

Six years' experience with Senning operation in a university hospital

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Abstract :

Background: Transposition of the great arteries (TGA) is the a common cyanotic congenital heart defect, accounting for 5% of all congenital heart diseases. ¹ Ideally the patients should undergo arterial switch operation for TGA which is done at the age of less than 3 weeks. ² in developing countries like ours, late presentation and diagnosis of TGA patients make arterial switch operation impossible. At delayed age, Senning operation is performed which is physiological repair of TGA

Patients and Methods: Design: retrospective . setting: Children's Hospital/ university of Child Health Sciences Lahore. Duration : 6 years (from January 2018 to December 2023). Record of all the patients who underwent Senning operation was reviewed.

Results: 77 patients had Senning operation for transposition of Great Arteries in last 6 years. 73 (95%) were successfully discharged home. Mean age was 4.2years and mean weight was 10.5kg. 4 patients died of low cardiac output.

Conclusion: In developing countries where diagnosis of TGA is delayed due to different reasons, the Senning operation can make remarkable difference in the life of these patients . In the expert hands, it is safe and reproducible operation with good outcome.

Introduction:

Transposition of the great arteries (TGA) is a common cyanotic congenital heart defect, accounting for 5% of all congenital heart diseases. TGA has a prevalence of 20–30 per 100,000 live births. In D-TGA, the aorta arises from the right ventricle with the pulmonary artery arising from the left ventricle. That results in parallel circulation. ¹ Ideally the patients should undergo arterial switch operation for d TGA which is done at the age of less than 3 weeks. ² In developing countries like Pakistan , late presentation of TGA patients make arterial switch operation impossible. At delayed age, Senning operation is performed which is physiological correction of TGA. ³

In 1958, Atrial switch operation, a radical surgical treatment for TGA, was introduced by Ake Senning. Since the start of Senning operation, the outcome of TGA patients improved significantly . The Senning operation baffles deoxygenated blood coming from superior and inferior vena cavae toward mitral valve



and subsequently into left ventricle. The pulmonary venous blood coming from pulmonary veins is baffled towards right ventricle thus making right ventricle a systemic ventricle.⁴ 90 percent of TGA patients die within one year of life if left untreated.⁵ with the help of Senning operation, most of these patients can reach adulthood.⁶ In this article we will discuss our six years' experience with Senning operation and its short-term results.

Patients and Methods

It's a retrospective review of the patients who underwent Senning operation from January 2018 to December 2023 at children's hospital / university of child health sciences Lahore. Files of all the patients were reviewed. Age , sex, weight , pre operative diagnosis, concomitant procedures, cross clamp time, bypass time, ICU stay were noted for each patient.

Operative procedure: After taking written informed consent from the parents, surgery was started with sternotomy. Thymus was removed in every patient. Aortic and bicaval cannulation with metal tipped canulae was made. DelNido cardioplegia was used in each operation. Right and left atria were then opened. After resecting the remanent of inter atrial septum, Coronary sinus was opened. We describe the senning operation in 3 layers 1st layer to isolate the pulmonary veins from mitral valve was made by inverting the left atrial appendage and sewing it to right margin of atrial septal defect thus making the floor of systemic venous baffle. 2nd layer was created with a autologous pericardial patch to baffle superior and inferior vena caval blood towards mitral valve and left ventricle. This completed systemic venous baffle. 3rd and last layer was completed by using the autologous pericardium to baffle the pulmonary venous blood toward tricuspid valve and thus into right ventricle and subsequently into systemic circulation, around the systemic venous baffle, as described by shumaker.⁷

Data were analyzed by the Statistical Package for the Social Sciences. Results were shown in mean with range.

Results:

From January 2018 to December 2023, 77 patients underwent Senning operation. There were 62 male and 15 female patients. Mean age was 4.2 years. Mean weight was 10.5kg. 6 patients had concomitant left ventricular outflow tract obstruction, which was dealt with during the operation. Out of 77, 65 had Rashkind operation (balloon atrial septostomy) in their neonatal age. Rest of them had natural large atrial septal defect. All the patients had diagnosis of d TGA with intact ventricular septum. Average cross clamp time was 71 minutes and cardiopulmonary bypass time was 93 minutes. All the patients underwent intra operative echocardiogram to rule out baffle obstruction, left ventricular outflow obstruction and other lesions.

