Journal of Cosmetics, Dermatological Sciences and Applications, 2024, 14, 335-342
https://www.scirp.org/journal/jcdsa
ISSN Online: 2161-4512
ISSN Print: 2161-4105

Safety and Efficacy of Carboxytherapy in Obese Patients

Julia Passo Machado Neto Viana[1], Natália Cristina de Oliveira[2], Sérgio Braga[1], Anderson Delano[1], Carine Paz[1], Laís Rocha Lima[1], Maiara Machado[1], Marília Santana[1], Márcia Cristina Almeida Magalhães Oliveira[1]

[1]Obesity Hospital, Camaçari, Brazil
[2]Adventist University of São Paulo (UNASP), São Paulo, Brazil
Email: juliapmn@gmail.com, oliveira.natalia@acad.unasp.edu.br, sergio.braga@hospitaldaobesidade.com.br, anderson.araujo@hospitaldaobesidade.com.br, carinepaz@yahoo.com.br, laisrocha635@gmail.com, maiaramachado@gmail.com, santana_marilia@hotmail.com, marcia.almeida@hospitaldaobesidade.com.br

How to cite this paper: Viana, J.P.M.N., de Oliveira, N.C., Braga, S., Delano, A., Paz, C., Lima, L.R., Machado, M., Santana, M., and Oliveira, M.C.A.M. (2024) Safety and Efficacy of Carboxytherapy in Obese Patients. *Journal of Cosmetics, Dermatological Sciences and Applications*, **14**, 335-342.
https://doi.org/10.4236/jcdsa.2024.144023

Received: November 6, 2024
Accepted: December 14, 2024
Published: December 17, 2024

Abstract

Obesity is a highly prevalent disease worldwide, associated with substantial economic and social costs. Besides the traditional treatment approach with low-calorie diet and regular physical exercise, some adjunct therapies have been investigated to assist body fat loss in obese patients. Carboxytherapy is an invasive intervention already studied for a range of conditions, from wound healing to the treatment of abdominal adiposity, due to its oxidative effect on adipocytes, in addition to contributing to improved skin elasticity. Thus, this study aimed to investigate the efficacy and safety of carboxytherapy in reducing abdominal circumference in patients hospitalized for obesity treatment. Fifty-eight adult inpatients with obesity underwent an individualized treatment (low-calorie diet and daily physical exercise for 40 - 90 days) associated with a mean of 11 sessions of carboxytherapy in the abdominal region and were assessed for body mass index (BMI), abdominal circumference (AC), waist to hip ratio (WHR) and percent body fat (%BF). After the intervention, significant reductions were observed in all studied variables ($p < 0.001$). The adherence rate was 53.67%, and absences were mainly related to the discomfort caused by the sessions. However, no important side effects were registered. Carboxytherapy was a safe intervention for obese patients, and when employed in combination with an inpatient program involving a low-calorie diet and regular exercise, contributed to the reduction of abdominal adiposity.

Keywords

Obesity, Abdominal Obesity, Caloric Restriction, Carbon Dioxide

1. Introduction

Abdominal obesity, or android obesity, is defined as an increase in adipose tissue in the abdominal region, a risk factor for various chronic diseases and also an individual risk when compared to other forms of body fat distribution [1].

Obesity is highly prevalent in both developed and developing countries. In Brazil, large population-based studies confirm that the prevalence of obesity has been increasing since 2013. The greatest increases occurred among middle aged men and among women with low education level [2].

It is estimated that developing countries will continue to experience increases in the prevalence of this disease in the current century. The implications of this situation for public health are critical, as it is associated with substantial economic and social costs [3].

Currently, adipose tissue is one of the primary focuses of obesity research, due to a paradigm shift in understanding its biological function over the past decade. It is now well-established that white adipose tissue secretes multiple bioactive peptides, known as adipokines (proteins synthesized and secreted by the adipose tissue) [4].

Excessive adipose tissue increases the production of numerous adipokines, which significantly impact various bodily functions, such as food intake control, energy balance, immune system function, insulin sensitivity, angiogenesis, blood pressure, lipid metabolism, and body homeostasis—all of which are strongly associated with cardiovascular diseases [4].

