



Medical Training and the Brain Death Exam: A Single Institution's Experience

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■ **BACKGROUND:** Clinicians may have limited opportunities to perform neurological determination of death (NDD, or brain death) certification during their training. This study aimed to evaluate the level of resident exposure to the brain death exam at a large-volume donor hospital.

■ **METHODS:** In March 2014, we adapted a dual-physician model for NDD certification at our institution to improve resident education regarding NDD. To evaluate the incidence of resident exposure, we collected examiner information from all brain death exams conducted between January 2014 and July 2015. Organ procurement, family authorization, and brain death intervals were also collected to evaluate the impact of NDD timeliness on organ donation.

■ **RESULTS:** A total of 68 patients who met NDD criteria were included in this study. For these patients, 127 brain death exams were performed, 108 (85%) by a critical care attending physician or fellow, 9 (7%) by a neurology resident, and 7 (6%) by a neurosurgery resident. Exposure rates for neurology and neurosurgery residents were approximately 0.22 and 0.20 exams/resident/year, respectively. The median brain death interval between exams was 1.0 hours (interquartile range, 0.0–2.5) hours. Resident involvement, time between exams, and dual exams were all found to be nonsignificant correlates of organ authorization and family refusal.

■ **CONCLUSIONS:** Neurology and neurosurgery residents may be limited in their exposure to the brain death exam during training. High-volume donor hospitals may be able to complete 2 exams for NDD certification in a timely

manner without detrimentally influencing organ authorization or family refusal rates.

INTRODUCTION

Death by neurological criteria, also termed “brain death,” is an accepted form of death as defined by the Uniform Determination of Death Act.¹ Guidelines for the brain death examination from the American Academy of Neurology consist of coma determination, loss of brainstem reflexes, and apnea testing.^{2,3} A trained physician must perform the examination in a systematic fashion to recognize and prevent potential sources of error, especially in controversial cases. For instance, a clinically brain-dead patient may exhibit signs of spinally mediated movement that can lead to confusion and uncertainty about the diagnosis in both staff caring for the patient and family members.^{4,5}

Physicians may have limited opportunities to observe a brain death exam during their training, however, given the infrequency of brain death determination in a hospital setting. Instead, their experience with brain death may be limited to didactic sessions. To that effect, Hocker and Wijdicks reported that 27% of the neurology residents at their institution have never even observed a brain death exam by their graduating year.⁶ Institutional guidelines on who can perform the examination vary significantly,⁷ which may further magnify this shortcoming.

Guidelines on the number of exams that are performed before brain death determination vary with hospital policy and practice. We recently updated our hospital policy to include a second brain death exam before NDD. Although a single brain death exam is congruent with American Academy of Neurology guidelines, our institution elected to require a second exam to increase exposure, fluency, and comfort in the certification of NDD among neurology

Key words

- Brain death exam
- Medical education
- Neurological determination of death
- Resident training

Abbreviations and Acronyms

- ICU: Intensive care unit
 NDD: Neurological determination of death
 OPO: Organ procurement organization

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Citation: *World Neurosurg.* (2017) 108:374-378.

<http://dx.doi.org/10.1016/j.wneu.2017.08.185>

Journal homepage: www.WORLDNEUROSURGERY.org

Available online: www.sciencedirect.com

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and neurosurgery residents. Before this change, critical care attending physicians were predominantly responsible for the brain death exam, leaving residents of any specialty with limited exposure. In the present study, we aimed to evaluate the effect of the dual-physician model for NDD certification on neurology and neurosurgery resident exposure to the brain death exam. However, performing 2 brain death exams can introduce delays into the NDD process, with a possible negative impact on organ viability and family authorization rates.⁸ Accordingly, a secondary aim of this study was to assess the impact of resident involvement and delays in NDD on organ authorization rates.

