Evolutive Echocardiographic Study of the Structural and Functional Heart Alterations in Obese Individuals After Bariatric Surgery

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Objcetive: To evaluate with Doppler echocardiography the reversibility of structural and hemodynamic changes in obeses after bariatric surgery.

Methods: Twenty-three patients (19 women = 82.6%) were studied. Mean age was 37.9 years. All subjects had Class III or Class II obesity with comorbidity and were submitted to bariatric surgery. Clinical and echocardiographic evaluation were performed preoperatively, in 6 months and 3 years after surgery.

Results: Preoperatively, the mean weight and blood pressure (BP) were respectively 128.7± 25.8 kg and 142.2 ± 16.2 / 92.2 ± 10.4 mmHg. Postoperatively, they showed important body weight reduction in 6 months (97.6 ± 18.3 kg) and 3 years (83.6 ± 13.5 kg), and BP reduction in 6 months (128.5 ± 16.1/80.7 ± 9.9 mmHg) that remain stable in 3rd year. On echocardiogram, preoperatively, there was hypertrophy of the septum and posterior wall associated with normal diastolic dimension; the predominant LV geometric pattern was concentric remodeling (74%). At six months, thinning of the ventricular septum and LV posterior wall, and increase in LV diastolic dimension were demonstrated. At 3rd year, the predominant LV pattern was normal (69%), with reduction of LV mass and LV mass/height^2 index. We noticed improved diastolic function, with an increased E/A ratio and a decreased LV isovolumic relaxation time. The Myocardial Performance Index was obtained retrospectively in 13 patients and improved in 6 months. There was an increase of the ejection time in 6 months and an elevation of the ejection fraction in 3rd year, suggesting improvement of the LV systolic function.

Conclusion: The weight loss obtained with bariatric surgery promotes both structural and functional myocardial changes that improve cardiac performance.

Key words: Obesity, bariatric surgery, transthoracic echocardiography, left ventricular function.

Obesity is defined as the presence of excess of total body fat[1]. In clinical practice, the main parameter used to characterize obesity is the Body Mass Index (BMI), defined as the ratio between the weight (in kg) and the the height (in m^2). The BMI allows the establishment of normality, overweight and obesity criteria, with the latter subdivided into 3 classes[2] (Chart 1).

Obesity is a chronic and progressive disease that predisposes to an increase in the mortality rate, as demonstrated by several population studies[3]. Its importance becomes even greater when it is observed that its prevalence has been increasing drastically, in developed as well as in developing countries, such as Brazil. It represents an independent risk factor for cardiovascular disease, defined as the incidence of coronary disease, sudden death and congestive cardiac failure[4]. The association between obesity and cardiovascular disease is independent from the levels of arterial pressure, cholesterol levels, smoking, presence of left ventricular hypertrophy or glucose intolerance, although there is an important association between excess weight, arterial hypertension and left ventricular hypertrophy[5]. Systemic arterial hypertension has an approximately 2.9 fold-higher incidence among the obese than in individuals with normal weight[6].

In the heart of the obese individual, the left ventricular filling pressure and volume increase, shifting the Frank-Starling curve to the left, and inducing chamber dilation. The volume of the dilated chamber also inappropriately increases the left ventricular wall stress, and the ventricle adapts by inducing an augment of the contractile elements and myocardial mass. The final product of this adaptation is the hypertrophy, normally of the eccentric type[7,8]. The echocardiogram is currently the most used method for the diagnosis of left ventricular hypertrophy, common in obesity and arterial hypertension. It is based on the left ventricular mass calculation, which can be estimated by several formulas, with the Devereux's formula being one of the most frequently employed[9]. The left ventricular mass index is also very often employed, which is obtained by the division of the left ventricular mass by the body surface

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area[10], but restrictions have been made to the use of this index in obese patients, suggesting an underestimation of hypertrophy as obesity is considered a physiologic variable of continuous increase[11]. In order to prevent this bias, LV mass index without the inclusion of weight in the formula has been proposed.[11] The distribution of the LV mass values in relation to the relative thickness of the LV allowed Ganau et al.[12] to propose a classification of ventricular geometry. The echocardiography has also been applied in the assessment of the LV systolic and diastolic functions in the obese[8,13-16]. The Myocardial Performance Index (MPI or Tei Index) that evaluates simultaneously the systolic and diastolic functions, has yet to be used in the study of obese individuals' hearts.

