Does Initial Point of Care Influence Neuro-ICU Outcomes?

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Most of the conditions that eventually get treated in the Neuro-ICU setting require initial diagnosis and management in the Emergency Department. As hospitals increasingly develop networks and other inter-hospital lines of referral, this initial evaluation and treatment often takes place in a center that does not have local expertise in Neurocritical Care, advanced neuroimaging, or a Neurosurgeon. If, by chance or by geographic necessity, a patient is brought by EMS to such a “non-Neurocritical Care” ED, does this adversely affect outcomes?

This is a big question, and it potentially applies to a host of conditions, including ischemic stroke, intracerebral hemorrhage (ICH), subarachnoid hemorrhage (SAH), and neurotrauma. The answer to this question might alter the ways in which initial EMS triage and initial ED care are organized as regional approaches to emergency care are further developed in the future.

In this issue of *Neurocritical Care*, Naval and Carhuapoma examine the impact of initial point of care on clinical outcomes among patients with ICH treated in the Neuro-ICU at Johns Hopkins Hospital. Although this a relatively small retrospective study of 125 patients, there is a strong suggestion from these data that initial treatment in the ED at Hopkins was associated with better outcomes. The authors show the outcomes at hospital discharge were improved in the Hopkins ED group across multiple favorable levels of the modified Rankin Scale, and the association between Hopkins ED treatment and good outcome remained after controlling for ICH and IVH volumes, age, and GCS in a logistic regression model.

Studies can often raise more questions than they answer, and the current paper by Naval and Carhuapoma is no exception. Many of the new questions raised by this study arise from one central question: what does treatment in the Hopkins ED (vs. another ED) really mean? Is this simply a demonstration of the excellent emergency room care provided at a world-famous hospital in a busy inner-city area (as compared to other, less notable facilities)? Or is it more specifically a demonstration of the added value of Neurointensivist or Neurosurgical intervention at an earlier point in the care of critically ill patients with ICH? Perhaps the effect seen here is that of *inferior* care at the outside EDs compared to standard care at the Hopkins ED (as compared to standard care at the outside EDs compared to superior care at the Hopkins ED). Examples of possible inferior care might include delayed triage, delayed diagnosis, or delayed or inadequate treatment or blood pressure or coagulopathy. Yet another explanation might be that the association seen here is purely based on the longer time between ED arrival and ICU admission that is by definition built into triage at one facility and ICU treatment at another. Of course, the real answer is likely to be multifactorial, resulting from some combination of these and other explanations.

If being brought to a Neurocritical Care center from the beginning is in fact better than being brought to a non-Neurocritical Care center, would it make sense to bypass non-Neurocritical Care centers during EMS transport, at the potential cost of delaying initial evaluation and treatment? Would better medical informatics networks and applications such as remote imaging access and telemedicine [1–3] improve outcomes for these patients and also avoid the risks of prolonged transport prior to initial evaluation?

To what extent does the lack of familiarity with specific medical interventions drive the association between

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non-Neurocritical Care ED and poor outcome in ICH? For example, use of prothrombin complex concentrate or activated factor VII (together with Vitamin K administration) have been adopted by many Neurointensivists and Neurosurgeons as first-line options to achieve warfarin reversal in Neurological emergencies such as ICH [4–6]. Many physicians in non-Neurocritical Care centers are not comfortable using these agents, and may not have the necessary stocked doses to prescribe them to patients in the ED prior to transport to a Neurocritical Care facility. Thus, most non-Neurocritical Care facilities continue to use fresh frozen plasma plus Vitamin K for warfarin reversal in ICH, which may be a slower method [7] and therefore may be associated with a higher rate of warfarin-related hemorrhage expansion. To some extent, the lack of compelling head-to-head data comparing these various medical options for warfarin reversal may drive these inter-institutional differences, and hopefully better data on this topic will lead to more uniform practices.

Blood pressure control may be another area in which physician comfort drives differences in practice between institutions. Based on data suggesting that there may not be a significant ischemic penumbra surrounding the hematoma in ICH [8–10], Neurointensivists have become increasingly aggressive about blood pressure control early in the course of ICH, such that practice in Neurocritical Care centers may anticipate the slowly decreasing targets specified by societal guidelines [11]. It is much less likely that physicians at non-Neurocritical Care centers would feel comfortable pushing blood pressures below the latest published guideline targets.

Ultimately, there will be some conditions, such as obstructive hydrocephalus, in which the patient simply needs a surgical procedure as soon as possible. Arrival at a non-Neurosurgical center with a condition such as obstructive hydrocephalus will likely always be associated with a worsened outcome.

The paper by Naval and Carhuapoma represents a starting point in an area of research that should be important to anyone engaged in the practice of Neurocritical Care. Future studies will hopefully be able to confirm the

findings of this paper and then go on to address the potential causes for differences in outcomes. In addition, one would hope that additional work may help determine if this local ED versus remote ED discrepancy extends to other Neurocritical Care diagnoses such as SAH or Neurotrauma.

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