Kingdom of Saudi Arabia
Council of Health Services
Saudi Center for Organ Transplantation

Diagnosis of Death by Brain Function Criteria
1434H – 2013G
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FOREWORD

Documentation of death by brain function criteria is a well established diagnosis in the field of medicine today and deceased organ transplantation is now considered the best available established technique for the treatment of end stage failure of most essential organs (kidneys, liver, heart, lungs and pancreas).

In the Kingdom of Saudi Arabia, the true era of deceased kidney transplantation started in 1986 after the establishment of the National Kidney Foundation (NKF). Since its inception, the deceased kidney transplantation program has depended on the close cooperation of colleagues handling cases of deceased donors.

The NKF was promoted to the Saudi Center for Organ Transplantation (SCOT) in 1993, ever since the practice of deceased organ transplantation has increased progressively. We acknowledge the previous work on the protocol of (diagnosis of brain death and policy on cadaveric organ procurement in KSA). The members of the committee provided support to SCOT over the years, in training intensive care units staff and the application of the protocol at the national level. The revision of the protocol by the current committee is intended to comply with the updated international protocols. The modification includes better explanation on the form used for the diagnosis of deaths by brain function criteria. The committee have revised the protocol and satisfied with most of it, however they updated some of the confirmatory test and some inclusion criteria such as level of hypothermia during the diagnosis and apnea test.

The SCOT is grateful to all members of the National Committee for Death Documentation by Brain Function Criteria who contributed so much energy and thought to initiate and maintain of this protocol which is fundamental for the practice of deceased organ donation and transplantation in the Kingdom of Saudi Arabia.

Dr. Faissal A.M. Shaheen
General Director
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1.0 INTRODUCTION

The advent of effective artificial cardiopulmonary support has created new concepts about the diagnosis of death in the last few decades. Previously, cessations of heart and lung functions were the only signs for diagnosing death whether the initial event occurred in the brain, the heart, and the lungs or elsewhere in the body. Since the cardiac and pulmonary functions can be recovered by modern resuscitation techniques and sufficiently maintained artificially, even when the brain is irreversibly damaged, the need emerged to establish other criteria to define death (impossibility to return to life). Hence the concept of brain-death and the need for definitive neurological criteria that must be used to assess whether the brain functions have ceased irreversibly.

The concept of brain death was first reported in 1959 by a group of French physicians. Later during the same year, Mollaret and Goulon called this condition *Coma depasse*, which means a state beyond coma. In 1968, the Ad-Hoc Committee of Harvard Medical School was appointed to examine the definition of “brain death” and the Harvard Criteria were adopted in the USA. In 1971, a major conceptual advance occurred when two Minneapolis neurosurgeons, Mohandas and Chou, made the challenging suggestion that patients with known irreparable intra-cranial lesions, irreversible damage to the brain-stem represented the point of no return. Thus, evolved the concept of brain-stem death. The criteria were laid down for the diagnosis and became known as the Minnesota Criteria. This stimulated much later work particularly in the UK. The UK code in 1976 and the addendum to the original report in 1979 described diagnosis of brainstem death and emphasized the need for observing strict pre-conditions and necessary exclusions without which the diagnosis by Brain Function Criteria cannot be considered.

In the USA, further important developments took place in 1981, thirteen years after the Harvard Criteria was adopted. A large panel of physicians from various specialties presented the report on *The Diagnosis of Death* to the President’s Commission for the Study of Ethical Problems in Medicine and Biomedical and Behavioral Research. They recommended uniform criteria for the diagnosis of brain death and defined brain death as irreversible cessation of all functions of the entire brain, including the brain-stem. Accordingly, the irreversibility of brain damage is recognized when evaluation discloses all of the following:

a. An established cause of coma sufficient to account for the loss of brain function.
b. Exclusion of the possibility of recovery of any brain function.
c. The persistent cessation of all brain functions during an appropriate period of observation and/or a trial of therapy. This may take 6-24 hours depending on the availability of different confirmatory tests such as EEG, evoked potentials and four vessel cerebral angiography. For patients suspected to have conditions such as drug intoxication, metabolic derangements and hypothermia, a longer period of observation and persistence of cessation of brain functions despite correction of these abnormalities are needed in order to declare them brain-dead. Infants and children before puberty also need longer observation periods.
The concept of brain death is very specific. It does not apply to patients existing in a persistent vegetative state or to other severe degrees of brain damage from causes such as metabolic derangements, drug intoxication, etc. (Figure 1).

