairs were selected for their reputations as educators and their specialty, with the requirement that they did not previously know each other well or at all and were preferably from different institutions, to avoid “group-think” or other engrained practices.

Each team of co-chairs drafted their protocols and these were posted for comment and feedback on an online

Table 1 List of ENLS protocols and their authors

Topic	Emergency medicine	Neurointensivist
Acute ischemic stroke	Harmut Gross, MCG	Gene Sung, USC
Acute weakness	Oliver Flower, Royal North Shore Hospital, Sydney	Eelco Wijdicks, Mayo Clinic
Airway, ventilation, and sedation	Andy Jagoda, Mt. Sinai, NY, USA	David Seder, Maine Medical Center
Coma	J. Stephen Huff, UVA	Robert Stevens, Johns Hopkins
Intracranial hypertension and herniation	J. Stephen Huff, UVA	Robert Stevens, Johns Hopkins
Intracerebral hemorrhage	Ed Jauch, MUSC	J. Claude Hemphill, UCSF SFGH
Meningitis and encephalitis	David Gaieski, University of Pennsylvania	Bart Nathan, UVA
Resuscitation following cardiac arrest	Jon Rittenberger, University of Pittsburgh Medical Center	Kees Polderman, University of Pittsburgh Medical Center
Spinal cord compression	E. Bradley Bunney, University of Illinois	Kristine O'Phelan, University of Miami
Status epilepticus	Robert Silbergleit, University of Michigan	Jan Claassen, Columbia
Subarachnoid hemorrhage	Jon Edlow, Harvard Medical School	Owen Samuels, Emory
Traumatic brain injury	Stuart Swadron, USC	Peter Le Roux, University of Pennsylvania
Traumatic spine injury	John Marx, Carolina Health	Deborah Stein, Shock Trauma Center

bulletin board service through the Neurocritical Care Website. After comments were posted, feedback was incorporated into the protocols. Shockwave-based software was commissioned to present these protocols in an interactive mode that allowed the additional feature of soliciting feedback from the end-user. With this feedback option, both the topic co-chairs and the ENLS co-chairs are emailed with comments in real time, with the goal that once the protocols are released we can rapidly incorporate constructive comments.

Our intention is to keep the ENLS protocols in the public domain so that everyone can benefit from them. Each co-chair submitted manuscripts defending their protocols, and their manuscripts comprise this supplement to Neurocritical Care. To maintain quality control over their content, and to insure adequate training in their utilization, we created a Moodle-based learning management system to educate medical professionals on application of the protocols and pass a certification exam. Continuing Medical Education credit will be available for such training and will be offered through the Neurocritical Care Society.

Future Goals

Delivering the protocols, updating them with current science, and providing an education framework to teach the

basis for these recommendations is the major focus of ENLS. However, one additional focus is to use these protocols as the basis for informing medical professionals about the dearth of medical evidence supporting these suggestions. As one reads through the protocols, it quickly becomes clear that little information currently exists to mandate these recommendations. Our hope is that researchers in clinical and translational research will be stimulated by the recommendations to design clinical research studies to prove or disprove the utility of such recommendations and, in time, management of the neurocritically ill patient in the first hour will be as evidence based as ACLS.

Acknowledgments We wish to thank all of the co-chairs listed in Table 1 for their efforts, as well as Drs. Daryl Gress, Allan Ropper, E. Sander Connerly, Art Pancioli, and Edward Sloan for advising us in this process. We extend special thanks to Dr. Ropper for his in-depth review all of ENLS manuscripts. We also thank Sarah Livesay, RN, and Mary Kay Bader, RN, for their critical comments and supervising the development of certification questions for ENLS. Stephanie Bruzzese spent countless hours editing the various manuscripts helping greatly to add consistency to their appearance and prose. Lastly, both Janel Fick and Tami Page from the Neurocritical Care society have helped remarkably with administrative support. To all those members of the Neurocritical Care Society who took time from their busy practices to provide feedback: these protocols are yours. Please use them to educate others outside of your craft so that all patients have access to the best care possible in that critical first hour.