Comment:
Intraventricular hemorrhage—
It's the blood that matters, not the timing

Intracerebral hemorrhage (ICH) is a highly morbid form of stroke. Recent research has sought to identify pathologic processes that continue to evolve after patients present for medical care, with the hope that those delayed injuries may be effectively detected and intervened upon to improve outcomes. Our group recently reported an observation that delayed intraventricular hemorrhage (dIVH) developed in 21% of ICH subjects with no intraventricular hemorrhage (IVH) present on initial imaging.[1] IVH has been characterized as an independent contributor to poor outcomes, and recognizing that delayed development of IVH was fairly common, along with the more widely recognized phenomenon of parenchymal hematoma growth, advanced it as another potential candidate for hemostatic treatments. Moreover, dIVH showed approximately the same effect size in contributing to death within 2 weeks and poor outcomes at 3 months as IVH on initial imaging, suggesting that IVH posed similar morbid consequences regardless of when it occurred.

The present work by Witsch and colleagues[2] provides additional insight into this phenomenon. A substantial number of patients in their cohort had dIVH (15%), and they similarly found that the discovery of dIVH was related to the scan timing, reinforcing the concept that intraventricular extension is a phenomenon that evolves for several hours after hemorrhage ictus. The effect of dIVH on outcomes did not reach statistical significance in their multivariate model, perhaps due to a lower observed incidence and a regression technique that dichotomized the modified Rankin Scale (mRS) rather than using an ordinal regression shift analysis. Ordinal statistical approaches to analyzing the mRS have become favored over dichotomization because they increase statistical power by using information from every stratum of the scale, and can identify clinical and significant effects not identified by simple binary regression.[3] That 20%–30% of patients with dIVH in these studies required ventriculostomy placement itself is notable and important. Their and our outcome analyses should not be interpreted as attempts to demonstrate or refute that dIVH is physiologically novel and distinct from initial IVH, but rather to confirm that they are similar and similarly morbid. What is remarkable from the data of Witsch et al. is how the effect estimates from the regression models confirm the similar morbidity of initial and delayed IVH: odds ratio of 2.70 and 2.87, respectively, for poor outcome (mRS 4–6 vs 0–3).

These findings are physiologically intuitive: Why would IVH affect outcomes differently when it occurs a few hours later, or when discovered in a patient who arrives at the hospital a few hours earlier? The key message for practicing clinicians is that important pathologic processes continue to evolve while patients are under our observation and care. The challenge ahead lies in elucidating the most effective methods for preventing, detecting, and treating these evolving and harmful processes.

1. Maas MB, Nemeth AJ, Rosenberg NF, Kosteva AR, Prabhakaran S, Naidech AM. Delayed intraventricular hemorrhage is common and worsens outcomes in intracerebral hemorrhage. Neurology 2013;80:1295–1299.
2. Witsch J, Bruce E, Meyers E, et al. Intraventricular hemorrhage expansion in patients with spontaneous intracerebral hemorrhage. Neurology 2015;84:xxx–xxx.
3. Howard G, Waller JL, Voeks JH, et al. A simple, assumption-free, and clinically interpretable approach for analysis of modified Rankin outcomes. Stroke 2012;43: 664–669.

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