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Libyan Experience in Congenital Heart Disease Interventions in Eastern region of Libya at National Heart Center Benghazi,2022

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Background: Interventional cardiology procedures are constantly increasing in management of structure heart disease in developing countries. Percutaneous catheterization plays an important role in diagnosis and treatment of pediatric and adult with CHD included Trans catheter device, balloon angioplasty and valvoplasty, atrial septostomy.

Aim of study: 1. To recognize the Libyan Experience in Congenital Heart Intervention in Eastern region of Libya. 2. To evaluate outcome of the non-surgical intervention in treatment of structure heart disease. Methods: Retrospective study was done include 192 of children and adult undergoing Percutaneous diagnostic and intervention catheterization at NHC in a period between 2011 and 2020. Patients were analysis according to type of catheterization either diagnostic or interventional and type of congenital heart disease.

Result: Revealed that Diagnostic were 68 patients (35.4%) and 124 interventional patients (64.5%). (47.9%) were male and (52%) were female ,42 patients (21.8%) underwent ASDs, PFO Transcatheter closure, 37 patients (19.2%) were Transcatheter closure of PDA, 27 patients (14%) were pulmonary balloon valvuloplasty, (11) patients (5.7%) were coronary angiography, (5) patients (2.6%) were atrial septostomy and (2) patients (1%) ballowen angio to COA stent. Complication in 2 patients (1%), failure in 2 patients (1%) and no death.

Conclusion: - Transcatheter intervention is an alternative to surgical intervention to repair certain types of congenital heart disease (CHD) with less morbidity and mortality than the surgical method of treatment.

Keywords – NHC: National Heart Center NHC, CHD: Congenital Heart Disease, ASD: Atrial Septal Defect, PFO: Patent Foramen Ovale. PDA: Patent Ducts Arteriosus. TGA: Transposition of great artery, PS: pulmonary stenosis, TCC: Transcatheter closure, BPV: Balloon pulmonary Valvuloplasty, COA: coarctation of the aorta.

I. INTRODUCTION

Transcatheter intervention is an alternative to surgical intervention to repaired certain type of congenital heart disease (CHD) with less morbidity and mortality than surgical method of treatment. Transcatheter intervention including: Device closure is used in ASD, VSD, PDA , Balloon Valvuloplasty for PS (Pulmonary stenosis) and AS (Aortic stenosis),Stent of COA(coarctation of the aorta) ,Transcatheter pulmonary valve replacement now a day its excellent initial restoration of pulmonary valve function in patients with dysfunctional right ventricle–PA conduits, stent of pulmonary artery branch stenosis[(1,2)] .

Advanced catheterization intervention in critical neonatal CHD including Stenting of the arterial duct in hypoplastic left heart syndrome and right ventricular outflow tract (RVOT) stenting in symptomatic infants with tetralogy of Fallot. Fetal cardiac intervention like balloon aortic valvuloplasty [(3)]. These nonsurgical Transcatheter devices intervention a have the advantages of a

short hospital stays, rapid recovery, and no residual thoracic scar avoid risk of cardiopulmonary bypass (CPB)and less stress to patient and parent [4].

Atrial Septal Defect: Atrial septal defect (ostium secundum defect) occurs as an isolated anomaly in 5% to 10% of all congenital heart defects (CHDs). It is more common in females than in males (male-to-female ratio of 1:2). About 30% to 50% of children with CHDs have an ASD as part of the cardiac defect, If left untreated ASDs can lead to pulmonary hypertension, atrial dysrhythmia, exercise intolerance and eventual clinical right heart failure. Most symptoms and complications are progressive so ideally closure should be performed during the childhood [5,6].

The use of the closure device may be indicated to close a secundum ASD, measuring 5 mm or more in diameter. only scandium ASD's can be closed in the catheter laboratory. There are rare reports of closure of certain types of sinus venous ASD using covered stents by in general these defects and premium ASD's and coronary sinuous ASD need surgical treatment. Currently defects of up to 40 mm in diameter provided the margins are adequate and need 5 mm rim for encourage of devices closure in all areas is necessary, the deficiency of these rims there is a risk for device related erosion of the myocardium [1,4,5] .

