Brain Death in Children

Although a brain death (BD) diagnosis in children encloses the same concept and similar diagnostic procedure as in adults, it is a more difficult task for physicians and nurses because of several ethical and psycho-emotional issues. Parents and the general population are more reluctant to accept death in children, and find it difficult to understand an explanation that a child with preserved heartbeats but no brain activity is dead.1,2

Moreover, according to Ashwal,3 the clinical exam of suspected brain-dead pediatric patients is more difficult to carry out because of the smaller size of the patients, the immaturity of the reflexes that change with central nervous system (CNS) maturation, and the existence of fontanels and open sutures in neonates and infants.

The most frequent etiology of BD in children is trauma, due to motor vehicle accidents, shaken baby syndrome, and abuse. Asphyxia producing anoxia is also a common cause, in home accidents such as near drowning, suffocation, and from the so-called sudden infant death syndrome (SIDS). Some massive infections of the brain can also be the origin of permanent destruction of CNS structures.3–5 The Cuban Commission1,6 has accepted with some modifications the guidelines of the U.S. Task Force (Table 6.1), published in 1987, that has been also widely introduced in pediatric hospitals.7 The commission has also proposed the use of ancillary tests to shorten the period of observation in children older than 1 year.1,6

Mejia and Pollack8 developed a prospective cohort study for selecting children undergoing BD evaluations from a total of 5415 consecutive intensive care unit (ICU) admissions. They found substantial variability among the criteria used by clinicians for the diagnosis of BD, and some practices were contradictory to the Guidelines for the Determination of Brain Death in Children and to apnea testing methodology.

Compared with BD diagnostic criteria in adults, these guidelines do not differ in any important way. The main differences are the age-related periods of observation and the requirement of particular ancillary tests in children under 1 year of age. As in adults, in children over 1 year of age the diagnosis is based on clinical examination, and confirmatory tests are not mandatory.9–14 Ashwal has proposed BD criteria for term infants younger than 7 days of age.4,11,15
TABLE 6.1. Guidelines for brain death determination in children

A. History: determine the cause of coma to eliminate reversible conditions

B. Physical examination criteria:
   1. Coma and apnea
   2. Absence of brainstem function
      a. Midposition or fully dilated pupils
      b. Absence of spontaneous oculocephalic (doll’s eye) and caloric-induced eye movements
      c. Absence of movement of bulbar musculature, corneal, gag, cough, sucking, and rooting reflexes
      d. Absence of respiratory effort with standardized testing for apnea
   3. Patient must not be hypothermic or hypotensive
   4. Flaccid tone and absence of spontaneous or induced movements, excluding activity mediated at spinal cord level
   5. Examination should remain consistent for brain death throughout the predetermined period of observation

C. Observation period according to age:
   1. 7 days to 2 months: Two examinations and electroencephalograms (EEGs) 48 hours apart
   2. 2 months to 1 year: Two examinations and EEGs 24 hours apart or one examination and an initial EEG showing electrocerebral silence (ECS) combined with a radionuclide angiogram showing no cerebral blood flow (CBF), or both
   3. More than 1 year: Two examinations 12 to 24 hours apart; EEG and isotope angiography are optional; multimodality evoked potentials and Doppler ultrasonography (TCD) can be used as ancillary tests to shorten periods of observation

Note: Modified from the Guidelines of the Task Force for the Determination of Brain Death in Children.7

One of the main differences with adult BD protocols is the exploration of brainstem reflexes, because the maturation of the nervous system entails different periods of time for a specific reflex to be fully developed. The pupil light reflex is only present after 30 weeks’ gestation and the oculocephalic response is absent before 32 weeks. Moreover, as has already been discussed, the small size of the infant’s head and body imposes added difficulties in assessing brainstem reflexes. Other complications in the neonatology critical care unit are related to the placement of the intubated infants in incubators, with adhesive tape around the face and cheek to restrict movements and protect the tracheal tube. These conditions make it difficult to perform the neurological exam.3,5,8,11–14,16–25

In addition, Ashwal3 has detailed other factors that make it difficult to perform the neurological examination in infants:

- Newborn’s pupils are small and barely pigmented, making it difficult to assess the light reflex. Moreover, corneal injury, retinal hemorrhages, and eyelid swelling impair the assessment of pupil responses.
- Regarding ocular motility, the exploration of oculovestibular responses by caloric stimulation is difficult because of the small size of the external ear canals. Hence, it is recommended to explore both the oculocephalic and the oculovestibular (caloric) responses.
- Regarding the corneal reflex and dehydration, irritation, and maceration of the cornea, the use of eye patches hampers this response.