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Evaluation of Patients Who Were Followed Up After Pediatric Cardiac Surgery in the Pediatric Intensive Care Unit: 6 Years of Experience

Çocuk Yoğun Bakım Ünitesinde Pediyatrik Kalp Cerrahisi Sonrası Takip Edilen Hastaların Değerlendirilmesi: 6 Yıllık Deneyim

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Abstract

Introduction: This study aimed to evaluate the outcomes and clinical conditions observed during the postsurgical follow-up of children with congenital heart disease at a single center that initiated pediatric cardiac surgery in 2015.

Methods: A retrospective analysis of pediatric patients who underwent cardiac surgery between October 1, 2015, and December 31, 2021 was conducted. Demographic, preoperative, perioperative, and postoperative data were collected from echocardiographic, perfusion, and clinical records. Statistical analyses were performed using appropriate methods.

Results: A total of 692 pediatric patients underwent surgical treatment for congenital heart disease. The most common defects were ventricular, atrial, and tetralogy of Fallot. The most common preoperative risk factors were malnutrition and failure to thrive. Complications, such as respiratory issues, arrhythmias, and acute kidney injury, were observed. The overall mortality rate was 3.6%. Mortality rates varied according to specific congenital heart disease defects and risk categories.

Conclusion: This study provides valuable insights into the postsurgical follow-up of pediatric patients with congenital heart disease, highlighting the importance of risk stratification, preoperative evaluation, and postoperative care. The findings of this study contribute to the global understanding of congenital heart disease management and outcomes. Further research should focus

Öz

Giriş: Bu çalışma, 2015 yılında çocuk kalp cerrahisinin başladığı tek bir merkezde doğuştan kalp hastalığı olan çocukların cerrahi sonrasında izlem sırasında gözlenen sonuçları ve klinik durumları değerlendirmeyi amaçlamaktadır.

Yöntemler: 1 Ekim 2015 ile 31 Aralık 2021 tarihleri arasında kalp cerrahisi geçiren pediatrik hastaların geriye dönük bir analizi yapılmıştır. Demografik, preoperatif, perioperatif ve postoperatif veriler; ekokardiyografi raporları, perfüzyon raporları ve klinik kayıtlardan toplanmıştır. İstatistiksel analizler uygun yöntemler kullanılarak gerçekleştirilmiştir.

Bulgular: Toplam 692 çocuk hasta doğuştan kalp hastalığı nedeniyle cerrahi işlem geçirdi. En yaygın görülen kusurlar ventriküler septal defekt, atriyal septal defekt ve fallot tetralojisiydi. Preoperatif risk faktörleri arasında en sık malnütrisyon ve büyüme geriliği bulunmaktaydı. En sık solunum sorunları, aritmiler ve akut böbrek hasarı gibi komplikasyonlar gözlemlendi. Genel mortalite oranı %3,6 idi. Mortalite oranları belirli doğuştan kalp hastalığı kusurları ve risk kategorilerine bağlı olarak değişiyordu.

Sonuç: Bu çalışma, çocuk doğuştan kalp hastalığı hastalarının cerrahi sonrası takibi konusunda değerli veriler sunarak, risk gruplarının, preoperatif değerlendirmenin ve postoperatif bakımın önemini vurgulamaktadır. Bulgular, doğuştan kalp hastalığı yönetimi ve sonuçları konusunda katkıda bulunmaktadır. Bu hastalarda uzun dönem sonuçların değerlendirilmesi, risklerin azaltılması, mortalite

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Abstract

on risk adjustment, long-term outcomes, and strategies to reduce complications and mortality in this vulnerable population.

Keywords: Pediatric cardiac surgery, pediatric intensive care unit, complications, outcomes

Öz

ve komplikasyonları azaltmaya yönelik stratejilerin geliştirilmesi hedeflenerek çalışmaların yapılması gerekmektedir.