Complications of Transcatheter closure of ASD are device embolization, vascular complications at the puncture site, thrombus on the device, recurrent thromboembolic events, atrial arrhythmias and cardiac erosion or perforation and cardiac tomponade , complete AV block(CAVB) [1,4].

Patent Ductus Arteriosus (PDA) Closure: Patent Ductus arteriosus occurs in 5% to 10% of all CHDs excluding premature Newborn babies. It is more common in females than in males (male-to-female ratio of 1:3). It's a cone-shaped tube connecting the descending thoracic aorta and the origin of the left pulmonary artery. first Transcatheter closure of PDA was in 1967 by Portsmann et al [2]. Clinically, PDA may be present in patients with congestive heart failure, but it can also be present in asymptomatic patients during routine pa clinical examination. It is necessary to close a PDA if there are symptoms of heart failure or if there is a continual heart murmur without symptoms. [7,8].

Pulmonary Valve Stenosis (PS): Pulmonary valve stenosis is one of a common congenital heart defect, in which the pulmonary valves opening from the right ventricle are restricted. There are two types of presentation: critical pulmonary stenosis in neonates presented with sever cyanosis need urgent intervention [3,7]. pulmonary valve stenosis beyond neonatal period in infant and adolescents are mostly asymptomatic, unless severe stenosis is present. With growth, moderate stenosis may cause symptoms, including fatigue, chest pain, arrhythmias, limited exercise tolerance, and cyanosis. Balloon valvuloplasty may be indicated in patients with Doppler peak gradient of 50 mm Hg or greater. The complication of the balloon valvoplasty of pulmonary valve including moderate to severe pulmonary regurgitation and fatal acute severe pulmonary edema, cardiac perforation and vascular injury and thrombosis [5,6].

Aortic Coarctation:- Aortic coarctation comprises roughly 7% of all known congenital heart defects, with an approximate frequency of 0.04% of live births. It is usually a discrete stenosis in the region of the ligamentum arteriosus. It may be associated with diffuse hypoplasia of the aortic arch and isthmus. Isolated aortic coarctation may occur in 82% of cases and is the commonest detected in adults. stent implantation has been considered the gold standard treatment in patients with suitable anatomy and weighing more than 20 kg. Balloon angioplasty can be an option for native discrete coarctation of the aorta without associated hypoplasia of the transverse arch and/or the isthmus also stenting and dilation of recurrent coarctation of the aorta following previous surgery or intervention, complication of this procedure including Bleeding, local hematoma, aorta Arterial wall damage can occur during Balloon angioplasty to stent of aorta [5,7].

Balloon Atrial Septostomy: -Balloon atrial septostomy (BAS) was first described by Rashkind and Miller in 1966 and should be available in every institution that cares neonate to enhance mixing in patients with complex transposition of the great vessels, complication of this procedure including rupture of the balloon with or without Embolization of balloon fragments, mitral valve injury or vascular injury, injury to pulmonary veins or the inferior cava vein. transitory rhythm disturbances [8].

Diagnostic cardiac catheterization used in diagnosis of complex CHD, Determination of pressures in the heart chambers and the great vessels and to measurement of QP and QS ratio and for coronaries angiography ,due to the emergence of noninvasive imaging modalities, such as magnetic resonance imaging and computed tomography, catheterization for diagnostic

reasons still constitutes a valuable tool in certain parts in the workup of pediatric heart disease specially in right heart study before cardiac surgical and Transcatheter intervention [7,8].

II. AIM OF STUDY

1. To recognize the Libyan Experience in Congenital Heart Intervention in Eastern region of Libya
2. To evaluate outcome of the non-surgical intervention in treatment of structure heart disease.

