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Early Postoperative Mortality of Total Correction of Tetralogy of Fallot

Ali Azari[1], Mohammad Hasan Nezafati[1], Leila Bigdelu[2*]

[1] *Cardiac Surgeon, Division of Cardiovascular, Vascular Surgery Research Center, Mashhad University of Medical Sciences, Mashhad, Iran*
[2] *Cardiologist, Division of Cardiovascular, Vascular Surgery Research Center, Mashhad University of Medical Sciences, Mashhad, Iran*

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ABSTRACT

Introduction: Since 1954, after the first surgical repair of tetralogy of Fallot (TOF), several innovations have occurred in cardiac surgery, especially in children. One stage complete repair of TOF is currently possible even in infancy; however, complications such as hypoxemia, arrhythmia, cardiac dysfunction, sudden death, and valvular disorders may happen. In this study, we evaluated the results of complete surgical repair of TOF with pulmonary stenosis.

Material and Methods: We assessed 74 cases of TOF with pulmonary stenosis that underwent surgery in Cardiac Surgical Ward of Imam Reza Hospital, mashhad, Iran from 2008 to 2010.

Results: Mean age was 5.74±3.31 years and more than half of the patients were male. Mean perfusion and cross-clamping times were 55.45±15.06 and 42.63±9.07 min,respectively. The most common coexisting anomaly was atrial septal defect. Further, 83.7% of the patients were symptomatic, and history of spell attacks was positive in 24.3% of the cases. Arrhythmia was reported in 28.4% of the patients. Mortality rate was 12.2% in our study, which was higher in younger patients (P=0.022) or those with lower weight (P=0.008), longer perfusion time during cardiac surgery (P=0.009), or presence of associated cardiac anomalies (P=0.030).

Conclusion: Outcomes and mortality rate of one-stage surgical repair of TOF with pulmonary stenosis was acceptable in our center, and arrhythmia was the most common postoperative complication.

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Introduction

Tetralogy of Fallot (TOF) is a rare, complex heart defect, occurring in about 5 out of every 10,000 infants. The defect affects boys and girls equally. It consists of right ventricular outflow tract (RVOT) obstruction, outlet ventricular septal defect (VSD), an overriding aorta (>50% on the left ventricle), and right ventricular hypertrophy. About 25% of patients have a right-sided aortic arch. If patients do not undergo surgical repair by the age of six years, the mortality rate would be 50%, but in children with simple forms of TOF treated surgically, quality of life is excellent.

The optimal management of symptomatic patients is surgical treatment, which ensures no residual RVOT obstruction, no residual ventricular septal shunt, competent pulmonary valve, and preserved sinus rhythm. In the present study, we postoperatively analyzed results of surgical repair during one-month follow-up.

Materials and Methods

Patients

All the patients who had undergone operation for TOF at Imam Reza Hospital, Mashhad

**Corresponding author:* Leila Bigdelu, Division of Cardiovascular, Vascular Surgery Research Center, Mashhad University of Medical Sciences, Mashhad, Iran. Tel: +985138012739; Email: Bigdelul@Mums.ac.ir

University of Medical Sciences, Mashhad, Iran, were enrolled in the study during 2008-2010. This study included patients with classic TOF with pulmonary stenosis, and those with complex cardiac anomalies were not included. Seventy-four cyanotic patients over one year of age had undergone total correction of TOF. All the available patient data, comprising of preoperative, operation, and postoperative charts, were retrospectively analyzed.

Operative Technique

Surgical repair was performed with moderate hypothermia and cardiac arrest. A short incision was made on the right atrium and RVOT region to visualize the internal anatomy. The infundibular hypertrophy was mobilized and resected. Another incision was made in the right atrium parallel to the right atrioventricular groove. The tricuspid valve was retracted to expose VSD and the defect was closed with a prosthetic patch (Gor-tex patch) using continuous 4-0 polypropylene sutures. The patch was inserted 5 to 7 mm below the inferior rim of the defect and exited 3 to 5 mm below the inferior rim of the defect, in the proximity of the base of septal leaflet of tricuspid valve. Then, pulmonary valve and annulus were evaluated. In the presence of stenosis (less than one standard deviation than that predicted by Rowlatt's standard charts intraoperatively), transannular repair was planned with pericardial patch. If there was concomitant pulmonary branch stenosis, patch was extended distally onto them.

Follow-Up

All the patients were visited by a cardiologist during the first week and month postoperatively. Chest X-ray, electrocardiogram, and echocardiogram were obtained during the follow-up.

Statistical Analysis

Data analysis was performed using SPSS, version 16.0. All the data was presented as mean±SD for continuous variables. Demographic characteristics and baseline clinical test, Chi-square test, as appropriate. P-value less than 0.05 was considered statistically significant.

