Postanoxic Myoclonus as a Prognostic Indicator

Is it time to re-evaluate postanoxic myoclonus following cardiopulmonary arrest as a prognostic indicator?

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Historical Framework

A 2006 practice parameter reviewed the literature regarding indicators of poor prognosis for people in a comatose state after cardiopulmonary resuscitation. Indicators of poor prognosis were absent corneal reflex, absent pupillary light reflex, extensor or absent response to pain at 3 days post arrest, and myoclonic status epilepticus.[1] The authors stated that "myoclonic status epilepticus (defined as spontaneous repetitive unrelenting generalized multifocal myoclonus involving the face, limbs, and axial musculature in comatose patients) was invariably associated with in-hospital death or poor outcome, even in patients with intact brainstem reflexes or some motor response." Clinical findings of single isolated seizures or sporadic focal myoclonus were specifically excluded from this finding and found not to be significantly associated with poor prognosis.

Since publication of that review, myoclonic status epilepticus or generalized myoclonus during coma after cardiopulmonary arrest, generally, has been considered to portend an abysmal prognosis. As a result, myoclonic status epilepticus or generalized myoclonus has informed many decisions regarding maintenance or withdrawal of life support. An increasing amount of data, however, suggests poor outcomes in the setting of postanoxic myoclonus are not universal, and up to 9% of patients may have a good prognosis.[2] Indeed, even the 2006 practice parameter references "incidental cases" with good recovery. Because postanoxic myoclonus is a common finding (18-22%) after cardiac arrest in the era of targeted temperature management, identifying clinical characteristics, semiology, and electrodiagnostic features that predict better potential for significant recovery would be highly valuable.[2,3]

Clinical Characteristics

A 2015 report of observational findings from cases in the International Cardiac Arrest Registry showed approximately 19% (471/2,532) had myoclonus after cardiac arrest.[2] Individuals in the subset of those who experienced myoclonus were categorized as having a good (Cerebral Performance Category [CPC] 1-2) vs poor (CPC 3-5) outcome (Table). The median age of those with good vs poor outcomes was 53.7 vs 62.7 years. Those with good outcomes were more likely to have ventricular fibrillation (VF)- or ventricular tachycardia (VT)-related cardiac arrests, witnessed arrests, shorter ischemic times, and longer stays in the intensive care unit (ICU) and hospital. In contrast, individuals with myoclonus and poor outcomes had longer total ischemic times, nonshockable initial heart rhythms, and longer intervals before professional resuscitation, all of which are consistent with increased potential for anoxic injury. Another study also reported better outcomes for people who had shorter ischemic times, preserved brainstem reflexes, and flexor or better motor responses.[3] Notably, time of onset for myoclonus was not different between those who recovered consciousness or did not.

Semiology

The semiology of myoclonic status epilepticus following cardiac arrest has been inconsistently and poorly defined. To remedy this, a 2017 study characterized clinical subtypes of myoclonus after cardiac arrest, beginning

TABLE. CEREBRAL PERFORMANCE CATEGORY SCALE

Good outcomes	1	Conscious and alert with normal function or only slight disability
	2	Conscious and alert with moderate disability
Bad outcomes	3	Conscious with severe disability
	4	Comatose or persistent vegetative state
	5	Brain dead or death from other causes

with a general definition of persistent myoclonus for more than 30 minutes beginning within 3 days of cardiac arrest.[4] Video EEG recordings, from 2008 through 2016, of people with postanoxic myoclonic status epilepticus were reviewed. Clinical features, including axial vs distal muscle group involvement, synchronicity vs asynchronicity, and stereotyped vs variable, were used to identify 3 distinct subtypes of post anoxic myoclonus. Type 1 were distal, asynchronous, and variable; Type 2 were axial or axial and distal, asynchronous, and variable; and Type 3 were axial, synchronous, and stereotyped. Further analysis found classification into these 3 types had interrater reliability and a suggestion of clinical significance for prognosis.[4] The presence of Type 1 or Type 2 postanoxic myoclonus potentially indicates the possibility of a better outcome. The authors of the study detailing the differing semiologies theorized these different presentations arise from anoxic injury to different brain regions. Injury to cortical structures more commonly results in a variable distal myoclonus. In contrast, injury to subcortical structures results in predominantly axial and stereotyped myoclonus. The finding that semiology can aid in identifying who may have better prognoses, sometimes termed *early Lance Adams Syndrome*, is supported by a study in which only those with multifocal myoclonus regained consciousness.[3]

EEG Findings

EEG is also emerging as an aid for identifying who may have a better chance of a good outcome in the setting of postanoxic myoclonus. There are EEG characteristics that are more closely associated with both good (CPC 1-3) and poor (CPC 4-5) outcomes. These EEG features include background continuity, reactivity, voltage, and the presence or absence of epileptiform features. More favorable outcomes generally were found in the absence of background attenuation, presence of reactivity, and absence of concurrent epileptiform discharges.[3] An additional EEG finding for those who regained consciousness was frequent, sporadic low amplitude midline maximal spikes over a continuous background or generalized spike and wave with normal voltage background. Among those who had poor outcomes, suppression burst or burst suppression with identical burst was the most common EEG finding in the first 24 hours; these individuals did not recover consciousness. Additionally, individuals with a poor outcome all had low voltages at least 1 timepoint. In those who did not recover, myoclonus was time locked to highly epileptiform bursts in a suppression burst pattern, blunt cortical bursts or myoclonus without associated EEG activity. It is important to note however, that there was no difference in the prevalence of discrete seizures between the 2 groups.

Summary and Conclusion

Emerging data support more careful and discerning evaluation of individuals after cardiac arrest to avoid a self-fulfilling prophecy by withdrawing life-sustaining support too soon. A more refined evaluation may identify a subset of people who can benefit from continued life-sustaining treatment. Survivors of cardiac arrest with myoclonus who had good outcomes required prolonged ICU care and had a longer hospital course than those without myoclonus.[2] In the studies discussed, many deaths occurred early—primarily due to withdrawal of life support. It is unclear if further support would have increased the proportion with a good outcome. Myoclonus should not be a sole determining factor for prognosis and should be evaluated carefully for semiology and EEG findings that may portend a more favorable outcome. Careful clinical exam, semiology of myoclonus, and EEG evaluation may be helpful in identifying those patients with potential for recovery ■

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