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BRIEF COMMUNICATION

Cardiac Function Normalizes 1 Year After Bariatric Surgery in Half of the Obesity Patients with Subclinical Cardiac Dysfunction

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Introduction

Obesity has reached epidemic proportions globally and the prevalence is still increasing. Subclinical cardiac dysfunction is common in obesity patients, and obesity is associated with an increased risk of heart failure [1]. Clinically significant weight loss is difficult to achieve with lifestyle interventions, and the results are often temporary. In contrast, bariatric surgery is an effective and safe treatment option resulting in large long-term weight loss [2]. However, little is known about potential improvement of subclinical cardiac dysfunction after bariatric surgery. The CARdiac Dysfunction In Obesity – Early Signs Evaluation (CARDIOBESE) study is a prospective study that was designed to investigate this, using a combination of (speckle tracking) echocardiography, blood tests, and Holter monitoring to simultaneously investigate different possible expressions of subclinical cardiac dysfunction. The protocol of the CARDIOBESE study has been described before [3]. In this brief communication, we describe the main results. Additional analyses of the data will be performed in the near future to provide further insight in the pathophysiological background of the findings.

Methods

We enrolled 100 obesity patients who were referred for bariatric surgery in this longitudinal study. Inclusion criteria were age 35–65 years and BMI ≥ 35 kg/m^2. Patients with a suspicion of or known cardiovascular disease were excluded. Bariatric surgery was performed by either a gastric sleeve, a gastric bypass, or a mini bypass operation. Conventional and

Key Points
• CARDIOBESE is the first study in which the focus was specifically on *subclinical* cardiac dysfunction in obesity patients.
• A combination of (speckle tracking) echocardiography, blood tests, and Holter monitoring was used to simultaneously investigate different possible expressions of subclinical cardiac dysfunction.
• Cardiac function normalizes 1 year after bariatric surgery in half of the obesity patients with subclinical cardiac dysfunction.

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speckle tracking echocardiography, Holter monitoring, and blood tests were performed. Patients were seen pre- and 1-year post-bariatric surgery. Subclinical (in other words, not previously diagnosed) cardiac dysfunction was based on the diagnostics used in CARDIOBESE and defined as either a reduced left ventricular (LV) ejection fraction [4], decreased GLS (< 17%), diastolic dysfunction [5], (supra) ventricular arrhythmia, or an increased BNP (> 30 pmol/L) or hs Troponin I (≥ 34 ng/L for male and ≥ 16 ng/L for female subjects). The study protocol was approved by the ethics committee, and written informed consent was obtained from all participants. Baseline characteristics of the studied population have been described before [6]. Subclinical cardiac dysfunction was present in 59 patients, mainly uncovered by decreased GLS [6].

Statistical Analysis

Patients who completed the follow-up were included in the analysis. The normality of the data was checked by the Shapiro–Wilk test. Continuous values with normal distributions were expressed as mean ± standard deviation, with skewed distributions as median and interquartile range and categorical values as percentages. The paired Student's *t* test was used for continuous variables with normal distributions, the nonparametric Wilcoxon signed-rank test for variables with skewed distributions, and the McNemar test for categorical variables was used to compare parameters pre- and post-surgery.

Results

A total of 85 patients underwent bariatric surgery, and 72 patients completed the 1-year follow-up. Patients did not undergo bariatric surgery because of various reasons, but mostly because of disapproval by a psychologist or because they had withdrawn themselves from surgery. There is a significant reduction in weight and BMI 1 year after bariatric surgery (Table 1). Prevalence of comorbidities decreased and medication use was reduced. Blood tests showed a decrease of CRP, HbA1c, ALAT, total cholesterol, LDL-C, and triglycerides. Moreover, HDL-C, folic acid, vitamin B6, and vitamin D significantly increased. The echocardiogram revealed a decrease in LV mass and Holter monitoring a decreased heart rate 1 year after bariatric surgery.

