

Case study

Rehabilitating case of Tetralogy of fallot undergone surgical repair with comprehensive exercise program: A Case report

Abstract

Tetralogy of Fallot (TOF) is one of the most common cyanotic congenital heart disorders (CHDs). The children with CHD lead relatively sedentary lifestyles, on account of the restriction imposed by treating doctors, parents, and society and by themselves due to fear. The disability related to CHD results in an additional adverse impact on quality of life and physical activity level due to deconditioning. The cardiovascular effects of deconditioning are a decrease in cardiac output, increase resting heart rate with activity, decreased blood pressure in upright positions (orthostatic hypotension), and decreased exercise capacity. These effects would be more pronounced and disabling in an already compromised heart. The operative procedure for the correction of TOF is not curative rather a palliative one. After the correction of the TOF defects, the patient has reduced activity level and exercise capacity. Cardiac rehabilitation including Interval and continuous exercise training modalities were proven to be safe and efficient in improving exercise capacity and functioning of the heart.

Keywords: Tetralogy of Fallot, Physical therapy, Rehabilitation, Case Report.

INTRODUCTION

Long-term prognosis has increased considerably in recent years for patients with congenital heart disease (CHD). (1) Fallot's tetralogy is an inter-ventricular communication congenital heart defect also known as a ventricular septal abnormality, right ventricular outflow obstruction, override of the aortic root of the ventricular septum, and right ventricular hypertrophy. Fallot Tetralogy is the most common cyanotic type and this makes up about 10% of all congenital heart defects. Fallot tetralogy poses the greatest risk of ventricular arrhythmia and sudden cardiac failure. Around 10% of sudden cardiac deaths in people with congenital heart disease, in general, tend to be associated with exercise and a 5-fold higher risk if exercises cause ventricular arrhythmia. (2). In reality, a significant number of children find their recovery treatments challenging in the rehabilitation centres involved in this issue.(3) Cardiac rehabilitation can be described as supervised incremental exercise training in patients with cardiovascular disorders to enhance aerobic fitness.(4) Cardiac rehabilitation services in adults with heart disease have been extensively studied. Acute or post-surgical services for chronic patients differ in duration, the degree of supervision employed, and the number of staff needed for supervision; similar are other aspects of services. To minimize morbidity, mortality, and economic costs along with the enhanced quality of life, it was found that intake of oxygen and exercise efficiency were increased.(5) The population faces similar issues with poorer exercise efficiency and a rise in the risk of cardiovascular disease. However, many CHD patients are not exercising, partially out of fear and over-protection, or maybe physicians who care for these patients are hesitant to prescribe physical exercise. Exercise results in increased performance and adaptive hypertrophy in healthy people, including children (physiological cardiac remodelling).(6, 7)

Case presentation

A 13 years old male child, the resident of Amrawati, was a known case of Tetralogy of Fallot for which intra-cardiac repair with midsternal incision was done on 21st May 2021. Following surgery, patient was shifted to the Cardiovascular and thoracic surgery ICU and complaining of pain at the incisional site, intensity- 6/10 on numerical pain rating scale, aggravated by coughing, turning in bed 8/10, tenderness in the left side of the chest below the clavicle with grade 2 (flinch to moderate palpation) in the 1st and 2nd intercostal space, shortness of breath after activity of daily living activities along with generalized weakness. Difficulty in breathing during defecation, bathing, dressing with assistance and rest pauses, walking <100m, stair climbing <1 flight, prolonged talking or in a high tone. (New York heart association dyspnea (NYHA) grade 3).

Past history:

The patient was apparently healthy till the age of 10 days when parents noticed bluish discoloration of skin during feeding and crying and cyanotic spell during the same time. The Suck-Rest-Suck cycle was present. The patient underwent investigations and was diagnosed to have CHD- tetralogy of fallot which would need surgery at later date. At 2 years of age, the patient underwent BT (Blalock Taussig) shunt surgery – subclavian & pulmonary artery anastomosis. No history of pre and post-operative complications present. The patient was under medications, which the parents discontinued after a year. The patient was symptomatically better for 8 years after surgery. In the last 3 years, the symptoms have aggravated progressing from Grade 1 to 3 on NYHA scale. He was not able to attend school regularly and could not engage in any outdoor activities due to dyspnoea and cyanotic spells. The family belongs to the lower middle class according to the Kuppuswamy scale.

