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Short-Term Outcome of Tetralogy of Fallot Repair: A Single Center Experience in A Developing Country

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ABSTRACT

Objective: To note short-term outcome of patients undergoing tetralogy of fallot repair.
Study Design: Retrospective longitudinal study.
Place and Duration of Study: Department of Pediatric Cardiology, National Institute of Cardiovascular Disease, Karachi Pakistan, from Sep 2020 to Feb 2021.
Methodology: A total of 113 patients under 25 years of age who underwent tetralogy of fallot correction were included. Pre-operative information, echocardiography, investigations and history of the patient were noted. Intra-operative and post-operative information and surgical procedure were also noted. Short-term outcome included data up to discharge or death of the patients enrolled.
Results: Mean age was noted to be 9.40+5.01 years, with 59(52.2%) of the patients undergoing tetralogy of fallot repair were male. Mean saturation of peripheral Oxygen (SpO_2) at the time of surgery was noted to be 79.27±.34. There were 76(67.3%) patients without history of previous surgery. Mean cardiopulmonary bypass time was noted to be 106.04±40.59 minutes. Mean aortic cross-clamp time was recorded to be 58.79±27.90 minutes. Additional procedures were required in 68(60.2%) patients. Mean duration of hospital stay was 13.96±8.68 days while mean duration of ICU stay was 87.04±69.37 hours. Mortality was reported in 3(2.7%) patients.
Conclusion: Low mortality and low post-operative morbidity were noted among patients undergoing tetralogy of fallot repair.

Keywords: Aorta, Mortality, Tetralogy of fallot.

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INTRODUCTION

Out of the wide spectrum of congenital heart diseases (CHD), Tetralogy of Fallot (TOF) is a common condition and was one of the first surgically corrected heard defects which has decades of research and clinical experience backing it.[1] TOF has been reported to be the second most common disease, preceded only by Ventricular Septal Defect (VSD) to present at the health centers.[2] Majority of the patients undergoing TOF repair have good post-surgical outcomes.[1-3] Low cardiac output is one of the important issue causing increased rates of morbidity among patients undergoing TOF repair. Prolonged Cardiac Intensive Care Unit stay (CICU) is generally due to pleural effusion, ascites and a prolonged duration of mechanical ventilation.[3] It has been postulated that this can be attributed to development of isolated right ventricular diastolic dysfunction with normal biventricular systolic function.[4,5] Because of interdependence of ventricular function, changes in right ventricular diastolic function effect left ventricular compliance and function. Stroke volume and preload to the left ventricle are ultimately compromised.[6]

In adults the increased deceleration rate of early rapid filling has been proposed as an index of both right and left ventricular restrictive physiology.[7] However, this measurement is made difficult in pediatric patients because of rapid baseline heart rates and poorly defined early rapid filling and atrial systole phases. Due to this limitation other indicators like E wave velocity, E:A ratio, index of myocardial performance, isovolumetric relaxation time and increased central venous pressures have been used to indicate right ventricular restriction.[8] One of the mostly widely accepted indicators has been the presence of antegrade diastolic pulmonary arterial flow.[4] Literature provides substantial evidence that illustrates the correlation between sub-optimal post-

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operative recovery and presence of antegrade diastolic pulmonary arterial flow.[8] Some studies have shown that this restrictive physiology is temporary [resolved by 9th post op day]4 while others show long term persistence of RV restriction even up to 12 weeks post operatively.[9]

Previous studies show inconclusive correlations between pre-op and post op parameters (for example, cardio-pulmonary bypass, aortic-cross clamp, use of trans-annular patch, infundibular resection) and restrictive right ventricular physiology.[8] This study was aimed to note short-term outcome of patients undergoing tetralogy of fallot (TOF) repair.

METHODOLOGY

The retrospective longitudinal study was conducted at Department of Pediatric Cardiology, National Institute of Cardiovascular Disease, Karachi, Pakistan from September 2020 to February 2021 after approval from Institutional Ethical Committee was taken (ERC-73/2021).

