Determining Brain Death in Adults
A Guideline for Use in Critical Care

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Very few decisions affect patients and their families as significantly as the determination of brain death. Besides the obvious need to make an accurate diagnosis, it is also imperative that the process be carried out proficiently and in a timely manner. Prolonging the process unnecessarily or giving inaccurate information can result in undue grief for patients’ families and can delay the process of organ donation. Clinicians must therefore be knowledgeable about making a diagnosis of brain death. Because the process requires a multidisciplinary approach, the best outcomes will be achieved when all members of the healthcare team are aware of the criteria being used to make the diagnosis.

Many excellent articles have been written about the diagnosis of brain death. These reviews present standards used in making a determination of brain death and highlight potential sources of confusion associated with brain death that may complicate or delay making the diagnosis.

As part of the performance improvement program at Mercy Medical Center in Springfield, Mass, a decision was made to update the hospital’s brain death policy, implementing the most recent standards of practice. In addition to rewriting the hospital’s policy for diagnosing brain death, a decision was made to develop a user-friendly guideline in the form of a checklist and an instruction sheet to assist clinicians involved in determining and documenting brain death (Figures 1 and 2). The use of a checklist is not unique to one organization but is a commonly used approach. The checklist identified in this article is unique because it includes instructions for conducting the clinical examination, interpreting the findings, and documenting the results. The primary advantage of this approach is that all members of the healthcare team are aware of the criteria being used to make the diagnosis. Ease of access to this information also makes it more likely that consistent information will be communicated to all members of the healthcare team and to patients’ families.

A guideline or checklist is never a substitute for the medical education and judgment necessary to make any diagnosis, particularly one with the significance of brain death. However, this type of structure (ie, checklist) can be used to organize a process, document results, increase multidisciplinary collaboration, and improve outcomes for all involved parties. In smaller hospitals or centers where making a diagnosis of brain death is less common, this type of guideline may be particularly useful. We think that this innovation will be helpful to clinicians who are seeking an efficient and practical approach to the determination of brain death.

Criteria for Determining Brain Death

Brain death is defined as the irreversible loss of function of the brain, including the brain stem. The most

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common causes of brain death in adults are traumatic brain injury and subarachnoid hemorrhage.¹

In the United States, principles of making a diagnosis of brain death are guided by the Uniform Determination of Death Act.² Although this document sets the standards for using brain-based criteria to diagnose death, it does not specify the elements to be used in making the diagnosis. However, both individual experts¹ and organizations, such as the American Academy of Neurology,² have published guidelines for brain death protocols. Consequently, although fairly consistent criteria are used to diagnose brain death, variability exists across states and practice settings as a result of local legislation and institutional policy.³ Individual hospital practice may also vary, depending on available resources and physicians’ experience.

Current standards for making a diagnosis of brain death require (1) identification of the suspected cause of the coma, (2) determination that the coma is irreversible, (3) performance of a clinical examination, and
Identification of the cause of coma is based on the patient’s history and the results of neurodiagnostic tests such as computed tomographic scans. Common causes of brain death detected on computed tomographic scans include brain masses with or without herniation and edema. In determining the cause of the coma, conditions that could confound the interpretation of appropriate neurodiagnostic and laboratory tests.

