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Bidirectional Glenn procedure with and without cardiopulmonary bypass: Short term results

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ABSTRACT

Background: Bidirectional superior cavopulmonary anastomosis (BDG) is a palliative surgical procedure for anatomical or physiological univentricular hearts, in which the superior vena cava is anastomosed to the ipsilateral pulmonary artery in an end-to-side manner with or without cardiopulmonary bypass (CPB) support. The objective of this study was to compare the short term results of the BDG procedure performed on CPB or without CPB.

Methods: Between February 2015 and September 2016, 57 consecutive patients (mean age 33.27 ± 18.4 months) undergoing BDG were randomly assigned to either group I: using CPB (n = 27 patients; mean age 30.56 ± 16.47 months) or group II: without using CPB (n = 30 patients; mean age 23.96 ± 14.67 months). In group II two techniques were used **(A)** A temporary veno-atrial shunt were used (n = 15 cases mean age 23.3 ± 14.58 months), **(B)** without using veno-atrial shunt (n = 15 cases mean age 24.6 ± 15.24 months). We monitored the superior vena caval (SVC) pressure, O2 saturation, Operative time, mechanical ventilation period, intensive care unit (ICU) stay, hospital stay, operative mortality and postoperative complications.

Results: There was significant decrease in the operative time in group II (81.63 ± 14.83 min) in comparison to group I (122.33 ± 16.21 min). The differences in the period of mechanical ventilation, ICU stay & hospital stay were insignificant. In addition, the differences between both groups as regard postoperative complications and mortality were insignificant.

Conclusions: The BDG procedure can be performed with no significant differences in operative mortality, morbidity, or use of resources, with or without CPB support.

1. Introduction

Bidirectional superior cavopulmonary anastomosis (BDG) is a palliative surgical procedure for patients with cyanotic congenital heart disease and univentricular physiology, in which the superior vena cava (SVC) is anastomosed to the ipsilateral pulmonary artery (PA) in an end-to-side manner with or without cardiopulmonary bypass (CPB) support [1–3].

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CPB extends the procedures that can be done at a time when preparing patients for Fontan procedure as pulmonary artery reconstruction, take down of an arterial shunt, resection of subaortic stenosis, Damus – Kaye procedure and repair of total anomalous venous connection to be coupled at the same setting of BDG. Moreover, CPB allowed performing the procedure for patients as young as 5 weeks with much safety [4,5].

The non-pulsatile blood flow provided by CPB has several disadvantages for the patient. There are risks of hemolysis, air embolization, and bleeding complications associated with the higher doses of heparin required for CPB. Furthermore, CPB is known to be associated with a systemic inflammatory response which increases lung water, decreases right ventricular compliance and increases the duration of ventilator support and the time required for convalescence. Also because of the systemic inflammatory response, the pulmonary vascular resistance is transiently increased and this may transiently reduce the flow through the BDG in the early post-operative phase [6–8].

The performance of a BDG procedure without CPB may be associated with significant SVC pressure elevations that may predispose patients to neurologic injury. However, the safety of performing BDG without CPB has been reported by many authors and most of these reports have recommended some decompression techniques of the SVC at the time of clamping [9–12].

The purpose of the present study was to compare short term outcome for patients undergoing a BDG procedure with and without the use of CPB.

2. - Patients and methods

This prospective randomized study was conducted between February 2015 and September 2016 at the Cardiothoracic Surgery Department, Zagazig University hospitals and Atfal Misr Hospital (Abo Alreech Talaba Hospital). After obtaining the institute's ethics committee approval and informed written consent from the parents, 57 consecutive children prepared to undergo BDG were randomly assigned to one of two groups: (i) group I: (27cases) where BDG shunt done using CPB, and (ii) group II (30 cases) where BDG shunt done without CPB either with using a temporary veno-atrial shunt (A) or without using veno-atrial shunt (B).

Our inclusion criteria were functional single ventricles with arterial oxygen saturation <80%, McGoon ratio >1.5 and mean pulmonary artery pressure <20 mmHg. All these patients had adequate atrial septal defects and none of these patients required any intra cardiac repair. Patients with complex congenital cardiac anomalies amenable to biventricular or one and half ventricular repair, patients <6 months of age and patients with pulmonary venous obstruction or systemic outflow obstruction were excluded from this study.

All patients underwent complete preoperative evaluation by full clinical examination especially cardiac and neurological examination and routine laboratory investigations. Preoperative evaluation included detailed 2D and Doppler echocardiogram and cardiac catheterization in selected cases to confirm the diagnosis and to evaluate PA pressures. Neurocognitive status of every patient was assessed before and after BDG (immediate, 1 month, and 3 months after surgery) by using Modified Glasgow coma score for infants and children.

2.1. Operative technique

Surgery was performed through a standard median sternotomy. After opening the pericardium, the SVC was dissected and isolated from the right atrial end to the innominate vein junction. The azygous vein was ligated. Marking sutures were placed on the medial and lateral aspects of the SVC to correspond to the right pulmonary artery (RPA) arteriotomy to ensure proper orientation during the BDG and prevent distortion of the anastomosis. The RPA was dissected from the bifurcation to the hilar region. The SVC was divided from the right atrium and The atrial end was closed by continuous sutures of 6/0 or 5/0 prolene, a wide incision was done in the dissected right pulmonary artery and the anastomosis end to side between the divided SVC and incised right pulmonary artery was performed using 7/0 or 6/0 prolene sutures.

2.1.1. Group (I) using CPB

This procedure was done using CPB, on beating heart with normothermia, body temperature between 36 and 37 °C, systemic heparinization 300–500 IU/kg, routine cannulation of distal ascending aorta, high selective SVC cannulation using metal tip right-angled venous cannula with snaring around it and right atrial appendage cannulation using straight venous cannula, the size of the cannulas used was according to body surface area.

2.1.2. Group II without using CPB

Two techniques were used in this group; (A) A temporary veno-atrial shunt was used and (B) without using veno-atrial shunt.

2.1.2.1. In technique (A). Systemic heparinization 300 IU/kg was done then a veno – venous (veno – atrial) shunt was established between the distal SVC using metal tip right-angled venous cannula with snaring around it and to the right atrium using straight venous cannula, the two cannulas were connected after de–airing the circuit. After establishing the shunt, the

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