ASSESSMENT OF RIGHT & LEFT VENTRICLES BY 4D SPECKLE TRACKING BEFORE & AFTER TRANSCATHETER CLOSURE OF ATRIAL SEPTAL DEFECTS IN CHILDREN

By

Islam Saad Ibrahim Mohammed, Hassan Ali Hassan, Hassan Saad Abu Saif, Hala Mounir Agha*, Ibrahim Mohamed Abu Farag

Department of Pediatrics, Faculty of Medicine, Al-Azhar University,
*Department of Pediatrics, Faculty of Medicine, Cairo University

Corresponding author: Islam Saad Ibrahim Mohammed,
Mobile: 00201143663346, E-Mail: abobakralsedeek@gmail.com

ABSTRACT

***Introduction**: Myocardial strain and strain rate are more accurate than velocities as indices of ventricular contractility, perhaps by eliminating translational artifact, Strain rate values appeared to be dependent on pressure overload but less dependent on volume overload compared to strain.*

***Aim of the Work**: The goal of this study was to analyze the acute changes in longitudinal strain and strain rate for both RV & LV walls& for early detection of Ventricular dysfunction through regular follow up,also to measure children mental health symptoms before &after transcatheter closure of Atrial septal defect.*

***Methodology:** prospective analytical study for 32 patients in the Pediatric Cardiology Division of Specialized Pediatric Hospital, Cairo University with haemodynamically significant Atrial septal defect (ASD) before & 6 months after transcatheter closure of ASD from September 2016 to September 2018, & using Spence Children Anxeity Scale (SCAS) to measure children mental health.*

***Results:** the mean age was 6.01 ± 3.19 (range 3 to 9 ys), was BSA 0.73 ± 0.22 m2 (range 0.5 to 0.94m2) with female to male ratio 1.3/1. There was improvement of RVMPI(Myocardial Performance Index) and LVMPI after 6-month post ASD closure, RVMPI (0.46±0.069 before vs 0.38±0.053 after P <0.0001) LVMPI (0.49±0.12 before vs 0.38±0.08 after P <0.0001) .There was a significant improvement of LV End Diastolic Volume (EDV), LV End systolic Volume (ESV) using 4D TomTec measures after device closure , LV EDV (32.96 ±10.99 ml before vs 44.024±14.9017 ml after P <0.0001) , LV ESV (15.16±6.08 ml before vs 21.76±8.34 ml after P <0.0001). There also was significant improvement of the LV Global Circumferential Strain(GCS) after device occlusion (-20.76 ±11.17 before vs -26.36±6.59) , & LV Global Longitudinal Strain(GLS) (-19.17± 3.67 before vs -22.36 ± 4.72) after device* *occlusion using 4D TomTec .4D RV volumes and strains are better predictors of the hemodynamic indices of RV dysfunction compared to conventional RV parameters . There was a significant decrease of the RV EDV (ml), 54.65±10.05 before vs 15.73 ± 8.67 after) & RV SV (25.15 ±6.36 before vs 20.06±7.2, after device occlusion) using 4D TomTec.*

Key Words: *Tissue Doppler Imaging _ Myocardial Performance Index _ ASD _ Transcatheter closure_4D STE.*

INTRODUCTION

ASDs constitute 8% to 10% of congenital heart defects in children. The incidence of ASDs has been estimated to be 56 per100,000 live births.[(1)]

Transcatheter occlusion of ASD is performed worldwide and has become one of the most practiced interventional procedures for structural heart disease; Closure of the defect causes a sudden change in loading conditions of both ventricles. [(2)] Quantitative evaluation of right ventricular (RV) function is still challenging due to RV complex anatomy and structure.[(3)]

3D echocardiography can overcome two-dimensional limitations by neglecting geometric assumptions and using multiple images to reconstruct the RV chamber.[(4)]

Myocardial strain and strain rate are more accurate than velocities as indices of ventricular contractility, perhaps by eliminating translational artifact, Strain rate values appeared to be dependent on pressure overload but less dependent on volume overload compared to strain.[(5)]

Ethical considerations:

1- The ethical committees of Al-Azhar faculty of medicine & pediatric department approved the study

2- Informed consent was obtained from parents of all included children 3-The research protocol did not interfere with any medical recommendations or prescriptions.