	BMI (kg/m^2)	Risk
Underweight	<18.5	Increased
Normal	18.5 - 24.9	Normal
Overweight	25.0 - 29.9	Increased
Obesity Class I	30.0 - 34.9	High
Obesity Class II	35.0 - 39.9	Very high
Obesity Class III	≥ 40.0	Extremely high

Data from the National Institutes of Health (NIH); National Heart, Lung and Blood Institute. www.nhlbi.nih.gov/guidelines/obesity
Obesity Class III = morbid obesity

Chart 1 - Obesity categories

Weight loss can be attained by decreasing the calorie intake, by increasing physical activity, and through the use of drugs and surgical procedures[18]. However, only approximately 20% of the obese can promote changes in their life styles and do so in a very irregular way. This makes the weight-loss programs based solely on dieting plus physical activity frequently ineffective: around 90 to 95% of the people who lose weight, eventually recover it, or even put on additional weight[19]. Drug treatments also have a very limited long-term efficacy, with studies showing little weight loss when compared to placebo.[20] Thus, currently, the therapeutic intervention that offers the most effective weight loss for severe obesity is the bariatric surgery[19]. The consensus for the management of obesity recommends that the best treatment for patients whose BMI is > $40kg/m^2$ in whom dieting, physical activity and drugs for weight loss have failed, is the surgical treatment[18].

Several studies have confirmed the decrease in arterial pressure, systolic as well as diastolic, following weight reduction, also showing an improvement in the parameters of serum lipids and glucose[14,21-23]. Therefore, weight loss and its subsequent maintenance reduce the major risk factors for cardiovascular disease, which must favor the fact that the cardiac alterations of obesity be partially reversible. In this study, the anatomofunctional heart behavior is analyzed after bariatric surgery, through mid-and long-term evolutive echocardiograms.

Methods

Twenty-three consecutive patients from the Obesity Outpatient Clinic of Hospital das Clinicas of the Federal University of Parana were selected from January 1999 and August 2000. Four patients were males and 16 were females, with mean ages of 39.7 ± 8.4 years, ranging from 26 to 56 yrs.

As inclusion criteria were considered the following items: (1) all of the patients who had obesity class III; (2) the patients who had obesity class II with associated co-morbidities; (3) signature of the free Informed Consent Term agreeing to participate in the study; (4) agreement to undergo the bariatric surgery; (5) echocardiographic study with satisfactory technical quality.

Patients underwent a clinical evaluation before the surgery, with particular attention on the weight, height and arterial pressure data. The arterial pressure measurements were carried out by the indirect method with a palpation and auscultatory technique, in the sitting position, with an adequately calibrated aneroid sphygmomanometer. The patients remained in a resting position for 5 to 10 minutes before the pressure measurement, and were instructed to avoid physical activity, eating, smoking and drinking coffee or alcoholic beverage for at least 30 minutes before the measurement and talking, pain, tension or anxiety during the procedure.

All of the patients were submitted to the intervention at the Service of Digestive System Surgery of Hospital das Clinicas of the Federal University of Parana. The operation performed in all patients was the one proposed by Capella et al[24], which involves a vertical banded gastroplasty associated to a gastrojejunal derivation Roux-en-Y gastric bypass.

The transthoracic echocardiograms were performed during the preoperative assessment, and six months and three years postoperatively, using a *SONOS 5500 (*Hewlett Packard, Andover*, MA, USA)*, echocardiographer with 2 to 4 MHz transducer. The recordings were performed in videotapes, using a professional equipment, *Super-VHS Panasonic AG-7300*. The examination technique was the one already established in literature[25-28]. The recordings of the events at the one-dimensional echocardiogram and Doppler were carried out with a velocity of 50 mm/s.

