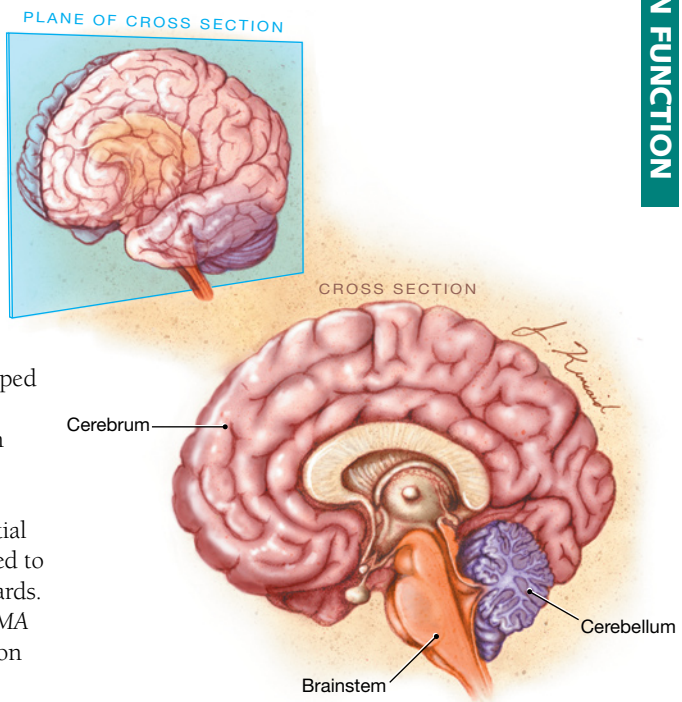
Brain Death



A person dies when brain function ceases, the heart stops beating, and breathing and blood circulation cease. Because life-support techniques have become so advanced, it is possible that even in the face of fatal injury or unrecoverable illness, the heart can be kept beating with medication, and **respiration** (breathing) can be artificially performed with a ventilator. The concept of brain death developed in response to these advanced medical techniques that can maintain some bodily functions. **Brain death,** as understood in US law and medical practice, occurs when there is no function of the entire brain. The **brainstem** is the area of the brain that controls breathing and circulation and therefore controls essential life functions. When the brain, including the brainstem, has ceased to function, the individual is truly dead by medical and legal standards. Thus, brain death is real death. The March 18, 2009, issue of *JAMA* includes an article about brain death. This Patient Page is based on one published in the May 14, 2008, issue of *JAMA*.

CLINICAL CRITERIA FOR BRAIN DEATH

- No response to any stimulus—no movement, withdrawal, grimace, or blinking
- No breathing efforts when taken off the ventilator (the **apnea test**)
- Pupils dilated and not responsive to light
- No gag reflex, no **corneal reflex** (blinking when the surface of the eye is touched), and absence of other specific reflexes

TESTING

- Computed tomography (CT) scans of the brain may show abnormalities such as bleeding (**hemorrhage**), massive stroke, brain injury, or severe brain swelling (**edema**).
- **Electroencephalography** (EEG) records electrical brain activity. If brain death is present, the EEG will show no activity.
- **Cerebral radionuclide injection** shows no uptake of the radioactive material in the brain when a person is brain dead.

These tests may be performed to confirm brain death. They may be used along with the examination-based clinical criteria to show irreversible loss of brain and brainstem function. Not all tests need to be used to declare brain death.

BRAIN DEATH AND ORGAN TRANSPLANTATION

Some organs (such as the heart) can only be transplanted if they are harvested from a dead person whose respiration and circulation are artificially maintained. Organ harvest takes place only after declaration of brain death. The dead individual's organs are maintained on life support for organ donation purposes only. The organ donation team is not involved until the patient is declared brain dead, and staff involved in organ donation or transplantation do not declare brain death.

FOR MORE INFORMATION

- National Institute of Neurological Disorders and Stroke
  www.ninds.nih.gov
- American Academy of Neurology
  www.aan.com
- United Network for Organ Sharing
  www.unos.org

INFORM YOURSELF

To find this and previous JAMA Patient Pages, go to the Patient Page link on *JAMA*'s Web site at www.jama.com. Many are available in English, Spanish, and French. A Patient Page on traumatic brain injury was published in the June 11, 2003, issue; one on head injury was published in the September 28, 2005, issue; and one on cardiac arrest was published in the January 4, 2006, issue.

Sources: National Institute of Neurological Disorders and Stroke, Coma Recovery Association, United Network for Organ Sharing, American Academy of Neurology

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