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ORIGINAL ARTICLE

Surgical outcomes of congenital heart diseases in a pediatric hospital: a two-year survey

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Abstract

Introduction: Along with advances occurring in cardiopulmonary bypass (CPB) including improved anesthesia intubation and early surgical interventions, it has become possible to correct life-threatening congenital heart anatomic abnormalities in patients. Our study aimed to collect information from one of the most important centers of pediatric cardiac surgery in Iran since there is limited information in this field in our country.

Methods: In this study, the results of pediatric cardiac surgery and mortality were studied for two years. A retrospective, descriptive study was carried out on 789 patients within two years. 401cases were excluded as they had congenital heart disease complexity. The patients were referred from other pediatric cardiac medical centers. Information related to kinds of surgical operation and deaths were collected from patients' documents and questionnaire. The data were analyzed by descriptive statistical tests in SPSS version-16.

Results: The age range of patients varied from three days to 18 years. The male/female ratio was 53.4%. CPB was not applied for 21.1% of patients. The frequency of operations included PDA (Patent Ductus Arteriosous) [D&L] (%8.5), total correction for TF (Tetralogy of Fallot) (%16.7), systemic to pulmonary shunt (%26.5), ASD (Atrial Septal Defect) and VSD (Ventricular Septal Defect) closure (%5.4) and (%28), respectively as well as coarctationrepaire (%14.6). Total mortality rate was 8.6%. Analysis of the operated population showed that outcome of patients has improved in recent years.

Conclusions: Compared with other studies, the results of our investigation showed that children's congenital heart surgery is on the rise.

Key Words: Congenital Heart Diseases; Cardiac Surgery; Mortality; children

Introduction

Cardiovascular diseases are life-threatening disorders. Their prevalence in the United States is estimated to be 17 million cases a year, among which 64% are related to coronary artery diseases, 29.4% to valvular diseases, and 5.8% to congenital heart diseases (CHDs). Almost 1 million of these patients require angiography every year, while 500,000 of them are operated [1].

Amongst them, CHDs are revealed as functional and structural disorders since birth. A total number of 130 million babies are born annually, while 4 million of them die during their neonatal

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period, 7% of which is due to heart disorders [2].

The overall incidence of CHDs is considered as approximately 6-8 cases per 1000 alive births. However, according to a systematic review and meta-analysis study in 2011, the incidence has been reported about 9.1: 1000 [3].

The number varies in African and Asian countries, and ranges between 1.9 to 9.7%, and in 2015, a study reported it about 5.3% in Brazil, where the prevalence of PDA, ASD and VSD are obtained as 7.6, 4.5 and 2.6 respectively [4]. According to a study in Oman in 2000, this number was reported as 7.1%. The pattern of CHD in Oman was similar to European countries so that 24.9% were VSD, 14.4% were ASD, and 10.3% were PDA. Only the prevalence of AVSD is reported higher and about 5.9%. Moreover, 21.3% of diseases were cyanotic [5].

The numbers of cardiac surgeries are increasing and by improving the quality of cardiac surgery, a greater number of patients become adults. Most of these patients suffer from simple forms of diseases, while complex types usually have shorter survival and require recurrent surgery [6].

Considering the importance of CHD, infant mortality, and lack of comprehensive information in this area, we have studied a variety of cardiovascular procedures performed on children as well as their consequential deaths in one of the main centers of cardiovascular surgeries.

Methods

This research was conducted using descriptive, retrospective method. The total number of hospitalized patients under study was 789 of whom 388 were included, while 401 were excluded because of CHD complexity. The study was carried out during two years in the intensive care unit of the Children's Medical Center of Tehran. The data related to age, gender, type of surgery, cardiopulmonary bypass and mortality rate were collected through questionnaire. The analysis of data was performed using descriptive statistical methods as ratio and average, and displayed in charts and tables.

Results

The age range of patients was from 3 days to 18 years and 53.4% of them were male. The finding of the research showed that cardiopulmonary bypass was used for 79.9% of the patients. The distribution of surgical procedures by age group is shown in table 1. The rate of deaths in the operated patients in the intensive care unit was about 8.6. d The distribution of surgical procedures in patients who have died are listed in Table 2.

Table 1: Distribution of surgical procedures according to age in the studied patients

Age	COA	VSD	ASD	TF	PDA	DTGA
month	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
<12	49 (12.2)	51 (42.8)	6 (28.5)	20 (30.7)	30 (90)	88 (85.43)
36-13	3 (1.9)	35 (32.1)	6 (28.5)	22 (33.8)	1 (3)	9 (8.7)
>37	5 (3.2)	43 (39.4)	9 (42.8)	23 (37)	2 (6)	6 (5.8)

* Patent Ductus Arteriosus ** Tetralogy of l *** Arterial Septal Defect
**** Ventricular Septal Defect # D-Transposition Great Arteries

Table 2: Distribution of surgical procedures in patients who have died

Operation	N (%)
Arterial switch	12 (26.6)
TF correction	2 (4.4)
ASD closure	1 (2.2)
VSD closure	6 (13.3)
PDA closure	2 (4.4)
Others	22 (48.8)
Total	45 (100.0)

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Discussion

According to Ahmadi et al's study (2002) in Shahid Rajaee's cardiology center of Iran, which was carried out on 1500 patients, extracted from 7900 documents, showed that the majority of the surgeries performed (83%) were on 3-12 year-old patients of whom only 10% were in infancy period. Moreover, in our study, 55.8% of the patients were less than 1 year old, 22.2% were between 13 to 36 months old, and only 22% of them were older than 3 years old. Lowered age of pediatric cardiac operation (less than 1 year) could be due to the improvement of surgical techniques as well as surgical skills [7].

