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Outcomes of Pulmonary Valve Replacement for Correction Pulmonary Insufficiency after Primary Repair of Tetralogy of Fallot (TOF)

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Abstract

Background

Total correction of Tetralogy of Fallot (TOF) anomaly in early childhood has been practiced in many centers with good results, but in some of patients after few years sever Pulmonary valve insufficiency occurred.

Materials and Methods

At a cross- sectional study from January 2015 to January 2016, 10 patients who had history of primary repair of TOF with free pulmonary insufficiency (PI) that underwent of pulmonary valve replacement (PVR) with bioprosthetic valves were evaluated.

Results

The mean age of patients was 6.5 $\pm$ 0.753 years old (ranged 8-12 years old) and male to female ratio was 6/4. The mean of Intensive care unit (ICU) stay and Hospital stay was 4.5+ 0.712 days (ranged 3-8) and 11.5+ 0.357 days (ranged 9- 16). Mean of cardiopulmonary bypass time and operation time was 45 $\pm$ 0.684 min (ranged 32-60) and 83 $\pm$ 0.317 min (ranged 65-112). In this study we did not find any mortality and ventricular arrhythmia and Heart block. There was only one case (10%) with superficial wound infection that was controlled. At 6 months follow up, all of patients were alive, but Echocardiography sign of Right Ventricular (RV) failure was present in 2 patients (20%) recently.

Conclusion

Although for Pulmonary insufficiency after primary TOF repair there is controversial in studies, but we had good results of PVR with Bioprosthesis in TOF patients.

Key Words: TOF, Pulmonary Valve replacement, Pulmonary Valve insufficiency.

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1- INTRODUCTION

Tetralogy of Fallot (TOF) is one of the most common cyanotic Congenital Heart Disease (CHD) that occurring in 3–6 infants for every 10,000 births. One third of patients are younger than 15 years. In many centers, surgery and primary repair of TOF is the most preferred strategy in any ages. In cases that repair of Tetralogy need to opening the annulus of pulmonary valve and transannular patch for repairing of pulmonary artery, further pulmonary insufficiency happened. In some studies follow up after primary repair, showed that pulmonary insufficiency (PI) is a common adverse event (1-5) (**Figure.1**).

Prolonged PI lead to chronic cardiac overload, can result in cardiac RV wall enlargement, tricuspid valve regurgitation, RV failure, heart failure, arrhythmias and unfortunately sudden cardiac death (6-8). Although, pulmonary insufficiency at first years is tolerated well, but after few years clinical and paraclinical deterioration of RV function was happened and need to surgical intervention (7). Option in redo surgery for correction of free PR consists of hemograft replacement and pulmonary valve replacement with biologic prosthesis (6). Result of reoperation with pulmonary valve replacement usually is good and preservation of right ventricle function and good hemodynamic and clinical status in short and long term follows up.

The purpose of this study was to analyze outcomes of pulmonary valve replacement for correction pulmonary insufficiency after primary repair of TOF.

