Obesity Surgery
https://doi.org/10.1007/s11695-023-06469-7

ORIGINAL CONTRIBUTIONS

Effect of Obesity and Bariatric Surgery on Saphenous Veins

Wendell Ricardo de Medeiros Alves Fernandes[1] · Esdras Marques Lins[2] · Fernanda Appolônio Rocha[2] · Gabriela de Oliveira Buril[1] · Emmanuelle Tenório Albuquerque Godoi Berenguer de Barros e Silva[3] · Rebecca Paes de Andrade Souza Caldas[1] · Filipe de Souza Leão Câmara[4] · Álvaro Antônio Bandeira Ferraz[2]

Received: 16 November 2022 / Revised: 7 January 2023 / Accepted: 17 January 2023

Abstract

Purpose Obesity is a risk factor for chronic venous disease (CVD) of the lower limbs (LL), affecting venous anatomy and physiology. Weight loss after bariatric surgery (BS) can reduce intra-abdominal pressure, improve mobility, and ultimately improve venous hemodynamics and CVD-related symptoms. There are no studies in the literature that adequately assess the effect of the obesity and BS on the LL veins, especially the saphenous veins (SV). The aim of this study was to evaluate the effects of obesity and BS on the saphenous veins.

Methods This is a longitudinal prospective study carried out from 2019 to 2021 with 19 patients, totaling 38 LL, underwent clinical evaluation (CEAP Classification) and by Doppler ultrasonography, to analyze their SV diameter and reflux measurements, in the preoperative period and again 6 months to 2 years after BS being performed.

Results There was no statistical difference between the groups regarding the characteristics of reflux in the SV among the evaluated LL. There was no significant increase in the diameter of the great SV in the majority of its segments. The groups were similar in terms of the small SV diameters. Moreover, a significant reduction in the clinical class of CEAP was observed after BS.

Conclusion Obesity and bariatric surgery had no influence on diameter or reflux in saphenous veins, but a reduction in the CEAP Clinical Classification was observed in the postoperative period.

Keywords Obesity · Bariatric surgery · Chronic venous insufficiency · Doppler ultrasound

Introduction

There is currently a consensus that weight loss resulting from bariatric surgery (BS) is an important factor for a better result in the clinical and surgical treatments of chronic venous insufficiency (CVI) of the lower limbs (LL). It is possible that weight loss after bariatric surgery promotes an improvement in the venous return of the lower limbs. In addition, it could even cause a reduction in the diameter of the saphenous veins (SV), since their dilation is often associated with venous reflux, which is characteristic of CVI of the lower limbs. In addition, many studies relate obesity as a causal factor for CVI; however, little is known about the influence of this condition and bariatric surgery on venous hemodynamics of the lower limbs [1, 2].

Despite the recognized importance of BS to improve symptoms resulting from CVI of the lower limbs, there are still no studies that adequately assess the influence of weight loss after this type of operation on the venous flow pattern, or on the SV diameter [3, 4].

The CEAP (Clinical-Etiology-Anatomy-Pathophysiology) classification is an internationally accepted standard for describing patients with chronic venous insufficiency of lower limbs, and it has been used for reporting clinical research findings in scientific journals [5]. Based on clinical

Key points
- There are still no studies that adequately assess the influence of obesity and weight loss after bariatric surgery on the flow pattern and diameter of saphenous veins.
- Obesity and bariatric surgery did not influence the diameter and reflux in the saphenous veins in the current study.
- A significant reduction in the symptoms of chronic venous disease (evaluated through clinical class of CEAP) was observed after bariatric surgery.

✉ Esdras Marques Lins
esdras.lins@ufpe.br

Extended author information available on the last page of the article

Published online: 26 January 2023

characteristics of CVI, patients are classified in six groups: C0 — no signs of CVI, C1 — Teleangiectasias or reticular veins, C2 — varicose veins, C3 — edema, C4 — changes in skin and subcutaneous tissue due to CVI, C5 — healed venous ulcer, and C6 — active venous ulcer [5].