Figure 1. Lateral view of the human brain showing areas affected in persistent vegetative state, brain-stem death and total brain death.
2.0 THE CONCEPT OF DEATH BY BRAIN FUNCTION CRITERIA

As cardiac arrest was sufficient in the past to declare death because no treatment existed for it, and it represented the point of “no return” to life. Advances in resuscitation made cardiac arrest in some circumstances reversible and thereby insufficient to define the point of “no return”. This necessitated the search for more robust criteria to define the point of “no return”. The concept of death based on viability of the brain, conveniently termed death by brain function criteria, is now a recognized entity in medicine. The diagnosis is made by clinical examination and supplemented by objective investigations. The determination of death by brain function criteria commonly referred to as diagnosis of death by brain function criteria can be made in every hospital with a well-functioning ICU and must be done as a part of the general management of any patient fulfilling the criteria of death by brain function criteria, irrespective of the issue of organ donation. Organ donation programs became a secondary issue in this concept as the organs that remain functioning may save someone else’s life while the alternative will be to bury them under earth. The question nowadays is not whether the diagnosis of death by brain function criteria is accepted, but is regarding further management of the brain-dead patients, i.e., whether to continue connection to life supporting equipments or not and for how long and how and when to procure donated organs.

2.1 Who is responsible for the Diagnosis of Death by Brain Function Criteria?

A neurologist, a neuro-surgeon, an internist, an ICU physician, an anesthesiologist, a pediatrician or a consultant physician who received training in evaluation of death documentation by brain function criteria can perform the examination. Physicians or surgeons who are involved in the transplantation operation should not be involved in the establishment of documentation of death.

2.2 Who is responsible for the care of patients with Death by Brain Function Criteria?

The following professionals are responsible for the care of the potential organ donor: an ICU physician, an anesthesiologist, an internist, a neurosurgeon or a neurophysician in cooperation with a nephrologists and treating physicians.

2.3 The Potential Deceased Donor

2.3.1 Initial recognition of a potential deceased donor

A potential deceased donor is usually a patient in coma, due to any of the following conditions and requiring ventilatory support:

- Head Trauma
- Cerebrovascular Hemorrhage
- Cerebral Anoxia
- Primary Brain Tumor
3.0 DEATH BY BRAIN FUNCTION CRITERIA: MEDICAL ASPECTS

3.1 Definition

Death by brain function criteria is a legal definition of death based on the irreversible cessation of all functions of the entire brain including the brain-stem due to total necrosis of the cerebral neurons following loss of blood flow and oxygenation.

3.2 Medical Criteria for the Diagnosis of Death by Brain Function Criteria

The diagnosis of death by brain function criteria needs to be rigorous to determine whether the condition is irreversible. The question of death by brain function criteria should not be entertained unless there is a positive history or diagnosis of a condition that usually leads to total brain injury such as severe head trauma or prolonged cardiac arrest etc. At least six hours should have passed after the initial event before such consideration is raised. The patient is usually deeply comatose and makes no respiratory efforts (See Appendix I – Glasgow Coma Scale). It is important to distinguish between brain death and states that may mimic brain death, such as narcotic or barbiturate overdose, hypothermia or severe metabolic disturbance such as hypoglycemia.

Testing in suspected death by brain function criteria is done only after the above preconditions and exclusions are exhausted. It is based on detailed clinical exams that must show complete absence of brain functions of both cortex and brainstem. Clinical exam should be performed by two trained physicians and repeated after an interval appropriate to the patient’s age. Confirmatory tests may include isoelectric (flat-line) EEGs done according to standardize criteria. The patient should have a normal temperature and be free of drugs that can suppress brain activity. Alternatively cerebral blood flow scan or angiogram that shows complete absence of intracranial blood flow can be used.

3.2.1 Preconditions for the Diagnosis of Death by Brain Function Criteria

Before proceeding to make the diagnosis of death by brain function criteria on a patient, the following conditions should be present.

a. Patient is in coma and the cause of coma has been firmly established.
b. Patient has no spontaneous respiration and is supported by a ventilator.
c. The event causing brain damage occurred at least six hours previously and the cause of irreversible brain damage has been clearly determined (i.e., head trauma, brain hemorrhage, etc).
d. Patient is not in cardiovascular shock.
e. Obvious metabolic and endocrinal derangements have been corrected.
f. No response to any kind of stimuli.
g. Complete areflexia. However, simple spinal cord reflexes may be present.
3.2.2 Exclusions

a. Patient should not be hypothermic. The core temperature must be above 34°C before testing for death. If the temperature is below this, the patient must be warmed up.

b. Patient is not receiving any sedatives, muscle relaxants, anticonvulsants, hypnotics, narcotics or anti-depressants. Blood test or hospital record should indicate absence of significant levels of sedative drugs or muscle relaxant, or receiving sedation in the preceding 5 days.

