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Evaluation of the Pediatric Cardiac Surgical International Assisted Campaign in Basra Governorate, Southern Iraq

Firas S. Al-Nuaim[1], Khalid A. Khalid [2], Alaa H. Abed [3], Dhurgham A. Abdulwahid [4], Basim A.A. Alhijaj [5*]

1. *Department of Cardiothoracic & Vascular Surgery, Basra Oil Hospital for Cardiology and Cardiac Surgery, Basra, Iraq*
2. *Department of Pediatric Cardiology, College of Medicine, University of Basrah, Basra, Iraq*
3. *Department of Science and Technology, Basra University College of Science and Technology, Basra, Iraq*
4. *Iraqi Association of Medical Research and Studies (IAMRS), Basra, Iraq*
5. *Center for Hereditary Blood Diseases, Al-Zahraa Medical College, IAMRS Secretary, Basra, Iraq*

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***Corresponding author:**

Basim A.A. Alhijaj,

Head of the Basra Center for Hereditary Blood Diseases, Al-Zahraa Medical College, IAMRS Secretary, Basra, Iraq

Email: basimhijaj76@gmail.com

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ABSTRACT

Background & Objective: Congenital heart disease (CHD) encompasses structural or functional defects of the heart and/or great vessels present at birth. According to the Ministry of Higher Education and Scientific Research, pediatric cardiac surgery remains among the scarcest medical specialties in Iraq, reflecting a substantial national shortage of human resources in this field. The medical recruitment program in Basra was established in 2005, with pediatric cardiac surgery as one of its main domains.

Materials & Methods: The present study reports comprehensive descriptive data that cover and compare the outcomes of the two surgical approaches, and constitutes the first national-level investigation on this issue. An electronic database was created for 143 patients who underwent surgical treatment under the governmental cardiac recruitment mission from January 20, 2022, to December 5, 2022.

Results: Ventricular septal defect (VSD) was the most frequently operated lesion (31.7%), followed by tetralogy of Fallot (28.6%). Total defect repair was the most commonly performed corrective procedure (76.2%). A RACH-1S score of 2 accounted for more than half of the cases. Respiratory infection constituted the most frequent complication, with an overall complication rate of 15.9%. Mortality was approximately 4.8%. The median ICU stay was 1 day (maximum 13 days), whereas the median total hospital stay was 9 days (maximum 40 days).

Conclusion: The 30-day complication and disease-related mortality rates observed in the present cohort were satisfactory and lower than those reported in comparable series. It is recommended that the local governmental cardiac surgery recruitment program be expanded to enroll a greater number of patients within similar risk categories.

Keywords: *Pediatric cardiac surgery, alliance, congenital heart disease, RACH-1 score*

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1. Introduction

Congenital heart disease (CHD) refers to structural or functional defects in the heart and/or proximal blood vessels present at birth. Its global incidence is approximately 8-10 per 1,000 live births (1). Although this prevalence varies by country, it has remained relatively constant worldwide (2). However, the burden appears to have increased in countries with high birth rates. Children born with CHD in developing countries often lack access to adequate care. The establishment of congenital heart surgery programs in these countries is frequently hindered by competition among providers for limited resources and opportunities (3,4). The shared goal should be to ensure universal access to cardiac care while reducing CHD-related mortality and morbidity. At present, access to cardiac facilities is highly unequal, and more than 70% of facilities lack adequate resources (4). The global burden of CHD is substantial, with estimates ranging from 8 to 12 cases per 1,000 live births. Although this burden appears to be distributed relatively evenly across countries, access to treatment is not. Low- and middle-income countries tend to have higher fertility rates, placing a greater burden on wage earners in these

