Deceased Organ Donation From Pediatric Donors: Does the Literature Really Help Us? Implication for More Powerful Guidelines

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ABSTRACT

Background. Brain-dead pediatric donors have always been the focus of attention because of the higher quality, utility, and possibility of their organ donation. However, donors under the age of 5 years always necessitate making more challenging management efforts, which are not clearly implied in most parts of the guidelines.

Methods. The data obtained from 79 brain-dead pediatric donors of the Organ Procurement Unit of Masih Daneshvari Hospital, Tehran, Iran, were assessed. The donors were divided into 2 groups, including donors under 5 years of age (group A) and those between 5 and 12 years of age (group B). Metabolic, hemodynamic, hematologic, and electrolyte status as well as the suitability for donation were compared in the study groups.

Results. Of 1252 donors, 6.3% were under 12 years of age. Trauma and drug toxicity were the two primary causes of brain death in group A. In comparison, trauma and brain tumor were the leading causes of brain death in group B. The prevalence of both hyperglycemia and respiratory acidosis was significantly higher in group A ($P < .05$). However, severe anemia and coagulopathy were more prevalent in group B ($P < .05$). The high-dose inotropic administration was used for 42.4% of the donors in group A, whereas only 26% of the donors in group B needed a high dose of inotropes ($P < .05$). The mean quantity of organ harvested per donor was 2.1 and 2.25 in groups A and B, respectively. Furthermore, donor loss was not significantly different in both groups.

Conclusions. The occurrence of different complications in donors under the age of 5 years requires special treatment considerations that should be the center of attention in the related guidelines. Organ donation per donor indicates that donors under the age of 5 years are a valuable resource for organ procurement.

THE QUALITY of life and life expectancy in children have been improved as the result of transplantation progress. Data published by the United Network for Organ Sharing in 2017 revealed that 8.5%, 3.5%, and 1.6% of the waiting list for heart, liver, and all organ transplantation, respectively, corresponded with the patients in pediatric classification [1]. Every 10 minutes, a patient is added to the national transplant waiting list in the United States, and the balance between supply and demand for organs is getting progressively one-sided. Hence, the main limiting factor for organ transplantation is still under investigation [2]. In this regard, neither the effort to expand the donor pool by use of circulatory death donors, nor the emergence of tissue engineering to fabricate the patient's organs, could solve this problem. Consequently, the optimization of accessible organs is crucial [3,4].

Among all potential donors, pediatric organs could be used for both children and adults. Moreover, organs

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retrieved from pediatric donors (PD) are not under the influence of risk factors associated with chronic diseases, including aging, diabetes insipidus (DI), and hypertension. Additionally, from an ethical point of view, in many centers and allocation systems, children are prioritized to receive organs [5]. These features along with the fact that PDs' families agree to donate more organs than the adult donors' families [6] point out the importance of PD. On the other hand, lack of dedicated intensive care units and experts would lead to donor loss [7]. Thereby, more efforts are required to reverse organ failure and resuscitate the potential deceased donors.

After the introduction of brain death by Harvard Medical School in 1968, a series of studies was conducted in 1996, particularly dealing with this issue in children [8]. By reviewing the literature, we can find out that numerous aspects of brain death pathophysiology and subsequent disorders and management challenges have been clearly discussed for adult donors [9,10]. In addition, several efficient management protocols have been proposed; even specific organ recovery guidelines have been published in the field of adult organ donation [11–13].

PDs, however, have not been equally valued. Furthermore, in PDs, the organs procured are more vulnerable because of the time-consuming protocol of brain death diagnosis; accordingly, organ resuscitation should be handled with great attention.

As Staworn et al described [14], a number of disorders associated with brain death vary between different ages in pediatric cases. For example, DI is more common in children between ages 2 and 5 years, and failure to control blood sugar affects children older than 5 years. Consequently, each group has its own concerns. However, an overview of the literature reveals an information gap in this regard. The purpose of our study was to describe the PDs' characteristics and complications throughout the organ procurement process and to draw a comparison between the 2 age groups of those under 5 years of age and those between 5 and 12 years of age.

METHODS

In this observational, retrospective study, deceased donors 12 years of age or younger during 2003 until 2016 were eligible to be enrolled. The potential donors were divided into 2 groups: group A, under 5 years of age, and group B, 5 to 12 years of age. The medical records were reviewed to gather information. Metabolic, hemodynamic, and hematologic status, fluid and electrolyte disturbances, and final outcomes in both groups during the procurement process were assessed and compared with each other.

During donor treatment, information about all complications and unstable conditions was conveyed to the transplantation centers. Therefore, the rate of organ donation per donor was affected by donor stability [2].

All statistical analyses were performed with the use of SPSS 21 software. The quantitative data were reported as means ± standard deviations. The categorical variables were presented as percentages. To compare the findings, the normal distribution of the data was first checked on the basis of the Shapiro-Wilk test, which resulted in P values >.05 (implying the rejection of the alternative hypothesis that the data distribution is not normal) and implied that the data came from a normal distribution. Subsequently, the Student sample t test or χ^2 with significance set at $P \leq .05$ was used to analyze the data.

RESULTS

Throughout the 13-year experience of organ donation, 79 (6.3%) of 1252 donors were pediatric. Among these donors, 33 (42%) cases were in group A and 46 (58%) were in group B.

Causes of Brain Death

The main causes of brain death in group A were trauma (n = 18, 54.5%) and drug toxicity (n = 9, 27.2%); other causes were primary brain tumor (n = 4, 15.1%) and hypoxic encephalopathy (n = 2, 6%). In group B, trauma, brain tumor, and drug toxicity were responsible for brain death in 35 (76%), 4 (8.6%), and 4 (8.6%) cases, respectively.

Electrolyte and Metabolic Disorders

In group A, the most common metabolic disorders were hyperglycemia and respiratory acidosis, which were observed in 16 cases (both 48.4%). Others were hypernatremia and hypocalcemia (both in 11 cases, or 33.3%) and metabolic acidosis, which occurred in 10 cases (30.3%). Hyperkalemia (n = 2, 6%) and alkalosis (n = 1, 3%) were less frequent disturbances. Additionally, DI and hypotension were found in all of the PDs without any exception.

In comparison, in group B, hyperglycemia was detected in 13 (28.2%) donors, being significantly lower than that of group A ($P < .05$). Moreover, respiratory acidosis was reported in 7 (15.2%) children between ages 5 and 12 years ($P < .001$).

Hemodynamic Instability

In group A, anemia and coagulopathy were detected in 10 (30.3%) and 7 (21.2%) donors, respectively. Severe anemia in 6 donors (18.1%), pulmonary edema in 4 donors (12.1%), cardiac arrhythmia in 4 donors (12.1%), and high-dose inotropic administration in 14 donors (42.4%) were observed.

Seven donors (21.2%) were given 3 different types of vasopressor/inotrope infusion to achieve hemodynamic stability according to the appropriate age/size and systolic blood pressure or mean arterial pressure>50 mm Hg. The latent state was often a consequence of severe acidosis with or without severe anemia in all of the cases. Reverse cardiac arrest occurred in 13 (39.3%) of 33 donors in group A before or after the diagnosis of brain death.

In group B, the occurrence of severe anemia was 10.8% (n = 5, $P = .03$), coagulopathy was 13% (n = 6, $P = .04$), and high-dose inotropic/vasopressor administration was 13% (n = 6, $P = .006$).

Reversed cardiac arrest was observed only in 7 donors (15.2%) in group B, being significantly lower than that of the younger donors in group A ($P < .001$). Despite severe