The data interpretation consisted of qualitative and quantitative analysis of the one and two-dimensional echocardiograms, pulsed and continuous wave Doppler, and the color-flow mapping. All echocardiograms were performed by a single examiner, Board-certified in the area of Echocardiography by the Brazilian Society of Cardiology and Brazilian Medical Association, with an experience of 23 years using the method. The intra-observer variability was not assessed.

The one-dimensional echocardiographic tracings were two-dimensional image guided. Using this technique, the conventional measurements were carried out, following the recommendations of the American Society of Echocardiography[29]. For the calculation of the LV Ejection Fraction, the systolic and diastolic volumes were estimated by the formula of Teichholz et al[30].

The LV mass was assessed using the Devereux formula [9]:

$$LVM = 0.8\,[\,1.04(VS + LVd + PW)^3 - (LVd)^3] + 0.6$$

where SV is the diastolic thickness of the ventricular septum, LVd is the diastolic dimension of the left ventricle and PW is the diastolic dimension of the LV posterior wall. The maximum normal mass limit was 294 g for men and 198 g for women[31]. Two left ventricular mass indexes were calculated, by dividing:

(1) the mass of the LV by the body surface[32] : LVMi = LVM/BS;

(2) the mass of the LV by the square height[11] : LVMi = LVM/H^2.

The relative thickness (RT) was calculated by the sum of the diastolic thickness of the ventricular septum and the posterior wall, in relation to the left ventricular diastolic dimension[12]: RT = (VS+PW) /LVd.

The patterns of ventricular geometry were defined as[12]:

1- *Normal*: individuals with normal LVMi and RT (respectively < than 125g/m^2 and 0.45);

2- Concentric Remodeling: characterized by increased RT with normal LVMi;

3- Eccentric hypertrophy: increased LVMi with normal RT;

4- Concentric hypertrophy: increased LVMi and RT.

At the Doppler study, all measurements were carried out in 3 consecutive cycles and their mean was calculated. The mitral flow velocity (E and A waves, E/A ratio), LV ejection time and LV isovolumetric relaxation time were measured.

To calculate the Myocardial Performance Index (MPI)[17] (Fig. 1) retrospective studies of the mitral flow Doppler recordings and LV outflow tract were carried out, with the appropriate calibration. The *a* interval was measured at the recording of the mitral flow, from the flow interruption in a cardiac cycle to the start of the next, and involved the sum of the isovolumetric contraction time (ICT), ejection time (ET) and isovolumetric relaxation time (IRT). The *b* interval, measured at the recording of the LV outflow tract, was equal to the ejection time. Tei index was calculated as (a – b)/b, which corresponds to (ICT + IRT)/ET.

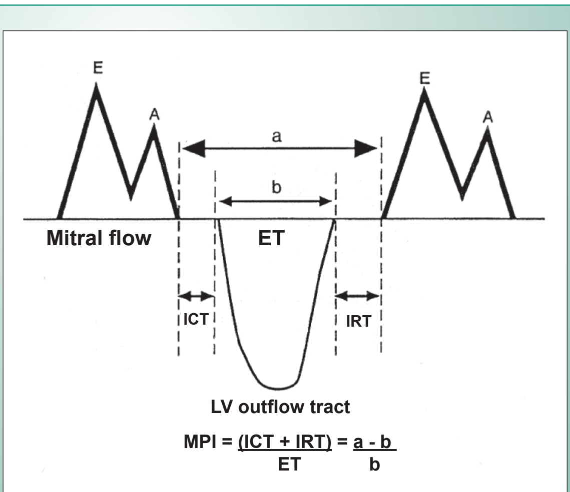

Fig. 1 - Schematic representation of the time intervals at Doppler for the calculation of the Myocardial Performance Index (MPI) or Tei Index. a = time interval between the start and the end of the mitral flow; b = ET = ejection time; ICT = isovolumetric contraction time; IRT = isovolumetric relaxation time; LV = left ventricle (modified from Tei et al.[17])

Statistical analysis - The descriptive analysis of the data was carried out through charts and graphs. In order to verify the aim of this study, analysis of variance was used for repeated data (Repeated Measures ANOVA) and the parametric student's *t* test for paired samples and Friedman's non-parametric test (through the software "Primer of Biostatistics") were also used. The level of significance was set at 5% (0.05)[33].