Anahtar Kelimeler: Pediyatrik kalp cerrahisi, çocuk yoğun bakım ünitesi, komplikasyonlar, sonuçlar

Introduction

The most common congenital malformations are congenital heart diseases (CHD). The incidence of CHD worldwide is 8-23 per 1000 births and is gradually increasing.[1-5] The frequency of CHD varies according to the population evaluated, diagnostic criteria used, and research methods.[4,5] There is a need for surgical treatment at varying rates depending on the type and severity of CHD. The success of surgical procedures depends on many factors.[6] For this reason, healthcare centers have used various risk classification systems to determine the risks and difficulty levels of pediatric heart surgeries. The STS-European Society of Cardio-Thoracic Surgery (STAT) Mortality Categories and Risk Adjustment for Congenital Cardiac Surgery (RACHS-1) Mortality Categories are methods used in risk stratification of performed procedures.[7,8] Various complications, including cardiovascular and non-cardiovascular systems, can be observed after pediatric cardiac surgery.[9] Cardiac arrest, arrhythmias, and low cardiac output syndrome (LCOS) are among the cardiovascular complications that may occur. Apart from the cardiovascular system, pulmonary/thoracic, infections, gastrointestinal, hepatic, neurological, hematological, and kidney complications can be observed.[10] Several registries have been conducted around the world to determine outcomes and advance the quality of treatment in patients with CHD.[11] The present study aimed to evaluate the results and clinical conditions observed during the postsurgical follow-up of children with CHD, which began in our center in 2015. In this way, we aim to identify crucial factors to reduce mortality and morbidity rates in patients in the future.

Materials and Methods

We retrospectively analyzed a series of pediatric patients who underwent cardiac surgery between October 1, 2015, and December 31, 2021. Cardiac surgery was performed on six hundred ninety-two pediatric patients, and these patients were subsequently evaluated. We scrutinized the preoperative, perioperative, and postoperative data extracted from echocardiography, perfusion, and clinical, inpatient, and operative notes of all patients.

The preoperative characteristics of the patients, including sex, cardiac and non-cardiac comorbidities, age at surgery, body weight at surgery, primary diagnosis of CHD, preoperative risk factors, and underlying genetic condition, were thoroughly examined. Preoperative risk factors are defined in the Appendices of the World Database for Pediatrics and Congenital Heart Surgery website.[12]

The outcome variables in this study included in-hospital death, mechanical ventilation (MV) duration in hours, the existence of the need for extracorporeal membrane oxygenation (ECMO) and kidney replacement therapy (RRT), pediatric intensive care unit (PICU) duration in days, hospital duration in days, STAT mortality categories, and RACHS-1 mortality categories.

The postoperative complications included acute kidney injury, pleural effusion requiring chest tube placement, atelectasis, junctional ectopic tachycardia, complete atrioventricular block, and major adverse events. Significant major adverse events included unplanned reoperation, complete heart block requiring the implantation of a permanent pacemaker, sudden cardiac arrest, and death. Acute kidney injury (AKI) is defined in accordance with the pediatric risk, injury, failure, loss, end-stage kidney disease criteria.[13] LCOS is defined as the use of ≥3 inotrope and is associated with the following: Tachycardia, oliguria, decreased skin perfusion, metabolic acidosis, or vasopressin requirement for hypotension and/or shock in the postoperative period. Pulmonary hypertension is defined as a clinically significant elevation of pulmonary arterial pressure requiring intervention.[14] Acute liver dysfunction was defined as liver dysfunction that met the PODIUM criteria, including aspartate aminotransferase >100 IU/L, alanine aminotransferase >100 IU/L, glutamyl transpeptidase >100 IU/L, total bilirubin >5 mg/dL or direct or conjugated bilirubin >2 mg/dL.[15] Systemic inflammatory response syndrome (SIRS) was determined according to the international pediatric sepsis consensus criteria, that is, the presence of at least two of the following four criteria with either abnormal temperature or leukocyte count as an obligate criterion: Core temperature >38.5 °C or <36 °C, tachycardia (irrespective of inotropic support) defined as mean heart rate >2 standard deviations (SD) beyond normal for age, mean respiratory rate >2 SD above normal for age, elevated or reduced age-specific leukocyte count or >10% immature neutrophils. Bypass-related SIRS is defined as SIRS occurring within the first 48 hours after bypass, at which no other etiological causes are detected.[16,17]

This retrospective study was approved by University of Health Sciences Turkey, İzmir Tepecik Education and Research Hospital Institutional Ethics Committee (2022/04-34) and was conducted in accordance with the principles of the Declaration of Helsinki.

