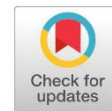


Research Article

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Surgical Outcomes of Congenital Heart Disease in the Eastern Region of Libya

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Abstract

Congenital heart disease (CHD) refers to a group of structural abnormalities in the heart that are present at birth. However, due to advancements in medical and surgical care, more children with CHD in developed countries are now surviving into adulthood. This study aims to assess the outcomes of surgically repaired congenital heart disease in the eastern part of Libya. Data was obtained from the medical records of 374 patients, of which 54.2% were male and 45.7% were female, who underwent surgical correction and palliative cardiac surgery between February 2015 and February 2019. The majority of patients were from Benghazi and Al-Jabal Al-Akhdar, and the most common diagnoses were ventricular septal defects (VSD) (25.4%) and complex congenital heart disease (CCHD) (21.9%). The death rate in atrioventricular canal (AVC) defects was 7.4%, CCHD had a mortality rate of 4.8%, and the total mortality rate was 2.9%. In the eastern part of Libya, pediatric cardiac surgery and cardiac surgical intensive care for children with congenital heart disease (CHD) still heavily rely on foreign cardiac surgery missions. There is a need for a comprehensive treatment plan and the development of local capabilities to manage CHD patients independently.

Keywords: Congenital Heart Disease, Surgical Outcome.

INTRODUCTION

Congenital heart disease (CHD) refers to structural abnormalities of the heart or surrounding blood vessels present at birth. It is a common condition affecting newborns. Studies have investigated the occurrence and patterns of CHD in Libya. In a 2018 study by (Mansour, 2018), ventricular septal defect (VSD) was the most prevalent type of CHD, accounting for 14.8% of cases. The most common complex CHD was Tetralogy of Fallot at 13.2%.

The majority of CHD cases in Libya (92.5%) were cyanotic, with a slightly higher prevalence in males. Another Libyan study in 2020 by (Mahmmed et al., 2020), found that the incidence of atrial septal defect (ASD) was 40.4% and VSD was 30.8%. According to a 2014 Iranian study by (SalehiAbarghuie et al., 2015) the most common surgical procedure for CHD was VSD closure, making up 28.5% of cases. Around 20.5% of infants with CHD required early interventional treatment in the first 3 years of life. Overall, the field of pediatric cardiology and cardiac surgery has seen significant advancements, leading to improved outcomes for patients with congenital heart diseases. Studies have shown that with appropriate care, many children with CHD, even complex cases, have a good chance of surviving into adulthood. Research by (Chinawa et al., 2019;



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Movahedian et al., 2017; Sharmin et al., 2008) supports this. Within developed high-income countries, pediatric cardiology and cardiac surgery have seen significant advancements, as demonstrated by a 2018 study by (Spector et al., 2018). This has led to successful repairs or treatments for most CHD cases, including complex ones.

However, low-income and developing regions, like Libya's eastern area, often lack the advanced CHD care necessary for their children. Consequently, parents in these areas face challenges when their child is diagnosed with CHD, especially in critical cases requiring immediate surgical intervention. Due to the unavailability of local surgery, these regions rely on cardiac surgery missions from other countries. This leads to a growing number of cases requiring surgery and critical cases that may result in death due to delays in treatment.

MATERIALS AND METHODS

Study Design: This was a descriptive, cross-sectional study.

Study Population: consisted of 374 patients with congenital heart disease (CHD) who underwent surgical correction or palliative cardiac surgery between February 2015 and February 2019.

Data Collection: The data was collected from Tobruk Medical Center and Benghazi Medical Center in Libya.

Diagnostic Tools: The diagnosis of CHD in the patients was made using various methods, including physical examination, pulse oximetry, chest X-ray, electrocardiography (ECG), and echocardiography. These tools were used to assess the nature and severity of the CHD and guide the appropriate surgical interventions.

Inclusion and Exclusion Criteria: The study excluded procedures such as thoracic duct ligation, pacemaker implantation, and stabilizing an unstable sternum. The researchers included the assessment of mortality within 30 days following open-heart surgery to examine the short-term outcomes of the surgical procedures.

Statistical Analysis: The study analyzed the demographic data, including age and sex distribution, as well as the types of congenital heart defects. The descriptive data were analyzed in Microsoft Excel and presented as numbers and percentages in tables.