Results

1- Demographic data:

There was significant weight reduction within the six-month evaluation period (24.2%) as well as after the 3yr follow-up period (35.0%). BMI and body surface also decreased simultaneously. The systolic arterial pressure and the diastolic arterial pressure decreased within 6 months (9.6% and 12.5%, respectively) of evaluation, maintaining approximately the same levels after the 3-yr follow-up period (Tab. 1).

2- Echocardiographic data:

2.1 One-dimensional Echocardiogram:

The analysis of the one-dimensional echocardiogram showed a decrease in the LV septum thickness (12.4%) and posterior wall (14.8%) within a 6-month evaluation period with the results being maintained in the 3-yr follow-up period. Before surgery, these structures showed increased mean values, which normalized after surgery (Tab. 2).

The LV diastolic dimension had a normal mean at the basal study, and a slight increase was observed within the 6-month evaluation period (8.2%), which was maintained in the 3-yr follow-up period. The LV percentage of systolic shortening was normal at the pre-operative evaluation and remained unaltered in the subsequent assessments. Ejection fraction was also normal at the basal echocardiogram and remained unaltered at the 6-month evaluation, but there was a slight increase (4.8%) at the 3-yr follow-up assessment, in relation to the initial study (Tab. 2).

The left ventricular mass was increased in 7 patients (30%), and it remained unaltered at the 6-month evaluation, but there was a reduction of 9.2% at the 3-yr follow-up assessment. The LV mass index for body surface (LVMi/BS) did not present variations at the 3-yr follow-up. On the other hand, the LVMi divided by the square height (LVMi/H^2), which did not show alteration at the 6-month evaluation period, demonstrated a reduction of 9.5% at the 3-yr follow-up (Tab. 2).

The relative LV wall thickness was increased in 17 patients (74%) before surgery (Tab. 3). At the post-operative period, 11 patients (48%) presented relative LV wall thickness, which decreased to only 5 (22%) after 3 years.

The predominant LV geometric pattern before the bariatric surgery was that of concentric remodeling observed in 17 cases (74%), which became normal in most patients at the 3-year follow-up period (16 cases, 70%) (Tab. 3).

2.2 Doppler Echocardiogram:

The E/A ratio presented a mean value of 1.29 at the basal assessment. Four patients had levels < 1.0, indicating LV abnormal relaxation. An increase in the E/A ratio of 11.9% at the 6-month evaluation was observed, and at this time, only one patient maintained a value < 1.0; there was no alteration

DATA	PRE-OP	6 MO POST-OP	3 YRS POST-OP
Weight(kg)	128.7± 25.8	97.6 ± 18.3*	83.6 ± 13.5$^{*,+}$
BMI (kg/m^2)	48.8 ± 8.8	37.1 ± 6.3*	31.8 ± 5.3$^{*,+}$
SAP (mmHg)	142.2 ± 16.2	128.5 ± 16.1*	128.9 ± 19.7 ^{§,ns}
DAP (mmHg)	92.2 ± 10.4	80.7 ± 9.9*	82.6 ± 13.6 ^{§,ns}
MAP (mmHg)	108.8 ± 11.6	96.6 ± 11.5*	98.0 ± 14.9 ^{§,ns}

*BMI: Body Mass Index; SAP: Systolic Arterial Pressure; DAP: Diastolic Arterial Pressure; MAP: Mean Arterial Pressure, OP: Operative; * p < 0.0001 in relation to pre-op; + : p < 0.0001 in relation to 6 mo post-op; § : p < 0.05 in relation to pre-op; ns: non-significant p in relation to 6 mo post-op.*

