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ORIGINAL ARTICLE

Outcome of early and late onset Fontan operation in patients with univentricular heart repair

Salem Deraz [a,b,*], Mohamed F. Ismail [c,d], Ahmed Jamjoom [d]

[a] Department of Pediatrics, Faculty of Medicine, Menoufia University, Shebin El Koum, Egypt
[b] Pediatric Cardiology Section, Department of Cardiovascular Diseases, King Faisal Specialist Hospital and Research Center, Jeddah, Saudi Arabia
[c] Department of Cardiothoracic Surgery, Faculty of Medicine, Mansura University, Mansura, Egypt
[d] Cardiothoracic Surgery Section, Department of Cardiovascular Diseases, King Faisal Specialist Hospital and Research Center, Jeddah, Saudi Arabia

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KEYWORDS

Univentricular heart;
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Abstract *Objective:* To evaluate our experience in the Fontan procedure comparing those below and above 6 years of age.
Methods: A review of our clinical database was conducted to identify the patients who received extracardiac Fontan between 2002 and 2010. All demographic, echocardiographic, surgical, haemodynamic and follow-up data were collected. The overall mortality was defined as death occurring from the time of surgery to the most recent follow-up. Early postoperative death was defined as death occurring during admission or within 30 days from the operation. Seventy-six patients with functionally univentricular hearts were included in the study. Patients were divided into two groups. Group A included patients who had received extracardiac Fontan at the age of 6 years or less, whereas group B included patients who had received extracardiac Fontan at an age of more than 6 years.
Results: The overall hospital mortality was 7.9% (10.2% in group A and 5.9% in group B). No statistically significant difference was seen between the two groups regarding the postoperative

Abbreviations: A SEPT, atrial septectomy; AV, atrioventricular; AVSD, atrioventricular septal defect; BT, Blalock taussing; BCPA, bilateral cavopulmonary anastomosis; BDG, bidirectional glenn; COP, cardiac output; DKS, Damus-Kaye-Stantel; DILV, double inlet left ventricle; DORV, double outlet left ventricle; ECMO, extra corporeal membrane oxygenation; INR, international normalized ratio; IVC, inferior vena cava; IVS, intact ventricular septum; LPA, left pulmonary artery; PA, pulmonary artery; PAB, pulmonary artery band; PLE, protein-losing enteropathy; PS, pulmonary stenosis; SVC, superior vena cava; TAPVD, total anomalous venous drainage; TCPC, total cavopulmonary connection

* Corresponding author at: Department of Pediatrics, Faculty of Medicine, Menoufia University, Shebin El Koum, Egypt. Tel.: +966 546060095.
E-mail address: drsderaz@hotmail.com (S. Deraz).

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mortality including thrombosis, stroke, chylothorax, bleeding, pericardial effusion, wound infection, serious postoperative arrhythmias and protein losing enteropathy. On the other hand the mechanical ventilation duration, duration of hospital and ICU stay, duration of the chest tubes and the postoperative saturation was not significant between the two groups.

Conclusions: The age of the patient at the time of Fontan surgery does not affect the results, in terms of both morbidity and mortality.

1. Introduction

Since the first report of a successful Fontan operation in 1971, this maneuver has been performed with various modifications in patients with single-ventricle physiology [1,2]. Among these modifications, total cavopulmonary connection (TCPC), introduced by de Leval and colleagues [3] has become a standard method for the Fontan procedure because it provides better venous hemodynamics [4] and is less arrhythmogenic [5] than the other Fontan modifications.

The management strategy for patients with a functional single ventricle has evolved into a sequence of staged procedures with a final goal of achieving normal volume and pressure work for the single ventricle and normal or near normal oxygen saturation of the systemic blood [6].