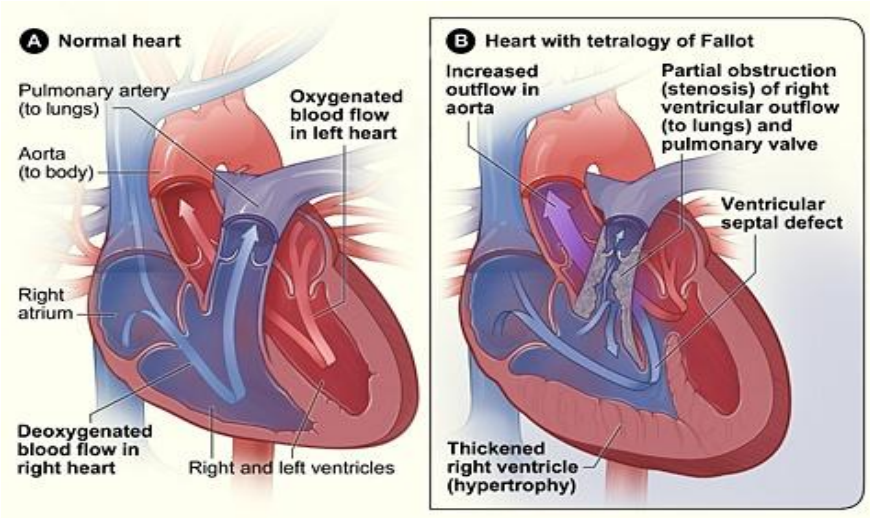

Fig1: The picture of Tetralogy of Fallot

2- MATERIALS AND METHODS

From January 2015 to January 2016 in single center experience (Imam Reza hospital, Mashhad – Iran) 10 patients who were known cases of previous primary repair of TOF anatomy were studied in retrospective study. Time interval from primary total correction of tetralogy to redo surgery was 20 months to 56 months. In all of these patients, medical records were evaluated and primary surgery were total correction of TOF with transanular patch. Patients were asymptomatic until recently with symptoms and sign of right side heart failure. In multiple echocardiography examination presence of

significant pulmonary insufficiency were observed with RV failure and sever enlargement of RA and RV. The age range of patients was between 5 years old to 12 years old. Patients were candidate for pulmonary valve replacement with bioproshthesis that all of the procedure was accomplished with single team of cardiac surgery. With resternotomy approach with oscillating saw at first limited decortications and pericardiolysis only around infundibulum of RV and proximal of main pulmonary artery (MPA) was performed. After heparin administrated cardiopulmonary bypass was initiated. Our experiences for PVR, was without Aortic Cross clamp and cardiac arrest, insertion of bioprosthesis with continuous suture technique for use of 4 to 6 prolene suture (2-0). The advantage of valve replacement in beating heart is shortness of operation time and without need for cardiac protection and prevention of any rhythm failure at end of procedure. We performed all of these PVR with this technique. Weaning of patients from CPB was easily achieved.

3- RESULTS

In this cross sectional study during 12-month, from overall 10 patients, 6 (60%) patient had 19mm bioprosthesis and 3 (30%) patients had 21mm and one (10%) patient had 23 mm bioprosthesis. Mean time of cardiopulmonary bypass time was 45 $\pm$ 0.684 min (ranged 32-60). Mean time of operation time was 83 $\pm$ 0.317 min (ranged 65-112). Mean time of intensive care unit (ICU) stay was 4.5 $\pm$ 0.712 days (ranged 3-8).

In this study we did not see any rhythm disorder or Heart Block. Average time of hospital stay in this group of patients was 11.5 $\pm$ 0.357 days after surgery (9- 16 ranged). Also, there was no hospital mortality and up to 3 months follow up and all of patients discharged in good clinical condition. Echocardiography examination was performed with single echo cardiologist twice before discharge of hospital and then monthly.

All of patients in echocardiography examination showed a good hemodynamic study of bioprosthetic valve and without any sign of paravalvular leakage. The mean and peak gradient of all of prosthesis were in acceptable range. In this study we did not see any significant postoperative ventricular and supraventricular tachycardia (**Table.1**).

Table 1: Demographic characteristics of the child patients with TOF

Variables	Statistics data (mean+ standard deviation) and %
Age (year)	6.5$\pm$ 0.753 (8-12)
Gender : Male/Female	6/4 (60%)
ICU stay (day)	4.5 $\pm$ 0.712 (3-8)
Hospital stay (day)	11.5 $\pm$ 0.357 (9-16)
Cardiopulmonary time (min)	45 $\pm$ 0.684 (32-60)
Operation time (min)	83 $\pm$ 0.317 (65-112)
Postoperative drainage and Bleeding (cc)	550 $\pm$ 0.372 (200- 800)
Prosthesis dysfunction (%)	0 (0%)
RV failure (%)	2 (20%)
Ventricular arrhythmia and Heart block (%)	0 (0)
Infection (%)	1 (10)
Thromboembolism (%)	0 (0)
Hospital mortality (%)	0 (0)

