Senning Palliation Surgery for D-Transposition of Great Arteries: Is there a Role for it?

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Editorial

Now a day’s Arterial Switch Operation (ASO) remains the procedure of choice for the treatment of various forms of Dextro-transposition of Great Arteries (d-TGA) with acceptable early and later outcome in terms of overall survival and free from reoperation. Earlier ASO within 1 to 21 days [median 5th day of life] has an excellent short-term result with exceptionally low mortality i.e., less than 2% [1,2]. In contrast, the atrial switch procedure; the Senning or mustard procedure for TGA was common during 1950 and was preferred until the 1990s. Here the surgeon creates an intra-atrial baffle to redirect the oxygen-rich Pulmonary Venous (PV) blood to the Right Ventricle (RV) and aorta and the oxygen-poor Systemic Venous (SV) blood to the Left Ventricle (LV) and the pulmonary artery. The atrial switch is still employed occasionally in cases with delayed diagnosis, Pulmonary Artery Hypertension (PAH), anomalous un-switchable coronary arteries and in patients with involuted or unprepared LV [3]. We performed the Senning procedure on a 2 year old male child, weighing 12 kg, diagnosed as TGA and unprepared LV under similar standard anesthesia and monitoring technique sand standard CPB technique used for any other child to undergo high- risk cardiac surgery. In addition, intra-operative Transoesophageal Echocardiography (TEE) was also performed, which also confirmed the diagnosis of D-TGA by delineating ventriculo-arterial discordance. Ostium Secundum Atrial Septal Defect (OS-ASD) with left to right shunt was the mixing site for the two parallel circulations. The RV was a markedly dilated resulting in the Interventricular Septal (IVS) shifting towards the LV. In contrast, LV was small, D- shape (banana shape configuration), thin walled [Posterior wall thickness 0.25 cm], and its mass was 13.5 gm [Assuming a formula; 0.8 × 1.04 ([IVSd + LVIDd + PWTd]3− LVIDd3) + 0.6 g], [IVSD- interventricular septal diameter in diastole, LVIDd: Left Ventricular Internal Diameter in diastole, PWTd: Posterior Wall Thickness in Diastole] and ejection fraction of 60%. Most of the parameters were suggestive of unprepared, involuted LV unsuitable for standard ASO. TEE was also utilized for post Senning palliation assessment for de-airing of cardiac chambers, PV and SV baffle flows and obstruction and leaks, biventricular functions, and to guide the fluid and drugs therapy (Figures 1-4) (Videos 1-4).

TGA means that both the great arteries originate from the morphologically inappropriate supporting ventricles; the aorta from the RV and the PA from the LV. It is the most common...
cyanotic cardiac lesion in newborns, accounting for 5% to 10% of all Congenital Heart Disease (CHD), and with a prevalence of about 20 to 30 per 100,000 live births.

The presentation of patients with D-TGA is highly variable depending upon its variants like, TGA with VSD, a combination of Ventricular Septal Defect (VSD) and LV Outflow Tract Obstruction (LVOTO), with intact IVS and LVOTO, or with Pulmonary Vascular Obstructive Diseases (PVOD) or with coarctation of the aorta, and Taussig-Bing Anomaly (DORV plus TGA). Accordingly, Neonates with profound hypoxaemia (partial pressure of arterial oxygen <25 mmHg and/or SaO2<60%) require urgent attention and need to be stabilized in a neonatal intensive care unit prior to subsequent definitive surgical repair. The initial management of newborn with TGA should focus on stabilization, optimization of mixing of
systemic and pulmonary circulations (management of hypoxia) and oxygen delivery, maintenance of adequate systemic perfusion and correction of acidosis. It may require various interventions such as; prostaglandin E1 (0.0125 to 0.05 mg/kg/min) to keep the ductus open, balloon atrial septostomy for adequate intercirculatory mixing, and inhaled nitric oxide (5 ppm to 50 ppm), sildenafil (0.4 mg/kg over 3 h followed by infusion of 0.07 mg/kg/hr), bosentan (2 mg/kg by nasogastric tube) for persistent pulmonary hypertension of neonate, and Extracorporeal Life Support (ECLS), alone or in combination in progressive hemodynamic and respiratory deterioration and or as a bridging therapy for definitive corrective surgery for D-TGA [4].

The patients with D-TGA with inadequate intercirculatory blood mixing, the morphologic LV supporting the low pressure pulmonary circulation is deprived of normal changes, [increase in LV mass, wall thickness and compliance] and involves in mass and volume as the child grows. The unprepared LV is unable to support the high-pressure systemic circulation after ASO. Therefore, it is recommended to perform ASO within few days to 3 weeks of life or immediately following its diagnosis [4]. In older children with D-TGA and involuted LV; the LV needs a retraining with PA banding and a systemic to pulmonary shunt to improve the outcome of ASO performed at a later stage. However, the patients who are un-switchable or with unprepared LV are subjected to undergo atrial switch palliation procedure. The atrial baffle procedures (Mustard and Senning operations) reroute the SV blood to the LV and the PV blood to the RV, thus allowing for physiologic correction. Following are the indications for the Senning palliation surgery such as, unprepared or involuted LV, Complex coronary transfer or coronary origin from the non-facing sinus, late referral, as an alternative to a two stage ASO especially in older infants and children, PPH of the new-born. Echocardiography (two-dimensional and color Doppler) usually provides all the anatomical and functional information needed for diagnosis and management of these babies, including preparedness of the LV for ASO. TEE is an invaluable perioperative tool for monitoring ventricular performance and evaluating surgical results. The benefits of intraoperative TEE include confirmation of the structural abnormalities, exclusion of suspected pathology, monitoring (ventricular preload, adequacy of cardiac de-airing, ventricular function-global and regional), assessment of SV and PV baffle patency and leaks, guidance for fluid and drug therapy and on the necessity of returning to bypass. Although the Senning procedure has excellent early (85% to 90%), and long-term outcome 80% survival at 25 to 30 years, but later on associated with the development of baffle stenosis obstructing the pulmonary veins or vena cave resulting in PAH, superior vena cava, inferior vena cava syndromes and low cardiac output. In addition, baffle leaks, atrial arrhythmias (atrial conduction defects, sick-sinus syndrome with Brady and tachyarrhythmia, atrial flutter), protein losing enteropathy and sudden death are other postoperative complications. In long term, these patients can also develop tricuspid regurgitation and RV dilatation and ultimately RV failure. Therefore, now a day's Senning and Mustard procedures are only performed in those patients that have un-switchable anatomy due to complex coronary abnormalities, late diagnosis, coexistent VSD with associated pulmonary hypertension, inadequate left ventricular function [1,4].

Conclusion

The Senning procedure can still be employed occasionally in cases of D-TGA with delayed diagnosis, PAH, anomalous un-switchable coronary arteries and in patients with involuted or unprepared LV. Intraoperative, TEE during Senning procedure can be utilized to confirm the TGA diagnosis, assessment for preparedness of LV, ventricular functions, and also adequacy of PV and SV baffles and to guide the fluid and drug therapy.

References