Although computed tomography is considered the most accurate method for assessing abdominal fat, only a few population-based studies have been conducted with this type of assessment due to its high operational cost. Abdominal obesity can also be assessed using anthropometric indicators such as waist circumference (WC), waist-to-hip ratio (WHR) and the conicity index (C-index) [5].

Among the therapeutic resources currently used to assist in the treatment of abdominal adiposity, the medicinal use of carbon dioxide (CO_2) is not a novel approach. It is based on the use of an equipment capable of controlling the injected CO_2 flow, and its safety has been scientifically tested for esthetic uses [6], besides being approved by agencies such as the Brazilian National Health Surveillance Agency (ANVISA) and the Food and Drug Administration (FDA) of the United States of America.

The benefits of this intervention include promoting local arteriovenous vasodilation, increasing regional blood flow, enhancing blood and lymphatic drainage, and stimulating lipolysis [7]. These actions result in greater oxygen availability for the tissue, increased collagen turnover, and reduction in the amount of adipose tissue. Another effect of CO_2 infiltration in the subcutaneous tissue is an increase in local temperature, which induces a lipolytic effect not observed with other gas mixtures. Clinical observations have also shown that CO_2 infiltration in subcutaneous tissue can reduce localized fat deposits [7].

Given these findings, carboxytherapy may be an adjunct therapeutic resource,

a dermato-functional treatment to reduce adiposity in patients with abdominal obesity. Thus, this study aimed to investigate the efficacy and safety of carboxytherapy in reducing abdominal circumference in patients hospitalized for obesity treatment.

2. Method

Obese patients aged between 22 and 60 years old, of both sexes, hospitalized in a reference hospital for obesity treatment in the state of Bahia (Brazil), participated in this study. Patients with high or very high WHR [8] were included.

Patients with contraindications to CO_2 therapy were excluded from this study: history of acute myocardial infarction, unstable angina, heart failure, systemic arterial hypertension, acute thrombophlebitis, gangrene, localized infections, epilepsy, respiratory failure, asthma, chronic obstructive pulmonary disease, renal insufficiency, pregnant women, and patients with psychiatric disorders.

In the first stage of the research, patients underwent screening, including anamnesis and functional evaluation, conducted by a single evaluator. After an average of 11 carboxytherapy sessions (±6.502), patients were re-evaluated by the same professional.

Anthropometric data were evaluated by perimeter measurements, abdominal circumference in specific, pre-marked areas using a measuring tape, graduated in millimeters. Two sites were measured: waist (2 cm below the last rib); and hip (at the greater trochanter). The patient was positioned at rest, standing with feet naturally spaced at hip width.

Bioimpedance analysis was conducted during the hospital nutritionist's monthly consultation, before the first session of therapy and after the last prescribed session, using a tetrapolar device with 8 tactile electrodes (InBody 570, Seoul, Korea).

After the anamnesis, initial assessment, and physical examination, all study participants were thoroughly informed about the technique and were prescribed to undergo carboxytherapy twice a week, with a 48-hour interval between sessions, each lasting 30 minutes, on the abdominal region, with gas flow rate of 150 ml/min. The Carbtek Advanced® device was used, with medicinal carbon dioxide gas from the Oximed® distributor, with single-use disposable extenders and 30 x 0.13 mm needles.

All inpatients in this study received the same standard treatment, including a low-calorie diet and daily physical exercises. The carboxytherapy protocol was established by the hospital attending team, as shown in Image 1. The total gas infusion averaged 3000 ml, distributed across 6 sites, with a total of 500 ml infused in each region (A, B, C, D, E, and F—**Figure 1**).

Data were analyzed using descriptive statistics, and paired Student's T test in SPSS v.24 for Windows. This study was approved by the research ethics committee, protocol number 5.960.977, and all patients signed a written informed consent form before participation.

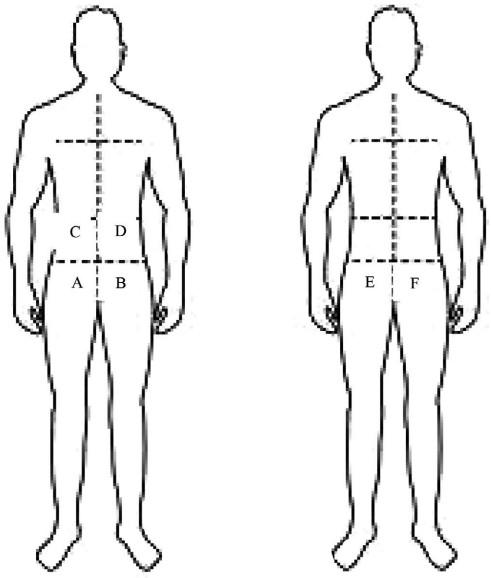

Figure 1. Illustration of the anatomic regions of the administration of carboxytherapy in obese patients.