Table 1 - Descriptive statistical analysis of demographic data of 23 patients (mean ± standard deviation)

DATA	PRE-OP	6 MO POST-OP	3 YRS POST-OP
Left atrium (mm)	38.9 ± 4.3	38.5 ± 5.2^{ns}	38.1 ± 4.0$^{ns,ns'}$
Posterior wall (mm)	12.2 ± 1.9	10.4 ± 1.7§	9.9 ± 1.5$^{*,ns'}$
Septum (mm)	12.1 ± 2.0	10.6 ± 2.0§	10.6 ± 1.5$^{§,ns'}$
LVd (mm)	44.9 ± 7.5	48.6 ± 5.8§	48.8 ± 5.4$^{§,ns'}$
Δ LVS (%)	43.9 ± 4.4	43.1 ± 5.0^{ns}	44.0 ± 4.6$^{ns,ns'}$
Ejection fraction (%)	71.3 ± 5.6	72.4 ± 6.5^{ns}	74.7 ± 4.9$^{§,ns'}$
LVM (g)	195.4 ± 46.0	183.8 ± 53.6^{ns}	177.5 ± 40.4$^{§,ns'}$
LVMi – LVM/BS (g/m^2)	89.1 ± 18.1	93.2 ± 22.3^{ns}	96.8 ± 21.5$^{ns,ns'}$
LVMi – LVM/H2 (g/m^2)	74.5 ± 17.7	69.6 ± 19.4^{ns}	67.4 ± 14.8$^{§,ns'}$

*mm: millimeters; LVM: left ventricle mass; LVMi: left ventricle mass index; BS: body surface; H: height; LVd: left ventricle diastolic dimension; Δ LVS: LV percentage of systolic shortening of the left ventricle; * p < 0.0001 in relation to pre-op; § : p < 0.05 in relation to pre-op; ns: non-significant p in relation to pre-op; ns': non-significant p in relation to 6 mo post-op.*

Table 2- Descriptive statistics of the one-dimensional echocardiographic study variables of the 23 patients (mean±sd)

between 6 months and 3 years of follow-up (Tab. 4).

The measurement of isovolumetric relaxation time decreased 9.0%, 25.0% and 17.6% at 6 months, three years and between 6 months and three years of evaluation, respectively (Tab. 4).

An increase of 8.7% was observed in the measurement of the ejection time at six months of follow-up, but no alteration was observed between 6 months and 3 years (Tab. 4).

The Myocardial Performance Index was studied in only 13 patients, who had their data located retrospectively. Its mean basal value was 0.59; a decrease of 23.4% was observed at the 6-month and 21.8% at the 3-year follow-up (Tab. 4).

Discussion

Obesity represents one of the main cardiovascular risk factors, with alarming progression in its prevalence. In addition to being considered an independent risk factor[4], it brings frequent associations that greatly augment this risk - among them, systemic arterial hypertension, diabetes, dyslipidemia, and the obstructive sleep apnea, augmenting even more the probability of structural and functional cardiac alterations that can lead to heart failure, coronary disease and sudden death[34,35].

Unfortunately, the attempts to change eating habits and the use of drugs in the treatment of obesity have been little contributive, especially in the most advanced cases. The efficacy of treatments is still deficient, and the side effects are frequent, with common psychological disorders, diarrhea, liver involvement and hormonal alterations, as well as cardiovascular manifestations such as systemic arterial hypertension, tachycardia, pulmonary hypertension and valvulopathies[18,36,37].

Therefore, the intervention that currently offers the most effective weight loss for severe obesity is the bariatric surgery[19]. In the present study, all patients who underwent surgery had a significant weight reduction, with improvement of the quality of life and a clear benefit for the health status as a whole. These benefits were kept along the 3-year follow-up, confirming the literature data[38].

