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Organ donation rates in a neurosurgical intensive care unit

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Object. The number of patients waiting for organ transplantation continues to grow, while organs are donated by very few of the thousands of potential donors who die every year. The authors' neurosurgical intensive care unit (NICU) has worked closely with coordinators from the local organ procurement organization (OPO) for many years. In this study, the authors analyze donation rates in the NICU and discuss factors that may be important in maximizing these rates.

Methods. All referrals from the NICU to the OPO from 1996 to 1999 were analyzed. Of the 180 referrals, 98 patients were found to be medically suitable as potential donors. Another 15 patients died of hemodynamic collapse shortly after admission to the NICU. If one assumes that all 15 patients would have been suitable donors, the unsuccessful resuscitation rate becomes 15 (13.3%) of 113. Of the 98 eligible donors, consent was obtained and organs or tissue were recovered in 72, yielding a successful organ procurement rate of 73.5%.

Conclusions. Close working relationships among physicians, nurses, and OPO coordinators can result in higher donation rates than have been reported previously. Aggressive resuscitation and stabilization of all patients, early identification of potential organ donors, prompt declaration of brain death, and attempts by the OPO coordinator to build rapport with families are all important factors that may increase donation rates. Because most organ donors have sustained catastrophic intracranial events, neurosurgeons are uniquely positioned to influence organ donation policies at their hospitals and thus to salvage some benefit from tragic cases of overwhelming brain injury.

Key Words • brain death • organ donation • organ transplantation

Organ transplantation continues to be the best treatment for many diseases of the heart, lungs, liver, kidneys, and other organs. The number of potential recipients continues to grow as technical and pharmacological advances increase the success rate of transplantation procedures. At the end of 1990, 21,914 people were on the waiting list for transplantation. As of June 2001, this number had skyrocketed to 82,731.[36] The waiting list has grown by at least 10% every year since 1990, with no plateau in sight. Unfortunately, the number of deaths among patients on the waiting list exceeded 6200 in 1999, a threefold increase since 1990. Less than 30% of patients on the waiting list in 2000 received donor organs.

The organ procurement rate has not kept pace with demand over the last 10 years. The first increase in the donation rate, 5.6%, did not occur until 1998.[27] Each year in the United States an estimated 12,500 to 27,000 deaths occur in individuals who satisfy criteria for becoming organ donors,[4,7,31] but only 15 to 20% of these people actually donate.[3,34] Gortmaker, et al.,[9] found that the major causes of death among potential organ donors were head trauma (49%) and cerebrovascular events (33%). In other reports it has been estimated that patients with nonsurvivable head injuries comprise 55 to 77% of organ donors.[9,14,15,17,29]

The fact that these conditions are the most common causes of death in potential organ donors enables neurosurgeons to play a particularly important role in the organ donation process. The purpose of this study was to analyze donation rates in a busy NICU in which doctors and nurses work closely with the local OPO.

Clinical Material and Methods

The BTGH is a Level I trauma center serving the greater Houston metropolitan area. Patients with neurosurgical emergencies are admitted to the 16-bed NICU, which is managed by the Neurosurgery Service. As a general practice, patients with traumatic brain injury, aneurysmal subarachnoid hemorrhage, intracerebral hemorrhage, and other life-threatening conditions undergo aggressive resuscitation and stabilization, including surgical intervention and use of blood products, mechanical ventilation, and pharmacological agents as necessary. We have adopted this uniformly aggressive approach for several reasons, including frequent use of sedating and paralyzing drugs in the emergency center, which obscures the results of the neurological examination, occasional inexperience and inaccuracy on the part of those who perform the initial neurological examination, and infrequent but gratifying experiences with patients who

Abbreviations used in this paper: BTGH = Ben Taub General Hospital; CBF = cerebral blood flow; HIV = human immunodeficiency virus; NICU = neurosurgical intensive care unit; OPO = organ procurement organization.

demonstrate remarkably good recoveries from insults that initially appeared to be devastating. We have chosen to err on the side of being too aggressive in seemingly futile cases (at least initially) rather than being too passive with potentially salvageable patients.

Patients who progress to apparent loss of all cerebral function despite these measures are carefully evaluated for brain death according to standard criteria, including those outlined in 1981 by the medical consultants on the diagnosis of death to the President's Commission for the Study of Ethical Problems in Medicine and Biomedical and Behavioral Research.[2,24] When these criteria are met, we perform an objective confirmatory test. The laws of the state of Texas do not require that such confirmation be obtained prior to declaration of death, but we have found that the objectivity of such tests provides an extra degree of reassurance to patients and healthcare workers alike. Although several types of studies may be used for this purpose, we prefer radionuclide CBF studies because they can be performed at the bedside and because we enjoy a collaborative and supportive relationship with the nuclear medicine personnel at our institution. Use of a radionuclide scan as a confirmatory test of brain death in the appropriate clinical setting has been well described.[5,17,18,37,38] If no CBF is detected, the patient is declared brain dead. This protocol facilitates a prompt declaration of death in appropriate cases.

