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The impact of COVID-19 pandemic on congenital heart surgery practice: An alarming change in demographics

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Abstract

Background: The aim of this study is to investigate the effect of COVID-19 outbreak on congenital cardiac surgery practice in a single center.

Methods: The first case of COVID-19 in our country was seen on March 11th, 2020. The patients operated between March 11th, 2019-and March 10th, 2020 were taken as the pre-COVID group, and those operated between March 11th and May 11th, 2020 were taken as the COVID group. The data was retrospectively collected, and the two periods were compared.

Results: Monthly average number of cases which was 52 patients/month (626 patients in 12 months) before COVID decreased to 35 patients/month (70 patients in 2 months) during COVID periods ($P < .01$). During the pre-COVID period the median postoperative length of hospital stay was 3 (IQR: 1-5) days. During the COVID period, this decreased to 1 (IQR: 1-3) day ($P < .01$). During the pre-COVID period, the hospital expenses of 17% (8/47) of the foreign nationals were covered by their homeland. The remaining 83% (39/47) were paid from the asylum seekers' fund. The proportion of foreign nationals operated significantly decreased during the COVID period ([7%; 47/632 vs 1%; 1/70]; $P = .04$). No significant difference was observed in terms of STAT mortality scores and categories and postoperative results of the operations performed between the two periods.

Conclusions: Congenital cardiac surgery practice can be safely maintained with restricted case volume during the pandemic period. It is alarming that patients in the deprived areas cannot access pediatric cardiac surgery and possibly other health services because of closure of the borders between countries.

KEYWORDS

cardiac surgical procedures, COVID-19, pandemics, postoperative period, refugees, severe acute respiratory distress syndrome coronavirus 2

1 | INTRODUCTION

The COVID-19 outbreak that started in China, spread to the whole world in a short time. In this context, elective medical services were limited to both reduce the possibility of transmission and to protect the health resources, which are likely to encounter a burden above its capacity. In this period of crisis, recommendations regarding the triage considerations came to the agenda in the medical literature.[1,2]

According to official statements, the first case in Turkey was detected on March 11th, 2020. As a reference center for pediatric

and congenital cardiac surgery, we restricted our case volume like many other congenital heart surgery centers around the world. However, to the best of our knowledge, there is no published data from countries like Turkey, who is near the conflict zones and accepts a large volume of asylum seekers. The purpose of this report is to analyze the effect of the pandemic on the clinical practice of congenital heart surgery in a single center.

2 | METHODS

The restriction of cases started with the detection of the first case in Turkey on March 11th, 2020. This strategy was continued until the data was collected on May 11th, 2020. The 1-year period before the date of the detection of the first case (March 11th, 2019-March 10th, 2020) was included as the pre-COVID period, and the period between March 11th and May 11th, 2020 was included as the COVID period. The data of all patients who had congenital heart surgery in our clinic on the specified dates were retrospectively reviewed. The study was approved by the institutional review board (604.01.01–E.148). The COVID period and the pre-COVID period were compared. Informed consent was obtained from each patient.

Routine laboratory tests and chest x-ray results were used in the preoperative preparation of the patients. There was no change in terms of these tests between periods. Patients hospitalized during the COVID period were also questioned for fever, cough, respiratory distress, and travel abroad in the past 14 days. In addition, the patient's family was questioned in terms of travel abroad, hospitalization with respiratory distress or COVID-19 test positivity in the last 14 days. Apart from this, no routine COVID test or CT scan was performed to the patients.[3] Within the framework of general restrictions in the country, all personnel inside the hospital used a surgical mask or more advanced protective equipment. Part of the hospital was isolated for the care of patients with COVID. However, operating theaters, intensive care units and wards used for pediatric cardiac surgery were left in the non-COVID part of the hospital and no additional regulation was made regarding the way of working.

Statistical analysis of the data was done using IBM SPSS Statistics Version 21. Continuous variables were defined as median (interquartile range) and categorical variables as numbers (%) in the description of cohort and subgroups. The Mann-Whitney U test was used to compare continuous variables, and the χ^2 test or Fisher's exact test was used to compare categorical variables. $P < .05$ was considered statistically significant.

