

# Brain Death and Importance of Preserving Organs of Brain-Dead Donors in Intensive Care Unit

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Nowadays, due to an increasing number of patients waiting for organ transplant, the diagnosis of brain death in the intensive care unit has become important. Anesthesiologists and intensive care specialists have important responsibilities when diagnosing brain death. In this paper, legislation in our country, the diagnostic criteria for brain death, and donor protection will be discussed.

**Keywords:** Brain dead, donor, intensive care unite

## LEGISLATIONS OF TURKISH REPUBLIC OF NORTHERN CYPRUS (TRNC)

Brain death was defined by two French neurologists who first described the concept in 1959 by detecting irreversible brain damage in 23 patients. Since then, the patients who are diagnosed as brain dead are considered to be the most important factors in terms of giving hope to other patients undergoing treatment for organ failure and waiting for organ transplant.

The laws concerning organ transplant in our country, which comprise the "Human Cell, Tissue and Organ Transplant Related Rules Regulating Act," were passed on October 27, 2014 by the Assembly of TRNC (1). On May 2, 2016, in addition to this law, the diagnostic criteria for brain death were published in the Official Gazette No. 269 (2).

According to this law, a neurologist, a neurosurgeon, and an anesthesiologist decide if brain death has occurred following the rules of evidence-based medicine.

## DIAGNOSIS OF BRAIN DEATH BY ORGAN REGULATION AND TISSUE TRANSPLANT SERVICES IN TRNC

Brain death is a clinical diagnosis that can be described as the irreversible and complete loss of all brain functions.

- [1] Prerequisites for the diagnosis of brain death are as follows:
- Determining the cause of coma
  - Determining that the brain damage is widespread and irreversible
  - Core body temperature  $\geq 32^{\circ}\text{C}$
  - Absence of hypotensive shock
  - Exclusion of intoxication and the effects of some drugs that can cause reversible coma
  - Absence of metabolic, electrolyte, and acid-base disturbances that can explain the clinical picture independently
- [2] The following points are to be considered in the diagnosis of brain death if all the conditions listed under Item 1 above are identified:
- Being in the state of deep coma (full unresponsiveness)
  - Absence of brain stem reflexes:
    - Pupils are unresponsive to bright light, fixed in a midsize or dilated position (4-9 mm)
    - Absence of oculoccephalic and oculovestibular reflexes in the eyes during the examination

- Absence of corneal reflex
  - Absence of tracheal and pharyngeal reflex
- c) Absence of spontaneous breathing efforts and having a positive apnea test.

[3] For an apnea test to be performed, the following prerequisites must be satisfied: normothermia, normotension, and normovolemia. Under these conditions with appropriate mechanical ventilation, the patient's PaCO<sub>2</sub> level has to be increased above 35-45 mmHg and PaO<sub>2</sub> level has to be increased above 200 mmHg. Once these conditions are met, intratracheal oxygen should be administered to the patient after disconnecting from mechanical ventilation. At the end of the test, if spontaneous breathing does not occur despite the PaCO<sub>2</sub> levels being ≥60 mmHg or rising by 20 mmHg or more compared with the baseline, the apnea test is considered to be positive. [4] In medical conditions such as pneumomediastinum and pneumothorax, where it is not possible to conduct the apnea testing, a supporting test specified by the physician is performed to evaluate if the brain circulation has stopped. If the test results are consistent with the diagnosis of brain death, the confirmation of brain death is complete.

- [5] The following findings do not pose an obstacle to the diagnosis of brain death:
- a) Detecting deep tendon reflexes
  - b) Detecting superficial reflexes
  - c) Presence of Babinski sign
  - d) Presence of spinal reflexes and automatisms
  - e) Presence of sweating, flushing, fever, and tachycardia
  - f) Absence of diabetes insipidus

- [6] In cases where brain death was diagnosed
- a) The clinical table is formed upon the first neurological examination where the diagnosis of brain death was confirmed; it was observed that the diagnosis remained unchanged in the second neurological examination performed on newborns (younger than 2 months) after 48 hours, children (aged between 2 months and 1 year) after 24 hours, and children (older than 1 year) and adults after 12 hours and in case of anoxic brain deaths, after 24 hours.
  - b) The diagnosis is confirmed with two supporting tests performed on the newborns (younger than 2 months) and 2-month-old infants and a laboratory method deemed suitable by the physicians' board for patients older than 2 months.
  - c) It is mandatory to perform a supportive clinical test (computed tomography angiography of brain), which would evaluate the cerebral circulation.

Diagnostic criteria around the world have shown little change. The most distinct differences among countries can be identified as the lack of mandatory confirmatory diagnostic tests and the number of specialist doctors (3, 4). Unlike other countries, in the United Kingdom, the irreversible loss of brain stem functions only is enough to confirm brain death.

After the conditions written above are fulfilled, the relatives of patients are reported that patient's brain death has occurred.

The family consent ranges between 30% and 40% around the world (5).

