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RECENT ADVANCES IN ICU

Neurological diseases in intensive care

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Acute neurological diseases represent a wide spectrum of illnesses that frequently require care in the intensive care unit (ICU). Their ICU management is highly complex, combining supportive care, and interventions to prevent secondary brain injury and promote recovery. This requires close collaboration between neurologists, neurosurgeons, critical care specialists, and other members of the multi-disciplinary team to provide comprehensive and coordinated care to patients.

Prognostication of patients with acute neurological diseases remains challenging, especially regarding decisions of withdrawal of life-sustaining therapy (WLST), because of a perceived poor neurological prognosis with a high degree of long-term disability. Given the significant long-term consequences and costs of neurological diseases from many different aetiologies, continued optimisation of care is of paramount importance to improve outcomes.

Here, we explore five important recent articles in this area and their broader context that have been chosen not only as they may influence practice but also raise important issues to consider when caring for critically ill patients with neurological diseases (Fig. 1). We discuss some of the challenges and controversies that surround the management of these complex patients and highlight areas where further research is needed to improve care pathways and outcomes.

The black box of neurocritical care: is it effective?

There is considerable variation in the way services are structured to look after patients with neurocritical illnesses with dedicated neurocritical care units commonly existing throughout Europe and United States of America but are less common elsewhere. Pham and colleagues performed a rigorous systematic review and meta-analysis of 26 studies and found a decreased risk of mortality and poor functional outcomes in adults with brain injury when looked after by specialized neurocritical care staff [1]. It is unknown whether discrete interventions, for example structured monitoring and prevention of delirium by trained nursing and other staff, or the overall package of care, including advanced neuromonitoring, are most important. The high volume of neurologically unwell patients may also lead to familiarity with their needs, improved knowledge of current best evidence, and/or higher accuracy at predicting good functional outcomes potentially providing less nihilistic care compared with other physicians [2]. However, there are many other potential causes of the differences in outcome between different models of care, and the optimum care model is not known.

An improved understanding of how to monitor, neuroprotect, and manage brain health may help improve outcomes for all ICU survivors. Impairments in cognitive, mental health, and physical domains (Post Intensive Care Syndrome) occur frequently after critical illness regardless of the initial disease leading to admission. It is striking that the most complex organ in the body, the brain, is often the least monitored in critical care. The increasing availability of non-invasive neuromonitoring options offers great opportunity for the transfer of neurocritical care concepts into general critical care. Better knowledge of when to start, how, and the dose of rehabilitation may be important to improve long-term cognitive impairment in ICU survivors [3, 4].

Heterogeneity of care and what can we learn from it

Raised intracranial pressure (ICP) after acute brain injury is associated with poorer outcomes, and ICP-guided management is recommended to help guide management of severe traumatic brain injury (TBI) in many guidelines [5]. A recent prospective cohort study of 146

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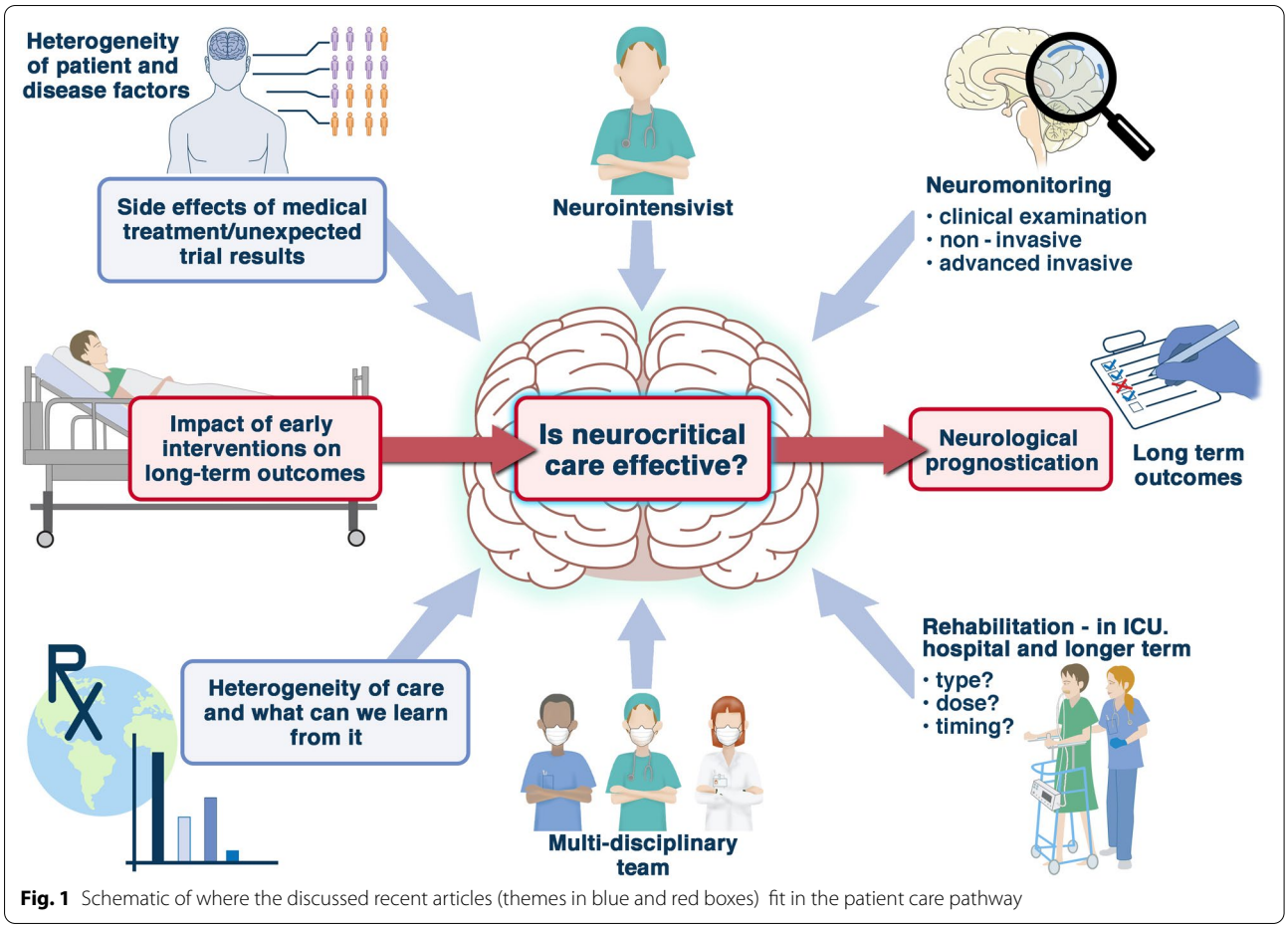