Results

Table 1 presents demographics of all the patients. There were 25 females (33.8%) and 49 males (66.2%), with a mean age of 5.74±3.31 years (age range: 1–14 years) and a mean weight of 16.7±6.9 kg (weight range: 6–39 kg). Age distribution of patients at the time of total correction of tetralogy of Fallot mentioned in figure 1.

Prevalence rates of blood groups A, B, O, and AB among patients were 24 (32.4%), 23 (31.1%), 22 (29.7%), and 5 (6.8%), respectively. Preoperative variables were noted in Table 2.

During intensive care unit stay, dobutamine,. Dopamine, Milrinone, and Adrenaline were prescribed for 49 (66.2%), 69 (93.2%), 13 (17.6%), and 2 (2.7%) patients, respectively.

Moreover, 16 (21.6%) patients had no concomitant cardiac anomalies. Table 3 shows

Table 1. Patients' preoperative, operative, and postoperative characteristics

Characteristics	Mean	Range
Age(year)	5.74±3.31	1-14
Weight(kg)	16.7±6.9	6–39
Perfusion time(minute)	55.45±15.06	23-106
Cross-clamp time(minute)	42.63±9.07	25-69
Pericardial drain time(hour)	53.9±15.9	24-120
Intensive care unit (ICU) stay time(hour)	53.50±15.8	22-120
Ventilation time in ICU(hour)	6.12±6.35	1.5-48
Hospital stay(day)	6.56±1.13	5-10
Infusion time of dopamine(hour)	19.25±19.85	6-48
Infusion time of dobutamine(hour)	9.5±12.1	1-56
Infusion time of milrinone(hour)	23.38±7.3	3-29
Infusion time of adrenaline(hour)	2.1±0.5	1-4
Admission period(day)	6.56±1.13	5-10

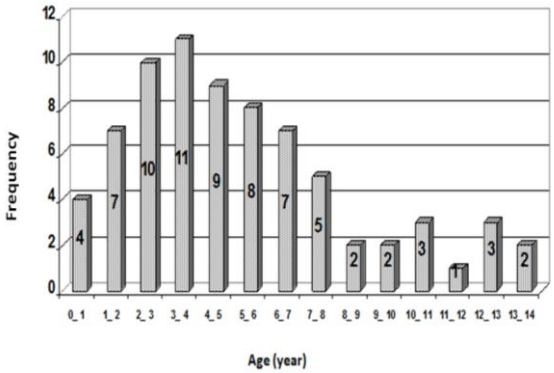

Figure 1. Age distribution of patients at the time of total correction of tetralogy of Fallot

Table 2. Preoperative variables

New York Heart Association class III or IV N (%)	32(43)
Spell N (%)	18(24.3)
Hematocrit (%)	55±2.3
Arterial oxygen saturation (%)	84.3±1.4
Syncope N (%)	20(27.0)
Arrhythmias N (%)	21(28.4)
Cardiovascular accident N (%)	5(6.7)
Hemoptysis N (%)	7(9.4%)
Previous Blalock–Taussig shunt N (%)	6(8.1%)

Table 3. Associated cardiac anomalies in tetralogy of Fallot patients

Anomaly	Frequency N(%)
PDA*	5(6.8)
ASD¥	6(8.1)
PLSVC £	1(1.4)
Right-sided aortic arch	4(5.4%)
Right-sided aortic arch and PDA	1(1.4)
ASD+PDA	2(2.7)
PLSVC+ASD	1(1.4)
Total cardiac anomaly	20(27)

*Patent ductus arteriosus; ¥ Atrial septal defect; £ Persistent left superior vena cava

Table 4. Variables associated with postoperative mortality

	Surviving patients	Dead patients	P-value
Age(year)	6.06±3.38	3.38±1.27	0.022*
Male gender N (%)	45(8.2)	4(91.8)	0.156 ¥
Weight(Kg)	17.46±6.94	11.0±3.12	0.008*
Previous shunt N (%)	5(83.3)	1(16.7)	0.544¥
Perfusion time(minute)	53.78±16.69	67.55±12.48	0.009*
Cross-clamp time(minute)	41.84±9.09	48.33±6.89	0.044*
Associated cardiac anomalies N (%)	49(84.5)	9(15.5)	0.030¥

*Student's T Test; ¥ Fisher exact Test

associated cardiac anomalies detected in the patients. Associated cardiovascular anomalies were 21 right-sided aortic arches, 15 atrial septal defects, 14 patent ductus arteriosus, 7 systemic venous anomalies, 3 coronary anomalies, 1 aortic coarctation, and 2 partial anomalous pulmonary venous connections.

