



FREQUENCY OF ARRHYTHMIA IN POST-OPERATIVE PATIENTS OF CONGENITAL HEART DISEASES

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Abstract: Background: CHDs are some of the most prevalent congenital abnormalities that need surgical treatment amongst pediatric patients. Regardless of the progress in surgical methods, the incidence of postoperative arrhythmias is still a very critical complication. **Objective:** To identify the frequency of postoperative arrhythmias in children who have undergone congenital heart surgery and to determine how they are related to surgical and intraoperative variables. **Methodology:** A descriptive analytical research was carried out on a population of 99 pediatric patients undertaking congenital heart surgery at Sharif Medical City Hospital Lahore. The information on age, gender, weight, the type of surgery, cardiopulmonary bypass (CPB) time, cross-clamp time and intraoperative hypothermia were gathered. The statistical analysis was done in SPSS, and the associations were measured with the help of the chi-square test. **Results:** Arrhythmias were also noted postoperative in about two-thirds of patients, which implies that they are frequent among people. The maximum regularly detected arrhythmias were junctional ectopic tachycardia and complete heart block. It was found out that there was a significant relationship between the nature of the surgery and the incidence of arrhythmias and the complexity of the surgery like Tetralogy of Fallot, transposition of the great arteries and TAPVC were more associated with the incidence. Also, long cross-clamp and prolonged CPB duration were related to the risk of arrhythmia. There was a significant association between intraoperative hypothermia and type of arrhythmia; moderate hypothermia was more often associated with tachyarrhythmias. Majority of arrhythmias were treated by either medication or observation, and less percentage were treated by pacing or cardioversion. **Conclusion:** Pediatric cardiac surgery leads to postoperative arrhythmias, which are largely predisposed by the complexity of the surgery, the duration of the operation, and the management during the operation.

Keywords: CHD, children cardiac surgery, arrhythmia, cardiopulmonary bypass, hypothermia, junctional ectopic tachycardia, complete heart block.

INTRODUCTION

Congenital heart diseases (CHDs) are among the most common congenital abnormalities worldwide and remain a major cause of morbidity and mortality in pediatric patients. These defects include acyanotic lesions such as atrial septal defect, ventricular septal defect, and patent ductus arteriosus, as well as cyanotic lesions including tetralogy of Fallot and transposition of the great arteries. The global prevalence of CHDs is estimated to be 8–10 per 1000 live births, making them a significant public health concern that often requires early surgical intervention. Improvements in pediatric cardiology, cardiopulmonary bypass (CPB) techniques, anesthesia, and postoperative intensive care have significantly increased the survival rate of children undergoing congenital heart surgery.

Despite advancements in surgical management, postoperative complications continue to affect clinical outcomes, among which cardiac arrhythmias are particularly important. Postoperative arrhythmias may occur due to surgical trauma, myocardial ischemia, inflammation, electrolyte imbalance, hypothermia, or injury to the cardiac conduction system during corrective procedures. These rhythm disturbances range from transient benign arrhythmias to potentially life-threatening conditions such as junctional ectopic tachycardia, atrioventricular block, atrial flutter, atrial fibrillation, and ventricular arrhythmias.

The incidence of postoperative arrhythmias following congenital heart surgery has been reported between 10% and 50%, depending on the complexity of the congenital defect and surgical procedure. Complex intracardiac repairs, prolonged CPB duration, and extended aortic cross-clamp times are considered important risk factors for postoperative conduction abnormalities. Junctional ectopic tachycardia is one of the most frequently reported arrhythmias in pediatric cardiac surgery and may result in significant hemodynamic instability and prolonged intensive care unit stay if not identified and managed promptly.

Postoperative arrhythmias can adversely affect patient recovery by reducing cardiac output, prolonging mechanical ventilation, increasing intensive care and hospital stay, and increasing healthcare costs. Severe arrhythmias may lead to low cardiac output syndrome, heart failure, thromboembolic complications, or sudden cardiac death. Therefore, early recognition and continuous cardiac monitoring during the postoperative period are essential to improve patient outcomes and reduce morbidity and mortality associated with congenital heart surgery.