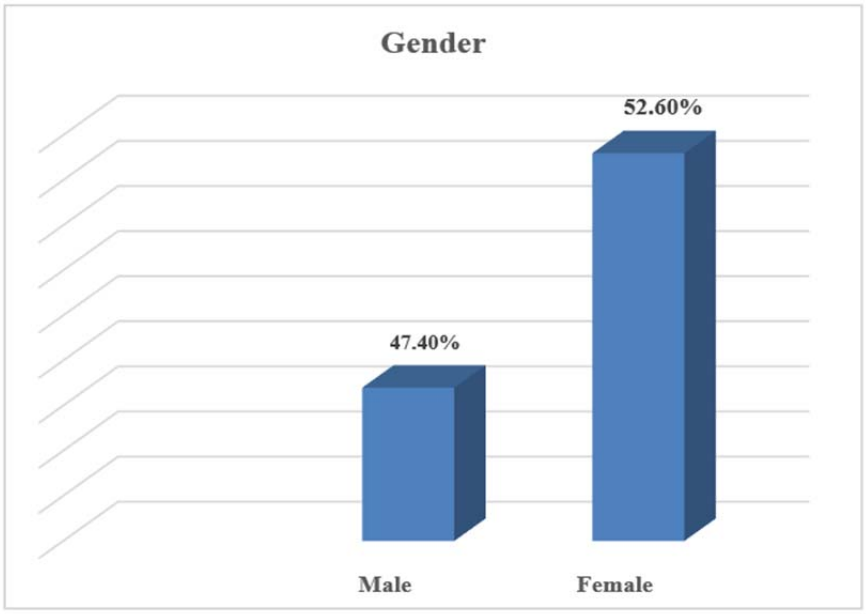
III. METHODS

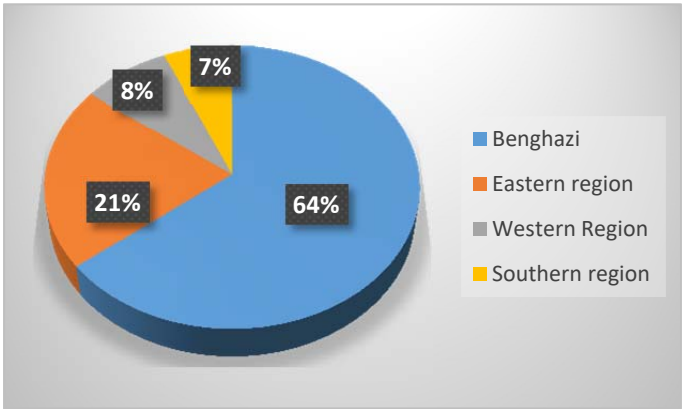
This Retrospective study carried out at NHC center in Benghazi Libya. NHC is a Referral center in Eastern region of Libya formerly Benghazi Cardiac centre (BCC) offers service to the whole of children with CHD from different cities of Libya. The service includes diagnosis and Transcatheter intervention in the newborn, Infant, Pediatrics and Adult with Congenital heart disease diagnostic and interventional catheterization carried out solely by Libyan congenital cardiology team alone started on 2007-2008. During period between (2011-2020) Patients referred to our center from different cardiac clinic and General hospitals in Libya. Patients were analysis according to type of catheterization diagnostic or interventional, type of CHD, age, sex, address , complication of each procedure, The Interventional procedures including : TCC of ASD and PDA, Balloon pulmonary Valvuloplasty to Pulmonary valve stenosis, balloon stent angioplasty for previous stented COA and Rash kind's for neonates babies with TGA referred from neonatal intensive care. We performed (192) diagnostic and intervention procedure,(42) case of ASD device closer ,(37) PDA device closure,(27) case pulmonary valve balloon valvoplasty, 68 cases diagnostic cardiac catheterization, (5) case Raskid Atrial Septostomy, (2) cases ballowen angioplasty to COA stent. (11) case coronary angiography.

All patients keep for one day for assessment of any complication, follow up next day by chest X-ray, Echocardiography, Electrocardiography.

IV. RESULT:

A total of 192 patients with structural heart disease underwent interventional and diagnostic procedures; diagnostic procedures involved 68 cases (35.4%) and 124 interventional cases (64.5%). There were 91 male cases (47.4%) and 101 female cases (52.6%). Most patients from Benghazi (64%).



