

# Interventional cardiac catheterization In Congenital Heart Disease: Experience at Queen Alia Heart Institute.

*Yazan Qawasmeh, MD\*, Issa Hijazi, MD\*,Hani Altarawneh, MD\*, Amro Almomani, MD\*,Abdelfattah Abu Haweleh, MD\*.*

## ABSTRACT

**Objective:** To analyze our experience in percutaneous interventional cardiac catheterizations in children and adults with congenital heart diseases including types of procedures done, success rate and complications.

**Methods:** This is a retrospective study of patients (children and adults) with congenital heart defects who underwent interventional cardiac catheterization at Queen Alia Heart Institute over the last 3 years (April, 2014 to April, 2017). The age, sex, indication for catheterization, the result and the complications of the procedure (if present) were recorded.

**Results:** A total of 574 patients underwent interventional cardiac catheterization during the study period. Age of patients ranged from 3 days to 62 years (mean age of 9 yrs). Two hundred and forty-one patients were males (42%). Twenty-six patients (5%) underwent catheterization post cardiac surgery for variable causes. The most common indication for interventional catheterization was patent ductus arteriosus closure in 200 patients (35%). Other indications were cardiac septal defects closure in 179 patients (31%), valvuloplasty in 115 patients (20%), balloon angioplasty of coarctation of aorta in 34 patients (6%), stenting of aortic coarctation in 14 patients (2%), fenestra closure in patients who underwent Fontan procedure in 7 patients (1%) and occlusion of venovenous and major aortopulmonary collateral (MAPCAS) and feeding artery of pulmonary sequestration in 6 patients (1%). Emergency indications were balloon atrial septostomy in 13 patients (3%) and temporary pacemaker insertion in 1 patient. The most recently introduced interventional catheterization to our center is pulmonary valve insertion which was done in 5 patients (1%). The most common presentation that led to referral to us was hearing a heart murmur while the most common symptom was effort intolerance. Failure rate was less than 3%. Significant complications occurred in 4 patients (less than 1%) and minor complications in 12 patients (2%). Over all the previous 574 cases, death was reported in only one patient during ballooning of critical pulmonary valve stenosis (0.2%)

**Conclusion:** Interventional catheterization is done in our center with a very high success rate and minimal complications. The commonest indications for intervention were device closure of patent ductus arteriosus followed by atrial septal defect and balloon pulmonary valvuloplasty.

**Key words:** Cardiac, Catheterization, Congenital, Intervention.

**JRMS Aug 2018; 25(2):64-67/DOI: 10.12816/0049835**

### Introduction

In comparison with diagnostic cardiac catheterization, therapeutic catheter procedures require more time and resources,

are more costly and risky, and demand more technical training and expertise. <sup>(1)</sup> It has replaced cardiac surgery in so many aspects of congenital heart disease management like closing atrial or ventricular septal defects,

From Department of:

\*Pediatric cardiology, Queen Alia heart institute, Royal Medical Services.

Correspondence should be addressed to: Dr. Yazan Qawasmeh. Email: qawasmeh.yazan@yahoo.com.

Manuscript Received Dec 20,2017,Accepted April 12,2018.

valve replacement like pulmonary valve replacement, dilating narrow valves or blood vessels, etc. Randomized studies to compare between cardiac surgery and cardiac catheterization in congenital heart disease are scarce; registry data are limited, and local series are potentially affected by selection and reporting bias. Well known draw backs of surgery against catheterization include scar formation, need for cardiopulmonary bypass with its complications and longer hospital stay. On the other hand, cardiac catheterization carries the risk of radiation exposure, device embolization and vascular injury. Also, not all cardiac defects are amenable to repair by cardiac catheterization. (2-5)

## Methods

This is a retrospective study including patients (children and adults) with congenital heart defects who underwent interventional cardiac catheterization at Queen Alia Heart Institute over the last 3 years (April, 2014 to April, 2017). The age, sex, symptoms and signs of the underlying congenital heart defect, indication for catheterization, the result, success rate and the complications of the procedure (if present) were recorded. Two-dimensional Echocardiography, CBC, chest X-ray and ECG were done for all patients in the second day post the procedure and as needed on follow up.