RESULTS

According to Table 1, the study included a total of 374 patients with congenital heart disease (CHD) who underwent corrective and palliative cardiac surgery. Of these patients, 203 were male, accounting for approximately 54.2% of the study population. The remaining 171 patients were female, representing about 45.7%. The male-to-female ratio in the study cohort was calculated to be 1.8:1.

Table (1). Gender Distribution:

Gender	N	%
Male	203	54.2%
Female	171	45.7%

Table (2) shows that the majority of patients who underwent surgery were between the ages of 1 and 3 years. These two younger age groups made up the majority of the study population.

Table (2). Age at the time of the operation:

Age	N	%
1 week-1 year	128	34.2 %
1 year-3 year	153	40.9%
3 year-5 year	42	11.2%
>5 year	51	13.6%
Total	374	100%

Table 3 illustrates the distribution of patients according to their region of residence. The majority of patients in the study were from Benghazi, accounting for 120 individuals or 32% of the total. Al-Jabal Al-Akhdar region had the second-highest number of patients, with 100 individuals, making up 28.8% of the total. Tobruk, Ajdabiya, the Western Region, and the Southern Region had progressively smaller numbers of patients, with percentages ranging from 6.1% to 18.7.

Table (3). Distribution of patients in different regions

Region	N	%
Benghazi	120	32
Al Jabal Al Akhdar	100	28.8%
Tobruk	70	18.7%
Ajdabiya	36	12.4%
Western Region	25	6.6%
Southern region	23	6.1%

In 2015, a total of 94 operations were performed. The most common operation was PDA (20.2%) followed by CCHD (18%). The male-to-female ratio was 1:1 and the mortality rate for the surgical procedures was 2.1%, Table (4).

In 2016, a total of 101 procedures were performed. Among them, VSD procedures constituted 29.7%, while CCHD procedures accounted for 19.8%. The male-to-female ratio was approximately 1.14 to 1, and the mortality rate associated with the surgical procedures conducted in 2016 was 2.9%, Table (5).

Table (4). Distribution of operated heart lesion 2015

CHD	N (%)	M/F	Death /%
ASD	10 (10.6)	6/4	0
VSD	16 (17)	8/8	0
PDA	19(20.2)	9/10	0
AVC	6(6.3)	1/5	1
TOF	14(14.8)	9/5	0
AS	2 (2.1)	0/2	0
PS	3 (3.1)	0/3	0
COA	5 (5.3)	3/2	0
MVR	2 (2.1)	1/1	0
CCHD	17 (18)	10/7	1

ASD: atrial septal defect, VSD: ventricular septal defect, PDA: patent ductus arteriosus, TOF: tetralogy of Fallot, PS: pulmonary stenosis, AS: Aortic stenosis, CCHD: Complex congenital heart disease, MVR: mitral valve repaired

Table (5) Distribution of operated heart lesion 2016

CHD	N (%)	M/F	Death %
ASD	7(6.9)	1/6	0
VSD	30 (29.7)	16/14	1
PDA	2(2.1)	1/1	0
AVC	11(10.8)	4/7	0
TOF	9(8.9)	7/2	1
AS	7 (6.9)	5/2	0
PS	6(5.9)	3/3	1
COA	8(7.9)	5/3	0
MVR	1(0.9)	0/1	0
CCHD	20(19.8)	12/8	1

In 2017, a total of 43 operations were performed. CCHD accounting for (23.2%) and VSD accounting for (20.9%). The male-female ratio was 1.2:1 and the mortality rate was 6.9%, Table (6).

Table (6). Distribution of operated heart lesion 2017

CHD	N (%)	M/F	Death /%
ASD	8(18.6)	2/6	0
VSD	9 (20.9)	6/3	1
PDA	9(20.9)	3/6	0
AVC	2(4.6)	2/0	0
TOF	3 (6.9)	2/1	0
AS	0 (0)	0/0	0
PS	2 (4.6)	1/1	1
COA	0 (0)	0/0	0
MVR	0 (0)	0/0	0
CCHD	10(23.2)	6/4	1

In the year 2018, a total of 95 operations were performed. The most common operation was VSD (29.4%), followed by CCHD (21%). The male-to-female ratio was 1.4:1, and the mortality rate was (2.1%), Table (7).