Although several international studies have evaluated postoperative arrhythmias in congenital heart disease

patients, limited local data are available in Pakistan regarding their frequency and associated perioperative factors. Differences in patient demographics, healthcare facilities, surgical expertise, and postoperative management may influence clinical outcomes in the local population. Therefore, local evidence is necessary to better understand the burden and pattern of postoperative arrhythmias in pediatric cardiac surgery patients.

The objective of this study was to determine the frequency of postoperative arrhythmias in pediatric patients undergoing congenital heart surgery and to evaluate their association with perioperative factors including cardiopulmonary bypass time, aortic cross-clamp time, and type of congenital heart surgery.

Material Methods

This descriptive cross-sectional study was conducted in the Department of Cardiac Surgery at Sharif Medical City Hospital, Lahore, over a period of four months. The study included pediatric patients diagnosed with congenital heart diseases (CHDs) who underwent corrective or palliative cardiac surgery and received postoperative care in the Cardiac Surgical Intensive Care Unit (CSICU). Patients were enrolled through non-probability consecutive sampling. A total of 99 patients were included in the study. The sample size was calculated using the single population proportion formula based on a previously reported postoperative arrhythmia frequency of 20.4%, with a 95% confidence level and 8% margin of error.

Patients diagnosed with CHDs through echocardiography and operative records, who underwent congenital heart surgery and had continuous postoperative electrocardiographic (ECG) monitoring, were included in the study. Patients with previous cardiac surgery, preexisting pacemakers, severe multisystem disease, mechanical circulatory support, or incomplete perioperative records were excluded.

Data were collected using a structured proforma that included demographic characteristics, preoperative investigations, intraoperative variables, and postoperative outcomes. Recorded variables included age, gender, weight, type of congenital heart surgery, cardiopulmonary bypass (CPB) time, aortic cross-clamp time, cardioplegia type, and intraoperative hypothermia temperature. Continuous ECG monitoring was performed during the postoperative period to detect arrhythmias within the first 72 hours after surgery. Additional clinical parameters including hemodynamic stability, duration of mechanical ventilation, intensive care unit stay, hospital stay, and laboratory investigations such as serum electrolytes, troponin levels, creatinine, and renal function tests

were also assessed. Preoperative and postoperative echocardiography was performed to evaluate cardiac function and identify residual defects or postoperative complications.

The primary outcome variable was the occurrence of postoperative arrhythmia, while secondary outcomes included the type of arrhythmia and associated postoperative complications. Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) version 26.0 (IBM Corp., Armonk,

NY, USA). Descriptive statistics were used to summarize demographic and clinical variables. Categorical variables were presented as frequencies and percentages, while continuous variables were expressed as mean $\pm$ standard deviation. Associations between categorical variables and postoperative arrhythmias were analyzed using the chi-square test. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 99 pediatric patients undergoing congenital heart surgery were included in the study. Postoperative arrhythmias occurred in 66 patients (66.7%), while 33 patients (33.3%) did not develop Arrhythmia. The most common arrhythmias were junctional ectopic tachycardia (21.2%), complete heart block (17.2%), supraventricular tachycardia (16.2%), and ventricular tachycardia (12.1%).

Prolonged cardiopulmonary bypass (CPB) time and aortic cross-clamp time were significantly associated with postoperative arrhythmias ($p < 0.001$). Independent sample t-test analysis demonstrated significant mean differences in cross-clamp time (37.27 min; $t = 13.68$), CPB time (54.75 min; $t = 11.51$), and weight (12.19 kg; $t = 7.16$) between patients with and without Arrhythmia.

A significant association was also observed between hypothermia temperature and occurrence of arrhythmias ($\chi^2 = 99.000$, $p < 0.001$). Complex surgeries such as Tetralogy of Fallot, transposition of the great arteries, and TAPVC repair demonstrated a higher frequency of postoperative Arrhythmia compared to simpler procedures. Logistic regression analysis identified types of surgery, hypothermia temperature, and gender as significant predictors of postoperative arrhythmia ($p < 0.001$).