Toxicology screen must be done especially in cases of road traffic accidents, drug overdoses and unexplained causes of coma, and in other cases, as deemed necessary. If indicated, and facilities are not available for estimating the blood levels, an interval of five days should lapse before testing for death.

c. Patients with metabolic and endocrine causes of coma should be excluded.

d. Patient should not have any sign of cerebral activity like decerebrate or decorticate posture and seizure activities. (See Appendix II – Clinical Triggers of the Diagnosis of Death by Brain Function Criteria)

3.3 How to Diagnose Death by Brain Function Criteria?

Once the patient is found to have the necessary preconditions and exclusions, one should proceed with the clinical examination as per the recommendation in the death documentation form by brain function criteria (See Appendix III – Death Documentation Form by Brain Function Criteria). The findings are to be recorded in the prescribed form and signed by the physicians conducting the examination. They must also be available also after the stipulated observation interval, to carry-out the second examination and sign the death documentation form.

3.3.1 Initial clinical examination

a. Confirm that the patient is in coma.

b. Evaluate the patient for the presence of any seizure activity and any decerebrate or decorticate movements.

None should be found in a death by brain function criteria patient. Presence of spinal myoclonus and/or spinal reflexes alone does not indicate brain viability and does not exclude death by brain function criteria.

c. Test for absence of motor response to painful stimulation.
For example, absence of grimacing upon applying pressure over the frontal sinus (Figure 3*).

Figure 3. Testing for motor response to painful stimulus

3.3.2 Tests for Brain-Stem Reflexes

After the initial evaluation described above, tests are done to demonstrate the absence of brain-stem reflexes. These tests have to be done in the following order: (If anyone of these reflexes is preserved, there is no need to proceed further).

a. Pupillary response to light

Shine a bright beam of light from a suitable source, e.g., a pen flashlight, on to the open eyes (Figure 4). In a death by brain function criteria patient, no response, neither direct nor consensual, is seen to the stimulus in either eye. Both eyes must be tested. Make sure that mydriatic or meiotic eye drops or drugs have not been used in the recent past prior to carrying out the test.

Figure 4. Testing for pupillary response to light
b. Corneal reflex

Touch the cornea with a wisp of cotton wool (Figure 5). If the brain stem is dead, no blinking response is noted on either side. The test should be performed on both sides. In a patient with suspected death by brain function criteria, much firmer pressure is justified while doing this test. The use of a cotton swab is more suitable.

Figure 5. Testing for corneal reflex

c. Oculo-cephalic reflex (Doll's head eye phenomenon)

Stand at the head-end of the patient’s bed. Hold the head of the patient in the neutral position firmly with both hands. Move the head briskly, first to one side and then to the other. Observe the eye movements during these maneuvers—by retracting the eyelids with the thumbs. A positive reflex is elicited in a comatose patient when the eyes move in an opposite direction to the head movement as if to keep the fixation axis straight ahead (Figure 6). If the reflex is elicited, the brain-stem is alive and there is no need to proceed with further testing. In a patient with non-functioning brain-stem, the head and eyes will move together.

The test should be avoided in cases of recent trauma with suspicion of cervical fracture. The ventilator may be disconnected for 20-30 seconds while performing this test.
Figure 6. Positive oculo-cephalic reflex. Notice the position of the eyes in relation to the direction of head movements. I. Head and eyes in neutral position. IIa & IIIa. Deviation of eyes to opposite sides when the head is moved to the left and right respectively. IIb & IIIb. Eyes in neutral position, after the realignment.

d. Vestibulo-ocular reflex (Caloric test)

Instill about 50 ml of ice-cold water or saline into each auditory meatus, in turn (Figure 7). In children, a smaller volume (10-20 ml) may be used. Normally, eye movements will be observed within 20-30 seconds. No eye movements are seen in case of death by brain function criteria.

Absence of eye deviation towards the tested ear indicates a disrupted reflex arc by damage to the reflex centers (brain-stem) or paralysis of extra-ocular muscles. Therefore, do not perform this test if muscle relaxants have been administered.

Otoscopic examination must have confirmed the integrity of the tympanic membrane. Make sure that there is no mechanical obstacle in the auditory canal, such as wax. If the tympanic membrane is not intact, elicit the reflex using cold air instead of cold water. Testing should be done in both ears. The test may be contraindicated in patients with local trauma.