Guide to completing the Determination of Brain Death Checklist

The Checklist is intended to provide a guideline for clinicians involved in determining brain death. The Table provides a list of clinical criteria that must be assessed at two different time periods by two separate physicians. Blood pressure and body temperature are recorded in the appropriate space and must meet the criteria designated below. Each criterion should be marked with an X in the appropriate column on the checklist in order for brain death to be declared.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>Two clinical examinations must be performed; the timing of the 2nd exam is determined by the attending physician based on the suspected cause of coma.</td>
</tr>
<tr>
<td>Time (military)</td>
<td>Blood Pressure: SBP should be &gt; 90 mm Hg.</td>
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<tr>
<td></td>
<td>Body Temperature: Body temperature should be above 32 degrees C (90 F).</td>
</tr>
<tr>
<td>Responsiveness/movement</td>
<td>No responsiveness (deeply comatose): Patient should be deeply comatose with no responsiveness to noxious stimuli (e.g., supraorbital, nail bed pressure).</td>
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<td></td>
<td>No movement (i.e., no spontaneous movement, no response to painful stimuli, no decorticate or decerebrate posturing): Patient should not demonstrate any movement (either spontaneously or to painful stimuli), including seizures or shivering. Neuromuscular blocking agents and sedatives must be worn off. Spinal reflexes, including the Babinski reflex, are not indicative of brainstem function and hence are compatible with a diagnosis of brain death.</td>
</tr>
<tr>
<td>Evidence of absent brainstem function</td>
<td>Absent pupillary light reflex: Bilateral absent pupil reflexes. (Note: pupil reflexes may be absent after eye injury, neuromuscular blocking agents, atropine, mydriatics, scopolamine, and opiates).</td>
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<td></td>
<td>Absent corneal, gag, cough reflexes: Cough response best assessed by bronchial suctioning versus moving endotracheal tube side to side.</td>
</tr>
<tr>
<td></td>
<td>Absent oculocephalic reflex (Doll’s eyes): Elicited by rotating the head briskly. A normal response (i.e., present oculocephalic reflex) is conjugate deviation of the eyes to the side opposite of the direction in which the head is turned.</td>
</tr>
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<td></td>
<td>Absent oculovestibular reflex: With head of bed at 30 degrees- instill 50 mls of iced water into ear canal. A normal response (i.e., present oculovestibular reflex) is tonic deviation of the eyes toward the irrigated ear.</td>
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</table>

Performing an apnea test
1. The patient’s BP and O2 saturation should be monitored and recorded prior to beginning the apnea test. The blood pressure should be adequate (> 90 mmHg systolic) prior to testing. Vasopressors should be used as needed. The baseline PaCO2 should be within normal limits for the patient prior to starting the apnea test.
2. The patient should not be hypothermic or receiving sedative or paralyzing agents.
3. Preoxygenate patient with 100% oxygen for 10 minutes while still on ventilator.
4. Disconnect patient from the ventilator and deliver 100% oxygen at a rate of 8-10 liters/minute.
5. Monitor the patient for spontaneous respirations.
6. If the patient starts breathing, he does not meet the criteria for brain death and should be placed back on mechanical ventilation at previous settings.
7. If the patient does not begin breathing after 8-10 minutes, an ABG is drawn and the patient placed back on the ventilator.
8. The arterial PaCO2 should be > 60 mm Hg or 20 mm Hg higher than it was at baseline.
   If the PaCO2 is > 60 mm Hg (or 20 mm Hg above baseline) and NO spontaneous respirations are noted, the requirement of the Apnea Test has been fulfilled (and does not need to be repeated).

Lab/radiological tests - As appropriate (e.g., CT scan, toxicology tests).

Other confirmatory tests (e.g., EEG, cerebral angiography, brain scans)- Useful in situations where clinical exam is equivocal or a full examination cannot be performed.

Assessment- Statement that criteria for brain death determination have been (or have not been) fulfilled.

Physician signatures- Two physician signatures should be obtained. The second physician should not be involved in the patient’s care. Neither physician should be involved with organ transplantation.

Figure 2 Instructions for completing brain death guideline.
clinical assessment must also be ruled out, such as hypothermia, hypoten-
sion, severe acid-base abnormalities, drug or alcohol intoxication, sedation, and neuromuscular blockades.

The next step in diagnosing brain death is performing a directed, clinical examination. According to the American Academy of Neurology, each criterion of the clinical examination should be satisfied on 2 separate occasions. The length of time between examinations has not been defined and varies depending on the cause of the coma. The American Academy of Neurology has suggested that a 6-hour interval between examinations is reasonable; others have recommended a period of up to 48 hours in instances in which unknown toxins may be responsible for the coma. In addition, 2 conditions must be met before the clinical examination is conducted: the patient’s blood pressure should be greater than 90 mm Hg, and the patient’s body temperature should be greater than 32°C (90°F).

The clinical examination includes an evaluation of overall responsiveness, brain-stem reflexes, and apnea testing. The patient should be deeply comatose, with no response to painful or verbal stimuli, including decorticate or decerebrate posturing. He or she should also have no spontaneous movement, including shivering, seizures, or respiratory movement. The single exception is movement resulting from spinal reflexes. The assessment of responsiveness and movement requires that the effects of all neuromuscular blocking agents and sedatives have worn off completely (see Table).