METHODS

Institutional Brain Death Policy

Effective March 31, 2014, our hospital transitioned from a single-to a dual-examiner model for certification of NDD. Under the new policy (HS-PS0502, Certification of Death in Adults), at least 1 of the certifying physicians is required to be an attending physician who must have experience in NDD (recognized as a practitioner of neurosurgery, neurology, or neurocritical care, as well as selected practitioners of critical care medicine). Documentation of the exam and declaration of time of death must be performed by completing a brain death examination note, which uses a basic checklist format to document key aspects of the exam, such as apnea testing and brainstem reflexes. Only after NDD certification can a patient's legal next of kin or surrogate be approached for organ donation.

Selection Criteria

All patients who experienced NDD at our institution between January 1, 2014, and July 31, 2015, were identified through a custom report generated by the local organ procurement organization (OPO). Exams performed between January 1 and March 31, 2014, were performed under previous policy and served as a historical comparison. Patients who had neurologic exams suggestive of neurologic death but who did not undergo formal certification of death were excluded from further analysis. In many of these instances, brain death exam was not performed, either because the patient did not meet baseline physiological or hemodynamic criteria or because the patient's family elected to withdraw ventilator support before initiation of brain death testing. Those who met the neurologic criteria for death but did not meet OPO criteria for potential organ donation (i.e., multisystem organ failure, defined as 3 or more organ systems in simultaneous failure for a period of 24 hours or longer without response to treatment, active or metastatic cancer, or rampant fungal infection) were also excluded from further study, because this information was not captured by the OPO database. Because all patients in this study met the NDD criteria,⁹ Institutional Review Board approval was neither required nor obtained.

Data Collection

Patients who were pronounced brain dead were identified through the OPO's patient database, and the medical records of these patients were then retrospectively reviewed for deviations from hospital protocol. Information on the training level (resident, fellow, attending physician) and specialty (critical care, neurology,

neurosurgery, pulmonology, or anesthesia) of the physician conducting the exam, the interval between exams (brain death interval), and organ donation information was also collected from the medical record. Organ donation outcomes were categorized as organ authorization, family refusal, or case abortion. In cases of organ authorization, the OPO proceeded with organ procurement and subsequent donation. In instances of case abortion, organ recipients could not be located, and thus the patient did not proceed to the operating room for surgical recovery. Because the OPO generally determines suitability before an organ approach, these outcomes reflect information discovered during donor testing and evaluation. On the occasions when a donor case is aborted by the OPO, primary reasons include overall organ viability, results of serologic testing, or additional history obtained through the family interview.

Data Analysis

To evaluate resident exposure rate, we identified the number of neurology and neurosurgery residents who performed a brain death exam within the time frame of this study. We then evaluated the effect of medical training level (independent, categorical variable) on deviations from hospital policy (dependent, categorical variable) using the Fisher exact test. Subsequently, we evaluated whether resident involvement (categorical variable, "yes" or "no") or time between exams (continuous variable) was associated with organ authorization or family refusal (dependent, categorical variable), using the Fisher exact tests for the categorical variables and the Wilcoxon rank-sum test for continuous variables. In cases when only 1 brain death exam was performed, the time between exams was considered to be 0 hours. Statistical significance was achieved at $P < 0.05$. Continuous variables are reported as median (interquartile range) unless noted otherwise.

RESULTS

A total of 68 patients who were pronounced brain dead based on NDD criteria were included in this study, with a mean age of 49 (95% confidence interval, 45–53) years (Table 1). In these patients,

Table 1. Patient and Physician Characteristics

Variable	Value
Number of patients	68
Patient age (years), mean (95% CI)	49 (45–53)
Male sex, number (%)	38 (56)
Number of brain death exams, number (%)	127
CCM attending physician	84 (66)
CCM fellow	24 (19)
Neurology resident	9 (7)
Neurosurgery resident	7 (6)
Other*	3 (2)

CI, confidence interval; CCM, critical care medicine.
*Two anesthesia residents and 1 pulmonology fellow.

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