Statistical Analysis

Statistical analyses were performed using the Statistical Package for the Social Sciences version 23.0 software (Armonk, NY: IBM Corp). The normal distribution of variables was evaluated using visual (histogram and probability graphs) and analytical methods (Kolmogorov-Smirnov and Shapiro-Wilk test). A descriptive analysis was performed using frequency tables for categorical variables, while means and SD were used to describe normally distributed variables. Medians and ranges were used to describe variables with non-normal distribution.

Results

In total, 692 patients underwent surgical treatment for CHD during the study period. Their demographic characteristics are presented in Table 1. The median patient age at operation was 14 months (range, 5-51.75 months). Among the patients, 348 (50.3%) were male. The median body weight of the patients was 8.5 kg (range, 5.53-15 kg) at the time of surgery. The most common defect was ventricular septal defect (VSD) (n=191, 27.6%), followed by atrial septal defect (ASD) (n=94, 13.6%), and tetralogy of Fallot (ToF) (n=57, 8.2%) (Table 2). Pre-existing diseases were present in 157 patients (22.7%); the most common genetic anomaly was Down syndrome (n=76, 11%). There were no non-cardiac anomalies in 542 (78.3%) patients. The most common non-cardiac anomaly was a craniofacial anomaly (n=113, 16.3%) (Figure 1). Among all patients, 409 (59.1%) had no preoperative risk factors, 157 (22.7%) had 1 risk factor, 73 (10.5%) had 2 risk factors and 53 (7.7%) had 3 or more risk factors. The number of preoperative risk factors was significantly higher in patients who died (0.66±1.01 vs. 2.08±1.92; p<000.1). The most frequent risk factors were malnutrition (n=175, 25.3%) and failure to thrive (n=105, 15.2%) (Table 3). Figures 2 and 3 represent the risk categories for cases submitted, stratified by STAT and RACHS-1 mortality categories, respectively. A total of 563 (81.4%) patients underwent an initial major cardiac procedure, whereas 129 (18.6%) had reoperation. The majority of surgical cases were transported to the operating room either electively (n=675, 97.5%) or urgently (n=17, 2.5%).

Table 1. Demographic characteristics, operative variables and postoperative complications of patients

Variable		Patients (n=692)
Age (months), median (interquartile range)		14 (5-51.75)
Weight (kg), median (interquartile range)		8.5 (5.52-15)
Males, n (%)		348 (50.3%)
Pre-existing disease, n (%)	Other syndromes	77 (11.1%)
	Down syndrome	76 (11%)
	Mental retardation	3 (0.4%)
	Asthma	2 (0.3%)
	Epilepsy	1 (0.1%)
Bypass time (min), mean ± SD		69.3±33.4
Aortic cross-clamp time (min), mean ± SD		52.2±26.9
Reoperation rate, n (%)		129 (18.6%)
Outcomes		
MV time (hours), median (interquartile range)		3 (2-4)
PICU hospitalization duration (days), median (interquartile range)		3 (2-5)
Total hospitalization duration (days), median (interquartile range)		6 (5-9)
Total complications, n (%)		149 (21.5%)
Mortality, n (%)		25 (3.6%)
Complications		
Respiratory events (%)	Pleural effusion	36 (5.2%)
	Pulmonary atelectasis	34 (4.9%)
	Chylothorax	9 (1.3%)
	Pneumothorax	5 (0.7%)
	Diaphragm paralysis	1 (0.1%)
Acute kidney injury, n (%)		50 (7.2%)

