FOCUS EDITORIAL

Focus on clinical neuroscience

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Introduction

Care of the critically ill neurological patient has developed through increased understanding of underlying pathophysiological processes and advances in neuroimaging and neuromonitoring techniques, as well as by the introduction of neurointensivists and neurocritical care units [1].

Neuromonitoring

Monitoring the brain and neurological function has broad relevance in critical care in general, and specifically in patients with acute brain injury (ABI). Comprehensive, consensus-based guidance on neuromonitoring has recently been published [2, 3]. Serial clinical assessment remains the cornerstone of neurological monitoring, and a pragmatic approach to the neurological examination in critically ill patients has been outlined by an European Society of Intensive Care Medicine (ESICM) Expert Panel [3]. This approach highlights the importance of a full and regular clinical neurological examination in every patient admitted to the intensive care unit (ICU) and recommends daily sedation holds to assess neurological function in all patients except those with reduced intracranial compliance when reliance is placed on other neuromonitoring techniques. Recent guidance highlights the importance of multimodal neuromonitoring to guide an individualized approach to patient management based on monitored physiological variables rather than pre-determined, generic thresholds [2]. This concept also applies to cerebral microdialysis monitoring, the guidance for which has been revised and updated [4]. Novel non-invasive neuromonitoring techniques would be advantageous when invasive monitoring is contraindicated. In a recent

study, computed tomography (CT)-measured optic nerve sheath diameter was found to be a more powerful predictor of directly measured increased intracranial pressure than any other CT finding, as well as being highly discriminatory for the prediction of intracranial hypertension [5].

Systemic physiology and brain dysfunction

Many patients develop brain dysfunction as a consequence of their critical illness. In a study of surgical ICU patients without primary neurological disease who underwent continuous electroencephalogram (EEG) monitoring due to altered mental state, 16 and 29 % were identified to have non-convulsive seizures (NCSz) and periodic epileptiform discharges, respectively [6]. Another study confirmed a high incidence of NCSz (11 %) and periodic discharges (25 %) in critically ill septic patients with altered mental status [7]. In this study, lack of EEG reactivity was associated with higher mortality up to 1 year after discharge. Large, prospective studies are required to determine the exact incidence and outcome effects of EEG abnormalities in the critically ill, and whether treatment modulates outcomes.

Targeted normothermia is often recommended after ABI despite the absence of high-quality evidence for any benefit of this treatment. A large retrospective cohort study of patients admitted to 148 ICUs in Australia and New Zealand and to 236 ICUs in the UK found that elevated peak temperature was not associated with an increased risk of death in those with central nervous system (CNS) infection (meningitis and encephalitis), whereas a temperature of <37 °C and >39 °C was associated with an increased risk of death in patients with traumatic brain injury (TBI) and stroke [8]. Thus, while targeted temperature management (TTM) may be beneficial after acquired brain injury, the febrile response may be advantageous in patients with CNS infection.

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It seems unlikely that the restrictive transfusion approaches used in general critical care can be extrapolated to patients with TBI because of the increased susceptibility of the injured brain to ischemia. A randomized controlled trial (RCT) of erythropoietin and two transfusion thresholds [hemoglobin (Hb) concentrations of 70 and 100 g/L] found that neither the administration of erythropoietin nor maintenance of the Hb level at >100 g/L improved neurological outcomes at 6 months after TBI, with the latter being associated with more adverse events, particularly thromboembolism [9].

Brain injury after cardiac arrest

Changes in post-resuscitation care after cardiac arrest have recently been summarized [10]. TTM remains crucial, but with an option to maintain temperature at 36 °C instead of 32–34 °C. It is now recommended that a multimodal prognostication strategy be used that allows sufficient time for neurological recovery before prognosis is determined.

ICU-acquired weakness

The mechanisms of ICU-acquired weakness (ICUAW) are multiple but not fully elucidated, although an early decreased synthesis and increased degradation of myosin heavy chain has been implicated [11].

Often suspected clinically, the definitive diagnosis of ICUAW requires a structured clinical examination to demonstrate decreased muscle strength in a cooperative patient, and electrophysiological studies which are time-consuming and uncomfortable for awake patients. A simplified but highly sensitive and specific electrophysiological screening approach for ICUAW, using a combination of unilateral peroneal (motor) and sural (sensory) nerve conduction studies, has been reported [12]. The compound muscle action potential has also been associated with 1-year mortality [13]. Together, these studies suggest that simplified approaches to the investigation of ICUAW can be used for both diagnosis and prognosis.

Stroke

Although accounting for fewer than 5 % of all strokes, aneurysmal subarachnoid hemorrhage (SAH) is a major cause of stroke-related death and disability. Early brain injury related to the immediate effects of aneurysm rupture has significant adverse outcome effects, as does the subsequent cellular, metabolic and inflammatory consequences that result in impaired neurovascular coupling, disruption of the blood brain barrier and cerebral ischemia and edema [14]. New insights into the pathophysiology of SAH and its complications, particularly delayed cerebral ischemia, have led to changes in approaches to treatment [15].

Increasing numbers of patients with acute ischemic stroke (AIS) are being admitted to an ICU for physiological optimization, management of post-stroke complications (including those related to thrombolysis) and novel therapies [16]. In 2015, five studies reported strong evidence that intraarterial interventions (intraarterial thrombolysis, mechanical clot retrieval, or both) combined with standard medical management improves the outcomes of appropriately selected patients with AIS and large artery occlusion [17]. A subsequent metaanalysis that included pre-2015 studies confirmed that endovascular thrombectomy is associated with higher rates of angiographic revascularization and improved functional outcomes, but it found no significant difference in symptomatic intracranial hemorrhage or all-cause mortality at 90 days after large artery occlusion-related AIS [18].

Poor swallow is a common consequence of AIS. It increases the risk of aspiration pneumonia, malnutrition and dehydration and is associated with increased mortality, poor long-term outcome and prolonged hospital stay. Neurostimulation strategies for the treatment of post-stroke dysphagia have been employed with variable degrees of success. A recent RCT in severely dysphagic tracheotomized patients found that electrical pharyngeal stimulation was significantly associated with improved airway protection and resolution of the dysphagia; it also facilitated decannulation in the majority of patients [19].

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Compliance with ethical standards

Conflicts of interest

None.

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