The evaluation of brain stem reflexes begins with an assessment of the presence or absence of the following reflexes: pupillary, corneal, gag/cough, oculocephalic, and oculo-vestibular. Clinicians must be aware of situations that can influence these reflexes. For example, the results of the oculo-vestibular test may be falsely abnormal if the ear canal is filled with blood or cerumen (see Table).

Once responsiveness and brain stem reflexes are deemed to be absent, an apnea test is performed as the final evaluation of brain stem function. Clinicians involved in performing the apnea test must be skilled in carrying out the procedure in order to avoid complications such as hypoxia and hypotension. (See Figure 2 for more details on conducting an apnea test.)

Because brain death is a clinical diagnosis, laboratory and radiological tests are indicated only when confounding variables must be ruled out (eg, drug or alcohol intoxication) or confirmatory evidence of brain death must be provided, when the findings on clinical examination are equivocal or a full examination cannot be performed (eg, with severe facial trauma).

Recommendations on the number and specialty of physicians required to make a diagnosis of brain death are not standardized. Although no data have indicated that a second assessment by a different physician will result in reduced error, hospital policies often require that 2 physicians be involved in making the diagnosis, particularly when organ retrieval is involved.

Checklist for Determining Brain Death

Our guideline is in the form of a checklist that a patient’s physician initiates when the patient is suspected of being brain dead. The checklist includes an area for documenting the suspected cause of coma, findings of the clinical examination, and results of the apnea, laboratory, radiological, and other confirmatory tests, as well as the physician’s overall assessment. The checklist also includes an area for physicians’ signatures, allowing it to serve as a legal document.

Instructions for Completing the Determination of Brain Death Guideline

On the reverse side of the checklist is a comprehensive instruction sheet for clinicians. In addition to detailing the procedure for completing the checklist, it also provides information about the clinical examination and a brief description of the neurological assessment. The instruction sheet also includes information about performing and interpreting an apnea test (Figure 2).

Nurses’ Role in the Determination of Brain Death

Nurses play a critical role in the determination of brain death. Because of the role of nurses in the ongoing evaluation of patients, a nurse is often the first person to determine that a patient’s condition may warrant an assessment of brain death. Nurses also play a pivotal role in providing ongoing information to other team members and patients’ families.

It is vital, therefore, that nurses be aware of current standards for the determination of brain death. Nurses are intimately involved in the conduct of the clinical examination. This involvement requires
### The neurological examination: implications for nurses

