Applied Clinical Cardiology

MINI REVIEW

Pushing Boundaries in Paediatric Heart Transplantation

Arun Beeman

Department of Paediatric Cardiothoracic Surgery, Great Ormond Street Children Hospital, London.

Heart failure is a global pandemic affecting 26 million people worldwide [1]. With advancement in diagnostic modalities, the recognition of heart failure in the paediatric population has gradually increased since last 2 decades. The prevalence and associated cost burden of paediatric heart failure are largely unknown [2]. Unlike adults, the heart failure in paediatric population is caused by variable etiologies, having variable prognosis and outcome.

Heart transplantation is the most effective therapy for end stage heart failure with median life expectancy of 10 to 15 years [3]. Unfortunately, the number of children requiring heart transplantation has increased gradually with no substantial increase in donor pool. In UK, only less than 43% of those waiting on transplant list are transplanted with more than 10% die while waiting for a heart and nearly 10% are removed from the list due to deterioration of their condition making them no longer candidates for heart transplantation [4].

Innovation to Increase Donor Pool

Whilst it's easy to blame the poor donor pool for inability to increase the transplantation numbers, we should look for alternative choices to match the recipient pool. Most of the countries understand the importance of increasing the number of donors and have implemented rules and innovative steps to increase the donor numbers, apart from the awareness campaigns. Countries like Spain, Austria, France, Belgium and Singapore have an opt – out system, where people are assumed organ donors unless they opt-out. Few countries like Israel provide positive incentives like giving priority for organ transplant to people who were registered organ donors and countries like Singapore and Chile assign a lower priority to receive organs if people are not willing to donate organs. In spite of all these efforts, the registration rates remain low. In UK, Only 38% of heart-beating solid organ donors permit the donation of cardiothoracic organs and there is a distaste for heart transplantation which is proving the limiting factor and a fear of planning for the end of life at a young age [5].

Converting a Potential Donor Organ Into an Available Organ

National Potential Donor Audit (a 24-month study between April 2007 and March 2009) in UK ICUs showed delay in performing brain-stem death tests and delay in consenting for organ donation as causes for loss of potential donor organs. Hence early engagement with ICU teams to encourage donation and clarify ethical and legal matters increases the conversion rates. There are no universal guidelines followed on accepting an organ. Various audits from UK has shown donor size, not achieving center specific criteria, not suitable recipients, poor function, donor age and ABO incompatibility as the major cause for declining donor organs. Utilizing these organs effectively will increase the donor pool. Implementation of UK scout pilot project 2013 model, where in all the transplant units send their teams to manage donors early in their zone and use of hormone replacement therapy including steroid, T_4 and vasopressin alleviating post-BSD hormonal and inflammatory changes increase donor rates.

Extending Donor Criteria

Making use of marginal donors increases the donor pool but with a risk of uncertainty about the graft function on long term follow-up. Marginal donor is only justified in situations when the risk of patient death due to heart disease is greater than that offered by the donor. Case report of successful intentional use of donor heart with ALCAPA for a one-year old recipient with restrictive cardiomyopathy has been reported from Great Ormond street children's hospital, UK [6]. Rational use of marginal donor is individualized and must be encouraged in centers having high volume of transplantation. Use of ABO incompatible donors have further revolutionized heart transplantation, especially among paediatric age groups. The survival rate and freedom from graft rejections were equal and comparable to ABO compatible transplantation. Due to immaturity of the immune system, ABO incompatible heart transplantation is no longer a barrier in paediatric groups. ABO-incompatible (ABOi) cardiac transplantation is now used widely in infants with isohaemagglutinin titers <1:4 [7].

