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Improving outcomes as a result of early inpatient cardiac rehabilitation in a child undergone surgical repair for congenital heart disease: A single case study

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ABSTRACT

Congenital heart disease is a term used to describe a set of congenital defects that affect the heart's ability to function effectively. It is one of the most common birth disorders, with an estimated prevalence of 10% present in population. The patient in this case has patent ductus arteriosus, atrial septal defect combined with a ventricular septal defect with bidirectional shunt, come with complaints of fever, cough and cold. Investigations like Electrocardiography, 2D Echocardiography, Chest X ray were done to assess the patient's current state. Surgical procedures alleviated the congenital abnormalities i.e. atrial septal defect closure, ventricular septal defect closure, patent ductus arteriosus ligation. Intervention aimed for this case was Pediatric Cardiac rehabilitation; the primary objectives for the same were to maintain one's physical health and staying active, in addition to one's socio-emotional well-being. In the care of newborns, parents must be provided with appropriate knowledge about treatment options and their anticipated consequences so that they may make educated decisions about the child's medical care.

Keywords: congenital heart diseases, cleft palate, cardiorespiratory physiotherapy, pediatric cardiac rehabilitation

1. INTRODUCTION

Congenital heart disease is the most prevalent birth defect in the world, impacting millions of infants each year. Between 1970 and 2017, the global prevalence of congenital cardiac abnormalities was 8.22 per 1000. Globally, the prevalence of congenital heart defect grew by 10% per 5 years throughout this time period. The reported prevalence of 'mild lesions' such as ventricular

septal defect, atrial septal defect, or patent ductus arteriosus increased nearly thrice, due to earlier identification. With recent breakthroughs in diagnostic tools, surgical management, and postoperative care, over 90% of children with critical or complex abnormalities are predicted to live to adulthood in the current period (Huisenga et al., 2021). Septal abnormalities are the most common type of congenital heart anomaly (Rao and Harris, 2018). The third leading cause of congenital cardiac disease is atrial septal defect.

The anomalies category includes various types of atrial connections that allow blood to be circulated between the pulmonary arterial circulations. Surgical closure is secure and successful, and it is linked to a healthy life span when performed before the age of twenty five (Geva et al., 2014). Another most frequent congenital heart anomaly in infants and youths is ventricular septal defect. Most patients with ventricular septal defect have had surgery using cardiopulmonary bypass, which allows for visible access to the abnormalities. Surgical repair, on the other hand, is often associated with a slew of problems that can impair physical function and lower quality of life (Huang et al., 2019). Patent ductus arteriosus is another congenital heart defect which accounts for around 10% of all congenital heart diseases, with a prevalence of at least 2-4 per 1000 term newborns. To avoid or lessen the danger of infective endocarditis, periodic closure of such defects has been proposed. In people with a mild patent ductus arteriosus, though, the risk of infective endocarditis appears to be quite low, and is curable (Eb et al., 2010). For long-term improvements, these patients require periodic follow-up by specialists and physiotherapists (van der Bom et al., 2011). A well and coordinated (individualized) recovery program should be started during the postoperative process to enhance physical exercise and strength, since it is essential to live a healthy lifestyle in order to achieve and maintain level of fitness post-surgery (Dam et al., 2021). Generally, five days following surgery, the patient's motor function abilities are reduced significantly compared to pre-surgery levels, hence early commencement of physical therapy, ideally on post-operative day 2 results in enhanced mobility grade.

2. PATIENT INFORMATION

Patient in the present case is a 5 year old male child; whose parents reported a history of poor weight gain and difficulty in breathing while playing in association with recurrent cough since 15 days. Symptomatic treatment was taken for the same from a local hospital. Symptoms were reduced for time being but again the child showed similar manifestations with aggravated intensity. The child was then admitted to our tertiary care hospital; was admitted to pediatric ICU for further management. The symptoms were evident of suspected congenital heart defect; in view of which 2-D echocardiography was done immediately. It revealed evidence of 1.5 mm patent ductus arteriosus with bidirectional shunt, 3 mm of atrial septal defect with left to right shunt, 5 mm perimembranous ventricular septal defect with bidirectional shunt. Cardiac surgery was planned for the child. Patient underwent ventricular septal defect closure with patent ductus arteriosus ligation with atrial septal defect closure. Patient was taken on cardiopulmonary bypass during surgery. Post operatively, after achieving homeostasis, patient was shifted to CVTS ICU.

