virtually diagnostic of drug toxicity. With metabolic coma of non–drug-induced origin, such as organ system failure, electrolyte disorders, or osmolar disorders, reflex eye movements are preserved.

Brainstem mass lesions are most commonly caused by hemorrhage or infarction. Reflex lateral eye movements, the pathways for which traverse the pons and midbrain, are particularly affected, and the reflex postures of decortication and decerebration typical of brainstem injury are common. Lesions restricted to the midbrain (e.g., embolization from the heart to the top of the basilar artery) cause sluggish pupillary reflexes or their absence, with or without impaired medial eye movements; both are controlled by the third cranial nerve. With lesions restricted to the pons (e.g., intrapontine hypertensive hemorrhage), pupils are reactive but very small (pinpoint or pontine pupils), reflecting focal impairment of sympathetic innervations; pinpoint pupils are rare. Ocular bobbing (spontaneous symmetrical or asymmetrical rhythmic vertical ocular oscillations) is most often a manifestation of a pontine lesion.

Seizures occurring in a patient with acute brain injury (such as that resulting from encephalitis, hypertensive encephalopathy, hyponatremia, hypernatremia, hypoglycemia, or hyperglycemia) or chronic brain injury (such as dementia or mental retardation) often result in prolonged postictal coma. The examination shows reactive pupils and inducible eye movements (in the absence of overtreatment with anticonvulsants), and often up-going toes or focal signs are often observed (Todd's paresis).

Nonconvulsive status epilepticus should be considered as a diagnosis even if there are no obvious seizure movements. Nonconvulsive seizures can cause coma and also can complicate other etiologies of coma, including infectious and metabolic disorders. Nonconvulsive seizures should be suspected in patients with (1) a seemingly prolonged "postictal state" after generalized convulsive seizures or prolonged alteration of alertness after an operative procedure or neurologic insult; (2) acute onset of impaired consciousness or fluctuating mentation interspersed with episodes of normal awareness; (3) altered mental status or consciousness associated with facial myoclonus or nystagmoid eye movements; or (4) episodic blank staring, aphasia, automatisms e.g., lip-smacking, fumbling with fingers), or acute-onset aphasia without an acute structural lesion. The diagnosis is made by electroencephalography (EEG) (see Chapter 118). EEG provides information about brain electrical activity even when brain function is depressed and cannot be evaluated otherwise, as in comatose patients. EEG is essential to detect electrical seizures and document their duration as well as the response to therapy and to improve coma prognostication.

Current evidence suggests that the presence of nonconvulsive seizures or periodic discharges, delay to diagnosis, and duration of nonconvulsive status in patients with or without acute brain injury are independent predictors of worse outcome.

PROGNOSIS IN COMA

Therapeutic hypothermia has been demonstrated to improve neurologic outcomes in patients who have return of spontaneous circulation but remain comatose after cardiac arrest. Historically, prognostication after cardiac arrest was solely based on neurologic examination. Although this still holds true for the most part, there has been extensive work using additional means besides the physical examination to better predict prognosis. Pupillary, corneal, and motor responses are the best clinical indicators of prognosis that can be assessed at bedside. Such responses give some indication of the functionality of the brainstem, which is the most resilient portion of central nervous system. Any signs of damage to the brainstem is strong evidence of cortical injury (Fig 105-3).

Current guidelines endorse the utility of EEG for predicting poor outcome in comatose survivors of cardiac arrest not treated with hypothermia. The early onset of generalized myoclonic status is an ominous sign. Serum biomarkers have been used in evaluating prognosis among comatose patients after cardiac arrest. Neuron-specific enolase (NSE) is the most promising biomarker and has been extensively studied. NSE levels of >30 ng/mL or higher have been found to predict persistent coma. Similarly, somatosensory evoked potentials (SSEPs), as electrophysiologic markers, are most helpful for predicting which patients will remain in a persistent coma. In particular, the bilateral absence of the N20 cortical response (a negative peak at 20 ms) to median nerve stimulation after 24 hours predicts a grave outcome. Despite tremendous potential, the role of neuroimaging as a prognostic tool after hypoxic-ischemic injury from cardiac arrest has yet to be clearly defined. Severe reductions in the apparent diffusion coefficient (ADC), as well as bilateral

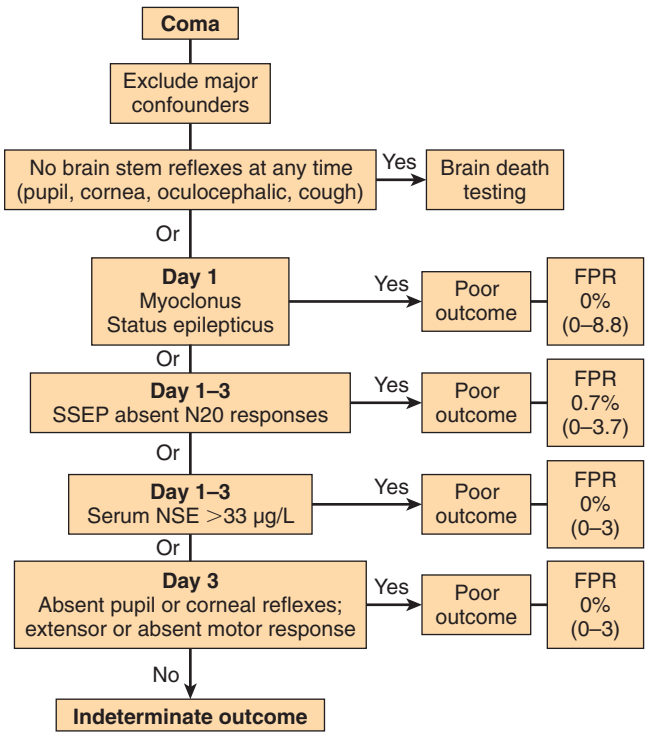

FIGURE 105-3 Decision algorithm for use in prognostication of comatose survivors after cardiopulmonary resuscitation (CPR). The numbers in parentheses show the exact 95% confidence intervals. FPR, False-positive rate; N20, a negative peak at 20 ms on SSEP; NSE, neuron-specific enolase; SSEP, somatosensory evoked potential. (Data from Wijdicks EFM, Hijdra A, Young GB, et al: Practice parameter: prediction of outcome in comatose survivors after CPR [an evidence-based review]: report of the Quality Standards Subcommittee of the American Academy of Neurology, Neurology 67:203–210, 2006.)