ORIGINAL ARTICLE

Ventricular assistance with extracorporeal membrane oxygenation (ECMO) in patients with with refractory cardiogenic shock after congenital cardiac surgery

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Objective. **To share the experience of the Instituto Nacional de Cardiología "Dr. Ignacio Chávez " utilizing ECMO as ventricular assistance in pediatric patients.** ***Material.*** **The files of patients undergoing cardiac surgery from May 2014 to May 2018 were reviewed. Only patients under 18 years old requiring veno-arterial ECMO, were included. The methodology used was non-experimental, transversal and descriptive.** ***Results.*** **From January 2014 to May 2018, 17 ECMO veno-arterial systems were installed, 12 by central cannulation and 5 with peripheral cannulation. The age range goes from 1 day to 15 years, and corporal weight from 2.9 kg to 26.7 kg. The average duration of ventricular support was 6 days (range, 2 to 13 days), length of stay in intensive care unit was 8.8 days (range, 1 to 30 days). Nine patients died (53%), 6 died in the first 2 years (85%) and 3 died in the next 2 years (30%).** ***Conclusion.*** **The complexity of congenital heart disease has increased progressively. Therefore, centers such as ours providing a high-level care, ECMO is becoming more and more frequent. The number of cases is still small. However, it is important to raise awareness of them. Initially mortality was high, decreasing significantly in the last two years.**

Key words**: Cardiac surgery; Congenital heart disease; ECMO.**

Objetivo. **Compartir la experiencia del Instituto Nacional de Cardiología "Dr. Ignacio Chávez" en el uso de ECMO como asistencia ventricular en pacientes pediátricos.** ***Material.*** **Se revisaron los expedientes de los pacientes sometidos a cirugía cardíaca de mayo de 2014 a mayo de 2018. Únicamente se incluyeron pacientes menores de 18 años, los cuales requirieron ECMO veno-arterial. El estudio es no experimental, transversal, descriptivo.** ***Resultados.*** **En el periodo comprendido de enero de 2014 a mayo de 2018, se instalaron 17 sistemas de ECMO, todos veno-arteriales, 12 con canulación central y 5 con canulación periférica. El rango de edad va de 1 día de vida a 15 años, y los pesos desde 2.9 kg hasta 26.7 kg. El tiempo promedio de duración de soporte ventricular fue de 6 días (rango, 2 a 13 días) con un tiempo de duración en la terapia intensiva de 8.8 días (rango, 1 a 30 días). Ocurrieron 9 defunciones (53%), 6 en los primeros 2 años y 3 en los últimos 2 años.** ***Conclusión.*** **La complejidad de las cardiopatías congénitas ha incrementado de forma progresiva. Por tanto, en los centros como el nuestro que brindan atención de alto nivel se hace cada vez más frecuente el uso de sistemas de ECMO. El número de casos aún es pequeño. Sin embargo, es importante darlo a conocer dado que inicialmente la mortalidad era elevada, disminuyendo significativamente en los últimos dos años.**

Palabras clave: **Cardiopatía congénita; Cirugía Cardiaca; ECMO.**

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Ventricular assistance with ECMO is a tool utilized in patients with congenital heart disease with refractory cardiogenic shock after cardiac surgery, with no residual defects [1]. ECMO a system of mechanical circulatory assistance offers temporary haemodynamic support in patients with postcardiotomy shock. It is used as a bridge for recovery or transplantation [2]. The main indications are severe but potentially reversible cardiovascular failure with central venous oxygen saturation lower than 60%, failure to wean cardiopulmonary bypass after surgery and rapid deterioration or severe ventricular dysfunction [3-6]. We sought to share the experience of the Instituto Nacional de Cardiología "Ignacio Chávez " by utilizing ECMO as ventricular assistance in pediatric patients cardiogenic shock after cardiac surgery.