In 2019, a total of 41 operations were performed, with CCHD accounting for (36.5%) and VSD accounting for (29.2%). The mortality rate for the surgical procedures conducted in 2019 was 2.4%, and the male-to-female ratio was 1.04:1, Table (8).

Table (7) Distribution of operated heart lesion 2018

CHD	N (%)	M/F	Death /%
ASD	8(8.4)	5/3	0
VSD	28 (29.4)	18/10	0
PDA	4(4.2)	2/2	0
AVC	4(4.2)	2/2	1
TOF	18(18.9)	9/ 9	0
AS	0	0	0
PS	6(6.3)	3/3	0
COA	6(6.3)	4 2	0
MVR	1 (1)	0/1	0
CCHD	20 (21)	13/7	1

Table (8) Distribution of operated heart lesion 2019

CHD	N (%)	M/F	Death /%
ASD	2(4.8)	1/1	0
VSD	12(29.2)	6/6	0
PDA	0	0	0
AVC	4(9.7)	2/2	0
TOF	6(14.6)	3/ 3	0
AS	1(2.4)	0/1	0
PS	1(2.4)	0/1	0
COA	0	0	0
MVR	0	0	0
CCHD	15 (36.5)	9/6	1

Table (9) shows the distribution of different congenital heart diseases (CHDs) among the patients. The most common CHD was Ventricular Septal Defect (VSD), accounting for 25.4% of the patients. This was followed by Complex Congenital Heart Diseases (CCHD) at 21.9%, Tetralogy of Fallot (TOF) at 13.3%, Atrial Septal Defect (ASD) at 9.3%, and Patent Ductus Arteriosus (PDA) at 9%.

The male-to-female ratio is also provided, with more males than females for most conditions except for ASD, PDA, and Pulmonary Stenosis (PS).

The mortality rate was low overall at 2.9%. The highest mortality was seen in CCHD at 4.8%, followed by Atrioventricular Canal Defect (AVC) and TOF at 7.4% and 4% respectively. VSD, AVC, and TOF each accounted for 18.2% of the total mortality, while PS accounted for 9%.

Table (9) Total Number of congenital heart defects and mortality rate

CHD	N (%)	M/F	Death /%	% from the total mortality
ASD	35(9.3)	15/20	0	0%
VSD	93 (25.4)	60/33	2(2.1%)	18.2 %
PDA	34(9)	15/19	0%	0%
AVC	27(7.2)	15/11	2(7.4%)	18.2 %
TOF	50 (13.3)	30/ 20	2(4%)	18.2 %
AS	10(2.6)	5/5	0	0%
PS	18(4.8)	6/12	1(5.5%)	9%
COA	19(5)	11/9	0	0%
MVR	0	0	0	0%
CCHD	82(21.9)		4(4.8%)	36.3%
Total	374	203 /171	11(2.9%)	100%

DISCUSSION

In Libya, unfortunately, there is a lack of community-based data available on the incidence and prevalence of CHD throughout the country. The underdeveloped nature of resources for CHD treatment in countries with limited resources leads to significant delays in management and a high mortality rate, particularly in newborns with Complex Congenital Heart Disease (CCHD) that require surgical correction.

A study conducted in (Al-Ammouri et al., 2020) found a mortality rate of 17% among Syrian refugee

infants with cardiac disease while they were waiting for surgery. Despite regional and international efforts, the treatment of Syrian refugee children with heart disease remains challenging, resulting in delays in care and increased mortality. The timing of cardiac surgery for children with congenital heart disease (CHD) is critical, as delayed surgical intervention can result in various complications and higher mortality rates. Conditions such as atrioventricular canal (AVC) and ventricular septal defect (VSD) pose a risk of early pulmonary hypertension, which can result in a longer stay in the intensive care unit and an elevated mortality rate (Beghetti & Tissot, 2009; Salehi Abarghuie et al., 2015).