Table 1. Continued

Variable		Patients (n=692)
Arrhythmia, n (%)	Junctional ectopic tachycardia	28 (4%)
	Transient complete AV block	9 (1.3%)
	Permanent complete AV block	1 (0.1%)
	First-degree AV block	1 (0.1%)
	Second-degree AV block	1 (0.1%)
	Nodal rhythm	1 (0.1%)
	Frequent ventricular extrasystoles	1 (0.1%)
	Ventricular tachycardia	1 (0.1%)
Low cardiac output syndrome, n (%)		28 (4%)
Acute liver dysfunction, n (%)		12 (1.7%)
Pulmonary hypertension, n (%)		7 (1%)
Bypass-related systemic inflammatory response syndrome, n (%)		6 (0.9%)
Pericardial effusion/tamponade, n (%)		6 (0.9%)
Shunt dysfunction, n (%)		3 (0.4%)
Mediastinitis, n (%)		2 (0.3%)
Major adverse event rate, n (%)		1 (0.9%)

PICU: Pediatric intensive care unit, SD: Standard deviation, MV: Mechanical ventilation, AV: Atrioventricular

Table 2. The types of congenital cardiac defects, procedures and outcomes of patients

Diagnosis, n (%)	Procedure	n (%)	Mortality, n (%)
Ventricular septal defect, 192 (27.7)	Repair	151 (78.6)	0 (0)
	Debanding and repair	25 (13)	0 (0)
	Pulmonary artery banding	16 (8.3)	2 (12.5)
Atrial septal defect, 94 (13.6)	Repair	94 (13.6)	0 (0)
Tetralogy of Fallot, 48 (6.9)	Complete repair	44	0 (0)
	MBT shunt	4	1 (25)
Tetralogy of Fallot with pulmonary atresia, 15 (2.2)	Rastelli	10 (66.7)	2 (20)
	MBT shunt	3 (20)	0 (0)
	Central shunt	2 (13.3)	1 (50)
Double-outlet right ventricle, 53 (7.7)	Complete repair	39 (73.6)	0 (0)
	MBT shunt	4 (7.5)	1 (25)
	Pulmonary artery banding	1 (1.9)	0 (0)
	Rastelli	9 (16.9)	0 (0)
Vascular ring, 44 (6.4)	Division	18 (40.9)	0 (0)
	Division and re-anastomosis	7 (15.9)	0 (0)
	Aortopexy	19 (43.2)	0 (0)
Atrioventricular septal defect, complete, 22 (3.2)	Complete repair	20 (90.9)	5 (25)
	Pulmonary artery banding	2 (9.1)	0 (0)
Atrioventricular septal defect, partial, 19 (2.8)	Complete repair	19 (100)	1 (5.3)
Aort coarctation. 34 (4.9)	End-to-end anastomosis	24 (70.6)	0 (0)
	Patch aortoplasty	10 (29.4)	0 (0)
Hypoplastic right ventricle.20 (2.9)	Glenn shunt	9 (55)	2 (22.2)
	Pulmonary artery banding	5 (25)	1 (20)
	MBT shunt	3 (15)	3 (100)
	Central shunt	1 (5)	0 (0)