Based on these considerations, the objective of this study was to evaluate the effects of obesity and BS on SV diameter in obese patients with lower limb CVI, in addition to studying their clinical profile, related to CVI, according to the CEAP classification before and after BS. The impact on the quality of life of obese patients in relation to CVI after BS was also studied.

Method

This is a prospective longitudinal study conducted from March 2019 to October 2021, which evaluated 19 patients (38 lower limbs) with CVI of the lower limbs and obese patients undergoing BS. The initial CVI diagnostic and selection for the study was based on clinical findings of the CEAP Classification. The inclusion criteria for performing BS followed the recommendation of the National Consensus of Health Institutes: obese patients with BMI ≥ 40 kg/m^2 without comorbidities or ≥ 35 kg/m^2 associated with comorbidities (ABESO, 2016), aged 18 to 60 years. All patients underwent surgery at the General Surgery Service of the Hospital das Clínicas/EBSERH – UFPE, using two techniques: 10 (52.6%) using the Sleeve and 9 (47.4%) by RYGB.

Each patient signed an informed consent form after agreeing to the study, and had their clinical data collected regarding the CEAP classification, anthropometric (weight, height, and BMI) and Doppler ultrasound (DU) of the lower limbs in the preoperative period (PRE). The same data were collected again in the postoperative period (POS), which ranged from 6 to 24 months.

The DU of the lower limbs was performed with a GE Logic S7 machine by a single examiner. Measurements were taken with the patient in orthostasis from the great saphenous vein (GSV) at the saphenofemoral junction (SFJ) and in the proximal middle and distal segments of the thigh and leg (M1, M2, M3, M4, M5, and M6). The small saphenous vein (SSV) was measured in the proximal, middle, and distal segments (P1, P2, and P3). The presence of reflux in the GSV and SSV was also evaluated through provocative maneuvers (Valsalva maneuver and distal manual compression).

All variables were analyzed descriptively. The analysis for the quantitative variables was performed through observing the minimum and maximum values, and the calculation of means, standard deviations (SD) and median. Absolute and relative frequencies were calculated for the qualitative variables. The paired Student's *t*-test was used to compare the means of two evaluation moments; the non-parametric Wilcoxon test was used when the assumption of data normality was rejected. McNemar's non-parametric test was used to compare proportions in two evaluation moments. The SPSS 17.0 software program for Windows was used for the calculations. The significance level used for the tests was 5%.

The VEINES QOL/SYM questionnaires were used to preoperatively assess symptoms and quality of life and again 6 to 24 months postoperatively. This study was approved by the Research Ethics Committee of the Hospital das Clínicas/EBSERH – UFPE, under the registration CAAE: 14564119.0.0000.8807.

Results

The age of the patients studied ranged between 25 and 60 years (mean of 42.68 years with standard deviation of 10.57 years and median of 43 years), and 10 (52.6%) of the patients were female.

Regarding the obesity degree in the preoperative period (PRE), two (10.5%) patients had grade I obesity, two (10.5%) grade II, five (26.3%) grade III, and 10 (52.6%) were super obese (Table 1).

A statistically significant change was observed from PRE to POS in relation to weight, BMI, and CEAP. Significantly lower weight and BMI values were found at the POS moment when compared to the PRE moment. It was also observed that 11 patients (59.9%) belonged to the C3 and C4 classes of the CEAP Clinical Classification at the PRE time, while 7 (36.8%) belonged to these classes at the POS moment (Table 2).

Reflux was observed in the GSV in 5 (15.2%) of the 38 lower limbs in the PRE, while 4 (12.1%) had reflux at POS. There was no significant change in reflux in the GSV from the PRE to the POS moment (McNemar's non-parametric test, $p = 1.000$). One (2.6%) limb had reflux in the SSV at the PRE time and none at the POS. There was also no significant change in the presence of reflux in the GSV and SSV from the PRE to the POS moment in the groups evaluated according to the weight loss percentage (WLP) (Table 3).