3 | RESULTS

Between March 11th, 2019 and May 11th, 2020, 696 patients were operated and 45% of the patients (n: 314) were girls. The median age was 16 months (IQR: 4 months-5 years). Monthly average number of cases was calculated as 52 patients (626 patients in 12 months) before COVID and 35 patients (70 patients in 2 months) during COVID ($P < .01$). The number of patients operated during the same period of the year before COVID (March 11th -May 11th 2019) was 105.

The comparison of the two periods in terms of demographic parameters can be seen in Table 1. No significant difference was found between the two periods regarding the age and gender distribution of the patients. In the pre-COVID period, patients were hospitalized for median 3 (IQR: 1-5) days, and this decreased to 1 (IQR: 1-3) day in the COVID period ($P < .01$). Seven percent (47/632) of the patients operated before COVID were citizens of foreign countries. The distribution of the country of origin of these patients is demonstrated in Table 2. Hospital expenses of 17% (8/47) of these patients were covered by their homeland, while the remaining 83% (39/47) were paid from the asylum seekers' fund. During the COVID period, only one foreign citizen (1%) was operated, which represents a significant decrease ($P = .04$). In addition, the proportion of patients coming from outside the province decreased from 70% (445/632) to 50% (35/70) during the COVID period ($P < .01$).

The distribution of the main procedures of 70 surgeries performed during the COVID period is shown in Table 3. No significant change was observed between median STAT mortality scores (0.5 [IQR: 0.4–1.4] pre-COVID vs 0.5 [IQR: 0.3-1.5] COVID; $P = .06$) and categories of surgeries performed during this period (Table 4) The most common procedure was bidirectional cavopulmonary anastomosis (n: 9; 13%). During the COVID period, there was a significant increase in operating time (300 [IQR: 240-360] vs 240 [IQR: 180-330] minutes; $P = 0.005$).

The comparison of the postoperative results can be seen in Table 5. The rates of diaphragm plication, AV block requiring pacemaker implantation, reoperation, major reoperation, and extracorporeal membrane oxygenator were similar between the two periods. Hospital mortality was 7% (41/626) before COVID, 4% (3/70) during COVID, and there was no significant difference between these two rates. Median postoperative hospital stay did not change.

TABLE 1 Distribution of the demographic variables

	Era	
	Pre-COVID	**COVID**
Age (mo)	17 (5-67)	10 (3-44)
Age group		
Adult congenital	22 (4%)	2 (3%)
Child	347 (55%)	29 (41%)
Infant	154 (25%)	24 (34%)
Neonate	103 (17%)	15 (21%)
Sex		
Female	280 (45%)	34 (49%)
Male	346 (55%)	36 (51%)
Out of province	441 (70%)	35 (50%)
Foreign citizen	47 (8%)	1 (1%)

Note: Categorical variables: n (%); continuous variables: median (interquartile range).

TABLE 2 Distribution of the countries of origin of the foreign nationals during the pre-COVID and COVID periods

	Era			
	Pre-COVID	COVID	2017 SDI index value	SDI quintile
Syria	36 (5.8%)	1 (1.4%)	0.61	Middle SDI
Iraq	6 (1.0%)	0 (0%)	0.58	Low-middle SDI
Afghanistan	1 (0.2%)	0 (0%)	0.29	Low SDI
Morocco	1 (0.2%)	0 (0%)	0.58	Low-middle SDI
Cyprus (North)	1 (0.2%)	0 (0%)	0.86	High SDI
Pakistan	1 (0.2%)	0 (0%)	0.49	Low-middle SDI
Somali	1 (0.2%)	0 (0%)	0.23	Low SDI

Abbreviation: SDI, sociodemographic index.

Among the health-care workers in our hospital, the first COVID-positive case was on March 26. Until May 11, 47 health-care workers tested positive. Four of them were hospitalized, and the rest were treated as out-patients. All the health-care workers healed after treatment; there was no mortality.

4 | DISCUSSION

The change of case volume, distribution, and outcomes in a congenital cardiac surgery referral center during the first 2 months of the COVID-19 pandemic was investigated in this study. Although the monthly average number of cases decreased, the operations continued without any significant change in case distribution and postoperative results. Fewer foreign nationals were operated. During the COVID period, the length of hospital stay before surgery was shorter and the duration of the operating room use was longer.

