Pediatric Cardiac Transplantation Using DCD Donors

Canadian Critical Care Forum
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Disclosure Statement

• No disclosures
DCD: What is “Old” is “New Again”

- Early solid organ recoveries were all from DCD donors
  - 1951 - Hume performed 1st kidney transplant
  - 1963 - Starzl performed 1st liver transplant
  - 1967 - Barnard performed 1st heart transplant
First “DCD” Heart Donor

Denise Darvall

25 year old female, severe brain injury from auto accident - hit by speeding car
First human to human heart transplant recipient

Louis Washkansky
- 53 year old ex-boxer with ischemic cardiomyopathy
- December 3, 1967, Groote Schuur Hospital, Capetown, RSA
- Lived 18 days, died from Pseudomonas and Klebsiella pneumonia
Dr. Christiaan Barnard

The “Filmstar Surgeon”
Initial DCD Donors

• Philosophical debate continued over the use of these DCD donors

• In Japan, 1968, cardiac surgeon Dr. Wada was indicted for murder for procuring organs from a brain dead drowning victim, highlighting the difficulty in acceptance of “brain death” with cessation of heart beat and death by traditional diagnosis

• In 1968, “Harvard criteria of brain death” were developed to define brain death and irreversible coma, and became widely accepted in the 1970’s

• Steady decrease in DCD donors until 1993, when the Pittsburgh Protocol for non-heartbeating donors was publicized
Why go back to the future?

• The number of pediatric heart transplants performed per year has remained relatively flat
• Wait list mortality has not changed in two decades, 15% in our series
• Length of time on waiting list has a direct relationship with poor neurologic outcome
• These are all related to the inadequate number of pediatric heart donors
ISHLT 17th PEDIATRIC HEART TRANSPLANT REPORT 2014
Pediatric Heart Transplantation

Death While Waiting: Significant

PHTS: 1993 – 2004
ALL INSTITUTIONS
Event: Death While Waiting

Diagnostic Group: (p = .0001)

- A: Hypoplastic Left Ventricle (n=561)
- B: Congenital Etiology (n=889)
- C: Non-Congenital Etiology (n=1067)

Patients are censored at time of transplant.
Infant Heart Transplantation
Risk of Death While Waiting

• Infants (< 1 year of age) awaiting cardiac transplant, as a status 1A, face a wait list mortality of 25-30%
  • There is a three-fold greater risk of death than older children
  • There is a ten-fold greater risk of death than adults awaiting transplant
Time to Transplant vs IQ/MDI


Developmental Outcomes of Patients with HLHS Treated with Heart Transplantation

‘93 - ‘98
p<.05
Why Use DCD Donors for Pediatric Cardiac Transplantation?

• **Primary Goal**: To increase donor pool and thereby decrease wait list mortality

• **Secondary Goal**: To allow families to participate in organ donation who have been denied in the past
  • 80% of families surveyed said they would want to participate in organ donation
Pediatric Cardiac DCD Program

Before undertaking such a program, we needed to know three things:

1. What experimental data was available?

2. What human data was available to suggest it would be feasible?

3. What would the potential be for increase in donors?
Experimental Data for Successful Cardiac DCD Donation

• Orthotopic cardiac DCD donation has been used successfully in pig, sheep, and primate models

• However, recovered function is not normal
DCD Cardiac Transplantation: Experimental reports of animal models

Pediatric Experience Donation Post CPR
Biologic Models

• Many successful cardiac donations and cardiac transplants following donor CPR of 35-120 minutes

• SIDS organ donation outcomes are equivalent to head injury without CPR
NICU Deaths

Withdrawal of life support 70-85%

Brain death 1-3% - Uncommon in neonates

Pediatrics 1989; 84:429-437
NBC Annual Reports 2002-2005
Potential DCD Donor Candidates at Children’s Hospital Colorado, Denver, CO

5 years (2001-2005)

49 patients – 8% NBC Deaths
Infant Heart Transplantation from Non-Heart Beating Donors: A Strategy to Reduce Waiting Mortality

Co-Investigators:
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David Campbell MD
Rebecca Frizell B.S.N.

Donor Alliance

Study Coordinator:
Chris Mashburn, RN
Pediatric Cardiac DCD Protocol

• Supported by a three year grant from the Department of Health and Human Services

• Full COMIRB approval
  • Risk of study is to the recipient: will hearts obtained in this fashion perform the same as traditional donors?
    • Informed consent required to participate
    • Extensive discussions held with families regarding protocol and option to participate
Donor Care Protocol

- Analgesia per ICU policy
  - 1mcg/Kg Fentanyl and/or 0.1mg/Kg Midazolam
- Extubation
  - OR staff NOT involved – heparin 300u/Kg
- Declaration based on EMD as determined by auscultation and no palpable pulse
- Procedure aborted if longer than 30 minutes to pulselessness
- 3 minute observation (original grant)
- Balloon occlusion aorta/cold cardioplegia
Donor Recovery

