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EARLY AND MIDTERM OUTCOME OF OUR SINGLE CENTER WITH BIDIRECTIONAL GLENN FOR UNIVENTRICULAR PHYSIOLOGY

Paediatric Surgery

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KEYWORDS

INTRODUCTION:

Bidirectional Glenn procedure is a staged palliative procedure used for the interim palliation of a variety of patients with univentricular hearts or complex cyanotic congenital cardiac lesions in the hope of achieving Fontan completion. It consists of anastomosis of superior vena to the right pulmonary artery in an end to side manner. [1] Diversion of superior vena cava flow to pulmonary arteries improves oxygen saturation and decreases volume load of systemic ventricle. [2] In the classical Glenn flow was to ipsilateral lung alone as the anastomosis was between side of the ligated SVC and end of transected PA with flow to the contralateral lung contributed by the MPA. In BDG the flow is to both lungs as the anastomosis is between end of transected SVC to ipsilateral pulmonary artery. Today BDG is part of a staging procedure as part of total cavopulmonary shunt where mixing of systemic and venous blood is eliminated after exclusion of insufficient right ventricle.

The Glenn, or cavopulmonary shunt, is a palliative surgery where an end-to-side anastomosis is created between the superior caval vein and the pulmonary arteries [3,4]. This procedure is mostly used to unload the systemic ventricle and simultaneously improve oxygenation of the systemic blood flow in congenital heart disease (CHD) patients with a functional or anatomical single ventricle. Most often, but not necessarily, the Glenn is an intermediary step towards completion of a total cavopulmonary connection (TCPC) or Fontan circulation [5,6].

The principal indication for a bidirectional superior cavopulmonary shunt today is for unloading right ventricle and as staging towards a total exclusion of a deficient/insufficient right ventricle. [7,8]

In this study we review our experiences with BDG shunt done in our hospital and evaluate the early and midterm outcomes in patients undergoing BDG procedure.

MATERIALS AND METHODS:

It is a retrospective observational single centre study done at ABVIMS and Dr RML Hospital New Delhi. A total of 31 patients who underwent BDG procedure between September 2018 to September 2022 were included in the study. Patient's preoperative and post operative data were retrieved from Departmental records and reviewed. Diagnosis was made from echocardiographic, cardiac catheterisation and cardiac CT, age, sex, etiology, previous palliation, procedure done and complications were the main study variables. Patients were followed up at 1 month, 6 months and then yearly thereafter. Echocardiographic findings, saturation levels and improvement of cyanosis were noted. All patients were given aspirin tablet for 6 weeks postoperatively.

Surgical Technique:

All Glenn shunts were performed by median sternotomy and on CPB.Cardioplegic arrest was done with Saint Thomas cardioplegia when atrial septectomy or AV valve repair was planned. Cannulation of ascending aorta and SVC was done at the brachiocephalic jugular junction with Bicaval cannulation when atrial septectomy was performed. Bidirectional B/L Glenn was done when 2 SVCs were present. Ascending aorta and IVC cannulated when procedure was carried out with beating heart. PDA was ligated when present. If a systemic–pulmonary arterial shunt is present, it is ligated either with heavy suture material or metal clips and always divided. The azygos vein is ligated to avoid late decompression of superior cavopulmonary shunt flow into the lower body. Glenn pressure was measured and antegrade flow was ligated if PA pressure was high. Otherwise antegrade flow was left open.

RESULTS:

Median age of the patients who underwent Glenn surgery was 2 years with a minimum and maximum age of 8 months and 15.4 years respectively. Male were predominant in the ratio (2:1). (Table 1)

Table 1: Showing distribution of patients by sex.

Sex	Number	Percentage
Male	21	67.7
Female	10	32.3

Most common etiology was Tricuspid Atresia in 51.6% of cases followed by DORV (35.4%), D-TGA (6.4%), DOLV (3.3%) and Single ventricle morphology with inlet VSD (3.3%). (Table 2)

Table 2: showing etiological distribution

Etiology	Frequency	Percentage
Tricuspid Atresia with VSD PS	16	51.6
Double Outlet Right Ventricle (DORV) with VSD PS	11	35.4
Double Outlet Left Ventricle (DOLV) with VSD PS	1	3.3
D-TGA (Transposition of Great Arteries) with VSD PS	2	6.6
Single Ventricle Morphology with Inlet VSD and PS	1	3.3

Previous Palliation was observed in only 16.2% of cases and most common palliation was MAPCA coiling in 2(6.3%), central shunt with MAPCA coiling in 1(3.3%), PA banding in 1(3.3%), LMBT shunt in 1(3.3%)