Considering the classification of arterial hypertension for adults (age ≥ 18 yrs) from the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure[6], which defines arterial hypertension as values ≥ 140/90 mm Hg, of the 23 patients in the study there were 19 (82.6%) who presented arterial hypertension before treatment, whereas, after surgery, only 8 (34.8%) were considered to be hypertensive. Thus, the relevant significance of weight reduction on the control of arterial pressure is confirmed.

In the face of the frequent association between obesity and arterial hypertension, many physiopathological aspects of these diseases end up being mistakenly diagnosed. The alterations more closely associated with obesity, especially resistance to leptin, reduction of the natriuretic factor, abnormal pressure natriuresis and sodium retention, lead to the increase of intravascular volume and cardiac output, with consequent left ventricular eccentric hypertrophy. On the other hand, other modifications such as sympathetic nervous system and rennin-angiotensin system stimuli, increase in the intracellular calcium concentration and insulin resistance determine the increase of the peripheral resistance and arterial pressure, causing left ventricular concentric hypertrophy. At the frequent situation of the hypertensive obese patient, these physiopathological alterations commonly combine and result in structural dimorphic cardiac adaptations, characterized by eccentric-concentric left ventricular hypertrophy[39].

The echocardiograms of the studied populations showed that the left ventricular mass (not corrected for body surface or height) was increased in 7 patients (30%), indicating left ventricular hypertrophy according to this criterion (normal up to 198 g for women and 294 g for men)[31]. On the other hand, a significant increase in the LV posterior wall diastolic thickness and ventricular septum was observed, with 16 posterior walls (69%) and 15 ventricular septa (65%) being hypertrophic (> 11 mm) among the 23 pre-operative assessments. The left ventricular cavities were not significantly dilated, and only one patient had a diastolic dimension equal to 57 mm (normal up to 56 mm). The left ventricular relative thickness was increased in 17 patients (74%) before surgery, and the geometric pattern of concentric remodeling was the predominant one (74%). These structural alterations of the left ventricle indicate modifications of the ventricular geometry in this population, possibly related to obesity and the elevated association with arterial hypertension. Despite the classic view of the predominance of eccentric hypertrophy in obesity, Mensah et al[40] report that the predominant pattern among the obese in their study population was also the concentric remodeling.

After the surgical treatment of obesity, with a significant weight reduction and associated arterial pressure decrease, a noteworthy reduction in the diastolic thickness of the ventricular septum ($p=0.003$) and left ventricular posterior wall ($p< 0.0001$) were observed. Additionally, there was also a decrease in the left ventricular mass and left ventricular mass index – weight/H^2 ($p<0.05$) after 3 years of post-operative follow-up. The use of the LVM/BS index did not show mass variation, as the reduction of the LVM is masked by the decrease of the body surface.

It is thus evidenced the better application of the LVM indexes in the obese that use only the height in their formula, confirming previous findings[11,41]. This study also contributes to validate the formula proposed in our country by Rosa et al.[11], which is simpler to use than the one proposed previously by De Simone[41] that used height raised to 2.7 power.

Weight as well as arterial pressure reduction can result in a decrease of the left cavity, but what was noticed was mainly a decrease in the wall relative thickness, a more relevant finding than the slight increase of dimensions that allowed, nevertheless, a long-term reduction in the left ventricular mass. This modification is attributed to the obesity-hypertension association that was prevalent in the sample, which presented several patterns in the pre-operative period and, once corrected, allowed varied rearrangements in the ventricular

Evaluation period	LV Relative wall thickness		LV Geometric pattern			
	NORMAL(n)	INCREASED (n)	NORMAL(n)	CR(n)	EH(n)	CH(n)
Pre-op	06	17	06	17	-	-
6 mo PO	12	11	12	09	-	02
3 yrs PO	18	05	16	05	02	-

n = number of patients; PO: post-operative period; LV: left ventricular; CR: concentric remodeling; HE: eccentric hypertrophy; HC: concentric hypertrophy.