The case volume was approximately halved during the COVID period. Available data on case volume reduction is limited to adult cardiac surgery clinics. According to the results of a newly published survey covering 60 international clinics, the median reduction in patient case volume was between 50% and 70%, in concordance with our outcomes.[4] In addition to a conscious choice by the surgical team, the decrease in the case rate was associated with the patients' reluctance to apply to the hospital due to transmission risk. In managing the process, the aim should be to balance the benefits of limiting case volume with the increase in risk in patients on the waiting list.[5] However, being hasty in reducing pandemic measures can lead to a high second wave like that seen in the 1918 Spanish Flu pandemic.[6] Reducing the number of patients operated daily is a useful approach in terms of keeping the intensive care beds available as well as contributing to social distancing. The patients were triaged according to urgency, but elective cases such as ASD closure were also performed (Table 2). This group consists mostly of patients who were already in the hospital at the beginning of the process. These data indicate that congenital cardiac surgery services can be safely maintained with simple measures during the pandemic period. For the responsible use of resources, it is recommended to consider the urgency status.

The proportion of foreign citizens as well as of patients coming from outside the province decreased significantly during the COVID period. Turkey is hosting an increasing number of foreign nationals from the regional conflict zones. Cross-border delivery of health services in Syria is a project recorded under the United Nations Refugee Agency Global Compact on Refugees Digital Platform. Under this project, 45 primary health care facilities and three hospitals in Syria were repaired, three new hospitals were built across the Syrian border and an ambulance radio communication system was established to manage the patient referrals.[7] Table 2 clearly shows that most of the foreign national patients were coming from countries with low to middle sociodemographic index.[8] Most of these patients are diagnosed by passing directly through the southern and south-eastern border and examined in the border provinces. Those who require surgical repair are transferred to reference centers and their operations are performed. The significant decrease in the rate of foreign nationals reflect the fact that the citizens of the countries in conflict zones crossing the border can no longer come due to the closure of the borders. This situation is important and alarming in that children in deprivation areas cannot access pediatric cardiac surgery and possibly various other health services.

During COVID period, operating room use was longer and the length of hospital stay before surgery was shorter. The prolonged use of the operating room can be associated with the long duration of the surgical preparations due to the measures taken. The shortening of the length of hospital stay before surgery can be explained by the operation of the patients shortly after hospitalization because of giving priority to emergency patients. The reduced case volume also contributed to this. As a result, the shortening of the patients' preoperative stays was positive in terms of pandemic management since the risk of contact decreased.

The findings of this study suggest that congenital cardiac surgery services can be safely maintained during the pandemic period if the case volume is limited, and simple safety precautions are followed. Triage considerations are recommended for the responsible use of

TABLE 3 Procedures performed during the first 3 mo of the COVID pandemic

	n (%)
Bidirectional cavopulmonary anastomosis (bidirectional Glenn)	9 (13%)
TOF repair, ventriculotomy, nontransanular patch	7 (10%)
Fontan, TCPC, lateral tunnel, fenestrated	4 (6%)
PA banding (PAB)	4 (6%)
VSD repair, patch	4 (6%)
Aortic arch repair	3 (4%)
AVC (AVSD) repair, complete (CAVSD)	3 (4%)
DORV, intraventricular tunnel repair	3 (4%)
Norwood procedure	3 (4%)
Shunt, systemic to pulmonary, central (from aorta or to main pulmonary artery)	3 (4%)
Valvuloplasty, aortic	3 (4%)
Aortic arch repair + VSD repair	2 (3%)
Aortic stenosis, subvalvar, repair	2 (3%)
AVC (AVSD) repair, intermediate (transitional)	2 (3%)
Valve replacement, pulmonic (PVR)	2 (3%)
Valvuloplasty, tricuspid	2 (3%)
Arterial switch operation	1 (1%)
Arterial switch operation and VSD repair	1 (1%)
Arterial switch procedure + aortic arch repair	1 (1%)
Arterial switch procedure and VSD repair + aortic arch repair	1 (1%)
ASD repair, patch + PAPCV repair	1 (1%)
PDA closure, surgical	1 (1%)
Pulmonary atresia–VSD–MAPCA repair, complete single stage repair	1 (1%)
Ross-Konno procedure	1 (1%)
Shunt, systemic to pulmonary, modified Blalock-Taussig shunt (MBTS)	1 (1%)
TAPVC repair	1 (1%)
TOF repair, ventriculotomy, transanular patch	1 (1%)
Valve replacement, mitral (MVR)	1 (1%)
Valvuloplasty, mitral	1 (1%)
VSD creation/enlargement	1 (1%)