## Results

A total of 574 patients underwent interventional cardiac catheterization during the study period. Age of patients ranged from 3 days to 62 years (average of 11.3 years). Two hundred and forty-one patients were males (42%). Twenty-six patients (5%) underwent catheterization post cardiac surgery for variable causes. The most common indication for interventional catheterization was patent ductus arteriosus closure (PDA) in 200 patients (35%). Other indications were atrial septal defects (ASD) closure in 153 patients (27%), ventricular septal defect (VSD) closure in 26 patients (4%), pulmonary valve balloon valvuloplasty in 104 patients (18%), aortic valve balloon valvoplasty in 11 patient (2%), balloon angioplasty of coarctation of aorta in

34 patients (6%), stenting of aortic coarctation in 14 patients (2%), fenestra closure in patients who underwent Fontan procedure in 7 patients (1%) and occlusion of veno-venous and major aortopulmonary collateral (MAPCAS) and feeding artery of pulmonary sequestration in 6 patients (1%). Emergency indications were balloon atrial septostomy (Rashkind procedure) in newborns with transposition of great vessels in 13 patients (3%) and temporary pacemaker insertion in one female patient aged 40 years with unrepaired atrioventricular septal defect. The most recently introduced interventional catheterization to our center was pulmonary valve insertion which was done in 5 patients (1%). Table I summarizes the indications for catheterization in our study. The most common presentation that led to referral to us was hearing a heart murmur while the most common symptom was effort intolerance. Other indications for referral include palpitations, poor weight gain and recurrent infections. Failure rate was less than 3 % and include suboptimal ballooning of aortic or pulmonary valve and re-coarctation of the aorta. Significant complications happened in 4 patients (0.8%) and include embolization of one ASD device to the aortic arch which was surgically explanted and the ASD was closed during the operation, and one PDA device which was snared, retrieved and repositioned appropriately. Another two post catheterization complications were staphylococcus aureus sepsis post coarctation stenting in one patient, which was treated by 4 weeks antibiotics and non-sustained ventricular tachycardia post pulmonary valve insertion (Venus valve) which resolved after few days. Minor complications occurred in 12 patients (2%) and included bleeding and hematoma at the site of puncture, arterial injury and mild reactions to contrast. All of these complications resolved spontaneously. Overall of the 574 cases that were included in the study, only one patient (aged 3 months) died in this study during ballooning of severe pulmonary valve stenosis. He developed sudden cardiac arrest after full inflation of the balloon in the pulmonary valve and didn't respond to any kind of resuscitation including temporary pacemaker insertion.

**Table I:** Indications for cardiac catheterizations

	M	F	M+F
Patient ductus arteriosus	63	137	200
Atrial septal defect	61	92	153
Ventricular septal defect	12	14	26
Ballooning of pulmonary valve	47	57	104
Ballooning of aortic valve	9	2	11
Ballooning of coarctation of aorta	21	13	34
Coarctation stent	9	5	14
Fenestra closure	3	4	7
Collaterals and sequestra closure	4	2	6
Pacemaker	0	1	1
Rashkind procedure	8	5	13
Pulmonary valve insertion	4	1	5
	241	333	574

## Discussion

The indications for cardiac catheterization have changed over the years from diagnosis to intervention because of the development and advancement of non-invasive modalities for assessing congenital heart problems like echocardiography, CT scan and MRI. This is reflected in a study by Malacic et al <sup>(2)</sup> in the Republic of Croatia from January 1996 to December 2009. The percentage of interventional catheterization out of all catheterization procedures has increased from 12.5% in 1996 to 31.25% in 2009. The most common indication for intervention in their study was atrial septostomy (26.4%), followed by PDA closure (25.1%) then pulmonary valve dilatations (15.1%). ASD closure accounted for 7% of all interventions. In our study, interventional catheterizations account about 38% of total catheterization that were done over that period. The main indication for intervention was PDA closure followed by ASD closure. This difference between studies is probably due to many factors. The age of our study population is much older than theirs (their study population age was 0-20.5 years). In older ages the ASDs constitute most of the encountered congenital heart defects. <sup>(6)</sup> The second reason is probably that they have low threshold for atrial septostomy or it's the hospital policy to buy time and do septostomy before corrective surgery when child is older. <sup>(7)</sup> Another reason may be that they do septostomy outside the newborn period but we don't. <sup>(8,9)</sup> A new and evolving procedure was the transcatheter pulmonary valve replacement which started after year 2000. <sup>(10, 11)</sup> We inserted 2 Melody valves

(Medtronic Inc, Minneapolis, Minn) and 3 Venus valves (Venus Medtech, Hangzhou, Zhejiang, China) these cases constituted 1% of all interventions. These procedures were done only last year and only 5 procedures were done because of the high cost of these valves. Major complications are reported to occur in 3.2% of the interventional procedures, while in 10% there were minor complications. <sup>(12, 13)</sup> Balloon aortic dilation had the highest incidence of all complications (42%), followed by dilation of pulmonary valve in Fallot's tetralogy (40%) and recoarctation angioplasty (30%). The lowest risk of complications happened in occlusion of the persistent arterial duct (5%). <sup>(12)</sup> In our study we had a low incidence of significant or major complications (less than 1%) and a low failure rate. This might be due to exclusion of ill and risky patients by sending them to surgery from the start and not doing all kinds of complex interventional procedures. One patient (0.2%) died in this study during ballooning of critical pulmonary valve stenosis. He had sudden cardiac arrest after full inflation of balloon size 10mm\*2cm in the pulmonary valve which is well known complication of balloon dilatation of cardiac valves. Cases of infundibular spasm "suicidal Right ventricle" after Ballooning of the pulmonary valve were reported by Al-Kasab et al. <sup>(14)</sup> In other studies, mortality rate was 0.14%. <sup>(12)</sup> This is a low figure and reflects the safe nature of cardiac catheterization. Patients with congenital heart disease in the form of single ventricle circulation will need to undergo surgery several times during their lives. The final stage being fontan surgery, or