Table 1. Baseline Demographic and Surgical Characteristics of Patients

Variable	Category	Frequency (n)	Percentage (%)
Age Group	1–5 years	24	24.2
	5–10 years	56	56.6
	10–14 years	19	19.2
Gender	Male	58	58.6
	Female	41	41.4
Weight Group	<10 kg	29	29.3
	10–20 kg	52	52.5
	>20 kg	18	18.2
Type of Surgery	ASD Repair	18	18.2
	VSD Repair	24	24.2
	TOF Repair	21	21.2
	TGA Repair	16	16.2
	TAPVC Repair	12	12.1
	PDA Ligation	8	8.1

Table 2. Frequency and Types of Postoperative Arrhythmias

Variable	Frequency (n)	Percentage (%)
Occurrence of Arrhythmia		
Yes	66	66.7
No	33	33.3
Type of Arrhythmia		
Junctional Ectopic Tachycardia (JET)	21	21.2
Complete Heart Block (CHB)	17	17.2
Supraventricular Tachycardia (SVT)	16	16.2
Ventricular Tachycardia (VT)	12	12.1
Other Arrhythmias	33	33.3

Table 3. Association Between Perioperative Factors and Postoperative Arrhythmia

Variable	Statistical Test	Statistical Value	p-value
Cross-Clamp Time	Independent t-test	t = 13.68	<0.001
Cardiopulmonary Bypass (CPB) Time	Independent t-test	t = 11.51	<0.001
Weight	Independent t-test	t = 7.16	<0.001
Hypothermia Temperature	Chi-square test	$\chi^2 = 99.000$	<0.001
Type of Surgery	Chi-square test	Significant association observed	<0.001

Abbreviations: CPB = Cardiopulmonary Bypass; χ^2 = Chi-square test statistic.

Table 4. Independent Predictors of Postoperative Arrhythmia

Variable	Odds Ratio (OR)	p-value
Gender	Significant predictor	<0.001
Hypothermia Temperature	Significant predictor	<0.001
Type of Congenital Heart Surgery	Significant predictor	<0.001

Binary logistic regression analysis identified gender, hypothermia temperature, and type of congenital heart surgery as independent predictors of postoperative arrhythmia.