Sinus rhythm was the most prevalent rhythm after surgery, but sinus tachycardia, bradycardia, atrioventricular block, ventricular fibrillation, atrial fibrillation, and junctional rhythm were noted in 2 (2.7%), 3 (4.1%), 9 (12.2%), 1 (1.4%), 1 (1.4%), and 5 (6.8%) patients, respectively.

The most common post-surgical complications were cardiac arrhythmia (28.4%); we also detected heart failure (5.4%), pneumothorax (4.1%), need to pacemaker implantation (4.1%), gastrointestinal bleeding (2.7%), acute tubular necrosis (1.4%), and acute pulmonary edema (1.4%) in the patients.

Redo operation was needed in three patients, the reasons for which were postoperative bleeding (in two patients) and sternal dehiscence (in one patient). There were nine early deaths (12.2%). Variables associated with postoperative mortality was noted in table 4. Patients died postoperatively were younger (P=0.022) or had lower weight (P=0.008), longer perfusion time during cardiac surgery (P=0.009), or associated cardiac anomalies (P=0.030).

Discussion

The corrective surgery of TOF has been performed for more than 60 years (1). Cardiac surgeons' experience, surgical management of TOF, and long-term outcomes have continued to evolve during the past decade. Although many cardiac surgeons and pediatric cardiologists endeavor to reduce the long-term complications by focusing on optimal timing for surgical repair and technique of RVOT surgery, there are controversies regarding these problems.

Dramatic advances in neonatal medicine, allow early (within the first 4–6 months) complete repair of TOF (2, 3). One-stage total repair is the ideal management for symptomatic TOF, and for such a goal, the pulmonary size should be well-preserved. In hypoplastic pulmonary arteries, continuity between RV and pulmonary artery with a conduit and leaving the VSD should be established to induce pulmonary arterial growth and dilatation, allowing for subsequent correction (4-9).

The potential benefits of early complete repair of TOF include 1) reduced late cardiac arrhythmia, 2) superior preservation of left ventricular function and higher functional capacity (10), and 3) avoidance of long-term cyanosis, palliative shunt, and right ventricular pressure overload (11). Best results are obtained when sinus rhythm is preserved, no residual stenosis in RVOT is present, the pulmonary valve remains competent, and the VSD is completely closed (12).

The early outcomes of total repair of TOF have improved since it was first introduced in the 1950s. However, repaired TOF patients develop late complications such as heart failure symptoms, arrhythmia, and even sudden cardiac death (10); the late outcomes of early repair remain uncertain. The need for a transannular patch defines the severity of RVOT obstruction at the annular level and severity of cardiac anomaly. In a retrospective study, Murphy et al. (13) showed that the need for a transannular patch was not associated with reduced 30-year survival.

Arrhythmia is a post-cardiac surgery complication, which causes hemodynamic imbalance, often requires treatment, and heightens mortality rate (14). The incidence rate of cardiac arrhythmia is lower in palliative rather than corrective surgery because palliative surgery does not significantly damage myocardium or interfere with conduction system (15). Previous studies classified postoperative arrhythmia as early and late according to the time of onset. Early postoperative arrhythmias occur during the first two postoperative days (16). In our study, arrhythmia was detected in 28.4% of the patients and it was the most common post operative complication meanwhile atrioventricular block was the most common cardiac arrhythmia.

Our early mortality rate was 12.2%, while it was 5.08% in a study by Hashemzadeh et al. (17). This discrepancy might be due to younger age of our samples. Early mortality rate was 4-11%; this rate is contingent upon study design, patient age, surgical experience, and many other factors. The mortality rate

has dropped during the recent years (from 11.1% in a large study designed by Knott-Craig et al. to 7.7 % in a study by Atik et al.) (18, 19). In the current study, the mortality rate was higher in younger patients (P=0.022), or those with lower weight (P=0.008), longer perfusion time during cardiac surgery (P=0.009), or presence of associated cardiac anomalies (P=0.030). Hashemzadeh also reported significantly higher operative mortality rate with longer cardiopulmonary bypass and aortic cross-clamp times, which was in line with our findings (17).

Saygi et al. (20) proposed that low preoperative oxygen saturation, coronary artery anomaly, high RV: aortic pressure ratio, requirement of postoperative extracorporeal membrane oxygenation, and pacemaker were associated with increased mortality.

Conclusion

Early surgical repair of patients with TOF was relatively low in our center, we also noted that this repair is hinged upon age, weight, perfusion time during cardiac surgery, and presence of associated cardiac anomalies.

Acknowledgments

None.

Conflict of Interest

The authors declare no conflict of interest.

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