regions (5). Several studies have investigated the local epidemiology of CHD in Iraq. In Sulaymaniyah Governorate, the overall incidence of congenital heart disease was 1.7 per 1,000 live births in 2015 and 1.6 per 1,000 live births in 2016 (6). In Baghdad, among 96 patients with CHD, 48 had a ventricular septal defect (VSD; 50%), 18 were diagnosed with tetralogy of Fallot (18.75%), and 14 had patent ductus arteriosus (14.58%). Nine patients were diagnosed with transposition of the great arteries (9.37%) (7). A similar distribution was observed in Mosul, where the reported prevalence was 6.1 per 1,000 patients. Atrial septal defect (42%), VSD (30%), and patent ductus arteriosus (9.3%) were the most common CHDs identified (8). In Basra, a study analyzing 1,414 echocardiography examinations conducted over 24 months found that 570 patients (40%) had CHD. The most common diagnosis was ventricular septal defect (43.3%), followed by tetralogy of Fallot (12.6%), atrial septal defect (11.9%), patent ductus arteriosus (9.4%), atrioventricular septal defect (6.4%), pulmonary stenosis (3.8%), and complex heart defects (2.6%) (9).

Enhancing local capacity for CHD repair is essential for improving child health outcomes (4,10). Nevertheless, pediatric cardiac surgery remains one of the scarcest specialties in Iraq, according to the Ministry of Higher Education and Scientific Research, highlighting a significant national shortage of medical human resources in this field (11). The waiting list for pediatric cardiac surgery in Basra reached 221 patients by the end of August 2022. This prompted the local government to adopt two parallel approaches: medical evacuation and medical recruitment. This study presents comprehensive descriptive data comparing the outcomes of both approaches, marking the first national-level study on this topic. The medical recruitment program in Basra was established in 2005, focusing on various specialized medical fields, with pediatric cardiac surgery serving as one of its major domains. In 2012, the International Children's Heart Foundation team—originating from the Dr. Novick Alliance—began its mission in Basra Governorate through three successive campaigns held in December 2012, July 2013, and October 2013, successfully performing surgery on 15, 20, and 16 pediatric CHD cases, respectively. This was followed by a compulsory three-year suspension due to the prioritization of adult cardiac cases. Pediatric surgeries resumed in 2016 with a single campaign treating 14 patients, which was then followed by a four-year complete hiatus caused by severe national financial constraints compounded by the ISIS conflict. The program was briefly re-established in 2020 through an Indian medical recruitment team in cooperation with Fortis Hospital, which operated on only 12 cases before being interrupted by the global COVID-19 pandemic. In 2022, following the establishment of a new governmental cardiac center and collaboration with the local medical team, the pioneering Novick Alliance team returned. Over four successive trips, the team treated more than 126 pediatric cardiac patients out of Basra's total waiting list of 225. This study aims to highlight the demographic and clinical aspects of the campaign descriptively, analyze the overall outcomes of the international mission, and identify the strengths and pitfalls of the recruitment program regarding cardiac surgical outcomes.

2. Materials and Methods

2.1 Patients

An electronic database was created for 143 patients who underwent surgical treatment through the governmental cardiac recruitment mission between January 20, 2022, and December 5, 2022. The database was developed by the research team using real-time data entry and included the following variables:

- Patient name, date of birth, gender, date of surgery, weight, and height;
- Preoperative oxygen saturation, preoperative hematocrit, prematurity, chromosomal abnormalities, and nutritional status;
- Final diagnosis, type of operation, bypass time, cross-clamp time, and temperature;
- Duration of ICU stay, pacing requirements, ICU complications, and discharge or mortality status.
- Data analysis was conducted, including the categorization of: Complication profiles into eight categories; Clinical outcomes into three categories.

The Risk Adjustment for Congenital Heart Surgery (RACHS-1) classification applied to all performed procedures. Using the RACHS-1S-1 method, procedures were grouped into six risk categories, ranking institutions according to increasing mortality rates, with details of the score applied as per the appendix (12,13). Data analysis, tabulation, and graph plotting were accomplished through multiple task-specific meetings of the research team.

2.2 Population

Patients of various ages, genders, diagnoses, and procedures were enrolled in this analysis. Statistical analyses were performed using Microsoft Excel 2020; IBM SPSS Statistics for Windows, version 22, for descriptive and comparative data tables.

Descriptive statistics were calculated to determine the distribution of variables and characteristics of the study population. Univariate analyses were conducted to assess the relationship between demographic and clinical variables and clinical outcomes (mortality).