Globally, Spain has the highest donor rate with 33-35 donors per million people. According to Turkey's data, 594 brain deaths have been reported in 2007, 245 of which were donors (41% acceptance rate), and 720 brain deaths have been reported in 2008, of which only 262 were donors (36% acceptance rate).

In TRNC, 6 brain deaths have been reported in 4 months, and 4 of these were donors (66.6% acceptance rate).

Some data show that the main reason for rejection of organ donation by patients' families is the religious factor. According to a study conducted in Saudi Arabia, the acceptance rate of families was reported as 17%. This rate was higher than the rates reported in 1982, but it has gradually decreased in the early 2000s. Recent fatwas against organ donation given by some religious leaders are considered as the reason behind the rate decrease. Therefore, it would be beneficial for clergymen to be directed to contribute to organ donation.

The media's influence on public awareness is significantly high. If the power of the media focuses on organ donation, with the help of more comprehensive, effective, and motivating broadcasts, the donation rate can increase.

In this regard, it is very important for the Ministry of Health, the Public Health Department, and hospital authorities to show the necessary management and to shape the society.

After the family or relatives give their permission for the organs of the patient whose brain death is verified to be used for transplantation, the patient automatically becomes a donor.

## DONOR CARE IN THE INTENSIVE CARE UNIT

### Cardiovascular Changes and Cardiovascular Support

Due to cerebral ischemia and an increased intracranial pressure, vasomotor control is lost, and levels of circulating catecholamines increase. This period is called "catecholamine storm." Hypertension, tachycardia, and increase in cardiac output occur. This phase is followed by the cardiovascular collapse phase. The loss of sympathetic activity and decreased systemic vascular resistance cause hypotension and bradycardia (6). The aim of treatment for the cardiovascular system is to meet the metabolic needs of the body and to prevent organ ischemia. Hemodynamic targets are defined using the rule of 100s: systolic blood pressure level >100 mmHg (mean arterial pressure >65 mmHg), heart rate level <100 beats/min, urine output >100 mL/h, hematocrit >30%, pO<sub>2</sub> >100 mmHg, and central venous pressure >10 mmHg. To achieve the rule of 100s while treating the target, central venous catheters, pulmonary artery catheter, and echocardiography can be used. Fluid management is performed using crystalloid and colloid fluids. If deemed necessary, a blood transfusion can be applied to the patient using positive inotropic agents.

### Pulmonary Changes and Pulmonary Support

Aspiration pneumonia, lung damage, and neurogenic pulmonary edema due to pulmonary complications often develop.

The goal of treatment is applying mechanical ventilation and providing normocapnia and normoxia. In addition, appropriate treatment should be initiated if lung infection is developed (7).

### Changes in the Endocrine System and Endocrine Support

Due to the brain stem death, hypothermia can develop significantly because of the primary temperature control center being affected depending on level of damage in the hypothalamus. Patients' body temperature should immediately be increased and maintained at a normal or near-normal temperature. For this purpose, heating blanket should be used, the ambient temperature should be increased, and the inhaled gas and intravenous fluids must be heated.

One of the most common problems, which develop due to the lack of antidiuretic hormone released from the posterior lobe of pituitary gland, is diabetes insipidus. In this case, polyurea occurs, and urine output increases (>4 ml/kg/hour). Urine specific gravity is generally lower than 1005. Accordingly, hypovolemia, hyperosmolarity, hyponatremia, hyperkalemia, and hypocalcemia can be observed. During the treatment, fluid replacement should be performed with hypotonic solution, tap water should be provided via nasogastric routes, and/or urine output of 1-2 ml/hr should be kept at normal levels. In severe cases, despite the fluid replacement that has been applied, biochemical analysis values of the patient may not be adequately balanced. In this case, desmopressin acetate 2-4 mmg/day may be given (8). Affected by the anterior pituitary gland, cortisol, insulin, and thyroid hormones decrease. When a decrease occurs in the insulin levels, increased anaerobic metabolism and acidosis occur. In this case, if hyperglycemia is detected, the patient is given insulin intravenously, and blood glucose levels must be kept lower than 200 mg/dL.

### CONCLUSION

As a result, to increase the rate of organ donation in our country, patients that may be potential donors should be identified. Specific tests must be conducted as soon as possible on the patients that are suspected to be brain dead, and the diagnosis must be verified quickly and accurately. Necessarily, there should be a meeting between donor's family and an experienced and trained transplant coordinator. After donor candidates are determined, organs must be well protected, and body functions must be maintained in a normal state until the organ transplantation is complete. Transplantation depends entirely on the supply of viable organs for implantation. There is a significant imbalance between the number of available organs and potential recipients. In the US and European transplant centers, the number of potential transplant recipients has increased to more than 133,000, yet the number of donated organs is not increasing sufficiently (9-11). For this reason, donors should be

cared for by experienced teams in the intensive care unit. If all these steps are successfully performed, the number of donors will increase in our country as well.

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