Regarding changes in parameters of cardiac function after bariatric surgery (Table 1), there is a mild increase in BNP. Levels of hs troponin I were comparable. Echocardiography showed an improvement of GLS. The prevalence of diastolic dysfunction and the LV ejection fraction did not change. There were no arrhythmias, and the frequency of extrasystoles did not change.

Fifty of the 59 patients with subclinical cardiac dysfunction at baseline underwent bariatric surgery, and 40 completed the follow-up. Of these patients, 20 (50%) had normalized cardiac function (in other words, no remaining signs of cardiac dysfunction as defined in this study) after bariatric surgery. Of the 20 patients with persistent cardiac dysfunction, 17 (43%) still had decreased GLS, one patient had an elevated hs troponin I level, and two patients had diastolic dysfunction.

Discussion

Although in previous studies changes in cardiac morphology and function after bariatric surgery have been investigated [7], CARDIOBESE is the first study in which the focus was specifically on *subclinical* cardiac dysfunction, also with an innovative approach using several diagnostic modalities to concurrently investigate different possible expressions of this.

This methodology allowed us to show for the first time that bariatric surgery not only was associated with a reduction in BMI and comorbidities but also with a decrease in LV mass and improvement of LV function, resulting in normalized cardiac function in half of the patients with subclinical cardiac dysfunction before surgery. An impressive result, bearing in mind that in large studies in which the effect of, for example, ACE inhibitors on LV function were studied in high-risk patient groups, results were clearly less pronounced [8, 9]. However, these studies noticeably did show improvement in hard clinical endpoints that are not available in the current study and obviously focused on other patient categories. Nevertheless, our findings emphasize that the relatively marked positive effect bariatric surgery may have on cardiac function.

Conclusion

Cardiac function improves significantly in obesity patients 1 year after bariatric surgery, resulting in normalized cardiac function in half of the patients with subclinical cardiac dysfunction before bariatric surgery.

Table 1 Clinical characteristics and parameters of cardiac function

Clinical characteristics	Pre-surgery (n = 72)	1-year post-surgery (n = 72)	p value
General characteristics			
Age (years)	48 [43–54]		
Female (n, %)	54 (75%)		
Physical examination			
Weight (kg)	122 [113–133]	83 [74–91]	**< 0.001***
BMI (kg/m^2)	41 [39–46]	28 [25–31]	**< 0.001***
Comorbidity			
Diabetes mellitus (n, %)	16 (22%)	6 (8%)	**0.002***
Hypertension (n, %)	24 (33%)	12 (17%)	**0.035***
Medication			
ACE inhibitors/ARBs (n, %)	11 (15%)	8 (11%)	**0.012***
Statins (n, %)	16 (22%)	9 (13%)	**0.039***
Oral anti-diabetics (n, %)	10 (14%)	4 (6%)	**0.031***
Blood tests			
CRP (mg/L)	6 [3–9]	0 [0–2]	**< 0.001***
HbA1c (mmol/mol)	45 ± 15	38 ± 8	**< 0.001***
Creatinine (umol/L)	73 ± 10	67 ± 9	**< 0.001***
ALAT (U/L)	30 [20–37]	19 [15–26]	**0.004***
Total cholesterol (mmol/L)	5.3 ± 0.9	4.6 ± 0.8	**< 0.001***
LDL cholesterol (mmol/L)	3.2 ± 0.8	2.6 ± 0.7	**< 0.001***
HDL cholesterol (mmol/L)	1.2 ± 0.3	1.4 ± 0.3	**< 0.001***
Triglycerides (mmol/L)	2.06 ± 1.8	1.20 ± 0.8	**< 0.001***
Folic acid (nmol/L)	13 [9–16]	27 [16–36]	**< 0.001***
Vitamin D (nmol/L)	49 ± 25	78 ± 26	**< 0.001***
Echocardiography parameters			
Left ventricular mass (g)	186 ± 72	156 ± 62	**< 0.001***
Holter monitoring			
Average heart rate (bpm)	83 ± 10	73 ± 8	**< 0.001***
Minimal heart rate (bpm)	53 [47–57]	46 [4–51]	**< 0.001***
Maximum heart rate (bpm)	137 [128–150]	130 [120–142]	**0.005***
Parameters of cardiac function			
Blood tests			
BNP (pmol/L)	5 [3–8]	8 [6–10]	**0.029***
hs troponin I positive (n, %)	1 (1%)	5 (7%)	0.06
Echocardiography parameters			
Diastolic dysfunction (n, %)	7 (10%)	3 (4%)	0.28
LV ejection fraction (%)	58 ± 8	57 ± 7	0.25
Global longitudinal strain (%)	− 15.6 ± 3.1	− 18.1 ± 3.3	**0.001***
Holter monitoring			
Total PAC per 24 h (n)	9 [2–38]	20 [8–68]	0.07
Total PVC per 24 h (n)	3 [0–22]	5 [2–58]	0.29
Supraventricular arrhythmia (n, %)	1 (1%)	0	0.53

