RIGHT VENTRICULAR DEFORMATION IN ASYMPTOMATIC CHILDREN WITH TPYE1 DIABETES MELLITUS

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INTRUDUCTION

- *Diabetes mellitus leads to increased cardiovascular mortality that is evident in all age groups, particularly in children and adolescents with type I diabetes.

- *Right ventricular function in diabetic children was not fully addressed. Previous reports were mainly directed for the left ventricle ignoring the role of the right ventricle.

*Right ventricular dysfunction has been recognized to be clinically and prognostically significant in various pathological settings, such as heart failure .This may be expected also in diabetes

AIM OF THE WORK

Our objective was to investigate the subclinical effects of diabetes on RV systolic and diastolic function in asymptomatic children with type 1 D.M. using echocardiographic two dimensional strain and strain rate imaging.

PATIENTS &METHODS

- The present work prospectively included forty five consecutive children suffering from type 1 diabetes mellitus and twenty of apparently normal children with comparable age, sex and socioeconomic status as controls

EXCLUSION CRITERIA

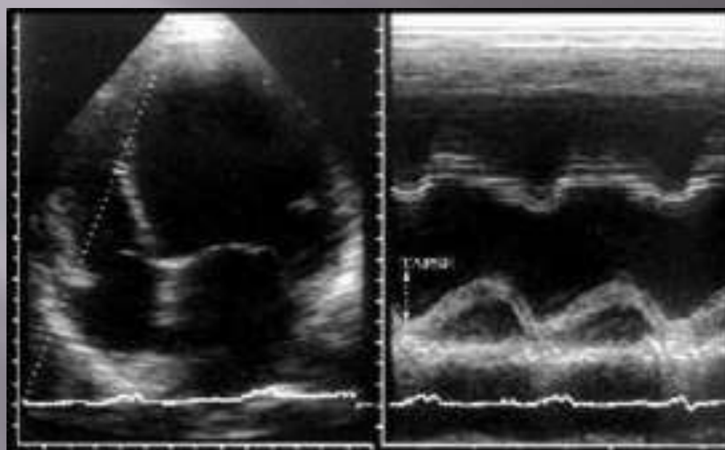
- Valvular and congenital heart disease.
- Arrhythmias.
- Impaired LV systolic function (EF < 50%).
- Pulmonary hypertension.
- Patients with more than grade I tricuspid regurgitation.
- Patients with poor quality of echocardiographic imaging.
- Patients with chronic anemia e.g. Thalassemia.
- Patients with hepatic or renal impairment.

Conventional echocardiographic Doppler examination as well as 2D- speckle tracking imaging was performed using commercially available system (Vivid 9 GE Vingmed Ultrasound AS,Horten,Norway) equipped with harmonic variable frequency (1.7-4)MHz phased array transducer and external work station for off line analysis . All patients were examined in left lateral position at end expiration . Multiple acoustic windows and imaging planes were used.

RV MEASUREMENTS

- ***Right ventricular dimensions (RVD) :*** basal and mid cavitary dimensions were measured in apical four chamber view focusing on the right ventricle.
- ***Tricuspid annular plane systolic excursion (TAPSE)*** was measured with M-mode in an apical four-chamber view, positioning the M-mode cursor on the lateral tricuspid annulus and aligning it as close as possible to the apex of the heart.).

