Research Article
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Decrease of the pericardial fat around the heart has a positive correlation with improvement of left ventricular performance

Abstract

Objective: The objective of the study was to evaluate the effect of an eight week period of very low calorie diet (VLCD) on left ventricular performance and on the amount of pericardial adipose tissue around the heart in obese people without heart disease. This is an extension of the study "Cardiac systolic and diastolic function can be improved over a short period of time in obese patients without heart disease by the very low calorie diet" with the same authors and study group, being currently under evaluation for publication in this Journal.

Methods: Fifty-seven obese patients (41 women, 16 men, mean age 48.0±12.0years, mean BMI 46.1±7.2g/m^2) were assigned to a VLCD enriched with vegetables for eight weeks. Transthoracic echocardiography was performed before and after the diet period. Left ventricular size, ejection fraction, myocardial performance index and thickness of pericardial adipose tissue were measured.

Results: During the diet period the BMI decreased from 46.1±7.2kg/m^2 to 41.7±6.4kg/m^2 ($p<0.0001$). The left ventricular performance index decreased from 0.41±0.07 to 0.37±0.07 ($p<0.0001$) showing significant systolic and diastolic improvement in the performance of left ventricle. The thickness of pericardial fat decreased from 2.2±1.6mm to 1.4±1.3mm ($p<0.0001$). The improvement of the left ventricular myocardial performance index correlated positively with the decrease of pericardial fat ($r=0.46$, $p<0.001$).

Conclusion: Changing the diet for only eight weeks time caused significant reduction in BMI as well as in the amount of pericardial fat and significant improvement in the systolic and diastolic performance of the left ventricle in obese persons. There was a positive correlation between the improvement on left ventricular performance and the decrease of pericardial fat.

Keywords: obesity, cardiac performance, myocardial performance index, very low calorie diet, epicardial fat, pericardial fat, weight reduction

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Abbreviations: VLCD, very low calorie diet; BMI, body mass index; MPI, myocardial performance index

Introduction

In our previous study we showed an improvement of cardiac systolic and diastolic function after an eight week period of Very Low Calorie Diet. This article is under evaluation for publishing in this same journal. The reason for this improvement of cardiac function is not known. In the previous study we also showed a decrease in fat around the heart. In this extension study with the same study group we tried to analyze further the fat around the heart and its possible effect on the improvement of the cardiac function.

Methods

Fifty-seven obese persons without any heart diseases (41 women, 16 men, mean age 48.0+12.3years, mean body mass index 46.1±7.2kg/m^2) were assigned to a very low calorie diet for eight weeks. The diet consisted of commercially available VLCD-products (Nutrifast, Allevo) enriched with vegetables. The estimated total amount of calories was 700-900kcal/day. The demographics of the patients are seen in Table 1.

Table 1 Baseline characteristics of the study participants (n=52)

	Range
Age	47.6±12.3 (16-70) years
Sex	
Female	38
Male	14
BMI	46.2±7.0 (33.1-65.0)

Table Continued....

	Range
Weight	134.0±24.7 (91-192) kg
Number of patients with hypertension	28/52 (54%)
Number of patients with diabetes mellitus type 2	24/52 (46%)
Number of patients with fasting blood glucose 6.1-7.0mmol/l without glucose lowering medication	6/52 (12%)
Number of patients with medication	38/52 (73%)
Medication	
Antihypertensive agents	
ACE inhibitors or A II blockers	28/52 (54%)
Diuretics	18/52 (35%)
Betablockers	10/52 (19%)
Calcium channel blockers	6/52 (12%)
Other antihypertensive agents	3/52 (6%)
Lipid lowering agents	18/52 (35%)
Insulin	4/52 (8%)
Oral glucose lowering agents	21/52 (40%)
Acetosalisylic acid	19/52 (37%)

No new medication was initiated at the beginning or during the VLCD. There were also no increased dosages of any medicine compared to the initial dosages.