3. Results

A total of 58 individuals participated in this study (40 women and 18 men), with mean age of 39.7 years (±10.34) and an initial BMI ranging from grade 3 obesity (62.1%) to grade 2 obesity (36.2%). The number of therapy sessions prescribed varied within the sample due to each patient's total hospitalization time (between 40 and 90 days), but the minimum number of sessions initially prescribed was 8 for all study participants, twice a week with (Table 1).

Table 1. Baseline data.

	Mean	Standard deviation
Age	39.71	10.34
BMI	42.81	5.72
Waist circumference	118.4	15.12
Hip circumference	125.16	12.23
WHR	0.94	0.09
% body fat (pre)	48.25	6.16
Sessions per patient	11.22	6.50
% adherence	53.67	21.76

BMI: body mass index; WHR: waist to hip ratio.

The total number of sessions varied by up to 34, accommodating individual demands and the specific needs of each patient, according to total hospitalization time and analysis of BMI, WHR, and abdominal fat percentage via bioimpedance.

Adherence rate was 53.67% of the sessions initially prescribed.

All analyzed parameters presented reduction after the treatment with carboxytherapy, as shown in Table 2. Abdominal circumference was the main target of the intervention with medicinal carbon dioxide therapy, and this variable presented a significant reduction of 9cm on average ($p < 0.001$) in the obese patients.

Table 2. Comparison of variables before and after the intervention.

	Before	After	p
Waist circumference	118.4 ± 14.6	109.4 ± 13.1	<0.001
Hip circumference	125.4 ± 12.4	117.2 ± 10.8	<0.001
WHR	0.94 ± 0.9	0.92 ± 0.9	<0.001
BMI	42.8 ± 5.7	35.1 ± 4.4	<0.001
% body fat	48.2 ± 6.16	42.7 ± 7.9	<0.001

WHR: waist-to-hip ratio, BMI: body mass index. Data are expressed as means ± standard-deviations.

It is noteworthy that all hospitalized patients also followed a low-calorie diet, individually prescribed by a nutritionist, adjusted weekly based on clinical analysis by this professional. In this study, the average caloric intake was 834.48 kcal/day. Participants of this research also performed daily exercises, individually prescribed by a physical educator, after each carboxytherapy session. Exercise sessions had a moderate-intensity and long-duration, under professional supervision and support.

4. Discussion

The accumulation of adipose tissue in the abdominal region is primarily recognized as a risk factor for cardiovascular diseases, diabetes, and metabolic syndrome [1]. The incidence of diabetes, atherosclerosis, and sudden cardiac death is quite frequent among obese individuals; however, when obesity is concentrated in the abdominal region, the negative repercussions—both metabolic and cardiovascular—are more significant [1].

The increased risk of mortality and morbidity associated with obesity has been the focus of some studies, as it is characterized by several metabolic diseases, such as insulin resistance, hypertension, and dyslipidemia [9].

Patients undergoing treatment for obesity in a hospital setting receive support from a multidisciplinary team, including dermato-functional physiotherapy, providing comprehensive and effective treatment. Weight loss through a combination of interventions, such as dietary behavior modification, physical exercise, sleep regulation, and metabolic rate management, can promote well-being and impact quality of life [10].

Carboxytherapy is a well-recognized treatment for improving conditions ranging from wound healing to the treatment of abdominal adiposity, due to its oxidative effect on adipocytes, in addition to contributing to improved skin elasticity.

Some studies have indicated results showing an improvement in the partial pressure of oxygen in the tissues and tissue perfusion in the area being treated [6] [7].

