Fat, Metabolism and Obesity
LB-8

Detection of Cardiomyopathy in Egyptian Children and Adolescents with Longstanding Obesity using cardiac marker NT-pro PNB and Speckled Tracking Echocardiography

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Background

Obesity is considered a major risk factor for developing cardiovascular morbidity and mortality[1]. Obesity affects the structure and function of the heart mainly by causing increased blood volume, elevated cardiac output, left ventricular (LV) hypertrophy, and LV diastolic dysfunction[2]. All of which can play a role in causing heart failure[3].

Objective

This cross-sectional study aimed to evaluate the effect of longstanding obesity on cardiac functions resulting in cardiomyopathy, to correlate the level of plasma NT-pro BNP biomarker to echocardiographic findings and to compare these values to apparently healthy normal controls.

Objective

A total of 80 obese children and adolescents above 8 years old with long standing obesity were included in the study. Patients with original cardiac disease or concomitant illness affecting the heart, those on medications known to affect cardiac functions and/or cases with syndromic obesity were excluded from the study.
Study group were subjected to full history taking including age, sex, birth weight, onset of obesity, dietary habits, exercise habits, cardiac manifestations (palpitation, chest pain, dyspnea, easy fatiguability, etc), family history of diabetes, hypertension or cardiac diseases. Thorough physical examination was done including anthropometry, blood pressure (BP) assessment as well as detailed cardiac examination. Biochemical evaluation included fasting lipid profile, HbA1c as well as the cardiac biomarker NT-pro BNP. Echocardiographic evaluation of the study group included conventional echo-doppler measures, tissue velocity imaging (TVI) measure and 3D speckle tracking echocardiography (STE). Study population were compared to 40 non-obese healthy age and sex matched controls regarding NT-pro BNP level, tissue velocity imaging and speckled tracking echocardiography findings.

Results

The study showed statistically significant difference between cases and controls regarding plasma NT-Pro BNP and echocardiographic findings (tricuspid annular E'/A', left ventricular e/è, left ventricular GLS) (p <0.001). Regarding echocardiography, 90% had LV systolic dysfunction, 67% had RV diastolic dysfunction and 100% had LV diastolic dysfunction within the study group. A statistically significant positive correlation was found between plasma levels of NT-pro BNP and ventricular dysfunction (GLS) (p=< 0.001, r= 0.888). ROC curve showed that plasma NT-pro BNP level had a sensitivity of 84.7% and specificity of 87.5% in the diagnosis of cardiomyopathy using GLS as an echocardiographic parameter.

Table 1: Clinical, biochemical data and echocardiographic data of study group

	Mean ± SD / Median*	Min	Max
Clinical data			
Age (yrs)	10.6±1.7	8	16
Duration of obesity (yrs)	7.1±2.6	5	16
Onset of obesity (months)	41.3±31.5	0	96
Weight (kg)	66.7±20	39	127.5
Weight SDS	3.87±1.9	1.3	9.2
Height (cm)	142.4±11.8	122.5	174
Height SDS	0.45*	-2.1	6
BMI (kg/m2)	32.2±6.1	24	48.7
BMI SDS	2.9±0.6	1.9	4.4
Waist circumference (cm)	98.9±13.6	65	140
Hip circumference (cm)	103.5±14.5	67	142
Waist / hip	0.96±0.1	0.84	1.1
Fat percent (%)	4.1±6.5	29.3	63.6
SBP (mm Hg)	106.9±5.9	91.7	119.7
DBP (mm Hg)	65.6±3.6	58.3	74
Biochemical data			
Cholesterol (mg/dl)	156.2±26.2	113	234
Triglycerides (mg/dl)	99.8±38.4	32	235
HDL (mg/dl)	38.6±7.6	23	69
LDL (mg/dl)	94.5±25.3	46	167
HbA1C (%)	5.01±0.5	4	6.4
TSH (uIU/ml)	2.5±0.9	0.9	5.2
FT4 (ng/dl)	1.17±0.2	0.8	1.8
NT-pro BNP (pg/ml)	675*	380	790
Echocardiographic data			
Tricuspid annular E' (cm/s)	13.1±3.4	6	26
Tricuspid Annular A'(cm/s)	14±3.9	4	26
Tricuspid Annular E'/A'	1.0±0.4	0.35	2.5
LV Lateral e (cm/s)	13.9±3.7	7	22
LV Septal è (cm/s)	12.2±2.9	7	23
Left ventricular e / è	13.1±2.9	7.5	19
LV GLS (%)	15.7±5.4	3	28
EF (%)	74.2±10.6	24	91
FS (%)	43.9±8.5	28	62

BMI: body mass index, **SBP**: systolic blood pressure, **DBP**: diastolic blood pressure **SD:** standard deviation, **HDL:** High density lipoprotein, **LDL:** Low density lipoprotein, **FT4:** free tetraiodothyronine, **TSH:** thyroid stimulating hormone, **HbA1c:** glycosylated hemoglobin, **NT-pro BNP**: N-terminal pro b-type natriuretic peptide, **E'**: Early diastolic tissue velocity, **A'**: Atrial late diastolic tissue velocity, LV: left ventricular, **e/è:** early mitral inflow velocity / average of the early diastolic tissue velocities of septal and lateral walls, **GLS:** global longitudinal strain, **EF:** ejection fraction and **FS:** fractional shortening.