4- The aim of the study & all investigations as well as the risks & benefits of study have been explained to parents of the patients.

5- The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

6- All data of patients & results of study are confidential &

patients have the right to keep it.

Financial Disclosure/Funding:

The authors received no financial support for research, authorship, and/or publication of this article

PATIENT AND METHODS

This work was carried out as prospective analytical study for 32 children in the Pediatric Cardiology Division of Specialized Pediatric Hospital, Cairo University with hemodynamic significant atrial septal defect (ASD) before & 6mon. after transcatheter closure of ASD.

Children with hemodynamic significant atrial septal defect with dilated RV from 2 to ≤18 years age, Body weight more than 12 kgs, hemodynamic significant ASD with left to right shunt will be included in the study

All the studied cases were subjected to the following:

1- **Informed consent:** of the parents was obtained for all patients,

2- **Thorough medical history talking**,

3- **Thorough clinical examinations**,

4- **Chest and heart x-ray:** Commenting on cardio-thoracic ratio and lung vascularity,

5- **Electrocardiography,**

6- **Transthoracic Echocardiography (TTE):** All patients was submitted to a complete transthoracic echocardiography Using different echocardiographic modalities 2D TTE, and, 4D TTE, Doppler myocardial imaging (DMI), speckle tracking, using Philips EPIC 7 & data analysis by Q-LAB & TOMTEC softwares analysis & Using **Philips EPIQ 7 C ultrasound system with X5-1, S8-3, or X7-2 broadband phased-array transducers**, depending on the age of the patient.

In assessment of:

a- Haemodynamically significant ASDs.

b- Assessment of biventricular function, pulmonary hypertention and RVH, TAPSE.

c- Doppler myocardial imaging (DMI) for RV free wall, IVS & LV lateral wall & calculation of RV &LV MPI and general data were obtained mostly from four-chamber view within one cardiac cycle.

d- 2 D speckle RV Longitudinal strain by Q lab analysis (Philips Medical Systems) & TOM TEC (4D -analysis 3.0; Tom Tec Imaging Systems, Unterschleissheim, Germany) before & after ASD transcatheter closure.

e- 4 D RV Global & 2D fun. Analysis through TOM TEC (4D LV-analysis 3.0; Tom Tec Imaging Systems, Unterschleissheim, Germany) before & after ASD transcatheter closure.

f- 2D LV Specle Q lab analysis (longitudinal & circumferential strain) before & after ASD transcatheter closure.

g- 4D LV TOM TIC (STRAIN) Global Analysis((longitudinal &circumferential strain) before & after ASD transcatheter closure.

h- 4D LV TOM TEC Apical & basal ROTATION, TWIST before & after ASD transcatheter closure.

7-4D Speckle tracking Echocardiography: The 3D data sets were displayed as multi-planar reconstruction images corresponding to four tiles containing three standard long axis (LAX) views (apical four chamber, apical three chambers, and apical two chambers) and a short axis view, which is orthogonal to the LAX views. LV boundaries were first manually selected for the three anatomic landmarks (mitral annulus, LV apex and aortic valve). Adjustments were made in the multi-planar reconstruction images until the landmarks were well positioned in each standard view. The 3D endocardial surface was automatically reconstructed and tracked in 3D space throughout the cardiac cycle. Subsequently, the Beutel revision state displayed a static 3D surface model of the LV (Beutel) automatically calculated by the application. Finally, the LV was automatically divided into 16 3D segments using the standard segmentation of the American Society of Echocardiography. The curves and maps of the 3D LV global rotation, twist and torsion analyses were calculated 19 **8-2D Transesophageal study (TEE):** TEE were performed using a system equipped with pulsed, continuous wave and color Doppler transesophageal echocardiographic transducer using a Vivid **S5 (GE Vingmed Ultrasound AS Strondpromenaden 45, N-3191 Horten, Norway)**. All patients were submited to general anesthesia and intubation before transesophageal echocardiography. The maximal diameter of the defect was measured using atrial end-diastolic frames in 0, 45, and 90 degrees **9-Lab** before intervention: Laboratory evaluation was earned out before catheterization including determination of haemoglobin, WBCs and platelet count and the coagulation profile.10- Spence Children Anxeity Scale (SCAS) to measure children mental health.