Differences between pre- and 1-year post-bariatric surgery. Values represent mean ± SD, median [Q1-Q3] or n (%). p values displayed were analysed by the paired Student's t test for continuous variables with normal distributions, the nonparametric Wilcoxon signed-rank test for variables with skewed distributions, and the McNemar test for categorical variables

BMI body mass index, *ACE* angiotensin-converting enzyme, *ARBs* angiotensin II receptor blockers, *CRP* C-reactive protein, *HbA1c* glycated haemoglobin, *ALAT* alanine transaminase, *LDL* low-density lipoprotein, *HDL* high-density lipoprotein, *BNP* brain natriuretic peptide, *hs troponin I* high sensitive troponin I, *LV* left ventricular, *PAC* premature atrial complex, *PVC* premature ventricular complex

*Significant at $p < 0.05$

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Declarations

Conflict of Interest The authors declare no competing interests.

References

1. Fernandes-Silva MM, Shah AM, Claggett B, et al. Adiposity, body composition and ventricular-arterial stiffness in the elderly: the atherosclerosis risk in communities study. Eur J Heart Fail. 2018;20(8):1191–201.
2. DeMaria EJ. Bariatric surgery for morbid obesity. N Engl J Med. 2007;356(21):2176–83.
3. Snelder SM, de Groot-de Laat LE, Biter LU, et al. Cross-sectional and prospective follow-up study to detect early signs of cardiac dysfunction in obesity: protocol of the CARDIOBESE study. BMJ Open. 2018;8(12):e025585.
4. Lang RM, Badano LP, Mor-Avi V, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. Eur Heart J Cardiovasc Imaging. 2015;16(3):233–70.
5. Nagueh SF, Smiseth OA, Appleton CP, et al. Recommendations for the evaluation of left ventricular diastolic function by echocardiography: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. Eur Heart J Cardiovasc Imaging. 2016;17(12):1321–60.
6. Snelder SM, de Groot-de Laat LE, Biter LU, et al. Subclinical cardiac dysfunction in obesity patients is linked to autonomic dysfunction: findings from the CARDIOBESE study. ESC Heart Fail. 2020;7:3726–37.
7. Aggarwal R, Harling L, Efthimiou E, et al. The effects of bariatric surgery on cardiac structure and function: a systematic review of cardiac imaging outcomes. Obes Surg. 2016;26(5):1030–40.
8. I. Heart Outcomes Prevention Evaluation Study, Yusuf S, Sleight P, et al. Effects of an angiotensin-converting-enzyme inhibitor, ramipril, on cardiovascular events in high-risk patients. N Engl J Med. 2000;342(3):145–53.
9. Fox KM, E.U.t.O.r.o.c.e.w.P.i.s.c.A.d. Investigators. Efficacy of perindopril in reduction of cardiovascular events among patients with stable coronary artery disease: randomised, double-blind, placebo-controlled, multicentre trial (the EUROPA study). Lancet. 2003;362(9386):782–8.