Figure 1. Frequency of Arrhythmias

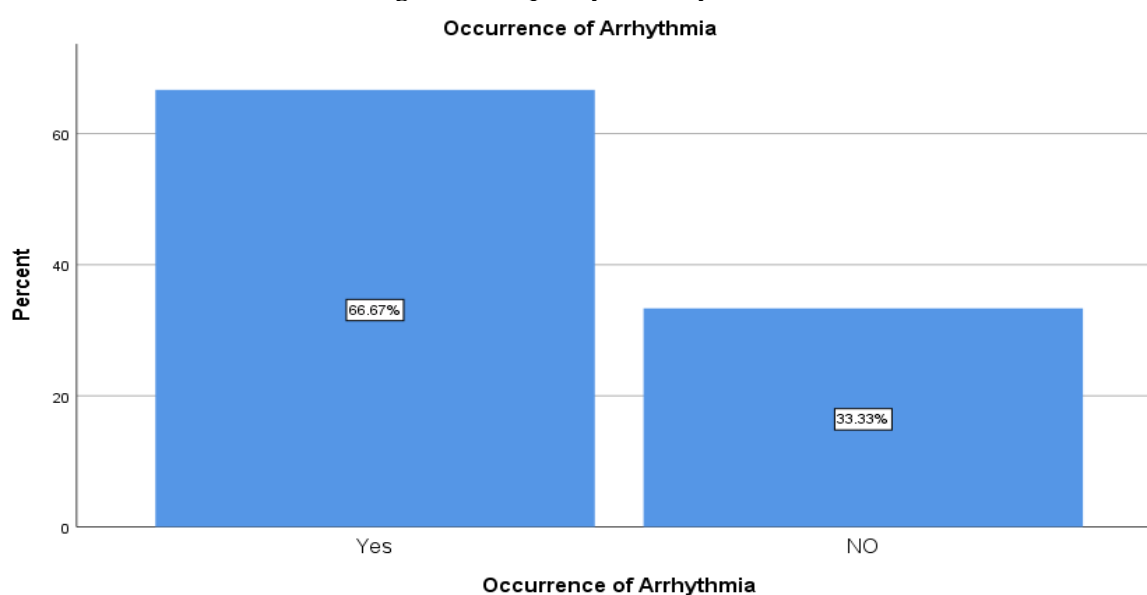
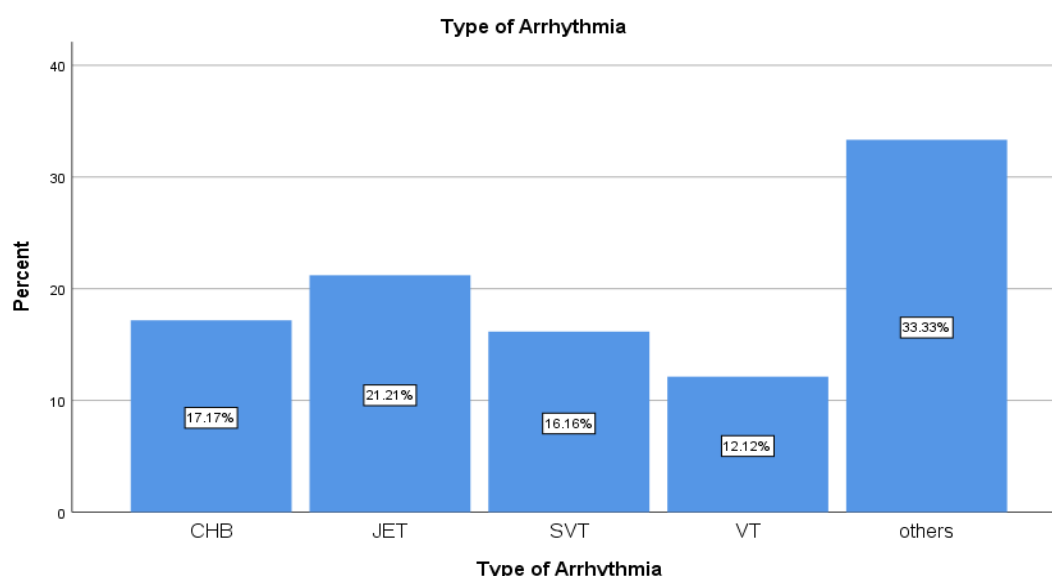


Figure 2. Types of Arrhythmias



DISCUSSION

Giant congenital melanocytic nevi (GCMN) represent a rare This study demonstrated a high frequency of postoperative arrhythmias in pediatric patients undergoing congenital heart surgery, with arrhythmias occurring in 66.7% of patients. Junctional ectopic tachycardia and complete heart block were the most commonly observed arrhythmias, which is consistent with previous studies in pediatric cardiac surgery.

Prolonged cardiopulmonary bypass (CPB) time and aortic cross-clamp time showed significant associations with postoperative arrhythmias, suggesting that longer ischemic and perfusion durations increase myocardial stress and electrical instability. Complex procedures such as Tetralogy of Fallot, transposition of the great arteries, and TAPVC repair demonstrated a higher frequency of arrhythmias compared to simpler surgeries.

Hypothermia temperature was also significantly associated with arrhythmia development, with moderate and deep hypothermia linked to different arrhythmia patterns. Logistic regression analysis identified type of surgery, hypothermia, and gender as independent predictors of postoperative arrhythmia. The study was limited by its single-center design, relatively small sample size, and lack of long-term follow-up. Despite these limitations, the findings provide important local data regarding postoperative arrhythmia in pediatric congenital heart surgery patients and highlight the importance of perioperative monitoring and optimization of surgical factors to improve patient outcomes.

CONCLUSION

Postoperative arrhythmias are frequent complications in pediatric patients undergoing congenital heart surgery. Prolonged cardiopulmonary bypass time, aortic cross-clamp time, hypothermia, and complex surgical procedures were significantly associated with arrhythmia development. These findings emphasize the importance of careful perioperative monitoring and optimization of surgical factors to improve postoperative outcomes.

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