RESULTS

Data were analyzed using IBM© SPSS© Statistics version 23 (IBM© Corp., Armonk, NY, USA).Continuous numerical variables were presented as mean and standard deviation (SD) and intergroup differences were compared using the independent-samples t-test.

Table (1): Demographic and baseline clinical and hemodynamic data of the studied population

Variable		Count	%
Age (yr)	6.013 ± 3.19		
Weight (kg)	20.16 ± 9.65		
BSA (m2)	0.73 ± 0.22		
Gender	Female	19	59.4%
	Male	13	40.6%
Presentation	Asymptomatic	16	50.0%
	Exertional dyspnea	10	31.3%
	Repeated chest infection	4	12.5%
	Feeding difficulty	1	3.1%
	Trisomy 18	1	3.1%
ECG	Normal	16	50.0%
	RAD, RVH	16	50.0%

The clinical characteristics of the patients with ASD and control group were represented in Table 1. There were no significant differences between two groups as regards the age, gender, weight or BSA.

Table (2): Characteristics of ASD size & device

	Range	Mean ± SD.	Median
ASD size(mm)	7.0 – 35.0	17.95 ± 5.45	17.0
ASD device size(mm)	7.5.0 - 38.0	21.25 ± 5.50	20.0

Table (3): Characteristics of ASD Device

	Size (mm)	count	percent
Device	7.5	1	3.1%
	10.5	1	3.1%
	12	2	6.3%
	13	1	3.1%
	14	1	3.1%
	16	3	9.4%
	17	4	12.5%
	18	3	9.4%
	19	4	12.5%
	20	2	6.3%
	22	1	3.1%
	24	5	15%
	26	1	3.1%
	28	2	6.3%
	38	1	3.1%

Table (4): Comparison of TDI measures before and after device occlusion (Mean ± SD): RV anterior wall

	Before **device occlusion** (Mean ± **SD):**	After device **device occlusion (**Mean ± **SD):**	Paired differences		
TDI measure	Mean ± SD	Mean ± SD	Mean ± SD	95% CI	P-value*
RVE' (cm/s)	16.18±3.88	12.73±2.40	3.45±4.58	-5.10 to -1.7999	**0.0002**
RVA' (cm/s)	10.65±2.56	8.87±1.41	1.78±2.97	-2.85 to -0.71	**0.0019**
MPI	0.46±0.068	0.38±0.053	0.07±0.05	-0.09 to -0.05652	**<0.0001**

Table (5): Comparison of TDI measures before and after device occlusion (Mean ± SD): LV lateral wall

	Before **device occlusion** (Mean ± **SD)**	After **device occlusion** (Mean ± **SD)**	Paired differences		
TDI measure	Mean ± SD	Mean ± SD	Mean ± SD	95% CI	P-value*
LVE' (cm/s)	15.60±2.99	14.85±2.86	0.75±4.2575	-2.28 to 0.78	0.3267
LVA' (cm/s)	7.28±1.543	8.11±1.84	0.83±2.109	0.06 to 1.52	**0.0344**
S' (cm/s)	8.97±2.019	10.18±1.61	1.22±2.35	0.36 to 2.05	**0.0065**

Table (6): Comparison of LV &RV MPI measures before and after device occlusion (Mean ± SD)

	Before **device occlusion** (Mean±**SD)**	After **device occlusion** (Mean±**SD)**	Paired differences		
LV MPI	0.46±0.122	0.38±0.08	0.12±0.07	0.13 to -0.08	**<0.0001**
RV MPI	0.46±0.068	0.38±0.05	0.07±0.05	0.09 to -0.056	**<0.0001**

Table (7): Comparison of STI measures before and after device occlusion (Mean ± SD): RV longitudinal strain