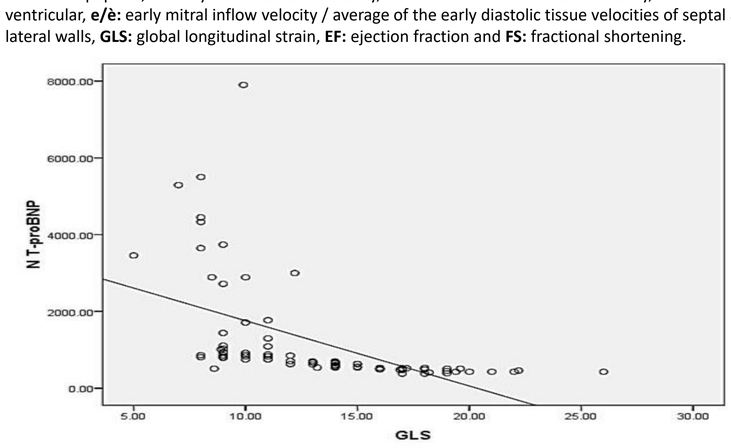


Figure 1: Correlation between GLS and NT- pro BNP (p<0.001)

Table 2: Clinical, biochemical data and echocardiographic status of study group

		No.	%
Clinical data			
Sex	Male	32	40
	Female	48	60
Puberty stage (Tanner)	Stage 1	23	28.75
	Stage 2	35	43.8
	Stage 3	15	18.8
	Stage 4	7	8.8
	Stage 5	0	0
Obesity onset	First 2 years of life	23	28.75
	Between 2-6 years	36	45
	Above 6 years	21	26.25
Waist circumference	< 75th percentile	3	3.75
	>75th- <90th percentile	13	16.25
	> 90th percentile	64	80
Acanthosis nigricans	Yes	61	76.2
	No	19	23.8
SBP	Normal	73	91.25
	Prehypertension	6	7.5
	Hypertension	1	1.25
DBP	Normal	76	95
	Prehypertension	4	5
	Hypertension	0	0
Biochemical data			
TC (mg/dl)	Normal	72	90
	High	8	10
TG (mg/dl)	Normal	74	92.5
	High	6	7.5
HDL (mg/dl)	Normal	76	95
	Low	4	5
LDL (mg/dl)	Normal	71	88.8
	High	9	11.2
HbA1c (%)	Normal	72	90
	Pre-diabetic	8	10
	Diabetic	0	0
NT-pro BNP (pg/ml)	Normal	0	0
	High	80	100

BMI: body mass index, **SBP**: systolic blood pressure, **DBP**: diastolic blood pressure **SD:** standard deviation, **TC:** total cholesterol, **TG:** triglyceride, **HDL:** High density lipoprotein, **LDL:** Low density lipoprotein, **HbA1c:** glycosylated hemoglobin, **NT-pro BNP**: N-terminal pro b-type natriuretic peptide