Table 3- Relative left ventricular wall thickness and geometric pattern in the 23 study patients

DATA	PRE-OP	6 MO POST-OP	3 YRS POST-OP
E Wave (cm/s)	84.0±17.4	98.4±15.70*	88.0±19.6 $^{ns, \#}$
A Wave (cm/s)	68.9±17.2	65.8±16.8 ^{ns}	59.9±16.8 $^{§, ns'}$
E/A ratio	1.29±0.41	1.63±0.63 §	1.60±0.67 $^{§, ns'}$
LVIRT (ms)	99.9±16.6	90.9±16.2 §	74.9±14.5 $^{*, +}$
ET (ms)	287.8±34.7	312.7±25.8 *	311.7±20.3 $^{§, ns'}$
MPI	0.591±0.127	0.453±0.127 §	0.462±0.106 $^{§, ns'}$

*cm/s: centimeters per second; LVIRT: left ventricle isovolumetric relaxation time; ET: ejection time; ms: milliseconds; MPI: Myocardial Performance Index; * p < 0.0001 in relation to pre-op; + : p < 0.0001 in relation to 6 months post-op; § : p < 0.05 in relation to pre-op; # : p < 0.05 in relation to 6 months post-op; ns: non-significant p in relation to pre-op; ns': non-significant p in relation to 6 months post-op.*

Table 4 - descriptive statistics of the doppler echocardiographic study variables in the 23 patients (mean±sd)

geometry; nonetheless, it permitted a reduction of almost 10% of the left ventricular mass.

An extensive benefit regarding all parameters of the diastolic function was noticed among the global study population, with an increase in thee wave, reduction of the A wave, increase of the E/A ratio and shortening of the LV isovolumetric relaxation time. The benefit in the diastolic function that resulted from the weight loss has been repeatedly documented by several authors[16,42-45]. The left atrium volume, another variable that has been associated with the LV diastolic function, was not studied in this sample. However, the study of the left atrium dimension at the one-dimensional echocardiogram did not reveal a significant variation after the treatment of obesity.

Regarding the systolic function, there is usually a lower obesity-dependent variation. All patients in this study had normal systolic indexes before surgery. The variation of the LV percentage systolic shortening did not show any significant change. At the 6-month re-study, no significant variation in the ejection fraction was observed, although it showed a slight improvement at the 3-year follow-up. Despite the fact that they consist of the same data that participate in the ejection fraction formula, the components of the percentage shortening are lower values, which will tend to group together with a consequent difficulty to display the significant difference among them. Ejection time is a measurement derived from the Doppler, which showed to have an inverse correlation with weight: as weight decreased, an increase in the ejection time was observed, which is indicative of systolic function improvement. Despite these favorable modifications regarding the systolic function, caution must be exercised when considering the data, as the contractile function was normal at the basal study.

The Myocardial Performance Index, MPI, was described in 1995 by Chuwa Tei, with the aim of developing a parameter that could simultaneously measure systolic and diastolic function data[17]. Several studies of different diseases have confirmed the applicability of the index, notably with diagnostic implications[17,46-54]. During the literature review, no study was found regarding the role of the MPI in obesity. Examinations from 13 patients were retrospectively obtained, as there were problems with image storage of 10 of the patients, taken 3 years before.

However, despite the smaller number of patients, it was possible to observe a behavior of the MPI that was compatible with that seen regarding the other parameters in this study: the reduction in this index after weight loss coincides with the previously described improvement of the diastolic and systolic functions.

As limitations of this study, we mention the small sample size, the difficulty to use other methods to evaluate the systolic and the diastolic function (pulmonary vein flow study, Tissue Doppler Imaging (TDI) and left atrium volume indexes) and the retrospective analysis, with patient loss, when analyzing the MPI.

In conclusion, morbidly obese patients, after undergoing gastroplasty, present a reduction in the arterial blood pressure and beneficial structural modifications to the heart, with decrease of the left ventricular hypertrophy translated as the reduction in the LV relative thickness, LV mass and LV mass index (LVM/height^2). They also present improvement in the diastolic function and an apparent beneficial effect on the systolic function, evaluated alone or jointly through the Myocardial Performance Index.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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