Potential Pediatric Organ Donors After Cardiac Death

A. Pregernig[a] and O. Karam[b,*]

[a]University of Geneva, Geneva, Switzerland; [b]Pediatric Intensive Care Unit, Geneva University Hospital, Geneva, Switzerland

ABSTRACT

Background. More than 50 people die each year on the Swiss transplant waiting list. To increase their organ donors pool, some centers have developed a post–cardiac death organ donation program. Information about its impact in the pediatric population is still scarce. The aim of this work was to determine the potential impact of a program of organ donation after cardiac in a pediatric population.

Methods. This was a retrospective study of all children deceased from 2005 to 2014 in a tertiary pediatric and neonatal intensive care unit. The deceased were categorized as brain dead, deceased despite maximal resuscitation, deceased after withholding of care, and deceased after withdrawal of care. Potential organ donors were identified by the absence of medical contraindication and agonal time <120 minutes.

Results. A total of 189 nonpremature children died during the 10-year period. Of the 36 (19%) brain-dead children, only 5 became organ donors. A further 67 (35%) died despite maximal resuscitation, 31 (16%) after withholding of care, and 55 (29%) after withdrawal of care. Regarding the latter category, median agonal time was 16 minutes. Eighteen children could potentially have given ≥1 organ each.

Conclusions. Development of organ donation after cardiac death in children could generate a 4-fold increase of the donor population.

MORE than 50 patients die each year in Switzerland while waiting for an available organ [1]. Indeed, solid organ transplantation is the only cure for some diseases, and each year the number of patients on the transplant waiting list rises.

Organ recovery is strictly regulated in Switzerland. The federal law on organ, tissue, and cell transplantation states (810.21): "organs, tissues or cells can be recovered on a deceased person if (a) consent for such a recovery was sought prior to his or her death and (b) death is certified." Death is defined as an "irreversible arrest of brain and brain stem function." Moreover, the law separates deaths into 2 types: death due to a primary brain lesion (brain death, or donors after brain death [DBD]) and death due to prolonged circulatory arrest (donors after cardiac death [DCD]). DCDs are further divided as dead on arrival (Maastricht 1 category), unsuccessful resuscitation (Maastricht 2), death following withdrawal of care (Maastricht 3), and cardiac arrest in a brain-dead donor (Maastricht 4). According to Swiss regulations, the diagnosis of death after circulatory arrest must be made by the following sequence of exams: 1) confirmation of circulatory arrest with the use of transthoracic ultrasound, which must demonstrate no activity for a minimum of 10 minutes; and 2) confirmation of all obligatory clinical signs regarding irreversible brain function arrest (same criteria as for the diagnosis of brain death) [2].

Criteria that guarantee the viability of organs after recovery also exist. In effect, donation warm ischemia time, during which organs suffer from diminishing perfusion pressure and oxygen transport, must be at its lowest. In the absence of Swiss recommendations concerning this issue, multiple centers use the French recommendations to determine the maximum tolerable time between withdrawal of ventilation and organ perfusion support and cardiac arrest [3]. A viability limit is thereby defined for each organ,

*Address correspondence to Dr Oliver Karam, Pediatric Intensive Care Unit, Geneva University Hospital, 6 rue Willy Donzé, CH-1205 Geneva, Switzerland. E-mail: oliver.karam@hcuge.ch

0041-1345/16
http://dx.doi.org/10.1016/j.transproceed.2016.06.049

ranging from 30 minutes of hypotension/hypoxemia for the liver [4] to 120 minutes of hypotension/hypoxemia for the kidneys [5]. A neoplastic tumor in the past 5 years, Creutzfeldt-Jakob disease, and uncontrolled sepsis delineate medical contraindications for organ donation.

Furthermore, the Swiss Medical Sciences Academy states that neonates (age <28 days and/or <44 weeks gestational age [GA]) are not allowed to become organ donors owing to "medical and ethical" reasons [2]. The decision to exclude infants of <44 weeks GA is debated, because there is no evidence that the clinical exam confirming the death of such infants is less reliable than that of an older child. Accordingly, countries such as the USA [6] and Australia [7] do not apply this customary neonate exclusion. Other countries, such as Great Britain [8], exclude neonates from DBD transplantation but allow them to be considered for DCD transplantation [9]. Some authors also shared their experience with neonatal transplantation [10], and one could argue the rationale behind a restriction.