The OPO is given early notification of all potential organ donors at BTGH. An OPO coordinator is available in house 24 hours a day, and this person determines the medical suitability of potential donors. Absolute contraindications for donation include extracerebral tumors other than local skin cancer or carcinoma in situ of the cervix; sepsis; and active viral infections such as hepatitis A or B, HIV, cytomegalovirus, and herpes simplex virus. Organs from hepatitis C–positive donors can be used for hepatitis C–positive recipients. Documented intravenous drug use or advanced age of the donor is considered a relative contraindication.

The OPO coordinators also receive specialized training in request techniques. They meet with or help locate family members before the pronouncement of death. After the neurosurgeon notifies the family that the patient is brain dead, the OPO coordinator allows some time to pass between notification of death and discussion about consent for organ donation. Emphasis is placed on having a racially matched requester approach families whenever possible.

In this study we analyzed all referrals to the OPO from 1996 to 1999. Data gathered included the total number of referrals, the percentage of referrals that involved medically suitable donors, and consent rates. The number and type of organs obtained were also analyzed. The number of vascular organs obtained was used as an indicator of the effectiveness of resuscitation efforts.

Results

Between 1996 and 1999, the OPO received 180 patient referrals from our NICU. Fifteen of the 180 patients died of hemodynamic collapse shortly after arrival in the NICU. After appropriately thorough clinical evaluation led to the diagnosis of brain death in the remaining 165 patients, they each underwent radionuclide CBF testing. Documentation of the absence of CBF was obtained before potential donation was discussed with family members. The in-house OPO coordinator was called before the confirmatory cerebral radionuclide study was performed. This early notification gave the OPO coordinator sufficient time to locate next of kin (if they were not already available) and to begin investigating the medical suitability of the potential donor.

Overall, 98 of the 165 patients were ultimately found to be medically suitable donors. Reasons for unsuitability in the remaining 67 patients included HIV infection, extracranial tumor, hepatitis B or C, and history of intravenous drug abuse. No patient in our series was unsuitable for donation because of sepsis, a result that may be attributable to our practice of establishing the existence of brain death in a timely fashion.

Although 98 patients were suitable potential donors, the families of 120 patients were approached for consent; 22 patients were later found to be medically unsuitable for the reasons listed earlier, that is, systemic malignancy, HIV infection, hepatitis, or history of intravenous drug abuse. The reason for this discrepancy is that, when the OPO coordinator approaches a family, consent is sought before the family is questioned in detail about the potential donor's medical history. Inevitably, some families consent but subsequently reveal that the potential donor had a contraindication to donation. Of the 120 families that were approached, 88 consented to organ donation, for an overall consent rate of 73.3%. No problems occurred as a result of the exclusion of some patients as donors after their families had given consent. Of the 98 eligible donors, consent was obtained and organs and tissue were recovered in 72 patients, yielding a successful organ procurement rate of 73.5%. If one makes the conservative assumption that all 15 patients who died of hemodynamic collapse shortly after arrival in the NICU would have been medically suitable donors, the unsuccessful resuscitation rate of potential donors becomes 15 of 113 (that is, 15 deaths among 98 potential donors plus the 15 deceased potential donors), or 13.3%.

Another marker of the effectiveness of resuscitation practices is the number of vascular organs that were procured successfully. Vascular organs include kidneys, heart, liver, lungs, and pancreas. If resuscitation is inadequate, a donor may still be able to donate tissue, but the all-important vascular organs may be lost. In our donor group, 70 of the 72 patients donated vascular organs successfully, yielding a vascular organ procurement rate of 97.2%.

Discussion

Mandatory request laws represent a legislative attempt to address the imbalance between the supply and demand of donor organs.[35] The 1986 Consolidated Omnibus Budget Reconciliation Act required that all hospitals participating in the Medicare and Medicaid programs refer all potential organ donors to the local OPO and that families of all potential donors be made aware of their right to donate organs and tissue. Most states have passed similar laws to supplement this legislation. Unfortunately, these actions have not improved donation rates as much as expected.[28]

After the failure of legislation to lessen the disparity in numbers between organ donors and potential recipients, increased attention was paid to the donation process itself. Actual procurement rates fall short of potential rates for a

number of reasons, including inability to resuscitate and hemodynamically stabilize potential donors, failure to identify appropriate candidates as potential donors, failure to declare brain death in a timely manner, and inability to obtain consent from the patient's family.[10,14–16,21,27] These problems continue to limit cadaveric organ donation rates despite the existence of a potentially large donor pool.