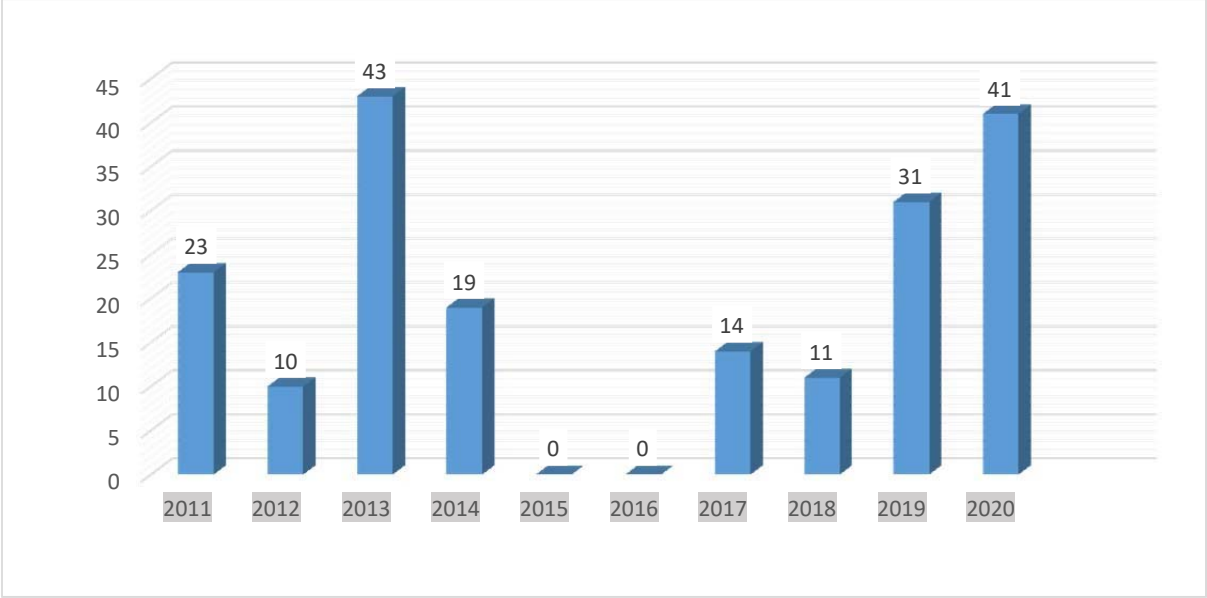


-Eastern region including Derna,jabal al akhader, marj, Albeda, tobrok .

-Western Region including Tripoli ,Western mountain.

-Southern region including Sabah, Alkofra, Jalu,Awjilah .

The highest number of patients from Benghazi city due to higher population compared other region of Libya.



No of cases per year

Table (1): Results of ASD device closure:

No. of patients	Age	Size of ASD	Device size	Successful cases	Complication
42	**7-53 year**	**10-34mm**	**12-36mm**	**41(97.6%)**	**1(2.3%)**

Transcatheter closure of ASD and PFO most common intervention procedure (42), patients (21.8%) underwent ASDs, PFO Transcatheter closure. The transthoracic echocardiography and transesophageal echocardiography (TEE) were used for determined the size of ASD and different rims of ASD for suitability of device closure. Our patient ranged in age from 7 to 53 years old, and the device size for ASD ranged from 10-36 mm. About (97.6%) cases of ASD had successful closures. One case was unsuccessful due to an inadequate inferior vena cava (IVC) and was referred for surgical closure; one case was complicated by retroperitoneal hematoma; one case developed transit-complete hemobloke (CHB); and no patient had residual ASD and no death.

Table (2): Results of PDA device closure:

No. of patients	Age	Size of PDA	Device size	Successful cases	Complication
37	1-12 year	4-7mm	6×4-10×8mm	37(100%)	1(2.7%)

About 37 cases of PDA closure by amplatzer duct occlude (ADO), size, and morphology of the PDA Determined by transthoracic echocardiography and aortic angiography, none of the patients had a residual shunt or significant gradient on the descending aorta or left pulmonary branches. Except for one patient, who was 12 years old due to a late diagnosis, all patients were under the age of three at the time of intervention, and device sizes ranged from 6/4 to 10/8. With investigation for the cause of coagulopathy, one case developed femoral artery thrombosis, and the patient had sickle cell trait.