Table 2. Continued

Diagnosis, n (%)	Procedure	n (%)	Mortality, n (%)
Hypoplastic left ventricle, 9 (1.3)	Pulmonary artery banding	4 (44.4)	2 (50)
	Norwood stage 2	1 (11.1)	0 (0)
	Norwood comprehensive stage 2	2 (22.2)	1 (50)
	Atrial septectomy	1 (11.1)	1 (100)
	Fontan	1 (11.1)	0 (0)
Patent ductus arteriosus, 22 (3.3)	Surgical closure	22 (100)	0 (0)
PAPVC 16 (2.3)	Repair	16 (100)	0 (0)
TAPVC =4 (0.6)	Repair	4 (100)	0 (0)
Discrete subaortic membrane, 11 (1.6)	Resection of the membrane	11 (100)	0 (0)
Truncus arteriosus, 3 (0.4)	Rastelli	3	0 (0)
c-TGA, 2 (0.3)	Pulmonary artery banding	1 (50)	0 (0)
	VSD closure	1 (50)	1 (100)
An anomalous origin of the coronary artery, 6 (0.9)	Unroofing	6 (100)	0 (0)
Interrupted aortic arch, 3 (0.4)	Aortic arch reconstruction	3 (100)	0 (0)
Cardiac tumor, 1 (0.1)	Resection	1 (100)	0 (0)
Cor triatriatum, 2 (0.3)	Membrane resection	2 (100)	0 (0)
Complete AV block, n=3 (0.4)	Pacemaker implantation	3 (100)	0 (0)
Ebstein anomaly, 2 (0.3)	Cone repair + Glenn shunt	1 (50)	0 (0)
	Glenn shunt	1 (50)	0 (0)
Supramitral ring, 2 (0.3)	Resection	2 (100)	0 (0)
Pulmonary artery stenosis 13 (1.9)	Pulmonary artery reconstruction	13 (100)	0 (0)
Pulmonary valve disease, 24 (3.5)	PVR	13 (50)	0 (0)
	Conduit replacement	4 (15.4)	0 (0)
	Valvuloplasty	7 (26.9)	0 (0)
Mitral valve disease, 7 (1)	MVR	4 (57.1)	0 (0)
	Valvuloplasty	3 (42.9)	0 (0)
Aortic valve disease, 12 (1.7)	AVR	8 (66.7)	0 (0)
	Valvuloplasty	4 (33.3)	0 (0)
Scimitar syndrome, 4 (0.6)	Complete repair	4 (100)	0 (0)
Other, 5 (0.7)	Repair	5 (100)	1 (20)

AV: Atrioventricular, VSD: Ventricular septal defect

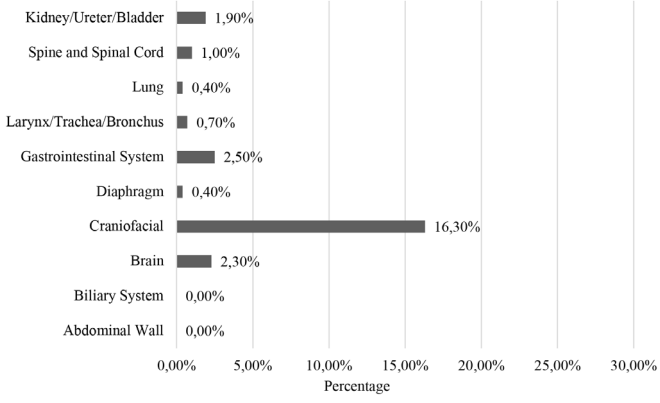

Figure 1. Non-cardiac congenital anatomic abnormality

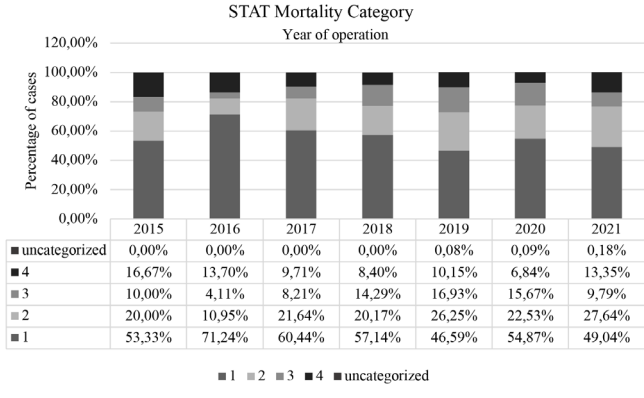

Figure 2. STAT mortality category by years
STAT: European Society of Cardio-Thoracic Surgery

Of all patients, 62.4% (n=432) underwent bypass during surgery. The mean cardiopulmonary bypass (CPB) time was 69.3±33.4 minutes (range, 10-217 minutes). The mean aortic cross-clamp (ACC) time was 52.2±27 minutes (range, 13-180 minutes).