Table 1 Descriptive values of weight, height, and BMI in the PRE

Variable	*n*	Mean	SD	Median	Minimum	Maximum
Weight (in kg)	19	142.78	133.50	42.75	69.00	228.00
Height (in m)	19	1.65	1.65	0.12	1.38	1.86
BMI (kg/m^2)	19	51.75	52.30	13.44	31.50	89.06

Table 2 CEAP clinical classification, weight, and BMI in the PRE and POS moments

Variable	Moment		
	Pre	Pos	*p*-value
Weight	146.88 + 39.97	110.39 + 28.24	< 0.001(1)
BMI	52.88 + 12.87	39.56 + 7.93	< 0.001(1)
BMI classes			0.001(3)
Obesity I	1 (5.5%)	7 (38.9%)	
Obesity II	2 (11.1%)	4 (22.2%)	
Obesity III	5 (27.8%)	5 (27.8%)	
Super obese	10 (55.6%)	2 (11.1%)	
CEAP			0.046(3)
C1	4 (21.1%)	4 (21.1%)	
C2	4 (21.1%)	8 (42.1%)	
C3	6 (31.6%)	2 (10.5%)	
C4a	5 (26.3%)	5 (26.3%)	

Willenberg et al. compared venous flow velocities in the deep veins (femoral veins) of obese and non-obese patients, and identified a lower peak velocity and lower minimum velocity in obese patients, but there are no similar studies on superficial veins [6].

It was observed that even the patients with severe obesity did not present SV dilation, considering that the diameter in the PRE moment measured a maximum of about 0.8 cm in the GSV and about 0.3 cm in the SSV, which are considered normal diameters, according to the literature. There was no increase in the GSV diameter, with a statistical difference between the PRE and POS groups, except for the distal leg segment, which however did not correspond to clinical significance. The groups were similar for the other segments. There was no statistical difference between the groups regarding the SSV diameter, but it was observed that even obese patients in the PRE group had a fine-caliber SSV (diameter < 0.4 cm). To date, there are no studies in the literature which have evaluated SSV in obese patients before or after BS. This finding also shows that obesity did not influence the SV diameter.

Table 3 Absolute frequencies (%) of the presence of reflux according to WLP group and evaluation time

	WLP < 25%		WLP 25–50%		WLP > = 50%	
	Pre	Pos	Pre	Pos	Pre	Pos
GSV						
Absent	6 (100.0)	6 (100.0)	12 (85.7)	10 (71.4)	15 (83.3)	18 (100.0)
Present	0 (0.0)	0 (0.0)	2 (14.3)	4 (28.6)	3 (16,7)	0 (0,0)
*p**	1.000		0.157		0.083	
SSV						
Absent	6 (100.0)	6 (100.0)	13 (92.9)	14 (100.0)	18 (100.0)	18 (100.0)
Present	0 (0.0)	0 (0.0)	1 (7.1)	0 (0.0)	0 (0.0)	0 (0.0)
*p**	1.000		1.000		1.000	

A significant increase in GSV diameter was observed in the distal leg segment (P3) from the PRE to the POS moment. No significant change was observed in the other variables evaluated (Table 4).

There was no significant change in the quality of life of patients undergoing surgery after 6 months (Table 5).

Discussion

In this study, only 15% of the evaluated lower limbs had reflux in the GSV in the PRE moment, and one limb had reflux in the SSV, showing that reflux in the saphenous veins is not common even in patients with severe obesity and with most of the more advanced clinical forms of CVI. In addition, no statistical difference was found regarding the presence of reflux in the SVs when considering the PRE and POS groups. These findings may suggest that obesity is not the cause of reflux in the superficial venous system.

Engelhorn et al. related a larger diameter of the GSV to the increase in the probability of venous reflux, so that a saphenofemoral junction with a caliber greater than 0.7 cm would have more than 70% of positive predictive value for the occurrence of reflux; however, contrary to this hypothesis, it was observed herein that the SFJ caliber averages in the PRE and POS measured about 0.8 cm, and even so venous reflux was only present in 15% of the lower limbs [7].

