

Letter to the Editor

The diagnosis of brain death in ICU patients on ECMO by means of an apnea test requires the exclusion of neuropathy and myopathy

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We were interested to read the article by Faria et al. on the diagnosis of brain death in intensive care patients undergoing extracorporeal membrane oxygenation (ECMO) using an apnea test [1]. The authors propose an apnea test based on a low-sweep flow protocol (200ml/minute) to achieve a CO₂ partial pressure of >55mmHg, which corresponds to brain death. In cases of severe hypoxemia during the test, it was proposed to increase ECMO blood flow to maintain oxygenation [1]. The authors concluded that their physiologically based proposal represents a clinically feasible strategy for managing the complex interplay between gas exchange, oxygenation and CO₂ clearance during the apnea test [1]. The study is noteworthy, but some points should be discussed.

The first point is that breathing is not only a cerebral function, but also requires peripheral nerves and skeletal muscles. If conduction along the peripheral nerves is interrupted, if the respiratory muscles are paralyzed, or if neuromuscular transmission is interrupted, a person cannot breathe voluntarily or involuntarily. Therefore, an apnea test is not suitable for diagnosing brain death without having examined the peripheral innervation, neuromuscular transmission and muscle function. The peripheral side of respiration can be blocked by numerous abnormalities. In the ICU, it is mainly critically ill neuropathies/myopathies that may be responsible for the inability to breathe. In addition, any drugs that slow or block conduction along nerve fibers or drugs that are known to impair neuromuscular transmission or affect skeletal muscle contractility can impair breathing. It is therefore important that the peripheral nerves, neuromuscular transmission and respiratory muscles are examined before using an apnea test.

The second point is that the diagnosis of brain death should generally not depend on cerebral function, which depends not only on the integrity of the brain but also requires other extracerebral structures for its functionality. To diagnose brain death, the brain itself should be thoroughly examined by cerebral imaging to assess the structure of the parenchyma and by angiography to assess the arteries

and veins. In addition, the absence of cortical function must be repeatedly documented on the electroencephalogram (EEG) [2]. Based on these considerations, several international guidelines for the diagnosis of brain death, such as the American Academy of Neurology brain death/death by neurologic criteria guidelines for adults and the 2011 American Academy of Pediatrics, Child Neurology Society, and Society of Critical Care Medicine guidelines for infants and children [3], propose that signs of cerebral hypoxia on imaging, interrupted cerebral perfusion by documentation of absent blood flow, and absent cortical excitability are documented, especially when clinical examination and apnea testing cannot be performed (e.g., in patients with head or neck injuries, or those in whom an apnea test cannot be safely performed).

In summary, before performing an apnea test on ICU patients on ECMO, it is essential to rule out damage to the peripheral nerves, skeletal muscles and neuromuscular transmission in order to truly test the cerebral part of respiratory function. In addition to an apnea test, the diagnosis of brain death can also include imaging of the brain parenchyma and blood vessels as well as an EEG.

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