	Before **device occlusion** (Mean±**SD)**		After **device occlusion** (Mean±**SD)**		Paired differences			
2D STE measure	Mean±SD		Mean±SD		Mean±SD		95% CI	P-value*
Basal anterior (%)	-23.2188	6.0681	-27.4844	6.6326	-4.2656	7.7522	-7.0606 to -1.4707	**0.0040**
Midanterior (%)	-24.7594	6.5481	-27.2	6.3937	-2.4406	7.0064	-4.9667 to 0.08547	0.0578
Apical lateral (%)	-19.2594	5.5064	-20.9719	5.8209	-1.7125	5.8521	-3.8224 to 0.3974	0.1079
Apical (%)	-21.1313	5.1052	-24.6063	5.9281	-3.475	6.3126	-5.7509 to -1.1991	**0.0040**
Septal apical (%)	-22.7188	4.9893	-25.5781	5.142	-2.8594	5.0451	-4.6783 to -1.0404	**0.0031**
Mid Inferior (%)	-22.2438	4.8632	-24.3625	6.1714	-2.1187	5.8632	-4.2327 to -0.004843	0.0495
Basal inferior (%)	-20.6563	4.9813	-24.8438	6.9797	-4.1875	7.9532	-7.0549 to -1.3201	**0.0056**
GLS (%)	-20.1774	3.1412	-25.8613	5.0219	-5.6839	3.8618	-7.1004 to -4.2674	**<0.0001**

There was a significant improvement of the RV global longitudinal strain after device application but, there was no meaningful difference in Midanterior, Midinferior (%), apical lateral (%) segments, before and after device application.

Table (8): Comparison of 4D TomTec measures before and after device application: RV

	Before **device occlusion**		After **device occlusion**		Paired differences			
4D TomTec measure	Mean±SD		Mean±SD		Mean±SD		95% CI	P-value*
RV EDV (ml)	54.652	10.0454	45.32	15.7329	8.668	17.7041	1.3601 to 15.9759	**0.0221**
RV SV (ml)	25.148	6.3585	20.064	7.2005	4.916	7.1327	1.9718 to 7.8602	**0.0021**
TAPSE (mm)	11.4625	2.5077	13.2125	2.8289	1.75	3.0845	0.4475 to 3.0525	**0.0107**

There was a significant decrease of the RV EDV (ml), RV SV, while there was a significant increase of RV TAPSE after device occlusion using 4D TomTec.

Table (9): Comparison of 4D TomTec measures before and after device occlusion: LV global analysis

	Before **device occlusion**		After **device occlusion**		Paired differences			
4D TomTec measure	Mean	SD	Mean	SD	Mean	SD	95% CI	P-value*
LVEDV (ml)	32.96	10.9857	44.024	14.9017	11.064	10.4072	6.7681 to 15.3599	**<0.0001**
LVESV (ml)	15.164	6.0787	21.764	8.3435	6.6	5.8685	4.1776 to 9.0224	**<0.0001**
LVSV (ml)	19.968	7.3634	27.62	9.8314	7.652	6.4194	5.0022 to 10.3018	**<0.0001**
LVEF (%)	57.44	8.0757	58.68	7.4801	1.24	8.3643	-2.2126 to 4.6926	0.4657
LV mass (g)	48.48	19.2573	62.056	25.4813	13.576	16.3405	6.8310 to 20.3210	**0.0004**
LVGLS (%)	-19.172	3.6891	-22.364	4.7247	-3.192	5.6406	-5.5203 to -0.8637	**0.0093**
LVGCS (%)	-20.7596	11.1768	-26.356	6.593	-5.5964	11.6704	-10.4137 to -0.7791	**0.0246**
LVSDI	5.0522	1.6456	5.1788	2.0802	0.1267	2.5922	-0.9943 to 1.2476	0.8169
LV twist (°)	10.952	4.3329	15.908	5.3947	4.956	5.1817	2.8171 to 7.0949	**0.0001**
LV torsion (°)	2.136	0.5663	2.896	0.8763	0.76	0.8958	0.3902 to 1.1298	**0.0003**

* There was a significant improvement of the LV EDV, LV ESV, LVSV, LVGLS after device occlusion by 4D TomTec analysis, also there was significant improvement of the LVGCS after device application by 4D TomTec analysis.