Throughout the year 2014 in Switzerland, 40 children were registered on the transplant waiting list, and 21 underwent transplantation [1]. Therefore, our objective is to gauge the potential increase in the pediatric organ pool that a pediatric DCD transplant program could offer.

METHODS

This was a 10-year (January 2005 to December 2014) retrospective study of all consecutive deceased children in a tertiary pediatric and neonatal intensive care unit (PICU/NICU), Geneva University Hospital.

Patients were identified using the deaths register of the center.

The local Ethics Committee waived individual consent for the study.

We included all children (<16 years of age) who were admitted in the PICU/NICU at their time of death. We excluded premature infants (<37 weeks GA) and adults (≥16 years old).

Deaths were categorized as:

1. Brain dead: diagnosis made by 2 qualified separate doctors following the Swiss criteria [2].
2. Dead despite maximal resuscitation: for example, dead despite cardiac massage and artificial ventilation.
3. Dead after withholding of care: anticipated decision, discussed with the parents and with their full consent, not to engage in resuscitative measures for reasons of futility.
4. Dead after withdrawal of care: anticipated decision, discussed with the parents and with their full consent, to withdraw all or part of medical support (mechanical ventilation, vasopressor drugs, extracorporeal circulation) while optimal pain medication is delivered, for reasons of futility.

Regarding patients deceased after withdrawal of care, their agonal time, defined as the time lapse between care withdrawal and asystole, was measured with the use of the medical record and the monitoring of vital signs.

We identified potential organ donors as those having no medical contraindications (uncontrolled sepsis, Creutzfeldt-Jakob disease, tumor in the past 5 years) and an agonal time short enough to allow organ donation: 30 minutes for the liver, 90 minutes for the lungs, and 120 minutes for the kidneys [3].

Results are expressed as mean ± SD or median (interquartile range [IQR]). Proportions are displayed with their 95% confidence intervals (CIs). Factors related to the agonal time were evaluated by means of a Mann-Whitney test (nonparametric comparison between a continuous variable and a dichotomous variable) or a Kruskal-Wallis test (nonparametric comparison between a continuous variable and a categoric variable). All analyses were executed with the use of SPSS version 20 for Mac (SPSS, Chicago, Illinois).

RESULTS

During the 10-year period, 189 nonpremature children died in our unit (18.9 deaths per year). Causes of death are detailed in Fig 1. Thirty-six children (19%) were declared brain dead, of which only 5 became organ donors (14%). The other brain-dead children either had organ donation refused owing to medical or parental reasons (58%), medical contraindications (25%), or suffering cardiac arrest before organ recovery could be undertaken (3%). Sixty-seven (35%) died despite maximal resuscitation, 31 (16%) after withholding of care, and 55 (29%) after withdrawal of care.

Dead After Withdrawal of Care

Regarding the 55 children that died after withdrawal of care, 33 (60%) had a contraindication for potential organ donation: 18 had uncontrolled sepsis, 14 were <44 weeks GA, and 1 had a neoplastic tumor.

Of the 22 children without medical contraindication, 13 (59%) were boys. Median age was 31 months (IQR 7–99) and median weight 12.2 kg (IQR 6.1–22.0).

Following withdrawal of care, median agonal time was 16 minutes (IQR 7–52). The patient's weight and the reason for withdrawal of care were not associated with the agonal time ($P = .49$ and $P = .37$, respectively).

Potential Donors

Eighteen children (81% of deaths after withdrawal of care with no contraindication for organ donation) could potentially have become donors of ≥1 organ each. Fifteen (68%) had <30 minutes of agonal time, 3 (15%) 30–90 minutes, and 4 (18%) >120 minutes. Therefore, 15 livers, 18 lungs, and 18 kidneys could potentially have been recovered.

Impact of Neonate Exclusion

Among the 14 nonpremature neonates (age <28 days and/or <44 weeks GA) deceased following withdrawal of care, 7 (50%) could have become organ donors. Five had an agonal time <30 minutes, and 2 an agonal time of 30–90 minutes.

DISCUSSION

Our results show that one-third of deaths in our PICU/NICU occurred after withdrawal of care. Although intensive care enables us to treat and cure the majority of patients, some are too ill and can not be saved. When such a situation arises and it appears vain to extend treatment, it seems ethically justified to discontinue all medical and mechanical