A two-dimensional Doppler echocardiographic examination was performed before and after the diet period. All the echocardiograms were performed by using an ACUSON SEQUOIA C 256 system (Acuson, Mountain View, CA, U.S.A.). Parasternal long-axis views were used for measuring left ventricular cavity size and ejection fraction. Pulsed wave (H4.0MHz) Doppler transmitral and left ventricular ejection time in left ventricular outflow tract were acquired from the apical four-chamber view. Pulsed Doppler were made at a sweep speed of 100mm/s. The images were recorded digitally (Syngo Dynamics, Siemens Medical System U.S.A) for later analysis. The myocardial performance index (MPI) (Tei index) was calculated as the sum of isovolumic contraction and relaxation times divided by ejection time thus being a very sensitive method for measuring of small changes in the cardiac performance. For left ventricular MPI Doppler measurements were averaged over five cycles.

Pericardial fat thickness was measured behind the left ventricle in Parasternal M-mode image in end diastole as the space between the pericardial leaflets. Three measurements were averaged for the final result. The study protocol was approved by the Ethics Committee of the Hospital District of Southwest Finland.

Results

During the diet period the BMI decreased from 46.1±7.2kg/m^2 to 41.8±6kg/m^2 ($p<0.0001$). All the patients were in sinus rhythm during echocardiographic recordings. There were no significant changes in the diameter or ejection fraction of left ventricle or in the diameter. The left ventricular MPI decreased in 48/52 (92%) patients, remained as the same in 3/52 (6%) and increased in 1/52 (2%) patient. The mean change in the MPI was from 0.41±0.07 to 0.37±0.07 ($p<0.0001$) indicating significant systolic and diastolic improvement of left ventricular performance. There was a significant improvement in both components of the left ventricular MPI. The ejection time of the left ventricle increased from 300+19msec to 321±22 ($p<0.0001$). The sum of the isovolumic contraction time and isovolumic relaxation time decreased from 125±22msec to 117±23msec ($p<0.0001$).

During the diet period the thickness of the pericardial fat decreased from 2.2±1.6mm to 1.4±1.3mm ($p<0.0001$). The new finding in this study was that the decrease of MPI of the left ventricle correlated positively with the decrease of the pericardial fat. The correlation coefficient between the change of MPI and the decrease of pericardial fat was 0.46 ($p<0.001$),

Discussion

In this study there was a positive correlation between improvement of left ventricular function and decrease of pericardial fat around heart. This improvement of left ventricular function happened rapidly, after only eight weeks on VLCD. However, the mechanism behind this phenomenon is unknown.

Pericardial fat is located between visceral and parietal pericardium. The anatomical close connection between excess fat around the heart might increase the weight of the left ventricle thus increasing the effort of involved in pumping.

Epicardial fat and pericardial fat are embryologically different. Vascularization is also different between these two layers. Vascularization for the epicardial adipose tissue is supplied by branches of the coronary arteries. Pericardial adipose tissue gets its Vascularization from non-coronary sources. At least one part of epicardial fat is physiological. However, excess epicardial fat that is seen in many obese persons may be harmful on heart function.

The fat around the heart is metabolically active and can be the source of inflammatory mediators. It could be speculated that the amount of metabolically active fat that is abolished adjacent to

the cardiac muscle could cause the positive change. Some harmful metabolites could disappear from the area very near the cardiac muscle. The beneficial effect of decrease of fat around the heart on left ventricular function may also have been affected be some other factors.

The amount of adipose tissue has been shown to correlate well with the amount of visceral adipose tissue, which is recognized as an important indicator of high cardiovascular metabolic risk. In the study of Sicari et al.,[1] epicardial fat and pericardial fat were compared. The fat depots were measured using echocardiography and magnetic resonance imaging. Most cardiac fat was constituted by pericardial fat (about 77%). In this study pericardial fat was correlated mainly with great cardiac risk factors: body mass index, waist circumference, visceral fat, subcutaneous fat, blood pressure, insulin sensitivity, triglyceride, cholesterol and glucose.

In obese diabetics myocardial triglyceride content decreased and diastolic function improved after weight loss over 20%.[2] The limitation of our study was that we could not measure myocardial fat. Fatty heart can be prevented by lifestyle modification and interventions, so it is important to recognize its existence as early as possible.[3]

Conclusion

There was a positive correlation between the improvement of the left ventricular myocardial performance index and the decrease of fat around the heart and this change was rapid. These surprisingly rapid changes might give rise to new motivations for the patient to treat obesity, as improvement for the cardiac function can be excepted even relatively rapidly.

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Conflict of interest

The author declares no conflict of interest.

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