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TABLE 1. PREOPERATIVE/INTRAOPERATIVE CHARACTERISTICS

AGE	WEIGHT (kg)	PREVIOUS DIAGNOSIS	OPERATION	ECMO INDICATION	ECMO LENGHT OF STAY	DETAH (Yes/No)
6 yr	25	Kawasaki disease	CABG	Cardiogenic shock	7 hr 54 min	No
6 days	2.9	TGA	Arterial Switch	Cardiogenic shock	12 hr 54 min	Yes
4 months	5.4	Arterial trunk type IIB + aortic arch interruption	Rastelli + aortic arch advancement	Cardiogenic shock	1 hr 36 min	Yes
17 days	3.1	Infracardiac anomalous drainage of pulmonary veins	Correction	Cardiogenic shock	3 hr	Yes
25 days	3.2	TGA + arterial trunk type I + hypoplastic aortic arch	Damus-Kaye-Stansel	Cardiogenic shock	18 hr	Yes
46 days	4.2	Aortic arch interruption + VSD + PAH	Correction	Cardiogenic shock	1 h 4 min	Yes
4 days	3	TGA	Jatene	Cardiogenic shock	3 h 5 min	Yes
1 month	3.4	TGA	Jatene	Cardiogenic shock	3 days	No
1 yr	6.3	Pulmonary sling + VSD + ASD + anomalous pulmonary artery origin	Reimplantation of left branch of pulmonary artery to pulmonar artery trunk + VSD and ASD closure	Acute respiratory distress syndrome	4 hr	Yes
7 months	8.6	Tetralogy of Fallot	Correction	Cardiogenic shock	13 days	No
1 day	2.6	TGA	Jatene	Cardiogenic shock	7 days	Yes
18 months	8.6	Arterial trunk type I	Rastelli + aortic valve replacement	Cardiogenic shock	4 days	No
9 yr	22	Mitral stenosis	Mitral valve replacement	Lef-sided HF + severe PAH	6 days	No
15 yr	24	Type A AV canal	Correction + left atrioventricular valve replacement	Cardiogenic shock	5 days	No
4 years 11 month	10	Pulmonar atresia + VSD	Rastelli + VSD closure	Cardiogenic shock	7 days	No
2 yr	10	Tetralogy of Fallot	Correction	Cardiogenic shock	4 days	No
14 yr	24	Double mitral valve orifice + dilated cardiomyopathy	Mitral valve replacement	Cardiogenic shock	4 days	Yes

AV: atrio-ventricular, ASD: Atrial septal defect, HF: Heart faiulre, VSD: Ventricular septal defect, PAH: Pulmonary arterial hypertension,

MATERIAL

Files of patients undergoing cardiac surgery from May 2014 to May 2018 were reviewed. Exclusively patients under 18 years old requiring veno-arterial ECMO were included. This study here was was non-experimental, transversal and descriptive.

RESULTS

Preoperative/intraoperative data are shown in **Table 1**. From January 2014 to May 2018, 17 ECMO veno-arterial systems were installed, 12 with central cannulation and 5 with peripheral cannulation. The age range goes from 1 day of life to 15 years, and body weight from 2.9 kg to 26.7 kg. The length of the period with ventricular support was 6 days (range, 2 to 13 days), length of stay in ICU was 8.8 days (range, 1 to 30 days). Nine patients died (53%), 6 died in the first 2 years (85%) and 3 died in the next 2 years (30%) (**Fig. 1**).

Causes of death were one case by hemorrhagic shock as a complication during the change of an arterial cannula; 1 due to multiorganic failure and non-recoverable ventricular dysfunction for myocardial ischemia after Jatene procedure) and 7 cases due to persistent cardiogenic shock.

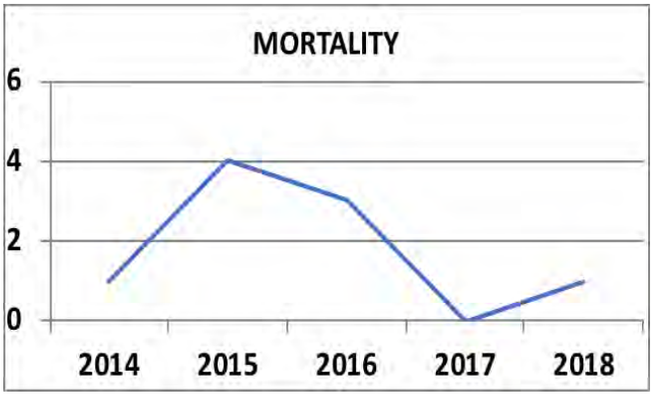

Figure 1. Mortality over the years

DISCUSSION

The complexity of surgical procedures for congenital heart disease has progressively increased. Thus, in some centers such as ours providing high-level care, ECMO is becoming more and more frequent. Indeed, veno-arterial ECMO use is highly increasing worldwide [7]. The two ECMO types are veno-arterial ECMO, and veno-veno ECMO The latter is used mainly in patients with respiratory failure [7]. In our case, ECMO was veno-arterial in all cases since all the patients had hemodynamic deterioration post-cardiotomy, but no respiratory failure [8]. Of note, although the range of weight is fairly broad, a large number of our patients (7 out of 17) had a weight of less than 5 kg, most of them under one year of age. All this above is associated with a full complexity of the surgical process undertaking, including perfusion strategy. All this can turn out in a more labile management.

Actually, our number of cases is still small. Nonetheless, it is important to raise public awareness of them, especially taking in mind that related mortality has significantly decreased in the last two years. Despite limitations we face on in our developing country, the experience has fairly improved.

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