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Commentary

Extracorporeal Membrane Oxygenation for Low Cardiac Output Condition after Pediatric Heart Transplantation

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Heart transplantation is a seductive topic of interest. It seems simple at first glance and its problems become apparent when it starts. Sometimes a heart transplant is the only way to save life. Heart transplantation in children secondary to cardiomyopathy is a logical option to improve prognosis [1]. One of the most common complications in the period immediately after heart transplantation is the initial low cardiac output. Left and right ventricular failure can be caused by prolongation of myocardial ischemic time, poor condition of myocardial preservation, acute rejection caused by the immune system, and incompatibility of the graft with the hemodynamic status of the recipient [2-3]. In many pediatric heart recipients, the myocardium is damaged to some degree and left heart failure occurs, resulting in increased pulmonary vascular resistance (PVR) and an increased risk of right ventricular failure after transplantation. The medical treatment used to decreasing PVR after transplantation includes medications with pulmonary vasodilator effects, such as Prostacyclin, Sildenafil, Millrinone and a drug from the category of catecholamines with vasodilatory properties on the pulmonary vessels, like dobutamine [3-5].

The transplanted heart, which is usually stimulated by chronotopic and dromotropic drugs for adequate heart rate like isoproterenol, is usually also supported postoperatively with inotropic agents such as dopamine or epinephrine to enhance ventricular function. Despite these interventions and drug treatments, ventricular failure may persist and mechanical circulatory support becomes necessary [5-7]. Extracorporeal membrane oxygenation (ECMO) and ventricular assist device have been used for mechanical rescue support for primary graft failure after heart transplant. ECMO is widely used for post-cardiac surgery low cardiac output syndrome in children and is occasionally required after pediatric heart transplantation [5-6,8].

We would like to provide explanations about an eight-year-old girl with dilated cardiomyopathy who was a candidate for a heart transplant. Our subject complicated with several catastrophic problems during the perioperative period. She presented clinical manifestation of early primary graft failure with left ventricular dysfunction and pulmonary hypertension. Immunosuppressant with methylprednisolone for 48 hours, low-dose Cyclosporine and Azathioprine are prescribed perioperatively but, we encountered with a low cardiac output condition after transplant. We thought

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about acute rejection reactions so, a single dose of immunosuppressive agents was infused in the immediate post-transplantation period in the operating room and increased inotropic support and vasoconstrictor drugs were used for weaning from cardiopulmonary bypass pump but hemodynamics did not respond to our efforts, appropriately. Epinephrine, Norepinephrine, Milrinone and Sildenafil are prescribed for cardiac support and reduction of pulmonary pressure. The condition was evaluated again and some of these hemodynamic instabilities was considered due to post cardioplegic myocardial stunning according to data obtained from transesophageal echocardiography (TEE) and pulmonary vascular (PA) catheter analysis.

Myocardial stunning is a transient reversible myocardial dysfunction [2,4] but we could not anticipate when the myocardial stunning would be relieved and grafted heart return to an acceptable function so we made a difficult decision. We prepared an ECMO for our patient. A standard ECMO circuit with a cannula of appropriate size according to the size of the patient was used. We performed transthoracic cannulation through an open chest via the right atrium and ascending aorta.

Pump flow was adjusted based on systemic perfusion, hemodynamic tracing, and systemic and mixed venous oxygenation, basic metabolism and serum lactate level. Heparin as an anticoagulating agent prescribed and Activated clotting time (ACT) was maintained between 220 and 320 seconds. She was transferred to pediatric open heart intensive care. Inotropic-chronotropic and vasoconstrictor-vasopressor drugs were weaned after stabilization of the patient during ECMO support in the ward. Recovery of graft performance was regularly assessed by Trance Esophageal Echocardiography (TEE) and Pulmonary Artery (PA) catheter analyzer. The ventricular function of the grafted heart become normal and hemodynamic parameters retuned to the acceptable range in the 5th day but, she suffered from heparin-induced thrombocytopenia (HIT). Consequently, we weaned ECMO on 6th day and heparin was interrupted. Chest closure postponed until 24 hours after ECMO weaning, decannulation and mechanical ventilation weaning and planed tracheal extubation was done 48 hours after ECMO discontinuation. Our patient stayed admitted in intensive care unit for three weeks and was discharged from hospital after six weeks.

There are many reports of heart failure and myocardial stunning in the early post-heart transplant period in children who required mechanical circulatory support. The response to mechanical circulatory support is variable and dependent on many factors [6-9]. According to our observation and clinical practice, we recommend ECMO preparation for early primary low cardiac output condition in the pediatric heart transplant surgeries.

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References

[1] Kirk R, Edwards LB, Aurora P, Taylor DO, Christie J, Dobbels F, et al. Registry of the International Society for Heart and Lung Transplantation: eleventh official pediatric heart transplantation report--2008. J Heart Lung Transplant. 2008; 27(9):970-7.

[2] Kaushal S, Matthews KL, Garcia X, Wehman B, Riddle E, Ying Z, et al. A multicenter study of primary graft failure after infant heart transplantation: Impact of extracorporeal membrane oxygenation on outcomes. Pediatr Transplant. 2014; 18(1):72-8.

[3] Raj S, Ruiz P, Rusconi P. Early primary graft failure after a pediatric heart transplant and successful rescue with plasmapheresis, immunoglobulins, and alemtuzumab. Ann Ped Cardiology. 2017; 10(1):69-71.

[4] Goland S, Czer LS, Kass RM, De Robertis MA, Mirocha J, Coleman B, et al. Pre-existing pulmonary hypertension in patients with end-stage heart failure: impact on clinical outcome and hemodynamic follow-up after orthotopic heart transplantation. J Heart Lung Transplant. 2007; 26(4):312–8.

[5] Perri G, Hasan A, Cassidy J, Kirk R, Haynes S, Smith J, et al. Mechanical circulatory support after pediatric heart transplantation. Eur J Cardiothorac Surg. 2012; 42:696–701.

[6] Takeda K, Li B, Garan AR, Topkara VK, Han J, Colombo PC, et al. Improved outcomes from extracorporeal membrane oxygenation versus ventricular assist device temporary support of primary graft dysfunction in heart transplant. J Heart Lung Transplant. 2017; 36: 650-65.

[7] Mitchell MB, Campbell DN, Bielefeld MR, Doremus T. Utility of extracorporeal membrane oxygenation for early graft failure following heart transplantation in infancy. J Heart Lung Transplant. 2000; 19:834–9.

[8] Botha P, Solana R, Cassidy J, Parry G, Kirk R, Hasan A, et al. The impact of mechanical circulatory support on outcomes in pediatric heart transplantation. Eur J Cardiothorac Surg. 2013; 44:836–40.

[9] Tissot C, Buckvold S, Phelps CM, Ivy DD, Campbell DN, Mitchell MB, et al. Outcome of extracorporeal membrane oxygenation for early primary graft failure after pediatric heart

transplantation. J Am Coll Cardiol. 2009; 54:730–7.