Figure 7. Caloric test
e. Upper and lower airways stimulation (e.g., pharyngeal and endotracheal suction)

This test is carried out with the intention to achieve pharyngeal and carinal stimulation. Pass a suction catheter down into the pharynx and the trachea up to the carina (Figure 8). In a death by brain function criteria patient; this will not produce either gagging or coughing.

Figure 8. Testing for gag reflex.

3.3.3 Observation Period (Interval between examinations)

After completion of the first examination, a second examination should be conducted after the stipulated time interval. The findings are to be recorded in the death by brain function criteria documentation form (See Appendix III – Death Documentation Form by Brain Function Criteria) and signed by the consultants conducting the examination. The recommended time intervals between the first and second examinations are given in Table 1.

<table>
<thead>
<tr>
<th>Table 1. Recommended time interval between first and second examination in various age groups.</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Neonate (7 days – 60 days)</td>
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<tr>
<td>*Infants (above 60 days – 1 year)</td>
</tr>
<tr>
<td>**Children (above 1 year)</td>
</tr>
<tr>
<td>**Adults</td>
</tr>
<tr>
<td>*Two EEGs separated by the stipulated time interval</td>
</tr>
<tr>
<td>** One EEG only, at the time of first examination</td>
</tr>
</tbody>
</table>

3.3.4 Confirmatory tests

If all the above-described brain-stem reflexes are found to be lost, then proceed to do one of the following confirmatory tests.

a. Electroencephalogram (EEG)

EEG should show electro cerebral silence recording is to be done for at least 30 minutes and must conform to the criteria given in EEG guidelines (See Appendix IV – EEG Guidelines). If the patient has hypothermia, he/she must be warmed-up before conducting EEG examination.
b. Cerebral angiography

Demonstration of absence of intracranial arterial circulation by four-vessel angiography is a confirmatory test of brain death for adults and children. In children, a cerebral radionuclide angiogram (CRAG) also confirms cerebral death by demonstrating the lack of visualization of the cerebral circulation. A technically satisfactory CRAG that demonstrates arrest of carotid circulation at the base of the skull and absence of intracranial arterial circulation can be considered confirmatory of brain death, even though there may be some visualization of the intracranial venous sinuses.

The indications for angiography are:

- a. EEG is either not available or cannot be interpreted due to technical problems. In this case, the clinical examination and apnea test are done by the examiners before the angiography.
- b. The cause of death cannot be determined with absolute certainty.
- c. Metabolic derangement, shock or hypothermia cannot be corrected with intensive therapy.
- d. Difficulty in convincing the relatives about the brain-death of their patient.

In all these cases, demonstration of absence of cerebral blood flow by angiography or radionuclide study or transcranial Doppler study proves that the brain is irreversibly damaged.

3.4 Apnea Test

Apnea test should be performed as the last test after two clinical examinations with the mandatory observation period in between, have confirmed the absence of brain stem functions and the result of EEG or one of the other confirmatory tests is compatible with brain death. This test is done once with both examiners observing and need not be repeated.

3.4.1 Testing for Apnea

The apnea test demonstrates the failure of spontaneous respiration. The following precautions should be observed before proceeding with the test.

3.4.2 General considerations

- a. Apnea test should be done with body temperature of ≥36.5°C.
- b. Avoid hypoxia which could damage the brain further.
- c. Ensure that PaCO2 builds up to a critical level of 8.1 kPa (60 mmHg) or 20 mmHg over the baseline by the end of disconnection period. This is a sufficient stimulus to the respiratory center in a functioning brain-stem.
- d. If the patient is unable to tolerate the apnea test, it can be substituted by brain circulation confirmatory test.
3.4.3 Procedure for the apnea test

a. Pre-oxygenate with 100% O2 for 10 minutes. Increase the inspired fraction of oxygen (FI02) without changing the ventilation rate.

b. Disconnect the patient from ventilator and supply a continuous flow of humidified 100% O2 at the rate of 6 liters/min through an intra-tracheal catheter placed at the carina. In children, a flow of 1.5-2 liters/min can be used. Make sure that the catheter is thin enough as not to block the airway. Pulse oximeter is recommended to be used throughout the apnea testing.

c. Maintain disconnection for 10 minutes while observing the patient to see if there is any attempt to breathe. Draw blood for ABG to check the final PaCO2 and record this value. The PaCO2 must be above 8.1 kPa (60 mmHg) in adults and 7.6 kPa (55 mmHg) in children or 20 mmHg over the baseline.