Although Fontan completion provides near-normal systemic oxygen saturation and reduces ventricular volume overload in patients with single-ventricular physiology, some preoperative factors affect the early and long-term outcomes of this procedure and age at the time of Fontan is among these factors [7]. Since the strategy now tends to introduce the Fontan procedure to younger patients, the influence of patients' age at the time of surgery on long-term results remains unclear [8]. The TCPC procedure carries a greater risk for the adult patient than for children because the adult functional ventricle usually presents with complications caused by long-term chronic hypoxia, ventricular volume overload, and increased venous pressure, such as arrhythmia, protein-losing enteropathy (PLE), pleural effusion, ventricular dysfunction, and limited exercise capacity [9]. In this study we evaluated our experience in the Fontan procedure comparing those below and above 6 years of age.

2. Patients and methods

A review of our clinical database was conducted to identify the patients who received extracardiac Fontan between 2002 and 2010. All demographic, echocardiographic, surgical, haemodynamic and follow-up data were collected. The overall mortality was defined as death occurring from the time of surgery to the most recent follow-up. Early postoperative death was defined as death occurring during admission or within 30 days from the operation. The Institutional Review Board approved the present retrospective study. Informed consent for retention and use of patient data for scientific purposes was routinely obtained at the same time as consent for the procedure.

Seventy-six patients with functionally univentricular hearts were included in the study. Demographic, anatomic and haemodynamic characteristics are shown in Tables 1 and 2.

Median age at extracardiac Fontan was 5.9 years (range 2–34 years). We used the median value of 6 years to divide the study population into two groups. Group A includes patients who had extracardiac Fontan at the age of 6 or less, whereas group B includes patients who had extracardiac Fontan at an age more than 6 years. After Fontan completion all patients were kept on warfarin therapy (plus aspirin) aiming to keep the international normalized ratio (INR) between 1.8 and 2.5.

2.1. Surgical techniques

Through a median sternotomy the heart, ascending aorta, pulmonary arteries, superior vena cava, and IVC were dissected out. After aorta and bicaval cannulation (with the IVC cannulated as close to the diaphragm as possible), cardiopulmonary bypass was instituted, the snare around the cannula in the IVC was tightened, and the SVC was clamped just proximal to its anastomosis with the right pulmonary artery. If there was no planned concomitant intracardiac procedure, the procedure was basically performed with the heart beating. If we had to make an atrial septectomy, we transected the inferior vena cava and carried out atrial septectomy under cross clamp. The heart was arrested with cold blood cardioplegic solution administered in the antegrade fashion, followed by the opening of the atrium and unroofing of the coronary sinus and atrial septectomy if indicated. The main PA stump was divided, and the cardiac stump was sutured closed if necessary. The IVC was divided from the atrium, the atrial stump was closed with a 4–0 Prolene suture (Ethicon, Inc, Somerville, NJ), and the IVC cuff was prepared for anastomosis with the conduit. Bovine jugular vein xenograft (Medtronic's Contegra, Medtronic, Inc, Minneapolis, Minn) was used for 47 patients; and Dacron tube vascular graft was used in 29 patients. The use of the contegra or Dacron tube was chosen by the cardiac surgeon and in most of the cases it was decided according to the availability in the hospital stock. The mean diameter of the conduits used was 17.74 ± 1.86 mm (range 12.0–22.0 mm) for the entire cohort. The fenestrations were made in 15 patients (19.7%). The mean bypass time was 140.61 ± 41.88 min. Cardioplegic arrest was used in 56 patients, with a mean duration of 87.3 ± 29.1 min. Preoperative diagnosis and procedures before Fontan are illustrated in Tables 2 and 3.

Statistical analysis was performed with SPSS statistical program (SPSS 19 Inc., Chicago, IL, USA). The Shapiro–Wilk normality test was used to assess normal distribution. Continuous variables with normal distribution were reported as the mean ± the standard error. Continuous data without normal distribution were reported as the median with ranges. Categorical data were presented as number and/or frequency.

3. Results

The overall hospital mortality was 6 (7.9%). Only one patient was in group B and the remaining 5 patients in group A. The