ECMO support was provided to a small percentage of patients (n=2, 0.3%). A total of 149 (21.5%) patients experienced at least 1 postoperative complication (Table 1). The most common complications were postoperative respiratory complications (n=85, 12.3%); arrhythmia (n=43, 6.2%); and AKI (n=50, 7.2%). One patient (0.1%) with kidney failure required kidney replacement therapy. The median [interquartile range (IQR)] MV duration, PICU stay, and hospital stay of the patients were 3 hours (2-4 hours), 3 days (2-5 days), and 6 days (5-9 days), respectively.

Overall mortality rate was 3.6 (n=25). Table 4 presents hospital mortality by year for the STAT and RACHS-1. The mortality rate following VSD repair was 1%, the following ASD repair was 0%, and following ToF correction was 1.8%. Mortality for most STAT category 1 and 2 procedures ranged from 0.3% to 2%, with higher STAT categories showing substantially higher rates. Mortality for most RACHS-1 category 1 and 2 procedures ranged from 0% to 1.2%.

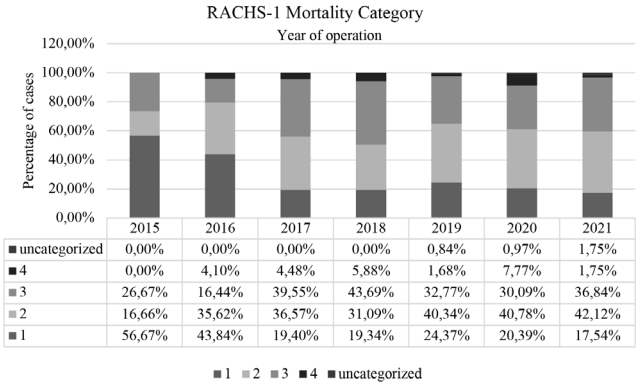

Figure 3. RACHS-1 mortality category by years
RACHS-1: Mortality Categories and Risk Adjustment for Congenital Cardiac Surgery

Discussion

This study is the first to evaluate the data of all patients who were followed up for 6 years from the initial day of congenital heart surgery follow-up at our center. This research has the potential to enhance the quality of our center, not only through the utilization of international classification and risk scoring systems, but also by incorporating real-time reports. The findings of our study on the postsurgical follow-up of children with CHD at our center in 2015 align with previous

Table 3. Preoperative risk factors

Preoperative risk factors	n	%
None	409	59.1
Malnutrition	175	25.3
Failure to thrive	105	15.2
Greater than 2 hospital admissions for non-cardiac infections in last 3 months	52	7.5
Neurological deficit	44	6.4
Endocrine abnormalities	43	6.2
Seizure	20	2.9
Shock, resolved at the time of surgery	10	1.4
Mechanical ventilation for cardiorespiratory failure	8	1.2
Respiratory failure not requiring ventilation	7	1
Bronchopulmonary dysplasia	6	0.9
Kidney dysfunction	5	0.7
Tracheostomy present	5	0.7
Cardiopulmonary resuscitation	4	0.6
Sepsis	3	0.4
Other	3	0.4
Coagulation disorder	2	0.3
Asthma	2	0.3
Pacemaker present	1	0.1
Kidney failure requiring dialysis	1	0.1

Table 4. Mortality by years

Year of operation	Total number	Mortality number (%)	STAT category mortality (n)					RACHS-1 category-related mortality, n				
			1	2	3	4	UC	1	2	3	4	UC
2015	30	1 (3.33%)	0	1	0	0	0	0	1	0	0	0
2016	73	5 (6.85%)	0	2	1	2	0	0	2	3	0	0
2017	134	2 (1.49%)	0	0	0	2	0	0	0	2	0	0
2018	119	7 (5.88%)	0	0	3	4	0	0	0	6	1	0
2019	119	6 (5.04%)	0	0	2	3	1	0	0	4	1	1
2020	103	0 (0%)	0	0	0	0	0	0	0	0	0	0
2021	114	4 (3.5%)	0	0	1	3	0	0	0	3	1	0
Total	692	25 (3.6%)	0	3	7	14	1	0	3	18	3	1

UC: Uncategorized, RACHS-1: Mortality Categories and Risk Adjustment for Congenital Cardiac Surgery, STAT: European Society of Cardio-Thoracic Surgery

research conducted in different regions. The incidence of CHD varies globally, as reported in various studies. For instance, the Guangdong Registry of Congenital Heart Disease in China reported an incidence consistent with our findings.[1] Similarly, studies conducted globally have highlighted the changing landscape and burden of CHD.[2-5] In a multicenter study conducted in our country, the most common cardiac defects requiring surgery were VSD, ASD, and ToF.[18] Correspondingly, in our study, the most common cardiac defects were VSD, ASD, and ToF.