Apnea test is considered positive when no respiratory movements have occurred during the disconnection period. (See Appendix V – Fact Sheet for the Approach to Diagnosis of Death Breath by Brain Function Criteria)

3.5 Documentation of Death by Brain Function Criteria

After the death by brain function criteria documentation form (See Appendix III – Death Documentation Form by Brain Function Criteria) is duly completed with the findings of all the tests and examinations specified therein and with the necessary signatures, it must be countersigned by the Chief of Staff of the hospital, who should ensure that all the stipulated criteria have been met. Documentation of death by brain function criteria must be done only at this stage.

Once death is confirmed, the treating physician should communicate the situation to the family, without offering the option of organ donation. (See Policy on Deceased Organ Procurement in Saudi Arabia, SCOT Publication).
4.0 DEATH CERTIFICATION BY BRAIN FUNCTION CRITERIA IN CHILDREN

In pediatric cases, one has to follow the same general guidelines, but with some necessary modifications described below, according to age.

a. In infants aged seven days to two months, the observation period has to be extended to 48 hours, during which two EEGs are taken separated by an interval of 48 hours, both showing electro cerebral silence, i.e., two recordings showing no cerebral activity, one at the beginning of the observation period and another at the end (Table 1 – Recommended Time Interval between First and Second examination in various age groups.).

b. In infants from two months to one year, an observation period of 24 hours is necessary. The confirmation should be done by two EEGs separated by 24 hours showing electro-cerebral silence in both, or one EEG with electro cerebral silence and one cerebral radionuclide angiography (dynamic isotope brain scan) showing no arterial blood flow to the brain.

c. For children over one year of age, the protocol is not different from that for adults except that the observation period should not be less than 12 hours.

d. After puberty, protocol for the adult is to be followed
## APPENDIX I

### GLASGOW COMA SCALE

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<td></td>
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<td>To verbal stimuli</td>
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<td></td>
<td>To pain</td>
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<td>Localizes pain</td>
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<td></td>
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<td></td>
<td>Semi-purposeful</td>
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<td>Decorticates</td>
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<td></td>
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<td></td>
<td>Decerebrates</td>
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<td></td>
</tr>
<tr>
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<td>No response</td>
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<td></td>
<td>Inappropriate words</td>
<td>3</td>
</tr>
<tr>
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<td>Incomprehensible sounds</td>
<td>2</td>
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| Total                | 3-15                   |
APPENDIX II

CLINICAL TRIGGERS OF
THE DIAGNOSIS OF DEATH BY BRAIN FUNCTION CRITERIA

Refer all severe brain damage regardless of age or diagnosis to Saudi Center for Organ Transplantation (SCOT).

Clinical signs to Refer a Possible Organ Donor:

- Any ventilator dependent, unresponsive patient with a possibility to progress to irreversible Brain Damage after more than 6 hours have passed since the initial insult.

  AND

- Clinical findings consistent with GCS ≤ 5

  OR

- Absence of 2 or more brain stem reflexes
  * no pupillary response
  * no corneals
  * no ice water calorics
  * no doll’s eyes
  * no gag/cough
  * not triggering the ventilator
  * no motor response

  OR

- Family mentions or asks about organ and tissue donation.

PUPIL GAUGE (mm)

Pupils
No Response to bright light. Size: midposition (4 mm) to dilated (9 mm).

Ocular Movement
No oculocephalic reflex. No deviation of eyes to irrigation in each ear with 50 ml of cold water (allow 1 minute after injection and ≥ 5 minutes between testing on each side).

Facial Motor Response and Sensation
No jaw reflex. No grimacing to deep pressure on nail bed, supraorbital ridge, or temporomandibular joint. No corneal reflex to touch with swab.

Pharyngeal and Tracheal Reflexes
No response after stimulation of the posterior pharynx with tongue blade. No cough response or bradyarrhythmia to bronchial suctioning.
Name: 
Age: 
Sex: 
Nationality: 
BLOOD GROUP: 
Hospital: 
Date of Admission: 

<table>
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<tr>
<th>FIRST EXAM</th>
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<td></td>
<td></td>
</tr>
<tr>
<td>Consultant B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Consultant A 
Consultant B 