* There was a significant improvement of the LV twist& LV tortion, LV mass after device occlusion by 4D TomTec analysis.

Table (10): Comparison of anxiety score using SCAS score before and after device occlusion

		Before **device occlusion**		After **device occlusion**		Paired differences	
Variable	n	Mean	SD	Mean	SD	95% CI	P-value*
Anxiety score	32	21.9688	6.3525	32.9688	3.3525	0.5011 to -0.2589	**<0.0001**

There was significant change in anxiety scale before and after device occlusion with negative behavioral and intrapsychic changes after catheterization.

DISCUSSION

The assessment of ventricular function following percutaneous ASD closure is complicated by the alteration to loading conditions caused by the elimination of intracardiac shunting[(6)].

To our Knowledge this work is the first eliciting the improvement of both right & left Ventriclular function using 2D & 4D STE with atrial septal defects before &after transcatheter closure in pediatric age.

Adverse ventricular interdependence associated with right ventricular volume overload was previously described as "Bernheim effect", in which the interventricular septum bulges into the left ventricular cavity and leads to impairment of left ventricular filling[(7)]. Hence, improvement in left ventricular form and function seen in patients after closure can be explained by improvement in left ventricular filling[(8)].In our study there was a significant decrease of the LV MPI by TDI on LV lateral wall after device application this improvement may be due to the restoration of LV compression and the increase in left ventricular filling[(8)]. As shown in table[(5)].

Deformation imaging is a promising technique to assess regional and global myocardial function in children with heart disease. STE-derived and TDI-derived deformation measurements were both feasible in children, but the speckle-tracking techniques are more user friendly and less time intensive[(9)]

also STE is a technique that provides a quantitative assessment of the motion of myocardial tissue, independently of angle and ventricular geometry, which could detect subclinical myocardial dysfunction[10].

In this study we found that LV circumferential strain of basal, papillary and apical levels significantly increased after ASD closure in response to acute change in loading condition. **(Table 9)** This result is accordant with[11, 12] which mentioned that circumferential strain was increased significantly 24 hours after ASD closure, thus it can be used as an indicator of LV response to normalized loading conditions.

Several studies in literature found therefore that LVEF derived from 4D measures are as accurate as MRI-based values[13].

4D STE showed significant improvement of LVGLS &LV GCS, after closure compared to before closure as well as there was a significant improvement of the LV EDV, LV ESV after device application by 4D TomTec analysis **(Table 9)**.

On the other hand our study revealed that LV longitudinal strain also significantly increased after ASD closure But this was not agree with [11] who mention that LV longitudinal strain was not affected early after ASD closure may be duo to later improvement after 6 months after closure.

Deformation analyses can differentiate between active and passive myocardial tissue movement[14], 4D echocardiography is a reliable quantitation of RV volumes, function, and mass. Also, STE measures actual tissue deformation within the myocardium. STE measures global and regional myocardial function[15].

This work points out the value of the combined use of 4D echocardiographic volume try and wall deformation analysis to determine systolic RV function from volume overload and volumetric strain changes after percutaneous closure 4Dechocardiography can overcome two-dimensional limitations by neglecting geometric assumptions and using multiple images to reconstruct the RV chamber[4]. Clinical value of real-time three-dimensional echocardiography for right ventricular quantification in congenital heart disease: validation with cardiac magnetic resonance imaging.

Also this study revealed that RVEDV decreased significantly after ASD closure **(table 8)**. Our data is supported by previous studies showing immediate significant remodeling of cardiac geometry early after the closure**(16)**. Reported a decrease in the RV end-diastolic volume during a median follow-up period of 6 months after ASD closure.

In this study, RV longitudinal strain was improved **(Table 7)**. This is supported by (**Eroglu et al., 17)** with no meaningful difference in Midanterior, Midinferior (%), apical lateral (%) segments, before and after device application.

In this study no significant difference in RV FAC (%), RFEF(%) before and after device application using 4D TomTec this not agree with **(Vitarelli et al. 2012)(18) (Table 7)** as patients candidates for ASD closure 3D-RVEF & RV FA Change was higher before the procedure and decreased after the ,this may be duo to that patients with had chronic RV volume overload due to an ASD have higher 3D RVEF and strain values with age-matched healthy adults18while There was a significant decrease of the RV EDV (ml), RV SV, which can be explained by the remodling of RV after relief the volume overload.