3. CLINICAL FINDINGS

On post-operative day 2, patient was visited by physiotherapist in CVTS ICU. He was seen in supine lying position conscious with ECG leads attached, Foley's catheter in situ, central line in situ and mediastinal drain in situ. Bandaging was present on surgical site i.e. mid sternal. On inspection, overall chest expansion of the patient was reduced. On auscultation, basal crepitations were heard with decreased air entry in lower zones. Pain at suture site was assessed on the basis of visual analog scale was 8.4.

Timeline of the current episode

Timeline of patient's course of hospitalization is mentioned in Table 1.

Table 1 Showing timeline of patient's course of hospitalization.

Date of diagnosis congenital heart defect	09/11/2021
Date of surgery	11/11/2021
Date of physiotherapy referral	13/11/2021
Date of discharge	29/11/2021
Date of follow up	13/12/2021

Diagnostic assessment

Echocardiography revealed evidence of 1.5 mm patent ductus arteriosus with bidirectional shunt, 3 mm of atrial septal defect with left to right shunt, 5 mm perimembranous ventricular septal defect with bidirectional shunt. Pre-operative Chest X-ray shows

marked broncho-vascular markings with increased cardiothoracic ratio indicative of cardiomegaly and Post-operative Chest X-ray showing normal cardiothoracic ratio with presence of sutures indicative of mid-sternal approach (figure 1).

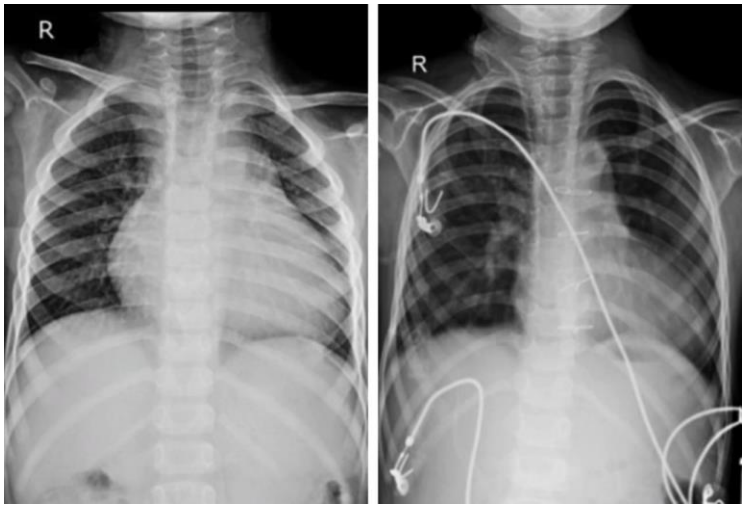

Figure 1 Showing Pre and Post-operative Chest X-ray.

Therapeutic Intervention

Physiotherapy Management

In pediatric cardiac surgery, physical therapy during the preoperative and postoperative periods is recommended to prevent the risk of cardiopulmonary issues as well as to treat it, since it contributes to proper ventilation and successful extubation. In this case study, the goal of physiotherapist was to achieve good chest expansion along with maintenance of bronchial hygiene. The beginning of therapy was done by educating the parent about the condition and benefits of physiotherapy rehabilitation. Physical therapy was given twice a day which involved administration of a bronchodilator via nebulization at the start of treatment. Nebulization was followed by postural drainage position was given, so as to mobilize the secretions in assistance with gravity for 5-7 minutes maintaining the vital signs in range followed by manual chest physiotherapy techniques like chest percussions and vibrations; which were given on posterolateral surface of the chest.

Forced expiratory technique was incorporated in the form of paper blowing exercise (figure 2), whistle blowing exercise and balloon blowing exercise. Upper extremity and lower extremity range of motion exercises were given so as to maintain the mobility of all joints. Breathing exercises in form of thoracic expansion exercises were incorporated in order to maintain overall lung compliance and thoracic mobility (figure 2). At the end of every session, paediatric incentive spirometry was given to child. It was prescribed to reduce pulmonary sequelae after surgery by improving preoperative respiratory state. In the paediatric population, it uses a toy as a more acceptable incentive spirometry instrument. The mouthpiece of this toy is attached to a lengthy flexible plastic strip on the other half.