**Confirmatory Test:** One of the following tests should be done after the above mentioned criteria are fulfilled:

<table>
<thead>
<tr>
<th>EEG</th>
<th>Flat [ ]</th>
<th>Date:</th>
<th>Signature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absence of Brain circulation evidenced by either:-</td>
<td>-cerebral angiogram [ ]</td>
<td>No Flow [ ]</td>
<td></td>
</tr>
<tr>
<td>-radionuclide angiography [ ]</td>
<td>-Transcranial doppler [ ]</td>
<td>Date:</td>
<td>Signature</td>
</tr>
</tbody>
</table>

Note: Recommended time interval between first and second examinations in various age groups:

- Adults: minimum of 6 hours
- Infants (above 60 days – 1 year): 24 hours
- Children (above one year): 12 hours
- Neonate (7 days – 60 days): 48 hours
- One EEG at end of first exam **Two separated by the mentioned time interval**
PRECONDITIONS:
1. It is absolutely certain that irremediable brain damage has occurred due to:
2. Appropriate time have passed between the first and second examination.
3. Coma with no spontaneous respiration.

EXCLUSIONS:
1. Hypothermia (core temperature < 34°C)
2. Sedation (blood test or hospital record should indicate absence of significant levels of sedative drugs or muscle relaxants).
4. Significant metabolic or endocrine causes of coma.

CLINICAL ASSESSMENT:
1. Lack of response to stimulation (Spinal reflexes excepted).
2. Absence of brain stem reflexes:
   a. Pupils to light
   b. Corneal
   c. Oculocephalic
   d. Oculo-vestibular (50 ml. of ice-cold water at 0°C in adults, 20 ml. in children)
   e. Gag
   f. Cough

APNEA TEST: (Body temperature $\geq 36.5^\circ$C) Performed as per Saudi Protocol and is compatible with death by brain function criteria.

<table>
<thead>
<tr>
<th>Consultant A</th>
<th>Consultant B</th>
<th>Hospital Director or Deputy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Seal of the Hospital</td>
</tr>
</tbody>
</table>

Note: After completion of the Death Documentation form, please fax to Saudi Center for Organ Transplantation P.O. Box 27049, Riyadh 11417. K.S.A. Tel: 01 4451100 – Toll Free Phone: 8001245500, Fax: 01 4453934
APPENDIX IV

EEG GUIDELINES*

1. A minimum of eight scalp electrodes and ear lobe references covering the major brain areas shall be used; ground electrode should not be used in ICU or if electrical monitoring equipment is in-use.

2. Disk electrodes will be applied; inter-electrode impedances will be kept under 10,000 ohms and over 100 ohms; the inter-electrode distance should be at least 10 cm.

3. Each electrode will be tested by touching it separately to create an artifact potential on the record.

4. Gain sensitivity will be increased by changing sensitivity from 7.5 V/mm to 2 V/mm during most of the recording with inclusion of appropriate calibration.

5. Filters should provide a wide window i.e., time constant 0.3 sec-land high frequency > 70 Hz.

6. EEG should be tested for reactivity to loud noise and pitch.

7. Recording will be done for at least 30 minutes.

8. A pair of electrodes will be applied on the dorsum of the right hand at a distance of 6-7 cm; electrocardiographic monitor will be applied.

9. Electromyographic artifacts can be seen sometimes in a patient with electrocerebral silence. If these obscure the recording, neuromuscular blocking agents like pancuronium or succinylcholine may be used, but during the recording only.

10. Recording should be made only by a qualified EEG technologist. A repeat EEG should be obtained if there is doubt about electrocerebral silence

*Modified from:


APPENDIX V

FACT SHEET FOR THE APPROACH TO THE DIAGNOSIS OF DEATH BY BRAIN FUNCTION CRITERIA

I. Preamble

Death by brain function criteria is a legal definition of death based on the irreversible cessation of all functions of the entire brain including the brain-stem due to total necrosis of the cerebral neurons following loss of blood flow and oxygenation. Before any supportive means are discontinued, the family members must be counseled. This should be documented in the patient's chart.

II. Criteria for establishing Death by Brain Function Criteria

All spaces provided should be initialed by two consultants (A & B) certifying the results of their assessment of the patient's condition.

1. Preconditions
   - The etiological diagnosis for death by brain function criteria should be entered.

Exclusions
   - Any signs of cerebral activity (like decerebrate or decorticate posturing or seizure activities).
   - Hypothermic patient should be warmed up to near normal body temperature.
   - Blood should be screened for the presence of barbiturates, opiates, benzodiazepines, synthetic narcotics, hypnotics and alcohol. No need for blood test if the patient had been hospitalized for 5 days or more.