Table (3): Result of Pulmonary Balloon Valvuloplasty:

Size of pulmonary Annulus	Size of balloon	Successful cases	complication
5-16mm	8-18mm	25(92.6%)	0%

Table (4): Pre balloon Pulmonary Stenosis Pressure Gradient:

Gradient before procedure	No	%
50-70mmHg	6	22.2%
> 70-100mmHg	13	48.1%
>100mmHg	8	29.9%

Table (5): Post balloon Pulmonary Stenosis Pressure Gradient:

Gradient before procedure	No	%
> 20 mmHg	13	48.1%
30-50 mmH	6	22.2 %
>50mmHg	8	29.9%

Table (6): oxygen saturation before and after Balloon atrial septostomy:

No. of patients	Po2 before BAS	PO2 after BAS
.1	65%	86%
.2	50%	90%
.3	70%	93%
.4	50%	70%
.5	50	75%

Table (7): complication of each procedure:

Procedure	%	Successful percent	Complication	Death
1. ASD TCC	21.8%	96.2%	1 (2.3%)	0%
2.PDA TCC	19.3%	100%	1 (2.7%)	0%
3. BPV	14%	92.6%	0	0%
4. Dilation of Aortic stent	1%	100%	0	0%
5. Diagnostic Catheterization	35.4%	100%	0	0%
6. Coronary Angiography	5.7%	%100	0	0%

twenty-seven pulmonary balloon valvuloplasty Patients with an invasive gradient between the right ventricle and the pulmonary valve greater than 40 mmHg require balloon valvuloplasty, depending on the severity of pulmonary stenosis assessed by transthoracic echocardiography and the size of the balloon as determined by transthoracic echocardiography and angiography. No case was complicated by more than trivial pulmonary valve regurgitation. There were two cases with significant residual stenosis obstruction: those with supravalvular PS and dysplastic pulmonary valve.

Two cases of balloon angioplasty on previously stented COAs were successfully completed. Five cases of TGA were referred from the neonatal intensive care unit for balloon atrial septostomy (BAS). Three of them were carried out before the age of seven days. Other (2) case procedures were delayed due to the septic condition of the babies, in one case until age 18-days and in another case until age 25-days, with no complications or deaths. Diagnostic catheterization was performed in 68 cases: 32 (47%) for CHD diagnosis, 20 (29.4%) for right heart pressure measurement, 11 (16.1%) for coronary angiography, and 3 (4.4%) for angiography for Aortic Arch anomalies.

V. DISCUSSION:

Currently percutaneous intervention has become an important treatment of certain types of structure heart disease with less complication than surgical intervention [5,6,9].

ASD Percutaneous device closure was done by Mills and King in 1976 [6]. The most widely used device in the world is the (amplatzer septal occlude), it has advantage of lesser incidence of erosion, a complication of TC closure of ASD is less than 0.05% to 0.3% due to oversized device [1,6] . The overall success rate with complete closure of the defect is over 95% [1].Various studies reported complication of TCC of ASD including residual shunt ,mitral or Aortic valve regurgitation,arrythemia, cardiac perforation, vascular trauma and death .These complication reported in study by Ming-Chun Yang et al in 2018 were device mobilization Reported in 0.2 to 0.4% of patients and cardiac erosion in 0.05 to 0.4% of patients, 11% of patients developed new atrial fibrillation/ flutter while Atrioventricular (AV)block was 0.2 to 1% and Thromboembolic events was 0.03 to 2.0% [8]. Furthermore, study by Rohit Mathur et al., carrying on 28 patients underwent to Transcatheter closure of ASD 2 patient out of 28 patient procedure was unsuccessful due to huge ASD in one patient and other patient due to insufficient IVC rim [10].