Hemodynamic Stabilization

Brain-dead potential donors are prone to severe hemodynamic and metabolic abnormalities that can result in the loss of viable organs.[1,6,11,13,21,25] Reports in the literature relate that 80 to 85% of donors manifest autonomic instability and hypotension.[13,25] Common causes include hypovolemia from diabetes insipidus, from blood loss during trauma or subsequent coagulopathy, or from osmotic agents used to treat increased intracranial pressure.[27] Diabetes insipidus has been reported in 81% of patients either during irreversible progression toward brain death, or after brain death occurs.[34] Adequate intravascular volume may be maintained with intravenously administered fluid, packed red blood cells, pressors, and vasopressin.

Hypothermia and autonomic instability can produce pulmonary edema or threaten potential donor organ viability in other ways. Cardiac dysrhythmias may occur after brain death, the most common being supraventricular tachycardia.[34] Coagulopathy is a frequent problem, with elevation of prothrombin time in 30 to 40% of these patients.[1,4,27] Release of tissue thromboplastins from necrotic brain may cause a consumptive coagulopathy, often leading to elevation of prothrombin times and to thrombocytopenia.[27] Many patients require fresh frozen plasma or platelets as part of their resuscitation. All of these problems must be treated promptly and aggressively to maintain organ viability. Those who might criticize the use of relatively scarce blood products in patients with devastating injuries must remember that donor organs are even more precious than blood products.

Reported failure rates of resuscitation and support range from 25 to 33%.[14,15,21] Our rate was 13.3%. This improvement over published rates is most likely attributable to uniformly aggressive medical management of all potential donors and to anticipation by both nurses and physicians of the metabolic problems that accompany severe head injury.

Identification of Potential Donors

Another well-recognized problem that reduces the number of organs donated is failure to recognize which patients may be potential donors. Nygaard, et al.,[25] reported that 84% of eventual organ donors had a Glasgow Coma Scale[33] score of 3 or 4 at admission, and another 8% had a Glasgow Coma Scale score of 5. Of all physicians, neurosurgeons have the greatest expertise in treating these severely injured patients. Consequently, neurosurgeons are often the first to recognize that treatment has failed and that organ donation has become a possibility. It must be emphasized that the same management strategies that neurosurgeons use to ensure hemodynamic stability and prevention of secondary insults in head-injured patients also preserve the function of potentially transplantable organs.

Knowledge of the contraindications to donation can facilitate targeted questioning of family members and can help direct laboratory analyses in potential donors. Such efforts can improve efficiency by identifying medically unsuitable donor candidates early, thereby avoiding expenditure of resources to maintain cardiopulmonary function in brain-dead patients.

Attitudes toward donation among the professionals involved clearly affect the process as well.[26] The 24-hour availability of OPO coordinators at our institution is an important factor in this regard. Without these dedicated individuals, this process would be much more onerous for the physicians.

Prompt Declaration of Death

The prompt declaration of brain death in the appropriate clinical setting is another important factor in improving donation rates. Patients with fatal head injuries have short survival times even with maximal support.[3,14,19] Jacobs, et al.,[15] found that 70% of nonsurvivors died within 6 hours, and 93% died in the first 24 hours postinjury.

At the Hospital of the University of Pennsylvania, implementation of a protocol similar to ours reduced the time to declaration of brain death from 12.4 to 3.4 hours.[27] Because the majority of potential organ donors experience severe physiological derangement in the first 6 hours, the expeditious declaration of brain death may have a significant positive impact on the number of donor organs salvaged.

Consent Rate

Past reports have listed consent rates of 16 to 55%.[3,7,9,12,14,15,17,20–23] Our consent rate for medically suitable donors was 73.5%, and our overall consent rate for all relatives approached (which includes some donors who were subsequently found to be ineligible) was 73.3%. A major reason for our high consent rate is our close working relationship with the OPO coordinators. The in-house OPO coordinator is notified early so that he or she has sufficient time to locate family and build some rapport before the declaration of brain death. Some time is allowed to pass after the notification of brain death to separate that event from the request for donation. Garrison, et al.,[8] found higher consent rates if the notification of death was separated in time from the request for organ donation. In addition, the objectivity of the radionuclide scans seems to help families to understand and accept the diagnosis of brain death.

Procurement rates overall are lower for African Americans, Hispanics, and Asians than for Caucasians.[32] Therefore, when the request for organ donation is made, emphasis is placed on racially matched requesters. A previously published article from our OPO[30] described a 115% increase in the number of organ donors, with no increase in the number of potential donors, after implementation of a protocol in which racially matched requesters are used when possible. Improved minority consent rates have substantially improved the overall consent rate in our NICU.

Conclusions

In the NICU at BTGH, physicians, nurses, and OPO coordinators work together to minimize the problems that interfere with organ procurement. This approach has resulted in higher organ donation rates than at most other hospitals. Although the degree of success reported here certainly re-

quires dedication on the part of nurses and OPO coordinators, commitment on the part of the neurosurgeons is also essential. Neurosurgeons must remember that they are uniquely positioned to influence organ donation rates in their facilities. Through such involvement, members of our discipline may help to bring about some benefit from otherwise tragic cases of overwhelming brain injury.

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