   It should first be established that the patient is normothermic, is not under the influence of barbiturates or other sedative drugs, and is not suffering from remediable, toxic or metabolic brain disorders. In addition, it should be established that the patient is not in cardiovascular shock. death by brain function criteria will then be said to have occurred when the following criteria are found on two successive examinations, separated by an interval of 6 hours, *and performed by two consultant physicians, experienced in the diagnosis of death by brain function criteria.

2. Clinical assessment
   - Total lack of response to any stimuli: painful, auditory or visual.
   - The absence of brain stem reflexes, Pupil to light, Corneal, Oculocephalic, Oculovestibular, Gag and Cough.
   - Maximal vestibular stimulation should be used by injecting 50 ml of ice-cold water (temperature near 0 C) as close to the eardrum as possible in both ears.
3. When the above are fulfilled then

One isoelectric electroencephalogram (EEG) of thirty minutes duration or by Cerebral Angiography.

(The presence of spinal reflexes does not rule out death by brain function criteria).

*See special requirements for children.

If 1, 2 and 3 are fulfilled then do:

Apnea Test
Absence of spontaneous respiration or movement. This is tested by ventilating with pure oxygen or an oxygen 95 % and carbon dioxide 5 % mixture for ten (10) minutes. At the end of this time, the PaCO₂ should be within the normal range. The respirator should then be disconnected from the patient for ten (10) minutes, while the patient is supplied by continuous flow of 100% Oxygen through an intratracheal catheter reaching the carina and delivering continuous flow at 6 liters/min (1.5-2 liters/min in children) and establishing that the Pa CO₂ has risen above 8.1 kPa (60 mmHg) in adults and 7.6 kPa (55 mmHg) in children.

III. Death Documentation Form by Brain Function Criteria

a. To document the above criteria, this form entitled “Death Documentation by Brain Function Criteria” must be completed and signed by the two consultant physicians conducting the tests. It must be countersigned by the Hospital Director or the Deputy Hospital Director, or they may appoint a Saudi senior staff physician to do so before any supportive means are discontinued. All names must be written clearly in Arabic and English and the completed form placed in the patient's chart.

b. This form does not replace the legal death certificate.

*Special requirements for death documentation by brain function criteria in children

- Infants 7 days to 2 months: two flat EEGs separated by 48 hours of observation.
- Infants 2 months to one year: two flat EEGs Separated by 24 hours of observation.
- Children from 1 year to puberty: observation period of 12 hours, one flat EEG.
APPENDIX VI

PURPORT OF THE SENIOR ULAMA COMMISSION’S

The board unanimously resolved the permissibility to remove an organ, or a part thereof from a Moslem or Thimmi living person and graft it onto himself, should the need arise, should there be no harm in the removal and should the transplantation seem likely successful.

The board also resolved, by majority, the following:

a. The permissibility to remove an organ or part thereof from a dead person for the benefit of a Moslem, should the need arise and should the removal cause no dissatisfaction and should the transplantation seem likely successful.

b. The permissibility for the living person to donate one of his organs or a part thereof for the benefit of a Moslem in need thereof.
APPENDIX VII

"RESOLUTION OF THE COUNCIL OF ISLAMIC JURISPRUDENCE ON RESUSCITATION APPARATUS"

Amman, 1407 H (1986 G) No.86-07-3D (5)

The Council of Islamic Jurisprudence academy in its third session held in Amman 13-02-1407 H (16-10-1986 G) discussed the supportive means in intensive care units and after comprehensive explanation from consultant doctors decided the following:

The person is considered legally dead, and all the Shariah principles of death apply if one of the following conditions is confirmed.

a  Complete cessation of the heart and respiration, and the doctors have ruled that the cessation is irreversible.

b  Complete cessation of all functions of the brain and the consultant doctors have ruled that the cessation is irreversible, and the brain has started to degenerate.

In this condition there is permissibility to discontinue the supportive means from the patient even if some of his organs, like heart, still work artificially.
Important Memo

His Excellency the Director of the National Guard Health Affairs

His Excellency the Executive Administrator of the General Organization
King Faisal Specialist Hospital and Research Center

Deputy Minister of Higher Education

His Excellency Deputy Minister for Executive Affairs

His Excellency Director General of Medical Services of the Armed Forces

Director General of Security Forces Hospital Program

Due to the importance of supporting the national program for organ donation and transplantation and the large increase in the number of patients on waiting lists for transplantation and the resulting health and social burden on the patients and financial burden on different health sectors, I appeal to the staff in all hospitals and especially those in the intensive care units, emergency departments, neurology and neurosurgical departments, and all relevant departments to cooperate with the Saudi Center for Organ Transplantation of the administration of each hospital to fulfill the following:

1. **Early Notification** of cases of brain death to Saudi Center for Organ Transplantation and considering that as the core tasks of intensive care physicians and other relevant departments.

