Lazarus sign and extensor posturing in a brain-dead patient

Case report

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A man was declared brain dead after having sustained a gunshot wound to the head. All clinical criteria for the diagnosis of brain death were met. The electroencephalogram was isoelectric, and four-vessel angiography demonstrated the absence of cerebral blood flow. However, stereotypic spontaneous movements were observed which persisted for several hours. The possible mechanism is discussed and a short review of the literature is given.

Key Words • brain death • abnormal movement • spinal reflexes

During the last two decades, the concept of brain death as opposed to the classical definition of death (the absence of cardiac and respiratory activity) has been widely accepted as an alternative criterion for establishing death. The Harvard criteria presupposed irreversible absence of all activity in the brain stem, cortex, and spinal cord, thus excluding any reflex motor activity. Later evidence accumulated to show that brain death in fact equaled brain-stem death. Recent criteria do accept that spinal reflex activity is compatible with the diagnosis of brain death. A patient is reported in whom all clinical criteria for brain death were met. However, complex motor movements were noted during apnea testing. The cause of these confusing signs is discussed.

Case Report

This 51-year-old man was admitted to our hospital after a suicide attempt with a pistol. The bullet had entered the cranium in the right temporal fossa and traversed the brain. On admission the patient was unresponsive, with fixed dilated pupils. There was occasional spontaneous respiratory activity (two to three respirations per minute). Cyanosis and a pronounced bradycardia and hypotension (70/40 mm Hg) were observed. Oculocephalic and corneal reflexes were absent. Rectal temperature was 28.9°C. The patient was intubated and hyperventilated. Mannitol and furosemide were not administered as the patient was extremely hypothermic and hypotensive. A computerized tomography scan of the brain demonstrated extensive lesions along the trajectory of the bullet. A plain skull x-ray film showed a fragmented bullet lodged inside the vault. Despite vigorous fluid therapy and the use of inotropic agents, hypotension could only be corrected after 2 to 3 hours, when the patient's temperature rose to above 32°C. The only sign of life 8 hours after admission was the existence of an agonal respiration. Twenty-four hours after admission, neurological examination showed the patient to be unresponsive to any stimulus and with fixed irregular dilated pupils. Oculocephalic, oculocephalic, and oculovestibular reflexes were absent. There was no gag or cough reflex to bronchial stimulation with a suction catheter. Spontaneous respiration was absent for more than 20 minutes during repeated apnea testing (PaCO₂: 54.8/62.4 mm Hg, PaO₂: 224/247 mm Hg with an oxygen flow of 10 to 12 liters/min via the endotracheal tube after disconnection from the respirator).

The laboratory tests included a negative toxicity screening test. Core temperature was above 35°C. At this stage, however, the electroencephalograph (EEG) was not entirely isoelectric; the gain setting at 2 μV/mm still showed minor electrocerebral activity. Twenty-four hours later, the neurological examination was re-
peated and again showed absence of all brain-stem reflexes. The EEG recorded at this time showed no trace of electrical brain activity. As all criteria were now met, the patient was declared brain dead.

While final contact was being made with the relatives, spontaneous movements were seen. The attending nurse said the patient appeared to grasp for his endotracheal tube. Complete neurological examination was repeated and again showed absence of all brain-stem activity. During this apnea test the same (now repetitive) movements were observed. One or, more often, both arms were lifted from the bed and flexed at the elbows, the hands were brought to the chin or face and then returned to the bed alongside the body. These movements were symmetrical about as often as they were asymmetrical. Concurrent with these movements, the patient exhibited hypertension (230/120 mm Hg), tachycardia (150 beats/min), and facial flushing. These stereotyped movements were observed for about 1 hour without any obvious external stimulus and could only be elicited by apnea testing but not by noxious or mechanical stimuli. These movements started 2 to 3 minutes after the patient was disconnected from the ventilator. Because diffusion oxygenation was used (10 liters/min through a tracheal catheter), the patient was not hypoxic at any time during these movements. Two samples were drawn during these movements for arterial blood gas measurement, the first about 2 minutes after apnea, the second at 22 minutes after apnea; a PaCO₂ of 32.6 and 68.9 mm Hg and a PaO₂ of 194 and 307 mm Hg, respectively, were obtained. A different movement pattern was seen several hours later which could be described as an asymmetrical opisthotonus. Back arching occurred repeatedly without any stimulus and was always one-sided, left or right. This pattern could not be elicited by apnea testing, and occurred while the patient was normoventilated and had a normal blood pressure and pulse rate. As no satisfactory explanation could be given for this phenomenon it was decided that a cerebral angioarchitecture was indicated. No intracranial circulation whatsoever was satisfactorily explained by apnea testing, and 307 mm Hg, respectively, were obtained. A differential blood gas measurement, the first about 2 minutes

Complex spinal reflex activity such as the flexion-withdrawal reflex and unilateral extension-pronation movements were described in 1973 by Jørgensen in patients without angiographic brain circulation. Spontaneous movements consisting of isolated jerks of the upper limbs were reported in two of 18 patients with brain death with a postmortem pathological diagnosis of “respirator brain.”

The spontaneous movements observed in this patient were to the best of our knowledge reported for the first time in 1982 by Mandel, et al. In 1984, Ropper reported on five patients who showed spontaneous movements after being declared brain dead. The observed movements were named the “Lazarus sign.” In four patients these movements occurred when the respirator was temporarily removed and in one patient during an apnea test. As all patients were either hypotensive or hypoxic it was concluded that these movements were precipitated by hypoxic stimulation of still functioning motor neurons of the upper cervical cord. Our observation indicates that these movements can occur while the patient is normotensive and not hypoxic. This, however, does not necessarily invalidate the aforementioned hypothesis as local blood flow to the upper cervical cord may very well be low in brain-dead patients, thus inducing cord-tissue ischemia.

Following the article by Ropper, a patient was described who, after respiratory support had been temporarily stopped, crossed both arms over his chest and sat up for 10 to 15 seconds. No cardiac or respiratory activity was observed during this period but it was not explicitly stated whether all brain-stem reflexes were absent immediately prior to this episode.

Although these reported movements are of a highly complicated nature, they are thought to be purely spinal in origin. The patient observed also repeatedly showed absence of all brain-stem activity, the EEG was isoelectric, and cerebral perfusion was absent on angiography. We considered this to be ample evidence that this patient was brain dead and we would not have hesitated to turn off the respirator if these movements had persisted much longer. On the other hand, the occurrence of this kind of movement certainly delays decision-making, such as starting a transplantation procedure.

We would suggest that, as this phenomenon does not seem to be extremely rare, codes of practice should specify more clearly what exactly is meant by “persistence of spinal-cord reflexes.”

References
Complex motor activity after brain death


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