Lessons from the medical and surgical ICU

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As the field of neurologic intensive care has become better defined and more independent from medical and surgical intensive care, there has been a trend to focus on the neurologic aspects of care. This approach has allowed many of the recent advances in neurocritical care, including research into hemicraniectomy for malignant stroke syndromes and cooling for brain injury.[1,2] As we continue to improve our therapies to protect brain function and augment recovery, it is increasingly important to look at the advances in medical and surgical critical care to evaluate both the new therapies that they test and the processes employed to study fundamental issues.

This review discusses three trends in research and care in medical and surgical intensive care units (ICUs) that may impact the care of patients in the neurointensive care unit (neuroICU). Although many of the studies behind these trends are important landmarks in critical care, it is important to note that they were conducted in patients with illnesses and injuries that are distinct from what is normally seen in the neurointensive care setting. These results may not be applicable in different ICU settings. As a specialty, we need to validate these promising studies in our patient population before we fully endorse a change in standard of care. For now, they serve as examples of current thinking on research into the problems of critically injured patients.

A SYSTEMS APPROACH TO INTENSIVE CARE RESEARCH

In the past 10 years, protocols have been developed and validated in many aspects of critical care. Arguably the biggest impact has been on the liberation of patients from mechanical ventilation. A number of studies have directly compared protocol-driven weaning programs with physician-run weaning and liberation from mechanical ventilation (reviewed by Ely et al[3]). In two of the four randomized controlled trials comparing these weaning methods, there was a statistically significant decrease in the number of days of weaning with protocol-driven programs compared with physician-directed weaning.[4,5] The other two studies showed a trend toward significance for a reduction in the time of mechanical ventilation or weaning time with protocol-driven programs.[6,7] Interestingly, the protocols used in these four trials were very different in two aspects: the type of practitioner who determined which patients were ready for extubation, and how that practitioner determined who was ready for liberation from mechanical ventilation. The conclusion that can be drawn is that regardless of the protocol used, the systematic approach to weaning is a more successful paradigm than physician-based decision-making.

This heralds a new type of research in intensive care: systems evaluation. The typical research done in the ICU has been to directly compare one intervention with another. This new approach, which evaluates groups of interventions based on a common premise, is proving to be a powerful tool for assessing the effect of complicated interventions such as ventilator liberation. A study by Bulger et al[8] exemplifies how this tool can be used in the neuroICU. In this retrospective review, the group aimed to determine if adherence to the Brain Trauma Foundation guidelines was associated with improved outcome for patients with severe head injuries. Instead, what they found was that "aggressive care," and not close adherence to the guidelines, was associated with improved outcome (no center adhered tightly to the guidelines).

REEVALUATION OF ROUTINE INTERVENTIONS

A second approach to research that has become important in the medical and surgical ICU is the reevaluation of currently held beliefs about routine

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interventions. Many tests and orders, such as blood glucose monitoring and blood pressure assessment, are ordered routinely at admission per the custom of the ICU. These aspects of critical care management are seldom part of the patient's admission problem. A current area of active research is the evaluation of the standard sliding scale of insulin coverage for hyperglycemia in the ICU. Interestingly, much of the rationale for this type of study comes from work done in rats subjected to cerebral ischemia.[9,10]

A landmark paper published in the *New England Journal of Medicine* by van den Berghe et al[11] showed that an aggressive protocol for controlling serum blood glucose in critically ill surgical patients yielded a 42.5% decrease in mortality compared with the standard sliding-scale practice (4.6% vs 8%). This reduction in mortality is impressive considering that none of the patients in the study had been admitted to the ICU expressly for hyperglycemia. Unfortunately, this study was not able to determine if blood glucose control or insulin therapy alone was the driving force for the mortality benefit. Although it is difficult to extrapolate these findings to the patient population in the neuroICU, if a similar magnitude of mortality benefit is seen in neurologic patients, it will be a more beneficial intervention for stroke patients, in terms of mortality, than intravenous tissue-plasminogen activator (t-PA) was in the NINDS t-PA Stroke Trial.[12] A trial involving the stroke population is currently under way in Europe.[13]

■ CRITICAL EVALUATION OF OLDER STUDIES USING NEW TECHNIQUES

Much of the information we use to make decisions in the ICU is based on studies done before the advent of more powerful research tools and the implementation of standards for statistical analysis. Consequently, much of the information we pass on to future intensive care physicians is suspect. Unfortunately, repetition is often used as a substitute for hard evidence, and information written in textbooks becomes irrefutable.

No better example of this can be found than the current reevaluation of blood transfusion policy in the ICU. The traditional teaching in the ICU is that the optimal hemoglobin level for a vascular patient in the ICU is 10 g/dL, based on physiologic studies showing that the optimal combination of oxygen carrying capacity and blood viscosity is in this range (reviewed by Chapler and Cain[14]). This has led to a protocol to give transfusions to all patients who are anemic, to maintain a hemoglobin level around 10 g/dL.

Although the studies done on the rheology of blood flow were quite elegant in their day and accurate, they didn't address the question of whether the risk of allographic transfusion of blood is sufficiently large to obscure the benefit of an increased hemoglobin level. The Canadian Critical Care Trials Group conducted a study, published in 1999, to address this question.[15] Despite the limitations of the study, they showed convincingly that in younger patients, a strategy of transfusions to keep the hemoglobin level above 10 g/dL was associated with a higher mortality. The population of patients in which the data were less convincing was in the cardiac ischemia group.

This study shows that our previous belief that transfusions of blood products to maintain a predesignated hemoglobin level will improve outcome is not necessarily true for all patients and is likely false for the young and those without severe illness. More importantly, it showed that blood transfusions, like many interventions in the ICU setting, have become a tradition without the scrutiny of rational science. It is important to reevaluate all of our interventions, whether old or new, so that we are not tainted by the traditions of the past.

■ CONCLUSIONS

Research into intensive care management has grown enormously over the last 30 years. Whereas there used to be only a handful of journals and journal articles dedicated to the care of critically ill patients, now there are hundreds of journals and many subspecialties in the field, including neurointensive care. As each of the subspecialized fields becomes more independent and develops research strategies of its own, individual practitioners and researchers become more enveloped by their own subspecialty and sequestered from many interesting advances in other areas.

As the examples cited for the first of our three trends illustrate, the complexity of interactions in the ICU makes direct comparisons of single interventions or medications statistically challenging. A systems approach allows researchers to buffer the effects of individual patient and physician variables that have vexed many critical care studies. Unfortunately, it also reduces the precision with which we can deter-

mine which individual interventions are most useful.

The studies cited in support of our second and third trends show how seemingly insignificant changes in care can have important effects. Looking critically at established intensive care management is not inherently interesting to most practitioners. It is more intellectually appealing to try to find as-yet-undiscovered therapies for neurologic diseases. It is also unfortunate that there is little financial incentive to study clinical practice unrelated to primary disease management, as it is seldom associated with a marketable product that brings with it pharmaceutical company funding. In the future, this type of research may very well improve patient outcome more profoundly than the high-profile studies directed at neurologic injuries.

The three trends highlighted here are interesting because they use techniques not usually seen in intensive care research. In developing these tools to look more closely at practice, these trends open the door for a host of other research projects that can employ similar techniques geared more closely to the problems of neurointensive care patients.

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