2. **Support** for organ donation in the hospital and put the appropriate plan with the Saudi Center for Organ Transplantation for optimizing cases of organ donation after death and overcome the obstacles faced by.

3. **Facilitate continuous communication** of medical and administrator coordinators inside the hospitals with intensive care units and emergency departments and relevant departments with respect to the organ donation and transplantation program.

**DR. ABDULLAH BIN ABDELAZIZ AL RABEEAH**
Minister of Health
Chairman of the Health Services Council
APPENDIX IX

OFFICIAL STATEMENT OF THE NATIONAL COMMITTEE FOR THE DIAGNOSIS OF DEATH BY NEUROLOGICAL CRITERIA AND VENTILATOR SYSTEM

STATEMENT

The members of National Committee for diagnosis of death by Neurological Criteria held a meeting in Saudi Center for Organ Transplantation (SCOT) on Sunday 31/01/2010 (23/11/1431H) to discuss what has been published recently in the media about the reluctance of some medical doctors on the “fatwa” on removing the ventilator machine from brain dead case where some consider it as killing a person. Accordingly the following steps were done by the committee:

- Review of these articles and international global scientific publications emerging on the subject.
- Review of the medical ethics of diagnosis of death by neurological criteria.
- Review the legal opinion “Fatwa” issued within the Kingdom of Saudi Arabia (Senior Ulama Commission) or abroad, especially the resolution of the Council of Islamic Jurisprudence on Resuscitation Apparatus.

Hence, we have decided unanimously the following:

1. The diagnosis of death by the time was, and continues to be a medical decision made by the experienced professionals.
2. The concept of brain death based on evidence has not undergone any recent disputing developments both in the definition or diagnosis using the Saudi protocol. Moreover, the protocol used within the Kingdom of Saudi Arabia is one of the most demanding protocols in the world.
3. According to the diagnosis of brain death by neurological criteria using the strict scientific protocol, the deceased person reaches the point of no return and no chance that he will regain his life.
4. It is permissible to remove the respirator from the persons diagnosed dead by the neurological criteria according to the scientific protocol applied in all the health institutions in the Kingdom and supervised by the committees of ethics and medical expertise.

The National Committee for The Diagnosis of Death By Neurological Criteria

Dr. Mohammad Zuheir Alkawi
Chairman,
Senior Consultant Neurologist
King Faisal Specialist Hospital & Research Center, Riyadh

Dr. Abdullah Turki
Consultant Pediatric Intensivist,
Director, Pediatric Critical Care Unit
King Faisal Specialist Hospital & Research Center, Riyadh

Dr. Mohammed Al-Bar
Consultant, Islamic Medicine
King Abdul Aziz University - Jeddah

Dr. Mohammad Al-Balala
Consultant, Neurologist
Riyadh Military Hospital

Dr. Mohammad Ibrahim Almajeed
Consultant Anesthesiologist,
King Khalid University Hospital – Riyadh

Dr. Nabil Biary
Consultant, Neurologist
Riyadh Military Hospital

Dr. Awad Addasi
Consultant Intensivist,
Riyadh Military Hospital

This statement is approved by the Saudi Society of Critical Care (SCCS):

Dr. Yasser Mandourah
Consultant Intensivist,
Head, Saudi Society of Critical Care
Head, Intensive Care Unit
Riyadh Military Hospital

Dr. Amin M. Yousef
Consultant Intensivist,
Deputy Head, Saudi Society of Critical Care
Head, Intensive Care Unit
King Saud Medical Complex, Riyadh
BIBLIOGRAPHY


ACKNOWLEDGEMENT OF PREVIOUS COMMITTEE (1992)

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Brain-Death Committee
National Kidney Foundation
Riyadh, Kingdom of Saudi Arabia

ACKNOWLEDGEMENT OF CURRENT COMMITTEE (2009)

We would like to acknowledge the SCOT secretarial help of Michael V. Abeleda, R.N, Johny E. Cillo, R.N, M.A. Taher, and Jaffer Adam in the preparation of the manuscript and all other colleagues at SCOT for their valuable assistance and support.

National Committee for Death Documentation
Saudi Center for Organ Transplantation
Riyadh, Kingdom of Saudi Arabia