Inclusion Criteria: Patients of either gender, aged up to 25 who underwent TOF correction during the study period were included.

Exclusion Criteria: All patients who expired intra-operatively or within the first 48 hours post-surgery, or those having TOF with pulmonary atresia for Rastelli procedure were excluded.

Written consent was sought from parents or attendants of all study participants ensuring them the confidentiality of their data. Non-probability consecutive sampling technique was adopted. We included all 113 patients as per inclusion and exclusion criteria. At the time of enrollment, pre-operative information including medical history and clinical examination, echocardiography findings and baseline investigations were noted. All surgical procedures were performed as per standard Institutional protocols. Intra-operative information and surgical procedure were also noted. All the study information was collected on a specially designed proforma. The information obtained was divided into pre-operative, intra-operative and post-operative variables. Short-term outcome included data up to discharge or death of the patients enrolled.

For data analysis, "Statistical Package for Social Sciences (SPSS), version 26:00 was utilized. Continuous variables were represented using mean and standard deviation while categorical variables were presented as frequency and percentages.

RESULTS

In a total of 113 patients, the mean age was 9.40±5.01 years (ranging between 1.3 to 25 years) while mean weight at the time of surgery was 28.54±17.50 kg (ranging between 6.8 to 82 kg). Majority of the patients undergoing TOF repair, 59(52.2%) were male. Mean SpO_2 at the time of surgery was noted to be 79.27±7.34. There were 76(67.3%) patients without history of previous surgery. The mean pulmonary valve z-score in our patients was -3.56±1.6 (ranging between -7.52 to 1.36). Pre-surgery catheterization was done in 64(56.6%) patients. Table-I is showing pre-operative characteristics of the patients.

Table-II shows details of intra-operative and post-operative study variables. Mean cardiopulmonary bypass time was noted to be 106.04±40.59 minutes (ranging between 60 to 336 minutes). Mean aortic cross-clamp time was recorded to be 58.79±27.90 minutes (ranging between 20 to 201 minutes). Additional procedures were required in 68(60.2%) patients while PFO-ASD closure was the commonest

Table-I: Pre-Operative Characteristics of the Patients (n=113)

Characteristics		n (%)
Age (years)(Mean+SD)		9.40±5.01
Weight (kg) (Mean+SD)		28.54±17.50
Gender (males)		59(52.2%)
Body Surface Area (m^2) (Mean+SD)		0.98±0.41
Down's Syndrome		18(15.9%)
Cyanotic Spell		73(64.6%)
SpO_2		79.27±7.34
Hemoglobin (gm/dl)		12.98±1.83
Clubbing Grade	No Clubbing	3(2.7%)
	1	5(4.4%)
	2	69(61.1%)
	3	36(31.9%)
Using Propranolol		38(33.6%)
RVOTO Gradient (mmHg)		80.53±18.8
RVOTO Level	Atresia	1(0.9%)
	Infundibular	26(23.0%)
	Valvular	6(5.3%)
	Combine	80(70.8%)
History of Previous Surgery	None	76(67.3%)
	RMBT Shunt	22(19.5%)
	LMBT Shunt	7(6.2%)
	PDA Stenting	3(2.7%)
	LMBT and RMBT Shunts	4(3.5%)
	Coil Embolization	1(0.9%)
Admission Status	Elective	109(96.5%)
	Emergency	4(3.5%)

**RVOTO: Right Ventricular Outflow Tract Obstruction*

additional procedure performed noted in 25(22.1%) patients whereas BT shunt taken down was done in 23(20.4%). Mean duration of hospital stay was recorded to be 13.96±8.68 days (ranging between 5-65 days) while mean duration of ICU stay was 87.04±69.37 hours (ranging between 24-340 hours). Post-operative oxygen saturation was found to be 97.28±3.8. Mortality was reported in 3(2.7%) patients. Two deaths were because of severe post-surgery right ventricular (RV) dysfunction while 1 death was due to post-surgery pneumonia.