3. Result

Table 1 shows that the sex distribution among the study patients was nearly equal. The median age was 3.5 years, the median BMI was 14.76 kg/m², the median preoperative oxygen saturation was 95% (minimum: 35%), and the median preoperative hematocrit level was 36.35%.

In Figure 1, it is clear that ventricular septal defect was the most frequently operated on (40 patients), followed by tetralogy of Fallot (36 patients).

Table 1. Basic Characteristics of the Study Population.

Variable		Frequency	Percent
Sex:	Male	65	51.6
	Female	61	48.4
		Mean ± SD	**Median (Min.-Max.)**
Age at Operation (yr)		4.95 ± 5.29	3.5 (0.25-29)
BMI (kg/m²)		15.33 ± 3.98	14.76 (2.88-30.07)
Preoperative O_2 Saturation (%)		88.28 ± 12.81	94 (35-99)
Preoperative HCT (%)		38.99 ± 8.71	36.35 (24-69)
Total		126	100

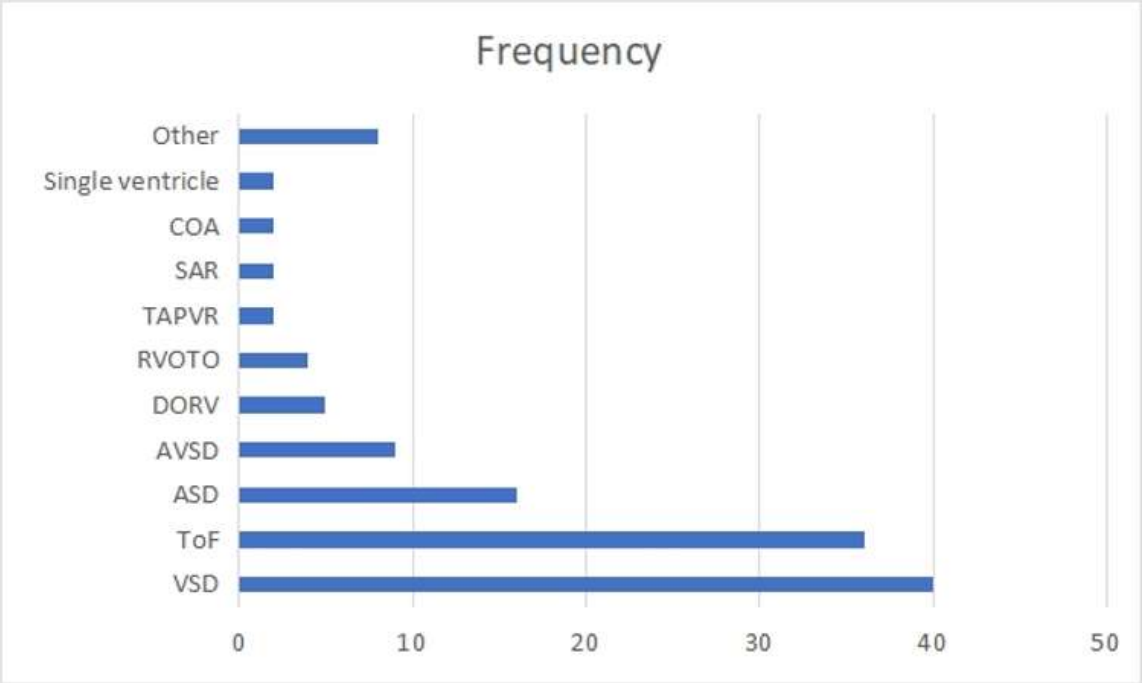

Figure 1. Frequency of diagnoses among the study patients. **(Prepared by Authors, 2026)**.

Table 2. Type of Surgical Procedure.