Abbreviations: ASD, atrial septal defect; AVSD, atrioventricular septal defect; DORV, double outlet right ventricle; MAPCA, major aortopulmonary collateral artery; PAPVC, partially anomalous pulmonary venous connection; PDA, patent ductus arteriosus; TAPVC, totally anomalous pulmonary venous connection; TCPC, total cavopulmonary connection; TOF, tetralogy of Fallot; VSD, ventricular septal defect.

TABLE 4 Comparison of STAT mortality categories between the pre-COVID and COVID periods

		Era	
		Pre-COVID	COVID
STAT mortality category	1	203 (32%)	22 (31%)
	2	181 (29%)	17 (24%)
	3	76 (12%)	4 (6%)
	4	150 (24%)	24 (34%)
	5	16 (3%)	3 (4%)

TABLE 5 Comparison of the postoperative outcomes between the two periods

	Era	
	Pre-COVID	COVID
Morbidity		
Diaphragm plication	10 (2%)	1 (1%)
Pacemaker	21 (3%)	4 (6%)
Reoperation	160 (26%)	23 (33%)
Major reoperation	13 (2%)	2 (3%)
ECMO	33 (5%)	5 (7%)
Postoperative length of hospital stay	9 (6-16)	9 (9-17)
Hospital mortality	41 (7%)	3 (4%)

Note: Categorical variables: n (%); continuous variables: median (interquartile range).
Abbreviation: ECMO, extracorporeal membrane oxygenator.

the resources. As a result of the closure of the borders between the countries, it is alarming that patients in deprivation areas, cannot access congenital cardiac surgery and possibly various other health services. The fate of the patients who require urgent/emergent surgical treatment in these areas are yet to be described if medical data will ever be published.

CONFLICT OF INTERESTS

The authors declare that there are no conflict of interests.

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REFERENCES

1. Shah PB, Welt FGP, Mahmud E, et al. Triage considerations for patients referred for structural heart disease intervention during the coronavirus disease 2019 (COVID-19) pandemic: an ACC /SCAI Consensus Statement. *JACC Cardiovasc Interv*. 2020;S1936-8798(20):30867-0. https://doi.org/10.1016/j.jcin.2020.04.001
2. Stephens EH, Dearani JA, Guleserian KJ, et al. COVID-19: crisis management in congenital heart surgery. *Ann Thorac Surg*. 2020;S0003-4975(20):30540-30543. https://doi.org/10.1016/j.athoracsur.2020.04.001
3. Levy E, Blumenthal J, Chiotos K, Dearani JA. COVID-19 FAQ's in pediatric cardiac surgery. *World J Pediatr Congenit Heart Surg*. 2020;11(4):485-487.
4. Gaudino M, Chikwe J, Hameed I, Robinson NB, Fremes SE, Ruel M. Response of cardiac surgery units to COVID-19: an internationally

based quantitative survey. *Circulation*. 2020;142:300-302. https://doi.org/10.1161/CIRCULATIONAHA.120.047865

5. Chikwe J, Gaudino M, Hameed I, et al. Committee recommendations for resuming cardiac surgery activity in the SARS-CoV-2 era: guidance from an International Cardiac Surgery Consortium. *Ann Thorac Surg*. 2020;S0003-4975(20):30722. https://doi.org/10.1016/j.athoracsur.2020.05.004
6. Fudulu DP, Angelini GD. Cardiac surgery in the time of the coronavirus. *J Card Surg*. 2020;35:1177-1179. https://doi.org/10.1111/jocs.14580
7. Cross-border Health Services by the Turkish Ministry of Health. https://globalcompactrefugees.org/article/cross-border-health-services-turkish-ministry-health. Accessed July 16, 2020.
8. Global Burden of Disease Study 2017 (GBD 2017) Socio-Demographic Index (SDI) 1950–2017. http://ghdx.healthdata.org/record/ihme-data/gbd-2017-socio-demographic-index-sdi-1950%E2%80%932017. Accessed July 16, 2020.

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