Table-II: Intra-Operative and Post-Operative Variables (n-113)

Study Variables		n (%)
Operation Techniques	Preserved Valve	81(71.7%)
	Transannular Patch	4(3.5%)
	Transannular Patch and Monocusp Valve	16(14.2$)
	Monocusp Valve	1(0.9%)
	RV-PA Conduit	10(8.8%)
	TAP with Preserved Valve	1(0.9%)
Additional Procedures Required		68(60.2%)
Patient Extubated in the Operation Room		29(25.7%)
Duration of Inotropes Support (hours)		72.08±30.96
Inotropic Scores	Low (<20)	90(79.6%)
	High (>20)	23(20.4%)
Duration of Hospital Stay (days)		13.96±8.68
Duration of ICU Stay (hours)		87.04±69.4
Drain Duration (hours)		136.05±71.99
Duration of Mechanical Ventilation (hours)		50.33±46.46
Pacemaker Required		4(3.5%)
Re-Operation Required		4(3.5%)
Post-operative Complications	Chylothorax	26(23.0)
	Neurological Events	2(1.8%)
	Lung Issues	69(61.1%)
Mortality		3(2.7%)
Discharged		110(97.3%)

DISCUSSION

Blalock and Taussing were the pioneers in performing surgical palliation of TOF whereas Lillehei was the first to conduct an intra-cardiac repair of TOF adopting controlled cross-circulation.[10] Surgical management of TOF has seen significant evolution in the last few decades. Primary TOF repair is considered to be the standard of care.[11]

In the present study, no intra-operative mortality was noted while post-operative mortality was noted in 2.7% patients. Our findings are consistent with local and international researchers who evaluated outcomes in patients undergoing TOF repair and reported low rates of mortality.[5-13] Knott-Craig *et al*. noted significant decrease in surgical mortality recording 11% in 1990 to 2% in 1990.[14] Local data has highlighted 8% mortality rates among late TOF patients.[15] The anatomic complexity of each patient involved in various studies must be taken into account while comparing mortality data among different findings.

In the present study, 4(3.5%) patients needed placement of permanent epicardial pacemaker, out of which, 2 patients had complete heart block that remained farther than 7 days post-surgery while other 2 patients had junctional ectopic tachycardia (JET). JET incidence reported in the present study correlates well what has been reported in the literature as between 3-10%.[16,17] Some studies involving patients of congenital heart surgeries report JET incidence rates between 8-10% which could be due to reasons that these studies involved patients who had lesions like transposition of great arteries along with VSD and truncus arteriosus which require intracardiac repair in very early age.[15]

We noted that mean duration of hospital stay as 13.96±8.68 days while mean duration of ICU stay was 87.04±69.37 hours. Egbe *et al*. analyzing patients undergoing primary TOF repair estimated median duration of ICU stay to be 6 days which could be due the fact that they had only enrolled infants in their study.[18] Hirsh *et al*.[19] found mean duration of ICU stay to be 9±8 days which is close to what we noted while Kolcz *et al*.[20] reported mean duration of ICU stay to be 7 days in their patients undergoing TOF repair. Various reports have found younger age to a risk factor for prolonged duration of ICU stay but as in the present study we had age ranging between 1.3-25 years among our patients so comparatively shorter mean duration of ICU stay could be one of the major reasons for this.[9, 21,22] Mean duration of mechanical ventilation was calculated to be 50.33±46.46 hours in the present study. Past research has elaborated variations in perioperative care as well as surgical and anaesthesia techniques along with post-surgery sedation strategies to assist significant decrease in the overall burden of mechanical ventilation among patients undergoing TOF repair.

CONCLUSION

Low mortality and low post-operative morbidity were noted among patients undergoing TOF repair. Various variables studied in the present study involving physician care and surgical expertise might influence the outcome especially length of ICU stay so more studies are required to further add to what little is known about the intra-operative and post-operative findings among patients undergoing TOF repair.

Conflict of Interest: None

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

AKA & RS: Data acquisition, data analysis, drafting the manuscript, critical review, approval of the final version to be published.

ASS & RAK & MUR: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

SKB & SBZ & NP: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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