Procedure	Frequency	Percent
Total Repair	96	76.2
BTS	9	7.1
PAB	7	5.6
Fontan Procedure	4	3.2
RVOT Resection	3	2.4
BDG	2	1.6
AVR	1	0.8
Sub-Aortic Ridge Resection	1	0.8
KONO	1	0.8
ASO	1	0.8
MV Repair	1	0.8
RACHS-1S score		
1	16	12.7
2	68	54.0
3	40	31.7
4	2	1.6
Total	**126**	**100.0**

As shown in Table 2, ventricular septal defect (VSD) was the most frequently operated defect (31.7%), followed by tetralogy of Fallot (28.6%). The most common surgical procedure performed was total defect repair (76.2%). In addition, a RACHS-1 score of 2 accounted for more than half of the cases. Patients requiring pacing in the ICU accounted for 13.5%. The median bypass time was 86 minutes, the median cross-clamp time was 50 minutes, the median lowest temperature was 34°C, and the median intubation duration was 3.62 hours (Table 3).

Table 4 shows that respiratory infection was the most frequent complication (15.9%), while overall mortality was 4.8%. The median ICU stay was one day, with a maximum of 13 days, while the median hospital stay was nine days, with a maximum of 40 days.

Table 3. Perioperative Details.

Variable		Frequency	Percent
Pacing in ICU		17	13.5
	Number	**Mean± SD**	**Median (Min.-Max.)**
Bypass Time	102	97.77 ± 56.71	86 (24-451)
Cross Clamp Time	97	59.45 ± 31.98	50 (10-139)
Lower Temperature	101	33.86 ± 0.78	34 (28-35)
Intubation Duration in the ICU (hr)	126	8.94 ± 21.47	3.62 (0-186)

Table 4. Surgical Outcomes.

Outcome		Frequency	Percent
Complication in ICU	No	106	84.1
	Respiratory Infection	6	4.8
	Arrhythmia	4	3.2
	CVA	2	1.6
	Diaphragmatic Palsy	2	1.6
	Sepsis	2	1.6
	Convulsion	1	0.8
	Mediastinitis	1	0.8
	Pneumothorax	1	0.8
	Bleeding	1	0.8
Mortality		6	4.8
		Mean± SD	Median (Min.-Max.)
ICU Stay (Day)	123	2.47 ± 2.28	1 (1-13)
Hospital Stay (Day)	126	10.35 ± 5.33	9 (3-40)

4. Discussion

A total of 126 patients were enrolled in this analysis, representing the initial outcomes of the pediatric cardiac surgery recruitment campaign. The sex distribution was nearly equal, with a median age of 3.5 years, a median BMI of 14.76 kg/m², a median preoperative oxygen saturation of 95% (minimum: 35%), and a median preoperative hematocrit level of 36.35%. This sex distribution is similar to that reported in other series from Peshawar (13). Ventricular septal defect was the most frequently operated defect (31.7%), followed by tetralogy of Fallot (28.6%), a pattern consistent with trends observed in other Asian countries, such as Pakistan (14). The most common surgical procedure used for defect correction was total defect repair (76.2%). Additionally, a RACHS-1 score of 2 accounted for more than half of the cases. A comparable series in the Middle East showed a similar distribution, involving Norwood procedures (31.5%), aortic coarctation repairs (13.8%), arterial switch operations (13%), and Blalock-Taussig or central shunts (10%) (15). While the central philosophy in Abu Dhabi has been single-stage primary complete repair since the 1980s, approximately 30% of cases do not allow for repair through a single operation due to physiological and anatomical factors (16). RACHS-1 scores among the studied patients were predominantly 2 and 3 (54.0% and 31.7%, respectively), while a minority had a score of 4 (1.6%). This distribution was influenced by recommendations from the health authorities and the treating team, as well as by the campaign's organizers, who designated this initial campaign for lower-risk cases. Two patients with a score of 4 were exceptions; both were critically ill and could not be referred abroad for treatment. A similar strategy and RACHS-1 distribution were reported in the largest Lebanese national cohort, in which 38.6% of patients were classified in categories 1–3 and 10.9% in category 4 (17). The initial RACHS-1 score in the present study was higher than that reported in a German study of 598 patients, in which the average score was approximately 1 (18). The mean cardiopulmonary bypass (CPB) time for the 102 patients was 97.77 ± 56.71.