Late timing of cardiac surgery in developing countries like Libya can be attributed to several factors, including late diagnosis of CHD and the lack of availability of continuous cardiac surgery programs. These factors contribute to delays in surgical intervention, potentially exacerbating the risk of complications and mortality rates. A study conducted by (Salehi Abarghuie et al., 2015) involving 789 patients found that 75.8% were younger than 3 years old, indicating the importance of early intervention in this age group. Additionally, 22% of the patients were older than 3 years, highlighting the need for timely surgical management across a wide age range. In Nigeria, where foreign cardiac missions are sometimes utilized. A study conducted (Nwafor & Eze, 2019) found that 75% of patients undergoing cardiac surgery were under the age of ten. This highlights the prevalence of pediatric cases requiring cardiac surgery in the country. Various indications exist for surgical closure of ventricular septal defect (VSD), which include a large VSD causing clinical symptoms of heart failure and recurrent chest infections, as well as cases of double-commit VSD and outlet VSD with Aortic valve prolapse leading to aortic valve regurgitation, and those with a history of infective endocarditis (Nadas et al., 1964). Such conditions necessitate surgical intervention to address the VSD and associated complications. Furthermore, a study conducted by (Ahmadi et al., 2002) focused on patients aged 3 to 12 years, indicating that this age group formed the majority of patients in their study.

This further emphasizes the prevalence of VSD cases requiring surgical closure within this specific age range. In the current study, it was found that 75% of the patients were younger than 3 years old, with the youngest patient being just 1 week old and the oldest being 30 years old. Among the patients, 54.2% were males and 45.7% were females. These findings align with previous research that has also observed a younger age profile for patients undergoing cardiac surgery, which can be attributed to the availability of regular visits by foreign cardiac surgical missions and the high demand for surgical correction of congenital heart disease (CHD) in the population. Pulmonary banding, a surgical procedure involving the placement of a band around the pulmonary artery, is commonly used in cases of multiple muscular VSD (referred to as Swiss cheese) and in infants with low body weight. This approach has been described in studies by (Kowalsky et al., 2006; Rao, 2013).

Transcatheter closure has indeed been implemented as a treatment option for atrial septal defect (ASD) and patent ductus arteriosus (PDA) in the western region of Libya. Transcatheter closure is a minimally invasive procedure that offers several advantages over traditional surgical intervention, including fewer complications and a shorter hospital stay. In the case of ASD, which is a hole in the wall between the heart's upper chambers, and PDA, which is the persistence of a blood vessel connecting the aorta and the pulmonary artery, trans-catheter closure has become the preferred method in many cases.

This procedure involves using a catheter to place a device (such as an occluder) to close the defect or block the abnormal blood vessel. The study conducted by (Madany et al., 2021) in Libya supports the transition to transcatheter intervention for ASD and PDA. According to their findings, on-

ly large ASDs and sinus venous ASDs are referred to surgical intervention, suggesting that transcatheter closure is now the primary approach for most cases. Infants who have a significant patent ductus arteriosus (PDA) are unlikely to experience spontaneous closure. Therefore, it is generally recommended to consider closing such PDAs due to the associated risk of complications. In addition, any PDA that presents with a murmur should be evaluated for closure as it poses a risk of infective endocarditis, an infection of the inner lining of the heart, or heart valves. Research conducted by (Afif et al., 2016; Chinawa et al., 2019) supports the notion that infants with large PDAs are less likely to have the ductus arteriosus close naturally. Consequently, intervention is typically required to close the PDA and avoid potential complications. Furthermore, the presence of a murmur in a patient with PDA indicates abnormal blood flow and serves as an indicator of an increased risk of complications. To mitigate this risk, it is often recommended to close the PDA when a murmur is detected. In our study, we observed that ventricular septal defect (VSD) was the most frequently operated cyanotic congenital heart disease (CHD) with a prevalence of 25.4%.