- Rapid Sternotomy
- Topical Cooling
- Cardiectomy
- Storage in iced saline as per routine donation
- Recipient preparation at delivery of cardioplegia via balloon in aorta
Clinical Scenario: Recipient #1

- Age: 2 months
- Weight: 4.1 kg
- Diagnosis: myocardial infarction s/p repair of complex congenital heart disease, ECMO
- Unstable, unsuitable for further surgery
Risk Factors

• Donor: History of CPR, 37 week gestational age, inotropic support

• Recipient: ECMO, ventilator, congenital heart disease, open chest

• Mismatches: age differential, donor/recipient weight ratio (0.7)
Recipient #1 at One Year
Results – Hemodynamics (1 year)

- LA mean = 8mmHg
- LV pressure = 96/8mmHg
- LVEF = 78%

ISHLT Score = 0
First Pediatric DCD Recipient at 3 years
Patient #1: Good Function
3 years Post Transplant

ASD occluder device

Short axis view
Changes to the Protocol

• Waiting time reduced to 75 seconds prior to the declaration of death for the second and third donors, to limit ischemia and distension
• Decompression of the donor heart by large bore CVP when cardioplegia is administered
• Monitors placed on silent to decrease confusion
• Attending physician – only – to determine pulselessness
• For the third procedure, parents were allowed to be in the operating room with their child
Pediatric Cardiac DCD Recipient #2 at 1 month

Zach A.
Season's Greetings!

Wishing you a Joyous Holiday Season and a Happy New Year.

Rob, MA, Zach and Baxter.

Zach
Christmas 2011
Age 5
Zach

Off to Kindergarten
2012
Pediatric Cardiac DCD Recipient #3

Annika K.
4 months post-DCD Cardiac Transplant
New England Journal of Medicine

Pediatric Heart Transplantation after Declaration of Cardio-circulatory Death

Boucek et al. 2008;359:709-14
Pediatric Cardiac DCD Recipient #4

Gabriella G.
Heart Transplant 2/11/2010
Two DCD Transplants Aborted

• One donor from the PICU did not reach pulselessness prior to half-hour time limit

• A second donor had cardiectomy carried out, but catastrophic abdominal infection found
GRANDAD TURNS GAY AFTER FEMALE HEART TRANSPLANT

Now 47-year-old superstud is a dud with the ladies

NATIONAL Examiner
FEBRUARY 2, 1988
AMERICA'S FASTEST GROWING WEEKLY

SECRET LOVE LIFE OF JEOPARDY'S CASANOVA
Outcomes

• Five Year Survival     75%
• Overall survival – 10 years   50%
• Neurologic Function     Same
• Cardiac Function     Same
• Rejection          Same
• Infection          Same
Waiting Time

- The time period between pulselessness and the declaration of circulatory death remains a major ethical dilemma.

- Our report stirred significant controversy.
Uniform Anatomical Gift Act of 1968
Uniform Rules for the Donation of Human Tissue and Organs

Donors of vital organs must be actually, not probably, dead

THE DEAD DONOR RULE

Uniform Laws Annot: 608, 1972
Uniform Determination of Death Act 1981

1. Irreversible cessation of circulatory and respiratory function

2. Irreversible cessation of all functions of the entire brain

President’s Commission on Defining Death
Wait Period
Donor must be actually and irreversibly dead
(the Dead Donor Rule)

2-11 minutes equivalent from physiologic
and ethical perspective

I.O.M., National Academy Press, 1997
Donation After Circulatory Death

“Auto-Resuscitation”

• In analyzing data on auto-resuscitation, the relevant event is the cessation of circulation, not the cessation of electrical activity

• When life sustaining therapy is withdrawn, based on the limited data available, spontaneous circulation does not return after 65 seconds of cessation of circulation

ETHICS COMMITTEE, SOCIETY OF CRITICAL CARE MEDICINE, 2001
“Lazarus Syndrome”

I believe that it is inappropriate to link this phenomenon to end of life withdrawal of life support and DCD donation, since these already severely brain injured children will not survive by the very nature of withdrawal of life support. It is only a matter of time.
Wait Time
Pulselessness to Pronouncement

We remain convinced that the most appropriate time period is 66 seconds.

This is in the best interest of the recipient.

No one wants a 200% mortality.

HOWEVER
What does the future hold?
or
Where do we go from here?

• Change the waiting time to 120 seconds
• Open up this protocol to children, adolescents and adults
• Change the organ recovery method so it can be easily utilized for outside hospital procurement
• Move to a more humane therapy for the end of life process and organ recovery
Cardiac Transplant Team

Cardiology
Dunbar Ivy
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Scott Auerbach

Surgery
David Campbell
Max Mitchell
James Jaggers

Donor Alliance
Rebecca Frizell and Sue Dunn

Transplant Coordinators
Bethany Diamond
Shelly Mason

Mental Health, TEAM iNO, Social Workers, etc.

Children’s Hospital Colorado
NICU

UCH Neonatology Group

UNOS DONATE LIFE
questions