Fig. 1 Schematic of where the discussed recent articles (themes in blue and red boxes) fit in the patient care pathway

intensive care units in 42 countries (SYNAPSE-ICU) of patients with an acute brain injury due to hemorrhagic stroke or traumatic brain injury found that the use of intracranial pressure (ICP) monitoring and management varies greatly [6]. The use of ICP monitoring was associated with a more intensive therapeutic approach and with lower 6 months mortality in more severe patients. This heterogeneity was also seen in the Global Neurotrauma Outcomes Study (57 countries) [7]. Fewer than 1 in 5 patients with severe TBI had intracranial pressure monitoring, and only ~ 25% were admitted to critical care indicating significant mismatch between severity of illness and critical care availability. ICP monitoring enables the burden of intracranial hypertension to be assessed and treated, the maintenance of adequate cerebral perfusion pressure, and assessment of cerebral autoregulation. These are important to understand the pathophysiology and to guide and optimise individual patient management [8]. Understanding the variation via comparative effectiveness research is important to identify and encourage best practices that could improve care in different contexts.

Impact of early interventions on long-term outcomes

Existing prognostication models for a variety of neurological emergencies only include admission characteristics. Yet, an improved understanding of the acute trajectory, response to interventions, timing of reliable prognostication, and trajectory of recovery are key to improving outcomes after neurocritical illness. A post hoc analysis of two trials of patients with high-severity intracerebral hemorrhage (ICH) found that hospital events including ICH and intraventricular hemorrhage volume reduction, prevention of systemic complications, and cerebral ischemic injury were significantly associated with long-term functional recovery [9]. The results suggest that prevention of hypoperfusion is more critical than presence of intracranial hypertension, which raises two important questions. First, how fast and aggressive to be with blood pressure reduction to prevent haematoma progression, and second, could invasive or non-invasive brain oxygenation monitoring guided management help to prevent secondary ischemia. Additionally, this paper shows that too early outcome prognostication using only

validated admission predictors is less accurate compared to prognostication at a later time point incorporating events or complications that arise within the first 30 days of intracerebral hemorrhage, in addition to the known admission predictors of outcome.

Side effects of medical treatments/unexpected trial results

Medical interventions in neurocritical care can be both beneficial and harmful. Steroids are commonly used in many acute neurological conditions to reduce oedema and inflammation at the acute phase. However, their impact on functional recovery and long-term outcomes is unknown. A recent randomized placebo-controlled trial conducted in patients with symptomatic chronic subdural haematoma found that treatment with dexamethasone resulted in fewer favourable outcomes and more adverse events than placebo at 6 months, despite fewer repeat operations were performed in the dexamethasone group [10]. Of note, the risk of any site infection was sixfold higher in the intervention group as compared to the placebo group. Other adverse events associated with dexamethasone included endocrine disorders and psychiatric disorders up to day 30 after randomization. Careful patient stratification and selection for future trials will be important avenues of research to improve outcomes and avoid with unacceptable side-effects.

Neurological prognostication

Prognostication of the long-term outcome of neurocritically ill patients remains challenging, especially regarding decisions of WLST, because of a perceived poor neurologic prognosis. However, three important recent studies, in intracerebral haemorrhage [9] and traumatic brain injury [11, 12], demonstrate that recovery may take months to years making early prognostication challenging, and support longer evaluation periods.

Even after cardiac arrest, an area where guidelines are more established for use than other acquired brain injuries, self-fulfilling prophecies remain a risk [13]. A recent retrospective study of electronic medical records of > 34,000 non-survivors of cardiac arrest found an extremely low rate of prognostic testing. Strikingly, only 9% of patients underwent at least one neurodiagnostic test, and 16% of deaths occurring on or after day 3 which is lower than would be expected [14]. Understanding the reasons is important to facilitate standardization and improve care. There is great variability in how clinicians formulate prognoses and have WLST discussions with surrogate decision-makers, and understanding these differences is also very important when facilitating treatment decisions congruent with patient values and preferences [15]. We will also need to await whether recently published guidelines on neuroprognostication after cardiac arrest examining in detail the reliability of individual factors and prognostication scales influence clinical practice [16]. Machine learning/artificial intelligence algorithms, potentially taking into account the temporal progress of a patient and large amounts of data, may offer improved ways to prognosticate in the future. Further research in this area, including validation and how best to implement such algorithms in clinical pathways, is required.

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