Brain Death in Children: Why Does It Have to Be So Complicated?

The clinical diagnosis of brain death should be based on a straightforward premise. After a known and untreatable catastrophic brain injury and after every possible confounder has been systematically excluded, brain death is recognized as the absence of all brainstem reflexes and verified apnea in a comatose patient. Medically and legally, death can be declared.[1]

Over the years, detailed criteria have been developed to diagnose brain death.[2] Recently the American Academy of Neurology (AAN) revised the criteria in adults.[3] This issue of *Annals of Neurology* includes the new American College of Critical Care Medicine (ACCCM) guideline for the determination of brain death in neonates and children, published elsewhere but reprinted here for neurologists to see.[4] Earlier, the AAN affirmed the educational value of this document, but as a result of substantially different methodology than that of the AAN, the document was not eligible for full endorsement. Specifically, the guideline results from a consensus-based approach and is not an evidence-based evaluation; this is necessary because there has been little if any notable original work since Ashwal's seminal papers in the late 1980s.[5,6]

The committee chose complexity over simplicity, and because the guideline is based on consensus, other experts and practitioners may disagree with specific recommendations; we wish to highlight some of these. Even more fundamental, there are a number of pediatricians totally convinced that these patients are not dead and may even recover.[7–9]

There may be disagreement about brain death determination and its dependency on age. The suggested age ranges are arbitrary. Two decades ago, age was addressed by the President's Commission for the Study of Ethical Problems in Medicine and Biomedical and Behavioral Research by including a cautionary warning of determining brain death in children aged <5 years.[10] Due to the unreliability of clinical signs, committees in the United Kingdom, Australia, and New Zealand decided only to declare children brain dead when aged ≥2 months. For years, Japan has struggled with pediatric brain death determination. The ACCCM document, similarly to the original 1987 guideline, allows determination at 37 weeks.

Why do these recommendations vary so widely on age considerations? Likely because of the lack of evidence and lack of detailed understanding of age-specific neurological functions. The ACCCM guideline provides little discussion on the difficulties with examining a newborn and the possibility of maturational lag. For example, one study found a corneal reflex in at least one eye in only 10% of newborns aged 1-3 days, but this gradually increased to 100% at 3 months.[11] We find it troublesome that pupils as large as 9 mm are considered compatible with absent brainstem reflexes, knowing that pupils in newborns are much smaller. Indeed, most concerns regarding interpretation of neurologic examination are in children only a few months old, and the advanced skill of a neonatologist or pediatric neurologist is needed to obtain reliable findings.

A number of restrictions and procedural refinements are introduced, and this may not improve clarity—at least not to us. The new ACCCM guideline suggests a 24-hour interval between examinations by 2 physicians in neonates from 37-week gestation to the end of the first month. However, in children aged ≥1 month, the ACCCM guideline still imposes 2 examinations 12 hours apart by 2 different physicians. The second examination, according to the ACCCM guideline, "proves irreversibility." This is a surprising recommendation. The combination of absent brainstem reflexes and demonstrable apnea in a comatose patient that passed through 2 filters—preconditions and exclusions—defines irreversibility, not stability over time. Failure to accept this certitude may invite a slippery debate about the correct observational time period. Anecdotal evidence of apparent improvement in cases days after anoxic or other brain injury are not credible when re-examined with a critical eye and with errors easily apparent.[12]

Moreover, the suggested set of steps to come to a diagnosis has one regrettable mistake of detail. The algorithm shows exclusion of confounders after a full examination. We feel that one should not start the brain death examination until after all exclusions are considered.

The document admirably summarizes the poor yield of ancillary tests in pediatric brain death, but then still notes their usefulness and offers their use for "social reasons." Although the authors do not wish to call these

tests confirmatory, they state that the patient cannot be pronounced dead if the electroencephalogram or cerebral blood flow study shows electrical activity, flow, or neuronal uptake, and recommend trying again 24 hours later. We can easily sketch a number of confusing scenarios. The guideline also indicates that ancillary tests may be useful when "there is uncertainty about the results of the neurologic exam." We hope no pediatrician concludes that an ancillary test trumps clinical examination findings of minimal but present brainstem reflexes that only 1 physician observed; rather, it should be explicit that if either physician sees brainstem function, the patient is not dead, and no ancillary test should even be considered. Will there ever come a day when we simply discard these ancillary tests?[13]

The ACCCM guideline recommends that physicians should have specific training in neurocritical care to be competent to perform examinations in infants and neonates and additionally recommends that these examinations are performed by pediatric intensivists and neonatologists, pediatric neurologists and neurosurgeons, pediatric trauma surgeons, and pediatric anesthesiologists with critical care training. In addition, the ACCCM guideline recommends that adult specialists should have appropriate neurologic and critical care training to diagnose brain death when caring for a pediatric patient from birth to 18 years of age. There are many pediatric intensivists who have not had specific neurocritical care training who should be capable of performing brain death determination reliably. Put differently, there are no data to limit such examinations to certain specialties.

The impact of this guideline on practice and eligibility of organ donation—recognizing very well that the issues are completely different—is not yet known. Fortunately, brain death is coupled with organ donation in $>3/4$ of all clinical brain death assessments. Two examinations may unnecessarily prolong the declaration of brain death. We have found that actual waiting times for the second examination in 82 children may be up to 10 times longer than proposed in a New York State Department of Health guideline for determining brain death.[14] Some families want closure, do not want to wait any longer, and will refuse organ donation because of this waiting period. Organ donation may be aborted due to premature cardiac arrest as a result of waiting for the second examination. One can imagine that bereaved parents of a 17-year-old teenager and the family of an 18-year-old adult may have completely different experiences—the first with endless waiting, the second with closure and gratitude that organ donation has been successful.

The ACCCM taskforce is congratulated for this effort, and the guideline is an impressive review of the current literature. The checklist could be useful in helping to standardize practice across institutions. This updated document on the determination of brain death in children provides some guidance, but we need to remake the argument that it can be simplified. We hope the guideline is not the last word.

Potential Conflicts of Interest

Nothing to report.

Eelco F. M. Wijdicks, MD, PhD[1]
Wade S. Smith, MD, PhD[2]

[1]Department of Neurology
Mayo Clinic
Rochester, MN
[2]Department of Neurology
University of California at San Francisco
San Francisco, CA

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