This was comparable to our study, in which 1 patient out of 27 patients attempted ASD device closure but was unsuccessful due to an insufficient inferior vena cava rim. The major complication was retroperitoneal hemorrhage in 1 patient and transient AV block in 1 patient; we had no mortality. Device closure of PDA started in 1992 with coil , The amplatzr duct occlude(ADO) used for closure of moderate and large PDA ,complications expected from the procedure are hemolysis, device embolization and residual shunt , device-induced left pulmonary artery stenosis or coarctation of the aorta [8]. Similarly, a 2007 study by Gi Young Jang discovered that the procedure was successful in 114 patients (97.4%) [11]. Major complications were detected in 4 patients (3.4%); significant hemolysis (1.7%); infective endocarditis (1); and a failed procedure due to embolization (0.8%). Minor complications occurred in 6 patients (5.1%); mild narrowing of the descending aorta was observed in the series of 12 PDA patients. In a study conducted by Rohit et al., there were no major complications as a result of the procedure. Furthermore, the study by Faranak Behnaz done on a PDA resulted in successful closure with no major complications; the only complications were benign arrhythmia (44.4%) and hemorrhage in 1 (1.4%) of the patients [7]. In our study 37 cases of PDA patients who underwent TCC, there was no residual flow and no narrowing effect on the descending aorta or left pulmonary branch, and we had 1 case (2.7%) complicated by arterial thrombosis that was successfully managed by anticoagulant discharge home after one week.

Pulmonary artery Balloon valvuloplasty is a pulmonary valve dilation by percutaneous balloon dilation used in 1948 as alternative method to surgical valvotomy This procedure performed to decreased gradient through the pulmonary valve and avoid or delayed surgical intervention on the valve. The complication of this procedure including pulmonary regurgitation, restenosis, cardiac erosion and vascular trauma including pulmonary artery rupture and the mortality rate of this procedure 0.2%. Study by

Hamid Amoozgar et al reported that peak pulmonary valve gradient before balloon was 93.21 (± 33.34) that decreased immediately to 27.34 (± 14.91) after BPV and Mild pulmonary regurgitation (PR) was detected in 72%, moderate PI in 26% and severe PR in 2% [12].

Another study by Claric Petersen et al. revealed that in 108 patients who underwent balloon valvuloplasty, the mean pressure gradient was reduced from 66.2 21.4 mm Hg to 23.8 15.8 mm Hg. Asim Yousuf Al Balushi et al. discovered in other studies that: 5 Fifty patients had balloon dilatation of the pulmonary valve, 32 patients (64%) had mild pulmonary valve regurgitation, and 9 patients (18%) had moderate pulmonary valve regurgitation. 2 patients did not respond to BPV and were referred to surgery. Many researchers have reported a high prevalence of pulmonary regurgitation after BPV, but no one needed intervention [6,5]. In our study 27 patients with Pulmonary artery Balloon valvuloplasty show significant decreased in pulmonary pressure gradient decrease from more than 50 mmHg to less than 20mmHg in 70.3% of patients, except 2 patients not respond to PBV one patient with dysplastic other with sup valvular pulmonary stenosis. Agreement with study done by Hamid Amoozgar [12].

Transposition of great artery (TGA) is a common congenital heart disease that need intervention in first 2 week of life, ballowen atrial Septostomy done to enhance mixing at atrial level and improving oxygen saturation and discontinuous prostaglandin (PGE1) [13].

In our study, BAS was performed on five TGA patients, and the procedure was successful in all of them, resulting in an increase in oxygen saturation before the age of seven days, with the exception of two cases at 18 and 25 days. One baby's BAS was delayed due to a septic condition, and another baby's BAS was delayed due to a delayed diagnosis. study conducted by G. Hiremath et al. in the analysis of BAS was performed in 42 infants and resulted in a significant increase in oxygen (O2) saturations with minimum (61 to 76%) and maximum (80 to 90%) oxygen (O2) saturations, which is near our range [14,15].

VI. Conclusion:

Transcatheter intervention is an alternative to surgical intervention to repair certain types of congenital heart disease (CHD) with less morbidity and mortality than the surgical method of treatment. In Libya, there has been a steady growth in the number of interventions and diagnostic procedures for structural heart disease. The success rate is rising as operator experience increases. We try to begin performing new procedures in our center, particularly those in critical neonatal situations such as PDA stenting, (RVOT) stenting to save a newborn's life, or delaying surgical intervention until cardiac surgery is available.

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Nil.

Conflicts Of Interest:

There are no conflicts of interest.

The authors alone are responsible for the content and writing of the paper.

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