



Is E.E.G. monitoring still necessary after brain death determination?

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The study entitled “Suitability of electroencephalography in brain death determination. A monocentric, ten-year retrospective, observational investigation of 428 cases” by Simone Rossi and coworkers at University of Siena [1] drives the attention of the scientific, clinical, and public health community to an extremely important problem, such as the timing of clinical and neurophysiological procedures necessary to establish brain death of an individual in view of organ transplantation.

In this retrospective, monocentric study on 428 adult patients in the last 10 years who underwent the procedures of brain death determination (BDD), the authors show that once the initial clinical examination performed in the intensive care unit has ascertained the absence of brainstem reflexes and of spontaneous breathing, and these clinical findings are supported by a electric silence of electroencephalographic (EEG) activity for 20 min, the repetition of a 30-min EEG two times spaced 6 h (i.e., what is currently required by the Italian Law, see Table 1) seems not to provide additional useful information to initial clinical findings. Indeed, none of the procedures of the Commission convened for BDD was interrupted due to a true reappearance of EEG activity (neither for changes in the clinical conditions) at any of the two sampling times throughout the 6 h. Thus, at first sight, the authors consider that a relatively long time period of observation is not useful, but rather it may even be detrimental in terms of organ donation, as 1.4% of these patients died throughout the death ascertainment for a cardiac arrest despite ventilation support.

So, a question—partly supported by the physiological considerations of Rossi et al. paper on the relationships between cerebral perfusion and neurons’ survival than by its sample numerosity [1]—arises: is it worth to revise our current law, in terms of timing and type of evaluations, in

view of the present report findings? The length of observation period and the number of clinical/neurophysiological observations have been already reduced from 12 h in 1975, at the time of the first Italian law on the topic, to 6 h since 1993 (see Table 1). Eventual confirmation of the Rossi et al. findings in a larger sample of patients during a multicenter and prospective study (see later) would trigger a revision of the current law. Meanwhile, several considerations should be taken into account.

Indeed, there is no general agreement worldwide on the procedures of BDD, and even on definitions of brain death itself: in the English-speaking countries, the prevalent view is that the loss of life-sustaining brainstem functions (i.e., breathing and cranial reflexes), rather than disappearance of cortical activity as indexed by the EEG, is sufficient to determine death [2]; this is also the current position of the American Academy of Neurology (AAN) for defining the “whole brain death” [3]. In this frame, EEG and other neurophysiological testing are considered ancillary to clinical evaluations. Similar rules are applied in about 50% of European countries, while in the remaining EU countries EEG is still mandatory beyond the clinical evaluation of vital brainstem functions [4].

Stratifying patients for lesion type and age is relevant because in certain clinical conditions, as when extensive facial lesions are present, it may be difficult to explore cranial reflexes, and only the apnea test can be reliably carried out. In heavy cranial lesions, even the EEG recording can be troublesome. In posterior fossa lesions, some residual EEG activity could be detected even when cranial reflexes, including spontaneous breathing, have disappeared. The current Italian law already considers that in these situations the absence of cerebral perfusion should be evaluated by angiography or CT scan.

Another point of analysis must be related to the pediatric age population, in which death ascertainment poses relevant problems, both clinically and neurophysiologically. But starting with a uniform view on a large dataset of adult patients would be already a good achievement.

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Table 1 Observation timing and clinical/neurophysiological procedures required for brain death determination in adult patients in Italy since 1975. The commission for brain death determination (one anesthesiologist, one neurologist expert in EEG (plus a technician), one

forensic doctor) is convened after the detection of loss of spontaneous breathing and a flat EEG recording for 20 min (or electrocerebral inactivity)

	Law n. 644, 2/12/1975	Law n. 578, 29/12/1993	DM 11/4/2018 GU 136, 12/06/2008
Length of observation	12 h	6 h	6 h
Cranial reflexes	Every hour	3, every 2 h	2 in the 6 h
Apnea test	-	3, every 2 h	2 in the 6 h
30-min EEG	3 times every 4 h Printed on paper	3, every 2 h Printed on paper with maximal amplification	2 in the 6 h Digital recording
Additional testing	Absence of tendon reflexes No plantar reflexes	-	CBF when cranial reflexes or EEG cannot be performed

DM, Decreto Ministeriale; GU, Gazzetta Ufficiale; CBF, cerebral blood flow

In conclusion, the study by Rossi et al. [1] has sown an important seed, which should be now well cultivated, in the frame of a full scientific and ethical respect for one of the most difficult periods in an individual's life: the end of life.

Declarations

Ethical approval and Informed consent Not applicable.

References

1. Rossi S, Mazza G, Del Testa M, Giannotta A, Bartalini S, Testani E, Savelli L, Gabbrielli M, Vatti G, Scolletta S (2023) Suitability of electroencephalography in brain death determination. A

monocentric, ten-year retrospective, observational investigation of 428 cases. *Neurol Sci* 44(4):1369–1373. <https://doi.org/10.1007/s10072-022-06547>

2. Black D, Turnberg L, London D, Bates D, Melia N, Pallis C, Prior P, Rolles K, Stoddart J, Kennedy C, Pickard J (1995) Criteria for the diagnosis of brain stem death. Review by a working group convened by the Royal College of Physicians and endorsed by the Conference of Medical Royal Colleges and their Faculties in the United Kingdom. *J R Coll Physicians Lond* 29(5):381–382
3. Wijdicks EFM, Varelas PN, Gronseth GS, Greer DM (2010) Evidence-based guideline update: determining brain death in adults: Report of the Quality Standards Subcommittee of the American Academy of Neurology. *Neurology* 74(23):1911–1918
4. Mecarelli O, Vicenzini E, Mecarelli O (eds) (2019) *Clinical Electroencephalography*. Springer Verlag

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