4- DISCUSSION

TOF is a congenital cardiac anomaly that basic mechanism of it development is lack of right ventricular infundibulum and pulmonary obstruction in face Pulmonary stenosis or Atresia and with ventricular septal defect (VSD) and also overriding of Aorta (1, 3). In classic form of TOF position of VSD is sub aortic type (1). Usual presentation of TOF anomaly, are newborns with cyanosis from birth and respiratory distress syndrome and Tet spell. Although, in the past palliative procedure consist of shunt procedure was performed, but recently there is ternd to total correction of this complex anomaly in any ages (7). Today, prognosis and result and long term survival in newborn that underwent total correction of TOF is excellent that in most studies 20 years survival reach to 88% (9-11).

If total correction of TOF need to t transannular patch, further pulmonary insufficiency will be expected (10). Chronic pressure and volume overload on cardiomyocytes, can lead to muscular hypertrophy and RV enlargement and finally RV Failure (9). Cardiac surgeon must notice to chronic RV failure resulted from prolonged PI because after few years, due to this phenomenon can lead to right side heart failure and RV enlargement, but after PVR, RV function and RV mass can regress and reach to normal range(11).

Most of redo procedure for replacing of disease pulmonary valve, prefer to use of biologic prosthesis due to lack of need for long time anticoagulation and also good durability (12); although, in some selected cases of Pulmonary valve insufficiency after primary repair of TOF, seldom repair of native pulmonary valve was reported, but most of experts believe in need to PVR (13). In review of studies, there are controversial about indication and time for intervention for PI because some of authors believe that PVR can not affect in long term survival and ventricular arrhythmia, but some other authors show good result after PVR for correction of PI after primary TOF repair (11, 14-16). After PVR, because of deletion of pressure and volume overload on right side of Heart, RV function steadily improve and result in decrease of clinical symptoms and better of quality of life (8).

Pulmonary valve replacement can also decrease the chance of ventricular arrhythmia due to relief of pressure and volume overload on RV and after PVR remodeling of RV mass and RV dilation can protect from ventricular arrhythmia and improve clinical symptoms (10). Some authors indicate that in compare of TOF patient after repair of TOF whom suffer from PI, with PVR and without PVR, show survival benefit in group of PVR and also decrease of ventricular arrhythmia in PVR group.

Silberman et al. at the follow up results of patients with free PI after primary TOF repair, showed that in Redo surgical bioprosthesis, was implanted in pulmonary position (4). In report by Lee in 2016, use of hand-sewn polytetrafluoroethylene (PTFE) bicuspid pulmonary value replacement were acceptable results (13). Also, Decellularized homografts for pulmonary valve replacement, showed the excellent results in some centers with lower rate of need for Redo operation (12). Yemets et al. showed that improvement of ventricular function is related on performance of bioprosthesis (17). It has been recommended that replacement of pulmonary valve with bioprosthetic, can reduce worsening of future right ventricular dilation and ventricular arrhythmia (18).

The index of QRS interval duration has been marked for this process, with some reports showing a reduction in duration of QRS interval after PVR. The last studies confirm that rapid restoration of Pulmonary valve function with bioprosthesis can regress the impaired

function of right ventricle and finally can normalize the RV function, but the exact time of replacement of Pulmonary valve is still unknown (4,18-20).

4. CONCLUSION

Despite the some bad results of PVR for PI after primary TOF repair, in small study of our patients who underwent PVR with bioprosthetic and without cardiac arrest, we found the good result without hospital mortality, but further studies especially long-term study for follow up of patients with PVR and also compare of them to TOF patients who have not PVR procedure for correction of PI is needed.

5- CONFLICT OF INTEREST: None.

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