<table>
<thead>
<tr>
<th>Facet of examination</th>
<th>Nursing implications</th>
</tr>
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<tbody>
<tr>
<td>Blood pressure</td>
<td>Hypotension may reversibly suppress neurological activity and hence preclude the diagnosis of brain death. Hypotension should be corrected with appropriate therapy (eg, fluid administration and vasopressors) before an evaluation of brain death is conducted.</td>
</tr>
<tr>
<td>Body temperature</td>
<td>Hypothermia may reversibly suppress neurological activity and hence preclude the diagnosis of brain death. Hypothermia causes a progressive loss of brain stem reflexes and pupillary dilatation. Pupillary response to light is lost at core temperatures of 28°C to 32°C and brain stem reflexes disappear with core temperatures of less that 28°C. Thermal blankets and warming of inspired air and intravenous solutions should be used to treat hypothermia.</td>
</tr>
<tr>
<td>Responsiveness</td>
<td>The patient should be deeply comatose and have no response to noxious stimuli (eg, nail bed or supraorbital pressure). There should be no spontaneous movement, no response to painful stimuli, no decorticate or decerebrate posturing. Spinal reflexes (eg, Babinski) may be present because they do not require brain innervation to occur. Motor responses may occur spontaneously during apnea testing in patients with hypotension or hypoxia and are considered the result of spinal reflexes. Spinal cord reflexes may also be generated by forceful flexion of the neck, body rotation, and respiratory acidosis. Other spinally mediated body movements, including flexion at the waist and arm raising, have been noted in brain-dead patients.</td>
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<tr>
<td>Pupillary light reflex</td>
<td>Pupillary reflexes should be assessed in a semidark room. A strong light is shone into each eye sequentially, and pupil size in both eyes is noted. There should be no response to bright light. Any reaction excludes the diagnosis of brain death. Nonreactive round, oval, and irregularly shaped pupils are compatible with brain death. Most pupils in brain-dead patients are midposition and midsize (4-6 mm), but they may be dilated. Pupillary assessment is confounded by eye injury, certain medications (particularly topically administered eye drops), and preexisting ocular abnormalities.</td>
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<tr>
<td>Corneal, gag, cough reflexes</td>
<td>Moving the endotracheal tube back and forth may not be an adequate stimulus for testing the cough response, hence bronchial suctioning is recommended.</td>
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<tr>
<td>Oculocephalic reflex (doll’s eye reflex)</td>
<td>The doll’s eye test is contraindicated in patients with fractures or instability of the cervical spine.</td>
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<tr>
<td>Oculovestibular reflex</td>
<td>Ears must be free of significant wax or clotted blood, which may diminish the response to cold caloric stimulation. The eardrums should not be perforated. Any movement of the eyes indicates that some brain pathways are intact.</td>
</tr>
<tr>
<td>Laboratory tests</td>
<td>Metabolic and electrolyte abnormalities may impair neurological functioning. Screens should be done as appropriate for alcohol, barbiturates, other depressant drugs (eg, tricyclic antidepressants), sedatives, and antiepileptic drugs that may affect findings on neurological examination.</td>
</tr>
<tr>
<td>Radiological tests</td>
<td>A computed tomographic scan is often essential for determining the cause of brain death. Common findings on computed tomographic scans in cases of brain death are a mass with brain stem herniation, multiple hemispheric lesions with edema, and edema alone. Findings on computed tomography scans may be normal in the early period after cardiopulmonary arrest.</td>
</tr>
<tr>
<td>Confirmatory tests</td>
<td>The 2 most common confirmatory tests are the electroencephalogram and cerebral blood flow studies (ie, cerebral angiography). The electroencephalogram is the most commonly used confirmatory test. It assesses only cerebral, not brain stem function. It is usually performed at the bedside. Patients who are brain dead will have at least 30 minutes without electrical activity. Bedside monitors, infusion devices, overhead lights and ventilators may produce artifacts. Electrocerebral silence may occur with alcohol intoxication and hypothermia. Electrocerebral activity precludes the diagnosis of brain death. Cerebral angiography may show absence of intracerebral filling at the level of the carotid bifurcation or circle of Willis. The absence of cerebral blood flow is consistent with a diagnosis of brain death. It should be noted, however, that the presence of cerebral perfusion does not mean that brain death has not occurred. A major benefit of cerebral angiography is that it is unaffected by coma-potentiating drugs (eg, barbiturates). Other confirmatory tests include transcranial Doppler sonography, nuclear imaging studies (eg, with technetium), and somatosensory evoked potentials.</td>
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knowledge of the specific indices that make up a clinical examination as well as an awareness of factors that may limit an evaluation or confound its findings (see Table).

Perhaps the most critical role of nurses in the determination of brain death is to provide support to patients’ family members during and after the diagnostic period. Accurate, understandable, timely, and consistent information is crucial to meeting important needs of patients’ family members during this time of crisis. It is impossible to overestimate the difference a caring and skilled nurse can make at this time. The ability to provide effective nursing care in this setting depends heavily on the level of communication and collaboration among members of the multidisciplinary team.

**Conclusion**

The importance of making an accurate diagnosis of brain death is obvious. What is not as obvious is the potential harm to patients’ family members that could result when the process used to make the diagnosis is less than optimal. Well-intentioned, yet uninformed clinicians can cause unnecessary stress for patients’ family members by prolonging the diagnostic process or inaccurately interpreting findings (e.g., mistaking spinal reflexive movements as indicative of intact brainstem function).

No guideline or checklist can substitute for the extensive knowledge and judgment required to make a diagnosis of brain death. Because of the fast pace and complexity of the critical care setting, however, tools such as guidelines and protocols have obvious appeal, and their use in other complex processes, such as weaning from mechanical ventilation, has resulted in improve outcomes.

The multidisciplinary nature of critical care necessitates that all members of the team be knowledgeable about important care processes. Collaborating on a plan of care is critically important in the case of a potentially brain-dead patient. An awareness of the criteria for making a diagnosis of brain death ensures that this collaboration occurs, so that optimal outcomes can be achieved for all involved.

**References**