Donation after Circulatory Death – DCD Donors

Donation after circulatory death will increase the overall heart transplantation by 20% [8]. DCD hearts require significantly less inotropic support and catecholamine surge in DBD

Correspondence to: Arun Beeman, Department of Paediatric Cardiothoracic Surgery, Great Ormond Street Children Hospital, London, London WC1N 3JH, UK, E-mail: aroune16[AT]gmail[DOT]com

Received: Mar 13, 2018; **Accepted:** Mar 15, 2018; **Published:** Mar 19, 2018

causing high PVR and myocardial stunning is absent in DCD, making DCD a potential option to reduce the heart transplant waiting list. Although the first heart transplantation was from DCD donor, the DCD donation did not become popular due to sustained obligatory hypoxic cardiac arrest, warm ischemic standoff period before organ procurement and subsequent severity of the ischemia-reperfusion injury. Proper selection of donors including age less than 50, with no inotropic supports and withdrawal to perfusion time less than 30 minutes and good myocardial preservation strategy including, prompt reperfusion within the donor, hypothermic and continuous perfusion during implantation will increase the success rate of DCD hearts. Cardio protective interventions delivered upon reperfusion can significantly reduce ischemic reperfusion injury.

Ex-vivo Heart Perfusion

The ex vivo perfusion of donor hearts improves the donor pool and acceptance of marginal donors. The organ care system (OCS) stabilize the perfusion of the cardiac grafts before transporting to the recipient center. If there is any evidence of ongoing ischemia despite perfusion, the use of the donor organ can be deferred. Although OCS was initially used for distant donor with longer ischemic time has now been extended for high risk recipients requiring longer time for dissection and also utilizing hearts deemed unfit for transplantation. Initial experiments from Hare field group, UK has shown that, the OCS heart system has markedly improved short-term outcomes and transplant activity by allowing use of organs previously deemed unsuitable for transplantation or by selection of higher-risk recipients [9].

Bridge to Transplantation

Mechanical circulatory support is now successfully used as bridge to transplantation in critically ill patients. UNOS thoracic organ transplantation registry shows that long-term post transplantation survival in patients receiving VADs is similar to that seen in those not requiring mechanical support [10]. But similar outcomes were not seen in patients bridged with ECMO. In spite of increased neurological risks, respiratory complications and higher immunological sensitization in usage of MCS, the long-term post transplantation survival looks promising.

Conclusion

The boundaries keep expanding in choosing an ideal donor. We are gradually developing with the advancement in medical science and technology and soon we will be a state of transplanting any donor heart in years to come.

References

1. Savarese G, Lund LH (2017) Global Public Health Burden of Heart Failure. CFR 3: 7-11. [View Article]
2. Nandi D, Rossano J W (2015) Epidemiology and cost of heart failure in children. Cardiol Young 25: 1460-1468. [View Article]
3. Eileen M, Hsich MD (2016) Matching the Market for Heart Transplantation. Circ Heart Fail 9: 2679. [View Article]
4. NHS Blood and Transplant (2014) Annual Report on Cardiothoracic Transplantation. NHS Blood and Transplant Pg: 1-113. [View Article]
5. Conesa C, Ríos Zambudio A, Ramírez P, Canteras M, del Mar Rodríguez M, et al. (2004) Socio-Personal Profile of Teenagers Opposed to Organ Donation. Nephrol Dial Transplant 19: 1269- 1275. [View Article]
6. Simmonds JD, Mustafa M, Fajardo Jaramillo DP, Bellsham-Revell HR, Marek J, et al. (2016) Successful orthotopic heart transplantation using a donor heart with ALCAPA. Pediatr Transplant 20: 859-865. [View Article]
7. Henderson HT, Canter CE, Mahle WT, Dipchand AI, LaPorte K, et al. (2012) ABO- incompatible heart transplantation: Analysis of the Pediatric Heart Transplant Study (PHTS) database. J Heart Lung Transplant 31:173-179. [View Article]
8. Osaki S, Ishino K, Kotani Y, Honjo O, Suezawa T, et al. (2006) Resuscitation of non-beati8ng donor hearts using continuous myocardial perfusion: the importance of controlled initial reperfusion. Ann Thorac Surg 81: 2167-2171. [View Article]
9. García Sáez D, Zych B, Sabashnikov A, Bowles CT, De Robertis F, Mohite PN, et al. (2014) Evaluation of the organ care system in heart transplantation with an adverse donor/recipient profile. Ann Thorac Surg 98: 2099-2105. [View Article]
10. http://www.uab.edu/ctsresearch/intermacs/description.htm

Citation: Beeman A (2018) Pushing Boundaries in Paediatric Heart Transplantation. Appl Clin Cardiolog 1: 001-002.