Furthermore, the presence of genetic anomalies, particularly Down syndrome, was consistent with previous reports.[2] In one study, 9.9% had a documented genetic syndrome, with the majority of patients having Down syndrome (72%). In the same study, the most common non-cardiac anomalies were the gastrointestinal system, larynx/trachea/bronchus, craniofacial, kidney/ureter/bladder, and brain anomalies, respectively.[19] Notably, our study identified a higher prevalence of craniofacial anomalies than other non-cardiac anomalies, warranting further investigation. After craniofacial anomalies, the order of frequency was gastrointestinal system, brain, and kidney/ureter/bladder. Genetic anomalies were present in 153 patients (22.1%); the most common genetic anomaly was Down syndrome (49.7%).

In one study, a preoperative risk factor was present in 25% of the patients. The most frequent risk factors were failure to thrive/malnutrition and respiratory issues.[19] In another study, the most common preoperative risk factors were mechanical MV and pulmonary hypertension. However, malnutrition and failure to thrive were not assessed as preoperative risk factors in this study. Additionally, in the same study, the mortality rate increased with the number of risks factors.[18] Similarly, our study revealed a relationship between risk factors and mortality. The distribution of preoperative risk factors observed in our study, such as malnutrition (25.3%) and failure to thrive (15.2%), is consistent with the existing literature.[6-8] These risk factors contribute to the complexity and management of CHD cases, necessitating appropriate preoperative evaluation and perioperative care.

In this study, the majority of surgical cases were scheduled as elective procedures (86%) or urgent procedures (12%). CPB was used in most cases (93%). The median duration of CPB was 84 min (IQR: 63-120 minutes), and the median ACC time was 52 min. Approximately 80% of patients in this study were categorized under STAT and RACHS-1 categories 1 and 2.[19] Another study involving 325 surgeries reported that 83% of them were performed with CPB support, whereas 17% were conducted without CPB support. The median CPB time was 120 min (IQR: 88-158 minutes), and the median ACC time was 41 min (IQR: 24-58 minutes).[9] In our study, 62.4% of patients underwent bypass during the surgical procedures. The mean durations of CPB and ACC were consistent with the existing literature. Furthermore, the distribution of patients according to STAT and RACHS-1 categories corresponded with that of previous studies, with the majority falling into categories 1 and 2. The surgical cases were primarily elective (97.5%), with a small proportion classified as urgent (2.5%).