This was followed by atrial septal defect (ASD) at 9.3% and patent ductus arteriosus (PDA) surgical ligation at 9%. These findings are consistent with the results reported by (Mirzaei et al., 2016) in a study conducted in Iran, where they evaluated 203 patients who underwent open heart surgery. They found that the most common CHDs were VSD at 25%, ASD at 13%, and PDA at 11%. Similar patterns have been observed in previous studies conducted in Guatemala (Kowalsky et al., 2006), Egypt (Gamal et al., 2020), and Twiam (McCracken et al., 2018). In a study conducted in Nigeria by (Nwafor & Eze, 2019), they examined 72 patients who underwent congenital heart disease (CHD) surgery. Their findings revealed that ventricular septal defect (VSD) was the most prevalent CHD, accounting for 27.16% of the cases. This was followed by patent ductus arteriosus (PDA) at 24.6% and atrial septal defect (ASD) at 17.28%. These results align with a study conducted by (Zahid et al., 2013), which showed a similar pattern of CHD prevalence. The previous study drew parallels with our research, indicating that these particular CHDs are commonly observed in these countries.

According to a study conducted by (Jacobs et al., 2019), aortic valve replacement was identified as the most commonly performed surgical procedure. This finding suggests that the high prevalence of certain types of congenital heart disease (CHD) may be influenced by the frequency of aortic valve replacement surgeries. According to a study conducted by (Pozzi et al., 2000), it is recommended that total repair of tetralogy of Fallot (TOF) should ideally be performed between the ages of one to two years. However, in cases where there is significant cyanosis or frequent cyanotic spells, it is advised to consider a systemic to pulmonary artery shunt procedure at an age of less than three months.

In a previous study conducted in the eastern part of Libya by (Mustafa et al., 2020), it was observed that 52.2% of patients with Tetralogy of Fallot (TOF) underwent surgery at the age of two years or older. This finding was attributed to an accumulation of TOF cases requiring surgical intervention. Similarly, in a study conducted in (Hashemzadeh & Hashemzadeh, 2010), the median age for TOF surgery was reported to be 5 years. On the other hand, a study by (Bacha et al., 2001) found that 57% of patients underwent primary TOF surgery before the age of 2 years with a median age of 8 months.

Newborns diagnosed with transposition of the great arteries (TGA) have a critical need for a surgical team within the first three weeks of life to have any chance of survival, as indicated by studies conducted by (Chang, 2007). Our study, however, had limited cases of TGA due to the availability of the surgical team at the time of birth, resulting in a small sample size for this specific condition.

In our study, the overall mortality rate was 2.9%. Among the different types of congenital heart diseases (CHDs) examined, atrioventricular canal defect (AVC) had the highest mortality rate at 7.4%, followed by critical congenital heart disease (CCHD) at 4.8%, and tetralogy of Fallot (TOF) at 4%. Comparisons with other studies revealed varying mortality rates in different countries. For instance, Egypt, (Gamal et al., 2020) reported a mortality rate of 4.8%, while in Brazil (Jacobs et al., 2019) found a higher rate of 13.4%. In Lebanon, (Arabi et al., 2011). observed a lower mortality rate of 2.6%, and in Sudan, (Algibali et al., 2018). reported a mortality rate of 6.3%. Furthermore, (McCracken et al., 2018) found similar mortality rates of 6.9% and 7.4% for TOF, respectively, which aligns with the current study findings. The timing of surgical referral for complete atrioventricular canal (AVC) in our patients was delayed, with surgery being performed at an age above 1 year, resulting in a mortality rate of 4.7%. In comparison, a study conducted by (Hirata et al., 2021) reported a lower mortality rate of 2% in patients who underwent surgery at the appropriate age of 3-6 months. Additionally, in a North American study by (Spector et al., 2018), the mortality rates for postoperative tetralogy of Fallot (TOF) and AVC were reported as 1.3% and 2.5%, respectively.

The timing of cardiac surgery in children with congenital heart disease (CHD) is critical to avoid complications and increased mortality. Delayed surgery in cases of AVC can lead to early pulmonary hypertension development, resulting in longer intensive care unit stays and higher mortality rates.

CONCLUSION

In developing countries, delayed cardiac surgeries are caused by a scarcity of cardiac surgeons, leading to delayed referrals for individuals with congenital heart disease (CHD) in the eastern part of Libya. Consequently, international cardiac surgical missions have been relied upon to address the demand for surgeries. The local medical team must provide independent care for CHD patients by developing the necessary skills and expertise to effectively tackle the challenges and provide better care for CHD patients.

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ETHICS

The study obtained ethical approval from the director of the cardiac center, and there is a strong commitment to preserving the confidentiality of all the information provided to us.

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