TAPSE



Normal TAPSE

RV dimensions

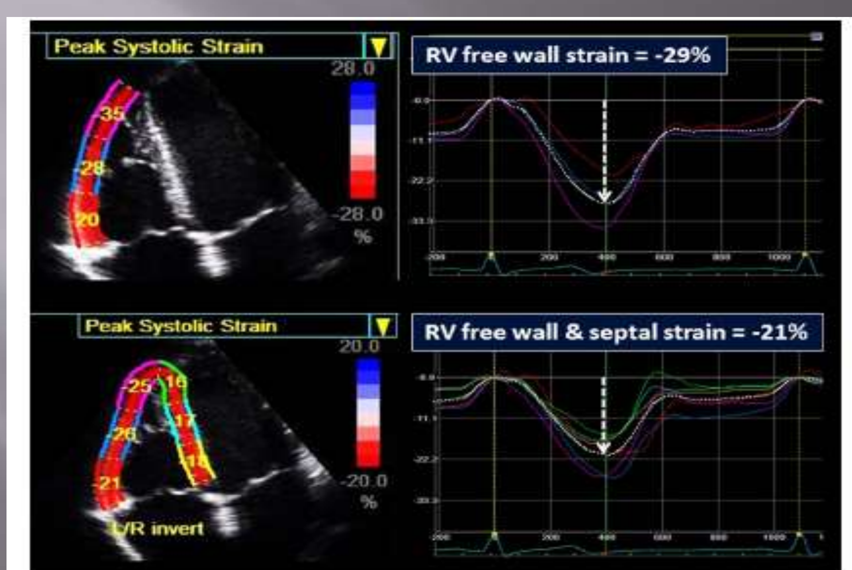
RV linear dimensions (inflow)

- Basal RV linear dimension (RVD1) = maximal transversal dimension in the basal one third of RV inflow at end-diastole in the *RV-focused view*
- Mid-cavity RV linear dimension (RVD2) = transversal RV diameter in the middle third of RV inflow, approximately halfway between the maximal basal diameter and the apex, at the level of papillary muscles at end-diastole.

STRAIN& STRAIN RATE

- Two dimensional strain analysis was performed offline using the Echopac software (GE ,version 1.8.X _Vingmed) .Myocardial strain and strain rate analysis included systolic strain (ε), peak systolic strain rate (SRs), peak early diastolic strain rate (SRe) and peak late diastolic strain rate (SRa) in the basal, mid and apical segment of RV free wall . Speckle-tracking derived 2D-strain images were obtained from apical 4-chamber view at 60-80 frame/ second .

RV strain



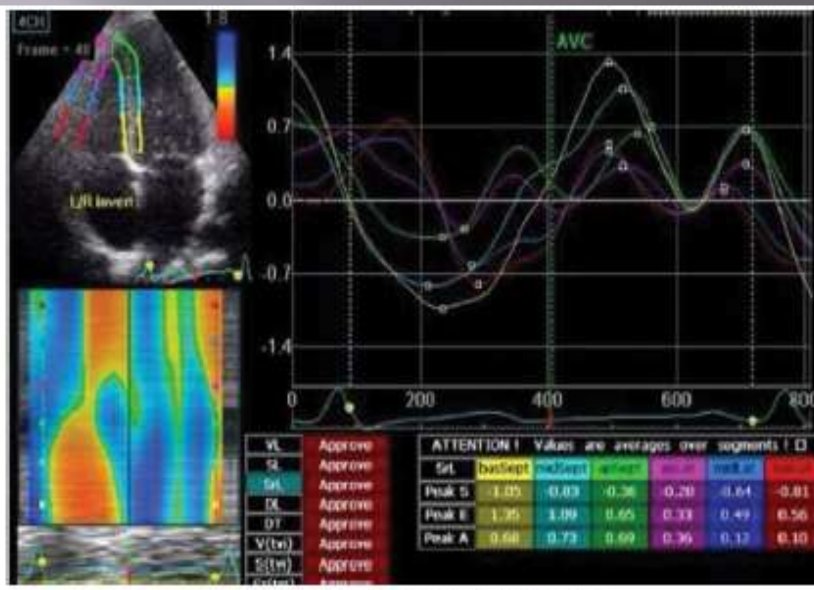


Figure 1: RV strain rate indices in diabetic child.

RESULTS

Table 1: Comparison between studied groups as regards Echo (2-D and M-mode) parameters.