Average ICU stay was 67 hours. Average stay on ventilator was 27 hours. Inotropic support was required for the mean of 40 hours. 4 patients died because of low cardiac output. Rest of the patients were discharged home on mean of 5th post operative day. See table 1,2 and 3





Table 1 demographic details

N	77	
Gender	Male 66	Female 15
Age	Mean 5.3yaers	Range 1 to 14 years
Weight	Mean 13.5kg	Range 7 to 30kg
Previous Rashkind balloon atrial septostomy	65 pateints	
Mode of admission	Out patient clinic	

Table 2 surgical details

Cross clamp time	77minutes (mean)	Range 35 to 135 minutes
Cardiopulmonary bypass time	103 minutes (mean)	Range 50 to 190 minutes
LVOT resection	3	
Accessory mitral tissue	1	
PDA ligation	2	

Table 3 short term Results

Survival	73 (95%)	
Icu stay	64 hours	24 to 90 hours
Duration of mechanical ventilation	26 hours	4 to 60 hours
Duration of inotropic support	32 hours	24 to 90 hours
Arrhythmia	22%	
RV dysfunction	9%	
Re operation for bleeding	2	

Discussion





The modern cardiac surgery centers are now doing arterial switch operation in most of the cases of TGA. Because of intra uterine echocardiogram, early diagnosis, early care of the patients, availability of atrial septostomy and prostaglandin, arterial switch has now become the gold standard operation⁸⁻⁹. In developing countries like Pakistan, the diagnosis of TGA is delayed because of almost non-existent antenatal diagnosis of TGA, small number of pediatric cardiac centers, birth in remote areas, home births, hesitation to go to pediatricians and financial problems. In cases of delayed diagnosis, when arterial switch operation is not possible, atrial switch is other viable option. Other option is two-stage prep switch. Senning performed the first physiological correction, (Senning operation) for TGA in 1957. In the Senning repair, a baffle is created within the atria that baffles the superior and inferior vena caval blood to the mitral valve and thus left ventricle and into pulmonary circulation for oxygenation and the oxygenated pulmonary venous blood to the tricuspid valve and thus right ventricle and into systemic circulation thus oxygenated blood in systemic circulation. This results in anatomic left ventricle acting as the pulmonary ventricle and the anatomic right ventricle acting as the systemic ventricle.¹⁰

Because of technical difficulties, most of the surgeons at that time were hesitant to opt this new technique. In the 1970s Broom was the one who modified it and made it simpler. Due to surgical modifications, there was more acceptance for Senning operation.¹¹⁻¹²

More and more infants were getting Senning operation in the 1980s. Long-term outcomes were available in the 1990s. The long-term results were not very encouraging. The problems of baffle blockage, arrhythmias, and right ventricle failure were disturbing. This led to a decline in interest in Senning operation.¹³⁻¹⁴

With technical modifications, using in situ pericardium to make wider pulmonary venous baffle,¹⁵ the problem of pulmonary venous baffle obstruction can be avoided. Results of recent studies are promising. Talwar et al.¹⁶ published their results of Senning operation. In that study, there was 100% survival and no one had venous baffle blockage. All the patients were asymptomatic and were enjoying healthy life. Results of our study are comparable to Helbing et al.¹⁷, Wells and Blackstone¹⁸ and Maluf¹⁹

With only 3 dedicated pediatric cardiac surgery centers in Pakistan and 45,000 new congenital heart disease patients every year, Senning will have its important role to play in TGA patients at least for the next 10 years.

Conclusion:

In developing countries where diagnosis of TGA is delayed due to multiple reasons, the Senning operation can make a significant difference in the life of these patients. In the expert hands, it is a safe and reproducible operation with a good outcome.

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