In our population, both 2D-STE and 3D-STE were shown to be more sensitive to detect subtle myocardial damage compared to conventional indices of RV function

In our study there was significant change in anxiety scale before and after device occlusion with negative behavioral and intrapsychic changes after catheterization, therefore, it is necessary to assess the anxiety of patients and their ability to be adjusted before cardiac catheterization in order to decrease their anxiety and prevent its complication **(Table 10)**.

CONCLUSION

- Deformation imaging is a promising technique to assess regional and global myocardial function in children with heart disease. STE-derived and TDI-derived deformation measurements were both feasible in children, but the speckle-tracking techniques are more user friendly and less time intensive in early detection of regional diastolic dysfunction of right & left ventricles.

- This study points out the value of the combined use of 4D echocardiographic volume try and wall deformation analysis to determine systolic RV function from volume overload and volumetric strain changes after percutaneous.

- 3D RV volumes and 2D-3D strains are better predictors of the hemodynamic indices of RV failure compared to conventional RV parameters.

- There was significant change in anxiety scale before and after device occlusion with negative behavioral and intra psychic changes after catheterization.

RECOMMENDATIONS

- The use of 4D speckle tracking imaging as non-conventional method can help better assessment of RV& LV function Evaluation of patients with ASD device occlusion as a new noninvasive tool of follow up after occlusion.

- The use of 4D RV volumes and 2D-4D strains can improve the evaluation of subtle RV changes when TAPSE, tricuspid valve annular systolic velocity, and FAC are not conclusive.

- Longer term follow-up is clearly needed to specifically evaluate the presence of the ASD device and to monitor the long-term effects of this device on the conduction system.

- Prophylactic play therapy could be utilized to decrease long-term negative behavioral and intrapsychic changes after catheterization.

Study Limitations

The current study had the following limitations:

- The results were from a single medical centre (Pediatric Cardiology Division of Specialized Pediatric Hospital, Cairo University).

- The sample size was rather small.

REFERENCES

1. **Hoffman JI, Kaplan S. (2002):** The incidence of congenital heart disease. J Am Coll Cardiol. 2002; 39 (12):1890–900.

2. **Chessa M, Carminati M, Butera G, Bini RM, Drago M, Rosti L, Giamberti A, Pomè G, Bossone E, Frigiola A. (2002):** Early and late complications associated with transcatheter occlusion of secundum atrial septal defect J Am CollCardiol. 2002 Mar 20; 39 (6):1061-5.

3. **Sheehan FH, Bolson EL.Measurement of right ventricular volume from contrast ventriculograms (2004):** in vitro validation by cast and 3dimensional echo. CathetCardiovas Intervention 2004;62:46–5

4. **Van der Zwaan H Van Dalen B, Soliman O, Vletter W, Kauer F, (2009):** Feasibility and reproducibility of left ventricular

rotation parameters measured by speckle tracking echocardiography. Eur J Echocardiogr 2009; 10:669–676.

5. **Antonio Vitarelli, Gennaro Sardella, Angelo Di Roma et al., Assessment of right ventricular function by three-dimensional echocardiography and myocardialstrain imaging in adult atrial septal defect before and after percutaneous closure, Received: 24 November 2011 / Accepted: 19 January 2012 / Published online: 5 February 2012**

6. **Agha H, El-Saiedi S, Shaltout M, Hamza H, Nassar :** H, Abdel-aziz D, Esmat A (2015)Incomplete RV Remodeling After Transcatheter ASD Closure in Pediatric Age.PediatrCardiol , DOI 10.1007/s00246-015-1196-3.

7. **Walker JR, Wassef A. (2004):** The utility of cardiac biomarkers, tissue velocity and strain imaging, and cardiac magnetic resonance imaging in predicting early left ventricular dysfunction in patients with human epidermal growth factor receptor II-positive breast cancer treated with adjuvant trastuzumab therapy. J Am CollCardiol. 2004; 57: 2263-22704,19-24.