	The studied groups		t-test	P value
	Cases N=45	Control N=20		
IVSd (cm) X ± SD Range	0.69 ± 0.14 0.40–0.90	0.66 ± 0.14 0.50–0.90	0.797	0.434
IVSs (cm) X ± SD Range	1.06 ± 0.19 0.60–1.4	1.01 ± 0.23 0.6–1.4	0.85	0.40
LVIDd (cm) X ± SD Range	3.92 ± 0.46 2.9–4.9	3.95 ± 0.47 3.2–4.9	0.24	0.812
LVIDs(cm) X ± SD Range	2.49 ± 0.36 1.4–3.3	2.55 ± 0.34 2–3.4	0.61	0.54
LVPWd(cm) X ± SD Range	0.69 ± 0.17 0.4–1.1	0.66 ± 0.18 0.4–1	0.78	0.44
LVPWs(cm) X ± SD Range	1.07 ± 0.19 0.6–1.4	1.02 ± 0.22 0.6–1.4	0.92	0.36
FS% X ± SD Range	36.56 ± 5.44 27–58	35.6 ± 4.86 27–48	0.67	0.50
FE% X ± SD Range	66.87 ± 6.84 53–89	65.45 ± 6.30 53–80	0.79	0.43
RVD (mm) Basal X ± SD Range Mid X ± SD Range	27 ± 5.20 23-32 22 ± 4.3 22-28	26 ± 6.1 22-30 21 ± 4.5 21-27	1.58	0.12
TABSE X ± SD Range	1.76 ± 0.13 1.5–2	1.76 ± 0.12 1.5 - 2	0.13	0.90

X=mean, SD=standard deviation.

Table 2: Comparison between studied groups as regards Mitral and Tricusped inflow parameters.

	The studied groups		t-test	P value
	Cases N=45	Control N=20		
Mitral inflow (pulsed Doppler)				
E max (m/s) X ± SD Range	1.04 ± 0.18 0.67–1.36	1.07 ± 0.15 0.76–1.44	0.67	0.51
A max (m/s) X ± SD Range	0.64 ± 0.15 0.3–0.97	0.64 ± 0.14 0.31–1.04	0.02	0.98
E/A X ± SD Range	1.69 ± 0.39 1.02–2.64	1.77 ± 0.49 1.09–3.49	0.67	0.50
Tricusped inflow (pulsed Doppler)				
E max (m/s) X ± SD Range	0.64 ± 0.14 039–1.09	0.62 ± 0.12 0.46–0.86	0.75	0.46
A max (m/s) X ± SD Range	0.46 ± 0.13 0.28–0.65	0.38 ± 0.12 0.22–0.72	3.02	0.004
E/A X ± SD Range	1.37 ± 0.24 0.81–1.95	1.73 ± 0.41 1.11–2.8	3.7	0.001

X=mean, SD=standard deviation, P value>0.05=non significant, P value<0.001=highly significant

Table 3: Comparison between studied groups as regards Strain (ε) in RV free wall segments.

E	The studied groups		t-test	P value
	Cases N = 45	Control N = 20		
Apical lateral X ± SD Range	 -12.71 ± 10.34 -32.42–16.01	 -32.35 ± 6.85 -44.14 - -20.47	U 9.04	 <0.001
Mid lateral X ± SD Range	 -21.92 ± 12.01 -40.63–2.69	 -35.57 ± 4.67 45.06 - -27.17	U 6.6	 <0.001
Basal lateral X ± SD Range	 -24.21 ± 13.05 -46.41 –20.34	 -34.09 ± 7.14 -47.22 -21.14	U 3.9	 <0.001

X=mean, SD=Standard Deviation, U=Mann Whitney, P value<0.001=highly significant

Table 4: Comparison between studied groups as regards Systolic strain rate (SRs) in RV free wall segments.

SRs	The studied groups		t-test	P value
	Cases N = 45	Control N = 20		
Apical lateral X ± SD Range	 -1.25 ± 0.62 -2.69 -0.91	 -2.0 ± 0.31 -2.59 —1.49	U 6.5	 <0.001
Mid lateral X ± SD Range	 -1.59 ± 0.79 -2.65–1.49	 -2.30 ± 0.34 -3.16 -1.85	U 5.1	 <0.001
Basal lateral X ± SD Range	 -1.64 ± 0.80 -2.98–1.16	 -2.27 ± 0.46 -3.72 - 1.47	U 4	 <0.001

X=mean, SD=Standard Deviation, U=Mann Whitney, P value<0.001= highly significant

Table 5: Comparison between studied groups as regards Peak early diastolic Strain rate (SRe) in RV free wall segments.