This was lower than the mean reported in several other series, including an Italian study of 264 patients, which reported a mean of 128.8 ± 89.2 minutes (19). In a study conducted at Vanderbilt University Medical Center, pediatric cardiac surgery patients had mean CPB and cross-clamp times of 107 ± 70 minutes (20).

The average ICU intubation duration in this cohort was 8.94 ± 21.47 hours, consistent with other reported studies. For instance, research at the Rajaie Cardiovascular Medical and Research Center (Tehran University of Medical Sciences, Iran) identified the duration of mechanical ventilation (MV) as a critical clinical factor for predicting outcomes in pediatric cardiac surgery. In that study, prolonged mechanical ventilation (PMV) was defined as lasting more than 72 hours (medium PMV) or more than seven days (extended PMV) (21). In the present study, 16% of the enrolled patients experienced at least one early complication within the first 30 postoperative days. The most frequent complications were respiratory infections (4.8%) and arrhythmias (3.2%), with other complications occurring less frequently. This complication rate is significantly lower than that observed in other series, such as in Indonesia, where 84.1% of patients experienced complications, including low cardiac output syndrome (19.8%), arrhythmias (18.6%), and sepsis (17.4%) (22). Infectious complications following cardiac surgery remain a common issue. In high-income countries, the prevalence of bacteremia ranges from 1.5% to 10.2% (23). In Jeddah, Saudi Arabia, post-procedural complications were reported in 96 (73.8%) of the procedures, with the most frequent complications being prolonged postoperative mechanical ventilation (27%), pleural effusion (21%), excessive bleeding (19%), cardiac arrest (18%), and systemic infections (18%) (14). A single-center study in Nashville, USA, indicated that 43% of patients experienced at least one complication, with 25% developing cardiac complications and 37% developing extracardiac complications (24). Similarly, an Iranian study found that 29.2% of enrolled patients experienced complications (25). Six patients (4.8%) in this study died, a figure that corresponds to or is lower than estimates from other developing countries, such as China (5.5%) (26), Iran (12.4%) (25), India (7.9%) (27), and Guatemala (10.7%) (27). The low mortality rate in this cohort can be attributed to several factors, including the lower RACHS-1S score of the enrolled patients (only 1.4% with a score of 4), a lesser percentage of cyanotic congenital heart diseases, and shorter aortic cross-clamp times compared to corresponding series from Iran and Indonesia (70.2 ± 36.6) (CPB, OR: 4.4, 95% CI: 1.5–13.4) (22,25). Additionally, current literature suggests that prolonged CPB is associated with a significantly higher incidence of adverse outcomes (19,28). Consequently, the lower incidence of postoperative complications in this cohort may also be linked to the lower RACHS-1S scores, as higher scores are independently associated with an increased risk of extracardiac complications (24).

5. Conclusion

In this study, the incidence of complications within the first 30 postoperative days and disease-related mortality among the patients were relatively low compared with those reported in comparable cohorts. The lower mortality rate may largely be explained by the characteristics of the study population and established predictors of mortality, including the predominantly low RACHS-1 scores, the lower prevalence of cyanotic congenital heart disease, and shorter aortic cross-clamp times.

6. Declarations

6.1 Acknowledgments

In this study, thanks go to the local governmental authority; acknowledgments go to the Novik Cardiac Alliance Team and the administrative and human resources staff.

6.2 Ethical Considerations

The study was approved by the Ethical Approval Committee.

6.3 Authors' Contributions

F.S.A. & K.A.K.: Conceptualized and designed the study, conducted experiments, analyzed data, and wrote the manuscript. A.H.A.: Assisted in the experimental design and contributed to data interpretation and manuscript revision. D.A.A. & B.A.A.: Assisted in sample collection and processing, performed statistical analyses, and reviewed the manuscript for intellectual content. All authors approved the final version of the manuscript and agreed to be accountable for the accuracy and integrity of the work.

6.4 Conflict of Interest

The authors have no conflict of interest.

6.5 Fund or Financial Support

This research received no specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

6.6 Using Artificial Intelligence Tools (AI Tools)

This work did not involve the use of artificial intelligence tools.

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