8. **Wu ET, Akagi T, Taniguchi M, Maruo T, Sakuragi S, Otsuki S, et al (2007):** Differences in right and left ventricular remodeling after transcatheter closure of atrial septal defect among adults. Catheter CardiovascInterv 2007;69:866-71.

9. **Koopman L, Slorach C, Hui W, Manlhiot C, McCrindle B, Friedberg M, Jaeggi E, and Mertens L (2010):** Comparison between Different Speckle Tracking and Color Tissue Doppler Techniques to Measure Global and Regional Myocardial Deformation in Children.American Society of Echocardiography. doi:10.1016/j.echo.2010.06.014.

10. **Voigt JU, Exner B, Schmiedehausen K, et al (2003):** Strain rate imaging during dobutamine stress echocardiography provides objective evidence of inducible ischemia. Circulation 2003;107:2120-2126.

11. **Razak A, Al Hajri M, Ranjan K, Nayak K (2018):** Left Ventricular Torsion Deformation in Atrial Septal Defect Patients Undergoing Transcatheter Device Closure. International Journal of Cardiovascular Practice, July 2018, Volume 3, Issue 3 (50-56).

12. **Dong L, Shu X, Guan L, Chen H, Pan C, Chen H (2008):** Assessment of left ventricular twist in patients with secundum atrial septal defect using speckle tracking imaging. Eur J Echocardiogr 9:S156 abstract.

13. **Smith BC, Dobson G, Dawson D, et al. (2014):** Three-dimensional speckle tracking of the right ventricle: toward optimal quantification of right ventricular dysfunction in pulmonary hypertension. J Am CollCardiol 2014;64:41-51.

14. **Dandel M, Lehmkuhl H, Knosalla C, Suramelashvili N, HetzerR.Strain and Strain Rate (2009):** Imaging by Echocardiography – Basic Concepts and Clinical Applicability

CurrCardiol Rev. 2009 May; 5(2):133-48. doi: 10.2174/157340309788166642.

15. **Ozturk, onder, UnalOzturk and Mehmet ZilkifKarahan et al (2017):** Assesment of Right Ventricle Function with Speckle Tracking Echocardiography after the Percutaneous Closure of Atrial Septal Defect) O ActaCardiol Sin 2017;33:523_529.

16. **Qin Y-W, Chen L, Bai Y, Wang F-Y, Zhang Z-G, Shan X-H, et al (2015):** Transcatheter Closure of Atrial Septal Defects Improves Cardiac Remodeling and Function of Adult Patients with Permanent Atrial Fibrillation. Chinese Medical Journal. 2015;128(6):780. doi: 10.4103/0366-6999.152617 pmid: PMC4833982.

17. **Eroglu E, Cakal S, Baydar O, Cakal B, Yazicioglu MV, Bulut M, et al (2015):** Two-dimensional strain and strain rate imaging of the left atrium and left ventricle in adult patients with atrial septal defects before and after the later stage of percutaneous device closure. Echocardiography.

18. **Vitarelli A, Sardella G, Roma AD, Capotosto L, De Curtis G, D'Orazio S, Cicconetti P, Battaglia D, Caranci F, De Maio M, Bruno P, Vitarelli M, De Chiara S, D'Ascanio M. (2012):** Assessment of right ventricular function by three-dimensional echocardiography and myocardial strain imaging in adult atrial septal defect before and after percutaneous closure Int J Cardiovasc Imaging. 2012 Dec;28(8):1905-16. doi: 10.1007/s10554-012-0022-8. Epub 2012 Feb.

19. **Zhang L, Zhang J, Han W, Gao J, He L, Yang Y, Yin P, Xie M, Ge S (2016):** Three-Dimensional Rotation, Twist and Torsion Analyses Using Real-Time 3D Speckle Tracking Imaging: Feasibility, Reproducibility, and Normal Ranges in Pediatric Population. PLOS ONE | DOI:10.1371/journal.pone.0158679 July 18, 2016.