In contrast, Van Rij et al. reported the presence of larger diameters and higher venous pressures, without evaluating the presence of venous reflux, in patients weighing more than 90 kg; they suggested a relationship with stasis and venous congestion resulting from the failure of mechanisms such as muscle pumping due to sarcopenia and reduced mobility frequency in obese patients [8].

A regression of the CEAP clinical class was observed in about 30% of the lower limbs after BS in the current study. In these cases, there was a change from class C3 to C2, meaning that the patients no longer had edema. This number

Table 4 Descriptive values of the variables studied according to the moment

Variable	Moment	*N*	Mean	SD	Minimum	Maximum	*p*-value*
JSF	Pre	38	0.81	0.22	0.46	1.44	0.757
	Pos	38	0.82	0.25	0.32	1.40	
GSV M1	Pre	38	0.59	0.21	0.25	1.27	0.081
	Pos	38	0.64	0.27	0.19	1.40	
GSV M2	Pre	38	0.46	0.16	0.23	0.86	0.664
	Pos	38	0.47	0.15	0.00	0.85	
GSV M3	Pre	38	0.38	0.17	0.00	0.78	0.220
	Pos	38	0.40	0.14	0.00	0.59	
GSV M4	Pre	38	0.29	0.14	0.00	0.60	0.063
	Pos	38	0.32	0.14	0.00	0.53	
GSV M5	Pre	37	0.24	0.13	0.00	0.46	0.526
	Pos	37	0.24	0.13	0.00	0.44	
GSV M6	Pre	38	0.27	0.10	0.00	0.44	0.006
	Pos	38	0.30	0.12	0.00	0.49	
SSV P1	Pre	38	0.33	0.12	0.13	0.61	0.088
	Pos	38	0.30	0.12	0.00	0.58	
SSV P2	Pre	38	0.23	0.09	0.00	0.39	0.979
	Pos	38	0.23	0.09	0.00	0.40	
SSV P3	Pre	38	0.21	0.09	0.00	0.41	0.842
	Pos	38	0.21	0.08	0.00	0.36	

Table 5 Descriptive values of VEINES-QOL and VEINES-Sym scores before and after surgery

Variable	Moment	*n*	Mean	SD	Minimum	Maximum	P25	Median	P75	*p**
Veines-QOL	Pre	22	50.00	6.78	36.31	59.47	46.36	49.84	56.44	0.709
	Pos	22	50.00	5.47	37.43	54.40	46.26	53.48	54.40	
Veines-Sym	Pre	22	50.00	7.02	34.83	58.92	44.62	52.02	56.37	0.770
	Pos	22	50.00	7.86	26.74	54.86	48.71	53.74	54.86	

*Descriptive level of probability of Wilcoxon's non-parametric test

stands out for being twice the rate of patients with venous flow alterations in the PRE, confirming that obese patients have more severe CVI symptoms even without anatomical and physiological alterations of the SV [5, 9].

There was no statistical difference between the PRE and POS groups regarding the assessment of quality of life using the VEINESQOL/SYM questionnaire. It is important to point out that obese patients may have comorbidities which are also included in the differential diagnosis of CVI, such as lumbosciatagia, lipedema, lymphedema, and lower limb arthritis. Most of these pathologies benefit from weight loss for their adequate control, and therefore there may be confusion when applying the symptoms and quality of life questionnaire [10, 11].

Another important point is that weight loss in the first postoperative months can be accompanied by loss of muscle mass and worsening of sarcopenia, interfering with the muscle pump mechanism, although studies are still needed to assess this possibility.

Regarding limitations of this study, it can be observed that more than half of the patients evaluated were classified as being superobese, and even with a significant weight loss when comparing the PRE and POS groups, most still remained obese after surgery; therefore, this may have hindered a better analysis of the influence of weight loss on venous hemodynamics. The small number of studied patients is another limitation.

Conclusion

Obesity and bariatric surgery did not influence the diameter and reflux in the saphenous veins in the current study. There was no improvement in quality of life after bariatric surgery, but a reduction in the CEAP Clinical Classification was observed in the postoperative period.