As the kid breaths into the mouthpiece, a fascinating sound from the toy continues to vibrate until the air is blown during exhalation, which is accompanied by extended inflation of the strip. As a result, to make sure the patient follows the instructions and involvement, this device includes the two most popular incentives for children, namely video and auditory. Physiotherapy treatment resulted in betterment of his health and facilitated overall condition. Progression of the patient's general condition was observed according to following outcome measures.

Table 2 Showing the ranges before and after surgery in Outcome measures.

Outcome measures	Pre- operative	Post- operative (POD 2)	Discharge	Follow up
Visual Analog Scale	_	8.4	5.6	2.7
Pediatric Incentive Spirometer	750	1000	1250	1750
Pediatric Quality of Life Inventory Scale (PedsQL Cardiac Module 3.0)	75	82	88	94

Follow-up and outcome of interventions

The comparison between values taken pre- operatively, post -operatively, at the day of discharge and at day of follow up of Visual Analog Scale, Pediatric Incentive Spirometer and Pediatric Quality of Life Inventory Scale (PedsQL Cardiac Module 3.0) are mentioned in table 2.

Figure 2 Post-Operative rehabilitation (A) Patient is performing Thoracic expansion exercise. (B) Mid-sternal incision site with bandaging. (C) Patient is performing Ambulation along the hallway. (D) Patient is performing deep breathing exercise.

4. DISCUSSION

Congenital heart disease is a term used to describe cardiac anatomical problems that occur before the actual birth. Such anomalies can emerge in the fetus while it develops in the uterus during pregnancy. In the United States, about 500,000 individuals suffer congenital cardiac disease. These include cardiac anomalies, atrial and ventricular septal defects, and cardiac muscle anomalies, all of which result in poor circulation, myocardial ischemia, and other problems. Breathlessness and reduced capacity to function are common signs of congenital heart disease, as are tiredness and an irregular heart sound known as a heart murmur heard on auscultation. Cyanosis (blue skin caused by inadequate oxygenation) and non-cyanotic congenital heart abnormalities are the two most common kinds of congenital heart disease. A congenital heart abnormality in which blood travels back and forth through the left and right atria is known as an atrial septal defect. It might be undiagnosed or manifest itself as cardiac failure (Adiele et al., 2014). Another most prevalent congenital heart abnormality in children is ventricular septal defects.

In ventricular septal defects, the main cause of hypotension is an incorrect connectivity between both the right and left ventricles, which contributes to the creation of shunts (Dakkak and Oliver, 2022). Patent ductus arteriosus is among the most prevalent infants with congenital heart abnormalities, accounting for 5–10% of all congenital malformations. Patent ductus arteriosus is negatively associated to gestational age and weight, with preterm infants having an even higher frequency. Despite the high level of morbidity associated with this surgical treatment for atrial septal defect and ventricular septal defect closure as well as patent ductus arteriosus ligation, it continues to be a treatment approach with significant clinical value and life-saving capacity when done judiciously. When someone is impacted by an injury, sickness, or handicap, a physiotherapist can assist them regain mobility and function, therefore post-surgery physiotherapy is recommended, which includes parent education on condition and benefits of physiotherapy, two weeks of phase I cardiac rehabilitation, a home - based exercise regimen following discharge, and a two-week follow-up. Patient education, airway clearance procedures, ventilation approaches, and a physical exercise programme are prescribed to patients. Our research strives to include rehabilitation, it has been discovered that therapeutic approaches are successful (Gupta et al., 2021).

5. CONCLUSION

Paediatric cardiac rehabilitation is critical in restoring the general health of patients who have had heart surgery. This case study summarises the effectiveness of a comprehensive monitored physiotherapy regime in improving the feeding tolerance in a patient with congenital heart defetcts; who underwent a corrective cardiac surgery.

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Author's Contribution

The report was approved by SG, MJ, PB, VY, and VV after SG examined the patient, and MJ and PB inspected the documentation and formatting.

Informed Consent

The patient granted his informed consent orally.

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Conflicts of interest

The authors declare that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

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