التقييم الوظيفي للبطينين الأيمن والأيسر بواسطة التتبع النقطي بالموجات الصوتية رباعية الأبعاد قبل وبعد غلق ثقب الحاجز الأذيني بالقسطرة القلبية في الأطفال

إسلام سعد إبراهيم محمد -حسن علي حسن -حسن سعد أبو سيف- هالة منير أغا*- ابراهيم محمد ابو فرج

قسم طب الأطفال – كلية الطب – جامعة الأزهر - جامعة القاهرة*

الهدف من البحث:

1- التحقق من وظائف البطينين الأيمن والأيسر بواسطه التتبع النقطي رباعي الابعاد مع قياس أعراض صحة الأطفال النفسية واحتمالية حدوث المضاعفات العصبية قبل وبعد إغلاق القسطرة لعيب الحاجز الأذيني الثانوي.

2- مقارنة بين الانواع المختلفة لتخطيط صدي القلب سواء ثنائي الأبعاد عبر الصدر، رباعي الأبعاد عبر طريق الصدر وكذلك عبر تصوير الأوعية خلال القسطرة القلبية.

3- دراسة فوائد الطرق الغير تقليدية لدراسة وظائف القلب ومقارنتها بالوظائف التقليدية.

الطريقة والأدوات: اشتملت الدراسة علي اثنين وثلاثين من المرضى الذين يعانون من عيب الحاجز الأذيني الثانوي أغلقت عن طريق الجلد محولة الي وحدة قلب الأطفال بقسم الاطفال بمستشفي الاطفال التخصصي جامعة القاهرة.

كل الحالات خضعت للتالي:

- تحليل كامل للتاريخ المرضي مع فحص إكلينيكي شامل.
- الفحوصات التقليدية مثل أشعة إكس على الصدر ورسم القلب.
- فحص بالموجات الصوتية على القلب ثنائية الأبعاد عبر الصدر مع التركيز على الفحص الكامل للحاجز الأذيني الثانوي
- فحص بالموجات الصوتية على القلب ثلاثية الأبعاد مع التركيز على الفحص الكامل للحاجز الأذيني الثانوي
- التتبع النقطي ثنائي وثلاثي الابعاد واشعة الدوبلر النسيجي
- تم استخدام مقياس سبنس لقلق الأطفال كأداة فحص ومقياس لقياس أعراض الصحة النفسية للاطفال قبل وبعد إغلاق القسطرة لعيب الحاجز الأذيني الثانوي

النتائج:

تمت الدراسة خلال سنتين في الفترة من اول سبتمبر 2016 حتي نهاية سبتمبر 2018 واشتملت الدراسة علي 32 حالة، 19من الذكورو13من الإناث وتتراوح أعمارهمم من ثلاثة الي 9 سنوات، وأوزانهم بين 11 إلي 29 كيلو جرام وقد أجريت القسطرة القلبية لكل الحالات لغلق العيب عن طريق الجهاز المخصص لغلق العيب وقد نجح الغلق في كل الحالات بنسبة 100%.

وقد أظهرت الدراسة نجاح غلق عيب الحاجز الاذيني الثانوي عن طريق القسطره القلبيه بنسبه مشجعه وعدم حدوث مضاعفات كبرى خلال متابعه المرضى لمده 6 شهور بعد الغلق.

الإستنتاجات:

1- غلق عيب الحاجز الاذيني الثانوي عن طريق القسطره القلبيه طريقه فاعله وامنه ولها مميزات عديده مقارنه بالتدخل الجراحى.

2- رجوع قياسيات عضله غرفه القلب الشمال وكذلك وظائف القلب الى المعدل الطبيعى فى جميع الحالات الى تم غلقها بنجاح.

3- تصوير التشوه هو أسلوب واعد لتقييم وظيفة عضلة القلب في الأطفال المصابين بأمراض القلب. لاسيما تقنيات تتبع البقع كانت هي الأكثر سهولة في الاستخدام وأقل وقتًا.

4- كان هناك تغير كبير في مقياس القلق قبل وبعد غلق عيب الحاجز الاذيني الثانوي عن طريق القسطره القلبيه الامر الذي يستدعي استخدام علاج اللعب الوقائي لتقليل التغيرات السلوكية والنفسية على المدى الطويل بعد القسطرة.