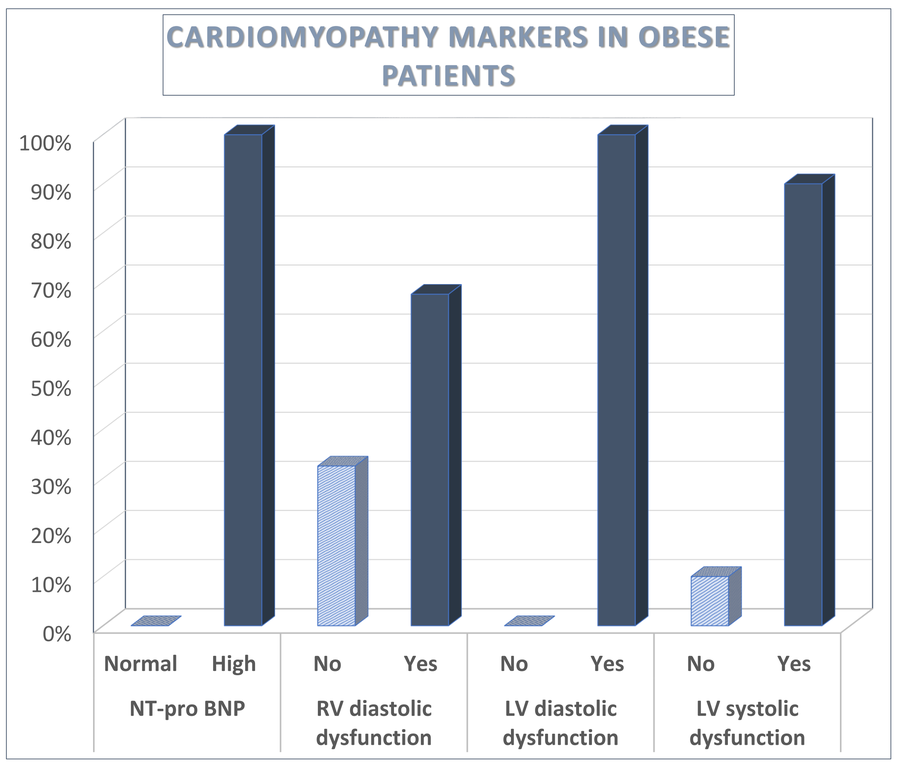
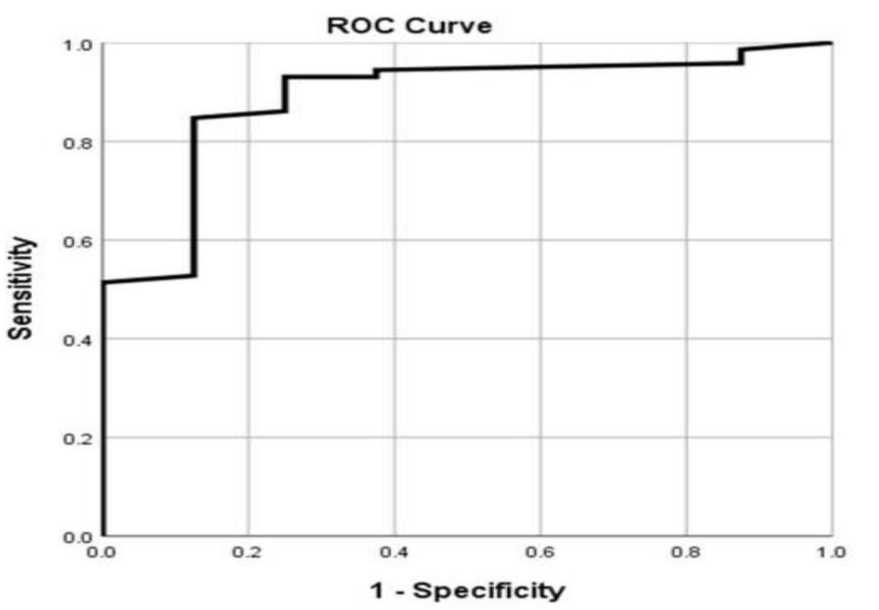


Figure 2: Markers of Cardiomyopathy within the study population

Table 3: Cardiomyopathy markers in cases compared to non-obese controls

		Cases		Controls		*p* value
		No.	%	No.	%	
NT-pro BNP	Normal	0	0	30	100	**<0.001**
	High	80	100	0	0	
Tricuspid E'/A'	Normal	26	32.5	30	100	**<0.001**
	RV diastolic dysfunction	54	67.5	0	0	
LV e/è	Normal	0	0	30	100	**<0.001**
	LV diastolic dysfunction	80	100	0	0	
LV GLS	Normal	8	10	30	100	**<0.001**
	LV systolic dysfunction	72	90	0	0	

E'/A: Early diastolic tissue velocity/ Atrial diastolic tissue velocity, **e / è:** early mitral inflow velocity / average of the early diastolic tissue velocities of septal and lateral walls, **LV:** left ventricular, **GLS:** left ventricular global longitudinal strain, **N T-pro BNP:** N-terminal pro b-type natriuretic peptide.



Area Under the Curve	*p* value	95% Confidence Interval		Cut Off	Sensitivity%	Specificity%
		Lower Bound	Upper Bound			
0.888	< 0.001	0.777	0.999	505	84.7	87.5

Figure 3: ROC curve for prediction of DCM using NT- Pro BNP

Conclusion

Longstanding obesity was associated with cardiomyopathy as evidenced by elevated levels of NT-proBNP and speckle tracking echocardiography (impaired ventricular systolic and diastolic functions). NT-pro BNP levels correlated significantly with LV systolic dysfunction.

Bibliography

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***Authors declare no conflict of interest**