In a study conducted in 2010, the mortality rate of infants after CHD was reported as lower during infancy than adulthood [8]. In our study, unlike the study of Ahmadi et al, the overall mortality decreased from 9.5% to 8.6%, and in recent years, the mortality rate after cardiac surgery during infancy period has dramatically decreased compared to adulthood, which is probably due to improved instruments and skills of heart surgeons [8,9]. In this study, for 79.9% of patients CPB is used which is different from the study of Ahmadi et al, where for 60% of the patients, heart-pulmonary pump was used [7].

In our study, the most common surgery was VSD surgical closure (28%) followed by arterial or atrial switch operation (13.3%) where 100% of the arterial switch operations were performed on children under 1-year old. VSD closure rate for children under 1-year old was 42.8%. Whereas PDA closure in Ahmadi et al. study was the most common surgery during 1366 to 1375 with a rate of 85% on 3-12 year-olds, the rate was 90% for less than 12-month children in our study [8].

Today, the age for PDA surgical closure is the infancy period in the developed countries, but we use the surgical option only in a few very large defects in infancy or childhood. Another method, PDA surgical closure, can be noted as a thoracoscopic procedure in which the patient lies on his/her left side under general anesthesia. In this method, three cuts are made on the left side of the chest in size of 3 centimeters and ends with installed clips on the PDA by thoracoscope; this method has a low mortality rate. Hospitalization continues for about 3 days in advanced centers by this method, and child rehabilitation after 3 to 4 weeks will be in full activity. In a study conducted in 2014, it was considered preferable to intervention [10]. However, the standard, more preferred treatments of PDA closure include Amplatzer and coilsin in infants and even in adults with a high rate of success, few complications and shorter hospitalization period, making it a standard approach [10, 11].

Total correction using Tetralogy of Fallot (TF/TC) was 16.5% of the cases in the study of Ahmadi et al, which was mainly performed on 5 to 7 year old patients. In our study, TF/TC was used in 16.5% of all cases. Also, the maximum age was over three years (37%), which was lower than the previous study so it has decreased significantly [7].

Ventricular septal defect surgical closure was of a rate of 8% in Ahmadi et al's study, and ventricular septal defect was closed in half of the patients between 3-12 years old. However, in our study, VSD was closed in %28 of patients, while 42.8% of them were less than one year. In the study of Ahmadi et al., the lower number of VSD surgical closure (compared to similar studies) could be due to spontaneous VSD closure in patients under 2 years old. Nonetheless, according to the study of Aydemir and colleagues, VSD surgical closure in patients under 1 year old and preferably less than 3 months, causes lower mortality and requires shorter hospitalization time [7, 12].

Today, using the hybrid procedure in Apical VSDs closure by Michel-Behnake et al. has a higher risk than surgery, and the VSD device closure has been used with ADO (Ampelatzer Ductal Occluder), although it has not yet been approved by FDA [13, 14].

VSD closure is indicated for heart failure, failure to thrive, recurrent respiratory infections, pulmonary hypertension and aortic valve associated insufficiency. Sometimes, because of pulmonary hypertension, VSD surgical closure is done in two stages: first, pulmonary artery stenosis is corrected on the pulmonary artery via the implementation of band and in the next stage. Later, the normalization of pulmonary artery pressure, the band is removed from the pulmonary artery, and the VSD is closed. The number of pulmonary artery banding was about 4.9% in this study [15].

Moreover, in the study by Ahmadi et al., ASD defect involved 5.4% of patients and in 68% of the cases, the age range of operated patients was between 7 to 12 years old, while in our study the isolated form of ASD was 2.7% , but association of PDA, PS and VSD were 1% of all the cases. During the past two decades, the surgical repair of ASD (via catheterization with ASO) has improved [7].

The study by Murphy et al on the repair of ASD showed that the delay in ASD closure may possibly increase damage to the patients after age 13-19 [16]. In our study, other operations were 50.8% of

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the total cases, while the figure was 32% in Ahmadi et al's study.

In the meantime, surgeries are very important in our study including FontanandGlenn operation which was 3.3%, aortopulmonary shunt which was 26.5%, while in the study by Ahmadi et al, the overall percentage for operations was 2.5%.

Also in our study, the occurrence rate of coarctation of the aortarepair was 14.6%, of which 12.2% was performed on children under one year old [7].

In the study of Ahmadi and his colleagues, Arterial Switch operation was conducted in few cases of Shahid Rajai's Cardiology Center, while 13.4% of our surgeries were switch operation and 85.4% of the cases were under one year old [7].

Conclusions

The annual number of surgical procedures has increased to 159 from 2011 to 2012 which was due to improved facilities and increased number of surgeons, increased experience of the surgical team and increased number of intensive care units.

Overall, compared to the previous studies, age of patients has decreased due to a number of factors including early visit, knowledge of the patient's parents, improved equipment in the operation rooms and intensive care units, and increased skills on the part of the surgical teams, making a better future for this group of patients [8].

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