Timeline:

Date of Admission	18/05/2021
Date of surgery	21/05/2021
Date of physiotherapy referral	22/05/2021
Date of discharge	04/05/2021
Date of the last follow-up	15/05/2021

Clinical Finding:

A proper informed consent was taken from the patient's caregiver prior. Physical examination was done. On inspection, the child was sitting comfortably on the bed and well oriented in time, place, and person. Built was moderate with poor nutrition. Body mass index was 13.4032. On cardiovascular examination, precordium normal and bilaterally symmetrical, apex impulse- present over left 5th intercostal space, sutures present over the midsternal line. Pulse rate: 106 beats per minute, rhythm: regular, all peripheral pulsations, respiratory rate – 26 breaths per minute, chest expansion reduced.

Table 1.1 Auscultatory findings

Pre-Operative	Post-operative day 2	Post-operative day 12
Air entry reduced in lower zones. Bilateral crepitus in lower zones	Air entry reduced in middle and lower zones (R>L) Crepitus Present in upper and middle zones	Air entry reduced in middle and lower zones bilaterally Crepitus present in upper zones

Various Investigations were done including a 2D Echo suggestive of the gradient across the right ventricular outflow tract is 90mm Hg. Pulmonary artery branches are fair and confluence, Severe valvular and infundibular regurgitation across right ventricular outflow tract along with ventricular septal defect. Cardiac CT reveals Ventricular septal defect with severe infundibular pulmonary stenosis with left-sided superior vena cava and multiple aorto-pulmonary communicating arteries. Cardiac Catheterization & Angiography: BT shunt patent. No signs of coarctation. On ECG there was normal sinus rhythm, right axis deviation, prominent R wave in V1. Pre-operative chest x-ray shows classical presentation of boot shaped heart.



Figure 1: Pre-operative chest x-ray showing boot shaped heart.

Management

Pre-Operative

Patient and family education regarding surgery: location of the scar, the probable need for mechanical ventilation, and drains. Various dyspnoea relieving positions during activities like forceful defecation, stress, overeating, dehydration, or positions (supine) that may trigger cyanotic spells by lying knee to chest in case of a spell was taught. Importance of chest physiotherapy pre and post-surgery regular follow-up in cardiac surgery and physiotherapy OPD is advised. To maintain ventilation incentive spirometry, segmental breathing, and thoracic expansion exercises are administered. For Airway clearance vibrations, Huffing and coughing techniques were given.

Post-Operative Management

The patient was extubated post-operative day second and started with physiotherapy management. Family Education regarding handling and positions were taught which includes do not lift or pull the child by the arm, avoid pulling and pushing activity by arm, do not lift the arm above the head, and avoid lifting heavyweight. Along with this importance of healthy diet and regular exercise, maintenances of personal hygiene, regular wound care, any sign of infection such as fever, redness, swelling, tenderness, and discharge should be immediately informed.

Improve air entry and reduce work of breathing:

Semi Fowler's position was preferred for deep breathing exercises like diaphragmatic and pursed-lip breathing exercises. Segmental breathing and thoracic expansion exercises were also given focusing on particular areas of the lungs to facilitate ventilation. Vibrations, huffing, and coughing techniques were given for airway clearance.

INPATIENT REHABILITATION PROGRAM

EXERCISE PRESCRIPTION:

Phase 1 given according to FITs principal with frequency: 2-4 times/day, intensity according to patient's tolerance if the asymptomatic rate of perceived exertion: 3-4 on Borg's scale, heart rate: HR rest + 30bpm as the arbitrary upper limit, duration: 5-10 minutes/day. It includes in-bed mobilization, relaxation exercises, range of motion exercises for all joints of the upper limb (shoulder not more than 90 degrees in flexion and elevation), lower limb. Core, scapular muscle strengthening exercises, standing, and marching activities along with graded walking. Regular monitoring of vitals was done throughout rehabilitation.

Table 1.2 Vital Parameters Report showing response to mobilization:-

	Pre-treatment	Post Treatment	Recovery (after 1 min)
BP(mm Hg)	110/80	126/88	120/80
PR (beats/min)	92	101	95
RR (breath/min)	24	28	25
SpO2 (%)	97	98	100

Follow Up and outcome:

The patient was followed up for 1 month every 2 weeks. At the time of discharge, there was a decrease in pain symptoms at the time of discharge with a VAS score of 2/10 on activity involving the upper limb. The patient was able to independently perform his activity of daily living with minimum difficulty. The patient was monitored over a telephonic conversation for appropriate training or assistance.