SRe	The studied groups		U	P value
	Cases N = 45	Control N = 20		
Apical lateral X ± SD Range	1.38 ± 1.03 0.83–4.63	2.66 ± 0.85 1.54–4.45	5.2	<0.001
Mid lateral X ± SD Range	1.94 ± 1.09 0.94–4.27	3.18 ± 0.68 1.98–4.68	5.6	<0.001
Basal lateral X ± SD Range	2.29 ± 1.28 0.75–3.66	3.44 ± 0.82 1.99–4.91	4.3	<0.001

X=mean, SD=standard deviation, U=Mann Whitney U, P value<0.001=highly significant.

Table 6: Comparison between studied groups as regards Peak late diastolic Strain rate (SRa) in RV free wall segments.

SRa	The studied groups		U	P value
	Cases N = 45	Control N = 20		
Apical lateral X ± SD Range	1.62 ± 0.91 0.45–3.19	1.53 ± 0.55 0.76–2.75	0.492	0.625
Mid lateral X ± SD Range	1.35 ± 0.93 0.66–3.67	1.90 ± 0.79 0.66–3.43	2.4	0.02
Basal lateral X ± SD Range	1.93 ± 1.21 1.07–3.89	2.25 ± 0.99 0.55–3.78	1.12	0.269

X=mean, SD=standard deviation, U=Mann Whitney test

Table 7: Comparison between studied groups as regards RV free wall mean ε, SRs, SRe and SRa.

RV lareral wall	The studied groups		t-test	P value
	Cases N = 45	Control N = 20		
ε X ± SD Range	-19.61 ± 11.09 -36.98—6.12	-34.28 ± 4.34 -42.51—27.13	t-test 7.6	<0.001
SRs X ± SD Range	-1.5 ± 0.62 -2.27–0.88	-2.19 ± 0.24 -2.85– 1.83	t-test 6.46	<0.001
SRe X ± SD Range	1.87 ± 1.01 0.33–4.1	3.1 ± 0.57 1.93–4.02	t-test 6.2	<0.001
SRa X ± SD Range	1.93 ± 0.92 0.63–3.79	1.89 ± 0.71 0.75–3.32	t-test 0.191	0.09

X=mean, SD=standard deviation, P value<0.001=highly significant

Table 8: Correlation between lateral wall ε, SRs, SRe and SRa and duration of DM and HbA1c in studied cases.

	DM duration		Hb A1c	
	r	P value	r	P value
Lateral wall ε	-0.05267	0.7312	-0.2139	0.1583
Lateral wall SRs	-0.01893	0.9018	-0.2124	0.1614
Lateral wall SRe	-0.09918	0.5169	0.2204	0.1458
Lateral wall SRa	-0.05668	0.7115	0.06273	0.6823

CONCLUSION

- * Diabetes mellitus type 1 leads to RV systolic and diastolic dysfunction.
- *Strain and strain rate imaging appear to be a sensitive tool for early detection such abnormalities
- * No significant correlation can be found between duration of diabetes or the degree of glycemic control and echocardiographic parameters of RV ventricular functions.

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Right Ventricular Deformation in Asymptomatic Children with Type I Diabetes Mellitus

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Abstract

ventricle. Right ventricular dysfunction has been recognized to be clinically and prognostically significant in various pathological settings, such as heart failure. This may be expected also in diabetes [2].

However, the assessment of right ventricular function remains difficult, because of the complex anatomy, non-uniform contraction and its retrosternal position. Strain/strain rate imaging provides extensive information about regional myocardial function which may be applicable to the right ventricle [3-7].

Methods


THANK YOU