

INVITED COMMENTARY

Bundled Treatments in Poor-Grade Subarachnoid Hemorrhage: Do They Help?



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Aneurysmal subarachnoid hemorrhage (SAH), a hemorrhagic stroke affecting a relatively young population, has major socioeconomic implications. Although it accounts for ~5% strokes worldwide, its cost burden is disproportionate, extending beyond the acute phase of the disease and into the postacute phase, and includes physical and (often under-recognized) cognitive rehabilitation followed by societal reintegration. Advancement in neurocritical care over the past 2–3 decades, along with development of specialized neurocritical care units, has resulted in decreased mortality, but morbidity remains high, especially among those with severe-grade SAH (i.e., Hunt and Hess [H&H] grades IV and V: comatose at presentation). It is also a complex disease that not only involves the brain (at the time of ictus and beyond) but also has multisystem manifestations. Several specialists and ancillary health care professionals need to work in collaboration to provide optimal outcome for such patients, including but not limited to the neurosurgeon, neurointensivist, interventional neuroradiologist, neuroscience nursing staff, respiratory therapist, nutritionist, and physical and occupational therapist. Hence, as a complex disease managed in a critical care setting, SAH is a recipe for practice variations and thus suboptimal patient outcome. To address such problems in the intensive care unit (ICU), most US hospitals have adopted a “bundle” care delivery model as recommended by the US Institute of Healthcare Improvement (IHI).

The guiding principles of the IHI are based on their triple aim, that is, simultaneously improving the health of

the population, enhancing the experience and outcomes of the patient, and reducing per capita cost of care for the benefit of communities [1]. To improve health care delivery, they recommend using an “evidence-based bundle,” defined as a structured way of improving the processes of care and patient outcomes. The bundle is a small straightforward set of (generally three to five) evidence-based practices that, when performed collectively and reliably, have been proven to improve patient outcomes. Ventilator-associated pneumonia prevention, central line-associated bloodstream infection prevention, severe sepsis management, and ABCDEF early mobility are some familiar bundles adopted in clinical practice. Given the complexity and morbidity of high-grade SAH and the absence of high-quality evidence in this patient population, apart from society guidelines, it is aspirational to develop a similar bundle using best available data and expert opinion, as described in the article by Choi et al. [2].

This study is a single-center retrospective chart review of H&H grade IV and V patients admitted over a ~15-year period comparing patient cohorts who underwent bundle treatment with those who did not. The authors identified 97 patients (and included 90 patients for analysis), of whom 43 received bundled treatment. The conventional treatment group received Korean clinical guidelines–based care, whereas the bundle group received primarily prevention of intracranial hypertension–based care, as described in their methodology section. The components of the bundle treatment, following IHI guidelines (of choosing three to five components), included: (1) early and aggressive control of hydrocephalus, (2) performing ultra-early repair of ruptured aneurysm, (3) applying multimodal monitoring, (4) early detecting and aggressively treating delayed cerebral ischemia (DCI), and (5) preventing medical complications (illustrated in Fig. 1 of ref. [2]). Of note, not all

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the monitoring (e.g., continuous electroencephalogram, near-infrared spectroscopy) or treatment (use of intra-arterial nimodipine, intrathecal nicardipine in management of refractory vasospasm to prevent DCI) are universally available at all neurocritical care units. Hence, study results need to be interpreted with caution, and their replicability at other centers may be limited. In addition, many of the factors that the authors used to perform propensity matching are either subjective (e.g., acute hydrocephalus based on “the comprehensive judgment of neurosurgeon and neurointensivist, taking into consideration the increase in measured intracranial pressure, enlargement of the ventricles on imaging, and worsening of accompanying neurological conditions”) or semiobjective (e.g., H&H grades that might have interobserver variation and postresuscitation grading have better clinical outcome correlation [3]; pupil reflex unless performed using automated pupillometry [4]; DCI: “accepted” definition often criticized and difficult to assess in comatose patients [5]). The only objective factor in this matching process was the presence of intraparenchymal hemorrhage. Hence, observer bias needs to be considered while interpreting the results.

In view of these study limitations, the authors report improved clinical outcome (after propensity matching and defining good outcome as a modified Rankin scale score ≤ 2) at 6 months in the bundled treatment group compared with standard care (46.4% vs. 20.7%; $p = 0.039$). In addition, 6-month mortality (bundle vs. conventional: 14.3% vs. 27.3%; $p = 0.01$) was also better. As expected, the interventional group had more external ventricular drains placed, intracranial pressure monitoring, lumbar cerebrospinal fluid drainage, and early and successful intracranial hypertension management, resulting in restoration of pupillary reflex (though not statistically significant; Table 4 in ref. [2]). Of note, the proportion of patients with H&H grade V was higher in the bundle group, whereas an absence of bilateral nonreactive pupils was higher in the conventional group. These observations likely provide credence to the principles of early intracranial hypertension–targeted bundle treatment. However, such management also resulted in a nonsignificant rise in ICU and hospital length of stay. This would be justifiable given the improvement in clinical outcome.

Considering these results, in addition to accepting current study limitations and the challenge in designing

a larger prospective multicenter study (especially in a resource-limited environment), it is reasonable for neurocritical care units to develop and implement a treatment bundle for patients with high-grade SAH. It would require close collaboration among all relevant stakeholders, including hospital administration, as is often seen during the implementation of well-known ICU bundles. Furthermore, it would be a worthy investment given the current limited ability or inability to predict who with an intracranial aneurysm will present with high-grade SAH.

Author Contributions

BR contributed to the article conception and design. The author read and approved the final manuscript.

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Conflicts of Interest

The author declares that the article content was composed in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Ethical Approval/Informed Consent

The study was conducted in accordance with the Declaration of Helsinki and the principles of good clinical practice.

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