In numerous studies, the most prevalent complications during the postoperative period are respiratory conditions.[20-23] In a study exclusively involving infants, respiratory complications were the most frequent, exceeding 20%. In this study, bleeding was identified in 19.2% of patients, arrhythmia in 16.9%, and AKI in 6.9%.[20] Notably, the rate of excessive bleeding, which was significantly higher than that observed in our study, may be attributed to the fact that the study focused solely on infants, with newborns being the majority. In a study by Murni et al.,[22] pleural effusion (14.8%) and atelectasis (6.2%) were the most common respiratory complications. The most common cardiac complications observed in this study were arrhythmia (18.6%) and LCOS (19.8%). Although the specific types of arrhythmias were not specified, the complete atrioventricular (AV) block rate was 5.8%. In a multicenter study conducted in Turkey, respiratory complications were the most common, with 32.1% of patients experiencing at least one complication. In this study, the requirement of postoperative ECMO was observed in 3.9% of patients, and LCOS was detected in 6.1%.[18] The occurrence of postoperative complications in our study, such as respiratory complications (12.3%), arrhythmia (6.2%), and AKI (7.2%), aligns with findings from other investigations. We found that 21.5% of patients experienced at least one postoperative complication. ECMO support was utilized in a small percentage of patients (0.3%). St. Louis et al.[19] reported a need for ECMO of 0.2%. Studies report variable (3-42%) incidences of AKI after cardiac surgery in children.[23-26] In previous studies, it has been observed that 4-8% of patients with AKI require RRT.[19,27,28] In our study, AKI was detected in 7.2% of patients, with 2% of these patients requiring RRT. Discrepancies in the incidence and need for RRT in AKI-related studies are attributed to variations in the selected patient populations and differences in AKI definitions. In our study, the low incidence of RRT requirement may be attributed to the inclusion of patients, such as those with vascular rings, who do not require bypass and are often excluded in many studies. In a study evaluating arrhythmias after postoperative cardiac surgery, junctional ectopic tachycardia (JET) (45.2%) and complete AV block (27.3%) were the most common.[29] Similarly, in our study, JET (65.1%) and transient complete AV block (20.9%) were the predominant arrhythmias. These complications underscore the necessity of vigilant postoperative monitoring and appropriate management strategies to minimize adverse outcomes.

We found that the median MV duration, PICU stay, and hospital stay were 3 hours, 3 days, and 6 days, respectively. Although the durations of ICU and hospitalization in our study were comparable to those reported in the literature, the MV duration was notably shorter. In other studies, the median MV duration was reported to be 12-18 hours, PICU stay 1-3 days, and hospital stay 6 days.[22,30,31]

In terms of mortality, our study reported an overall mortality rate of 3.8%. Various studies reported mortality rates ranging from 2.6% to 13.6%.[18,19,22,32] Mortality rates varied according to specific CHDs and the STAT and RACHS-1 categories. Comparisons with the existing literature revealed similar trends, with higher mortality rates associated with complex procedures.[18,19] In our study, mortality for most STAT categories 1 and 2 ranged from 0.3% to 2%, with the higher STAT categories showing substantially higher rates. Mortality for most RACHS-1 category 1 and 2 procedures ranged from 0% to 1.2%.

Study Limitations

It is essential to acknowledge the limitations of our study, including its retrospective nature and single-center design. These limitations may have affected the generalizability of our findings. Other study limitations include the absence of long-term follow-up and the exclusion of patients in the mortality categories STAT category 5, RACHS-1 category 5, and 6. This exclusion was attributed to the fact that the newborn patient group was not included in the follow-up. However, our study provides valuable insights into the existing body of knowledge on the post-surgical follow-up of children with CHD. Additionally, it provides important data regarding the 6-year experience of a center where congenital heart surgery has been performed in a developing country and its role in this process.

Conclusion

In conclusion, our study provides valuable data on the results and clinical conditions observed during the postsurgical follow-up of children with CHD at our center since 2015. The findings align with previous research, thereby contributing to a global understanding of CHD management and outcomes. Further research, collaborations, and the use of clinical databases and registries will continue to enhance our understanding of pediatric cardiac surgery and improve patient care. Future studies should focus on risk adjustment methods, long-term outcomes, and interventions to reduce complications and mortality rates in this vulnerable population.

Ethics

Ethics Committee Approval: This retrospective study was approved by University of Health Sciences Turkey, İzmir Tepecik Education and Research Hospital Institutional Ethics Committee (2022/04-34) and was conducted in accordance with the principles of the Declaration of Helsinki.

Informed Consent: Retrospective study.

Footnotes

Authorship Contributions

Surgical and Medical Practices: A.B.A., G.Ö., F.D., E.P.K., O.I., Ü.A., A.R.B., Concept: A.B.A., G.Ö., A.R.B., Design: A.B.A., G.Ö., Data Collection or Processing: G.Ö., F.D., E.P.K., Analysis or Interpretation: A.B.A., G.Ö., O.I., Ü.A., A.R.B., Literature Search: A.B.A., G.Ö., F.D., E.P.K., O.I., Ü.A., A.R.B., Writing: A.B.A., G.Ö., F.D.

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