Declarations

Conflict of Interest The authors declare no competing interests.

References

1. Piecuch J, Slowinska-Lozynska L, Sosada K, et al. Impact of weight loss due to sleeve gastrectomy on shear stress of the femoral vein in morbid obesity. Obes Surg. 2014;24(5):806–12.
2. Davies HOB, Popplewell M, Singhal R, et al. Obesity and lower limb venous disease – the epidemic of phlebesity. Phlebology. 2017;32(4):227–33.
3. Campos GM, Khoraki J, Browning MG, et al. Changes in utilization of bariatric surgery in the United States from 1993 to 2016. Ann Surg. 2020;271(2):201–9.
4. Moussa O, Ardissino M, Muttoni S, et al. Longterm incidence and outcomes of obesity-related peripheral vascular disease after bariatric surgery. Langenbecks Arch Surg [Internet]. 2021;406:1029–36. https://doi.org/10.1007/s00423-020-.
5. Lurie F, Passman M, Meisner M, et al. The 2020 update of the CEAP classification system and reporting standards. J Vasc Surg Venous Lymphat Disord. 2020;8(3):342–52.
6. Willenberg T, Schumacher A, Amann-Vesti B, et al. Impact of obesity on venous hemodynamics of the lower limbs. J Vasc Surg [Internet]=. 2010;52(3):664–8. https://doi.org/10.1016/j.jvs.2010.04.023.
7. Engelhorn C, Engelhorn A, Salles-Cunha S, et al. Relationship between reflux and greater saphenous vein diameter. J Vasc Technol. 1997;21(3):167–71.
8. van Rij AM, De Alwis CS, Jiang P, et al. Obesity and impaired venous function. Eur J Vasc Endovasc Surg. 2008;35(6):739–44.
9. García-Gimeno M, Rodríguez-Camarero S, Tagarro-Villalba S, et al. Reflux patterns and risk factors of primary varicose veins' clinical severity. Phlebology. 2013;28(3):153–61.
10. De Maeseneer MG, Kakkos SK, Aherne T, et al. European Society for Vascular Surgery (ESVS) 2022 clinical practice guidelines on the management of chronic venous disease of the lower limbs. Eur J Vasc Endovasc Surg. 2022;63(2):184–267. https://doi.org/10.1016/j.ejvs.2021.12.024.
11. Rocha FA, Lins EM, Almeida CC, et al. Quality of life assessment before and after surgery for lower limb varicose veins. J Vasc Bras. 2020;19:e20190108. https://doi.org/10.1590/1677-5449.190108.

Authors and Affiliations

Wendell Ricardo de Medeiros Alves Fernandes[1] · Esdras Marques Lins[2] · Fernanda Appolônio Rocha[2] · Gabriela de Oliveira Buril[1] · Emmanuelle Tenório Albuquerque Godoi Berenguer de Barros e Silva[3] · Rebecca Paes de Andrade Souza Caldas[1] · Filipe de Souza Leão Câmara[4] · Álvaro Antônio Bandeira Ferraz[2]

[1] Department of Vascular Surgery, Hospital das Clínicas/EBSER-UFPE, Universidade Federal de Pernambuco. Av. Prof. Moraes Rego, 1235 - Cidade Universitária, Recife, Pernambuco, CEP 50670-901, Brazil

[2] Department of Surgery, CCM – UFPE, Universidade Federal de Pernambuco. Av. Prof. Moraes Rego, 1235 - Cidade Universitária, Recife, Pernambuco, CEP 50670-901, Brazil

[3] Department of Clinical Medicine, CCM – UFPE, Universidade Federal de Pernambuco. Av. Prof. Moraes Rego, 1235 - Cidade Universitária, Recife, Pernambuco, CEP 50670-901, Brazil

[4] Faculdade Pernambucana de Saúde. Av. Mal. Mascarenhas de Morais, 4861 - Imbiribeira, Recife, Pernambuco, CEP 51150-000, Brazil