total cavopulmonary connection. In our cardiac center fenestrations were placed in those patients felt to be at higher risk of early post-operative morbidity. However Closure of the fenestration is necessary due to the long term harmful effects of chronic hypoxemia. The development of percutaneous implantation devices has allowed greater flexibility in surgery which can be adapted to the hemodynamic conditions of each patients. On the other hand surgical closure of the fenestration is more demanding. <sup>(15)</sup>

## Conclusion

Interventional cardiac catheterization is done in our center with a very high safety profile and success rate. The most common indication for intervention was patent ductus arteriosus closure followed by atrial septal defect closure and pulmonary balloon valvuloplasty.

## References

**1-Allen HD, Beekman RH, Garson A, et al.** Pediatric therapeutic cardiac catheterization: a statement for healthcare professionals from the Council on Cardiovascular Disease in the Young, American Heart Association. *Circulation*. 1998; 97: 609–625

**2-Malčić I, Kniewald H, Sarić D, Gjergja Z, et al.** The development of interventional catheterisation in the referral centre for pediatric cardiology of the Republic of Croatia—a retrospective study 1996–2009. *LijecVjesn*. 2011 Jul-Aug;133(7-8):241-9.

**3- Baumgartner H, Bonhoeffer P, De Groot NM, et al.** ESC Guidelines for the management of grown-up congenital heart disease (new version 2010). *Eur Heart J* 2010; 31:2915–2957.

**4- Z.D. Du, Z.M. Hijazi, C.S. Kleinman, N.H et al.** Comparison between transcatheter and surgical closure of secundum atrial septal defect in children and adults. *J Am Coll Cardiol*, 39 (2002), pp. 1836-1844

**5- Glatz AC, Patel A, Zhu X, et al.** Patient radiation exposure in a modern, large-volume, pediatric cardiac catheterization laboratory. *Pediatr Cardiol* 2014; 35: 870–8.

**6-Abdelfatah Abu Haweleh, Monther Obeidat, Hani Tarawneh, et al.** Spectrum of

Adult Congenital Heart Diseases: Jordanian Experience. *JRMS*. March 2016; 23 (1): 54-59

**7- Villafañe J, Lantin-Hermoso MR, Bhatt AB, Tweddell JS, et al.** D-transposition of the great arteries: the current era of the arterial switch operation. *J Am Coll Cardiol* 2014; 64: 498–511

**8- Pranav Chandrashekar, Jae Yoon Park, Mohammad A. Al-Hijji, et al,** Atrial Septostomy to Treat Stiff Left Atrium Syndrome. *Circulation: Heart Failure*. 2017;10: e004160

**9- Robert Sabiniewicz.** Balloon atrial septostomy in pulmonary arterial hypertension: Atrial flow regulator — New therapeutic option. *Cardiol J* 2017;24(4):455-456

**10- Bonhoeffer, Y Boudjemline, Z Saliba, et al.** Transcatheter implantation of a bovine valve in pulmonary position: a lamb study. *Circulation*, 102 (2000), pp. 813-816

**11- Bonhoeffer P, Boudjemline Y, Saliba Z, Merckx J, Aggoun Y, Bonnet D. et al.** Percutaneous replacement of pulmonary valve in a right-ventricle to pulmonary-artery prosthetic conduit with valve dysfunction. *Lancet*. 2000;356:1403–1405

**12- Renato Vitiello, Brian McCrindle, David Nykanen et al.** Complications associated with pediatric cardiac catheterization. *Journal of the American College of Cardiology* Volume 32, Issue 5, 1 November 1998, Pages 1433-1440

**13- Yilmazer MM, Ustyol A, Güven B, et al.** Complications of cardiac catheterization in pediatric patients: a single center experience. *Turk J Pediatr*. 2012 Sep-Oct;54(5):478-85

**14-Al Kasab S, Ribeiro PA, Al Zaibag M, et al.** Percutaneous double balloon pulmonary valvotomy in adults: One- to two-year follow-up. *Am J Cardiol* 1988;62(10Pt1):822-4.

**15-Sebastian Góreczny1 et al.** Fenestration closure with Amplatzer Duct Occluder II in patients after total cavo-pulmonary connection. *Arch Med Sci* 2, March / 2017,337-345