Table 3: Showing history of previous palliation

Previous Palliation	Frequency	Percentage
MAPCA Coiling	2	6.3

Central Shunt with MAPCA Coiling	1	3.3
PA Banding	1	3.3
LMBT Shunt	1	3.3

Type of procedure:
In our series 16 of the patients underwent BDG with atrial septectomy. In 15 cases atrial septectomy was not done.11 of the cases underwent the procedure with antegrade flow and 20 without antegrade flow.1 patient with LMBT shunt underwent shunt ligation.2 patients with LSVC underwent B/L Glenn

Table 4: Showing distribution of type of procedure

Procedure	Frequency	Percentage
BDG with Atrial Septectomy	15	48.38
BDG without Atrial Septectomy	16	51.61
BDG with Antegrade Flow	11	35.48
BDG without Antrgrade Flow	20	64.51
BDG with LMBT Ligation	1	3.3
Bilateral Glenn	2	6.4
Fontan completion	2	

Complications was seen in 12.9% of cases. Complications like pleural effusion, arrythmias and renal dysfunction were observed. There was 1 mortality in our study. One patient of tricuspid atresia with VSD who underwent BDG with antegrade flow surgery expired on 5 th day due sepsis and AKI.

Table 5: Showing distribution of complications

Complications	Frequency	Percentage
Pleural effusion	1	3.3
Arrythmias (intermittent AF, supraventricular tachycardia)	1	3.3
Renal Dysfunction	1	3.3

Follow up:
25 patients were followed up after 1 month, 6 months and then yearly thereafter. 6 patients were lost to follow up. Follow up echocardiography showed patent shunt with patients having good effort tolerance, improved NYHA grade, good quality of life and improvement of cyanosis. Two patients underwent Fontan completion.

DISCUSSION:

Anastomosis between superior vena cava and right superior pulmonary artery to palliate certain congenital heart diseases with decreased pulmonary blood flow as a way of bypassing the right ventricle has been described as early as 1950s.Palliiation for the treatment of congenital heart disease is intended to relieve signs, symptoms, or pathological situations that increase the probability of death or the development of other irreversible or challenging alterations(pulmonary hypertension, cyanosis or heart failure). [9,10] The most striking change after operation was increase in effort tolerance.

Our study had a male preponderance with male to female ratio of 2:1. Other studies by Luo et al (69.4%), Lapar et al (67%), Talwar et al (72%) also had male preponderance. Western studies report median age of the BDG procedure at less than 1 year as found by Kogon et al (164 days),Alsoufi et al (7.6 months), Lapar et al (195.8 days). Studies by Liu et al (mean age: 2.7 years), Deebis et al (33.27 months), Hussain et al (3.11 years) have a higher mean age of surgical intervention. In our study the median age of the patients who underwent Glenn surgery was 2 years with a minimum and maximum age of 8 months and 15.4 years respectively. Lack of timely referral and financial constraints could be the reason of delayed presentation. [11,12,13]

In our study tricuspid atresia was the most common diagnosis (51.6%) followed by DORV (35.4%), D-TGA (6.4%)DOLV (3.3%), and single ventricle morphology with inlet VSD(3.3%). This was similar with the studies by Talwar et al (40%) and Reddy et al (30.95) who also reported tricuspid atresia as the most common etiology. [8,14]

Previous palliation was observed in 16.2% of the cases in our study; MAPCA coiling (6,3%), central shunt with MAPCA coiling (3.3%), PA banding (3.3%) LMBT shunt (3.3%). Previous palliation was higher in other studies by Reddy et al (62%), Hussain et al (32.4%), and Alsoufi et al(81%). It could be attributed due to lack of timely referral or reluctancy of the attendants to subject the patient to staged palliative pathway due to affordability or accessibility reasons. [15,16]

In our study it was observed that 12.9% cases had complications; pleural effusion (3.3%), arrhythmias (3.3%), renal dysfunction (3.3%), surgical site infection (3.3%). There was 1 mortality (3.3%) which was attributed to sepsis and AKI.

Majority of our patients were mildly cyanotic and disease free and thus were reluctant to undergo second stage completion Fontan procedure. Limitation of finances and poor socioeconomic status also adds to reluctance in second stage surgery in our patients. Only 2 patients underwent completion Fontan in our study with good outcome. Further study of larger scale and multi center data analysis shall throw light on efficacy of completion Fontan undergoing Glenn palliation.

CONCLUSION:

Glenn surgery used as a palliative interim procedure in univentricular congenital heart disease offering excellent results. It significantly improves cyanosis, signs of low cardiac output, and decreases the presence of heart failure for a long time before the presence of total cavopulmonary bypass with few complications and mortality.

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