Discussion

This study presents the case of a thirteen-year-old male child operated case for tetralogy of Fallot. Postoperatively, he underwent a tailor-made in-hospital cardiac rehabilitation program

for 2 weeks and has shown positive effects in reducing pain, respiratory parameters along with enhancing the quality of life after 2 weeks of follow-up post-discharge.

The American Heart Association recognizes the importance of physically active lifestyles to the health and well-being of children and adults with congenital heart defects. Counselling patients with congenital heart defects should emphasize the importance of daily physical activity and decreasing sedentary behaviour as appropriate for the patient's clinical status.(8)

In a recent review, Forman et al (2019) concluded that early recognition and intervention of postoperative complications are essential to improved patient outcomes. Continued advancements in knowledge, technology, surgical techniques, and postoperative management should lead to on-going improvements in short-term, intermediate-term, and long-term outcomes for patients with TOF in the future.(9)(10)

Conclusion:

To sum up, the reported case highlights the need for patient education, breathing retraining, airway clearance techniques, positioning, walking program with supplemented oxygen, and psychological support in Post-operated Tetralogy of Fallot cases. A short period of modified pulmonary rehabilitation program proved to be tremendously helpful in improving the overall functional performance and enhance the quality of life in such children.

Informed consent: A proper informed consent was taken from the patient prior.

Reference

1. Duppen N, Kapusta L, de Rijke YB, Snoeren M, Kuipers IM, Koopman LP, et al. The effect of exercise training on cardiac remodelling in children and young adults with corrected tetralogy of Fallot or Fontan circulation: A randomized controlled trial. *Int J Cardiol.* 2015 Jan 20;179:97–104.
2. The impact of exercise on ventricular arrhythmias in adults with tetralogy of Fallot - ScienceDirect [Internet]. [cited 2021 Mar 20]. Available from: <https://www.sciencedirect.com/science/article/abs/pii/S0167527316310208>
3. Martínez-Quintana E, Miranda-Calderín G, Ugarte-Lopetegui A, Rodríguez-González F. Rehabilitation Program in Adult Congenital Heart Disease Patients with Pulmonary Hypertension. *Congenit Heart Dis.* 2010;5(1):44–50.
4. Calzolari A, Turchetta A, Biondi G, Drago F, De Ranieri C, Gagliardi G, et al. Rehabilitation of children after total correction of tetralogy of Fallot. *Int J Cardiol.* 1990 Aug 1;28(2):151–8.

5. Galioto FM, Tomassoni TL. Exercise rehabilitation in congenital cardiac disease. *Prog Pediatr Cardiol*. 1993 Jun 1;2(3):50–4.
6. Paediatric cardiac rehabilitation in congenital heart disease: a systematic review - ProQuest [Internet]. [cited 2021 Mar 20]. Available from: <https://search.proquest.com/openview/40c872486244bb4d61a53dbc00644be4/1?pq-origsite=gscholar&cbl=15995>
7. Yadav V, Naqvi WM, Burhani T. Pandemics and physiotherapy: An overview of the role of the physiotherapists in restoring functions and quality of life. *Int J Res Pharm Sci* [Internet]. 2020 Jan 1 [cited 2021 Jun 14];11(Special Issue 1). Available from: <https://covid19.elsevierpure.com/en/publications/pandemics-and-physiotherapy-an-overview-of-the-role-of-the-physio>
8. Goyal C, Naqvi W, Sahu A. Xia-Gibbs Syndrome: A Rare Case Report of a Male Child and Insight into Physiotherapy Management. *Cureus* [Internet]. [cited 2021 May 22];12(8). Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7478925/>
9. Forman J, Beech R, Slugantz L, Donnellan A. A Review of Tetralogy of Fallot and Postoperative Management. *Crit Care Nurs Clin North Am*. 2019 Sep;31(3):315–28.
10. Acharya S, Garikapati A. Right atrial sarcomas masquerading as myxoma presenting with fatal cardiac tamponade: A rare case report. 2020 Nov 30;