Maraee *et al.* [11] evaluated a group of adult men with abdominal fat deposits treated with carboxytherapy. Photographic records were taken in addition to ultrasound measurement of the thickness of subcutaneous fat deposits and abdominal circumference. Patients underwent 8 sessions of carboxytherapy (once a week) and were infused with 300 - 600 ml of carbon dioxide (CO_2) in the abdomen. The intervention was effective for reducing localized fat deposits, with minimal side effects (ecchymosis and mild to moderate pain).

Corroborating this data, in the present research, abdominal circumference was the primary intervention target in medicinal CO_2 therapy, with a satisfactory impact of the treatment observed on the abdominal perimeter of obese patients. Furthermore, to the best of our knowledge, no data have yet been found in the literature establishing a protocol for carboxytherapy intervention in patients undergoing a comprehensive obesity treatment, thus this research demonstrated the efficacy and safety of carboxytherapy in these cases, as no important side effects were registered.

The infusion of CO_2 into the adipose tissue of obese patients was well tolerated by the majority of the research participants. Thus, the application of 3000 mL of CO_2 in the abdominal region, divided into six anatomically designated areas (illustrated in **Figure 1**), was satisfactorily effective due to the uniform distribution of the gas, as well as safe for therapeutic purposes in areas with greater fat accumulation. Cases of withdrawal from the intervention or absence from some prescribed sessions revealed an adherence rate of 53.67%, and were related to discomfort during sessions, as also mentioned by previous research [11].

In clinical practice, pain caused by carboxytherapy is considered the primary limiting factor for its use [12], and regarding local complications, the literature reports erythema, bruising, pain, and a sensation of crepitation following CO_2 therapy. The risk of gas embolism with CO_2 injections has not been reported [13].

Some female patients reported discomfort during the application of the technique during the follicular phase of the menstrual cycle, resulting in longer intervals between sessions than the initially proposed 48 hours, which allowed for improvement in pain symptoms. Others exhibited heightened anxiety regarding the first treatment session, which normalized as treatment persisted and as support from the psychology team was provided.

Costa *et al.* [14] demonstrated a significant reduction in the population of adipocytes in the anterior abdominal wall, as well as in the area, diameter, perimeter, length, and width of adipocytes, following the percutaneous infusion of CO_2. In the research conducted by Lee *et al.* [15], there was also a significant reduction in abdominal perimeter measurements following carboxytherapy, and the procedure was considered safe, locally effective, and tolerable regarding the sensations experienced during application.

Carboxytherapy was not associated with other invasive therapies in the present

study. However, given that the patients were in a medium- to long-term hospitalization setting, other techniques could have been prescribed based on individualized assessments, including thermotherapy, electrotherapy, or pressotherapy. An important limitation of this study is the absence of a control group, but given the scarcity of studies in this area, and the main goal of this research (to evaluate the safety of the treatment), it is believed that results herein bring an important contribution to this field of knowledge. Another limitation is related to the fact that patients were submitted to a comprehensive intervention including a low-calorie diet and daily physical exercise. Thus, it is impossible to predict which part of the improvements were due to carboxytherapy itself. Other approaches, including randomization of patients and groups undergoing carboxytherapy and no other diet or exercise intervention are suggested for future studies.

Acknowledgements

Authors acknowledge the Hospital of Obesity (Camaçari, Bahia, Brazil) for the support in data collection and analysis.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Dhawan, D. and Sharma, S. (2020) Abdominal Obesity, Adipokines and Non-Communicable Diseases. *The Journal of Steroid Biochemistry and Molecular Biology*, **203**, Article 105737. https://doi.org/10.1016/j.jsbmb.2020.105737

[2] de Souza Ferreira, A.P., Szwarcwald, C.L., Damacena, G.N. and de Souza Júnior, P.R.B. (2021) Increasing Trends in Obesity Prevalence from 2013 to 2019 and Associated Factors in Brazil. *Revista Brasileira de Epidemiologia*, **24**, e210009. https://doi.org/10.1590/1980-549720210009.supl.2

[3] Safaei, M., Sundararajan, E.A., Driss, M., Boulila, W. and Shapi'i, A. (2021) A Systematic Literature Review on Obesity: Understanding the Causes & Consequences of Obesity and Reviewing Various Machine Learning Approaches Used to Predict Obesity. *Computers in Biology and Medicine*, **136**, Article 104754. https://doi.org/10.1016/j.compbiomed.2021.104754

[4] Taylor, E.B. (2021) The Complex Role of Adipokines in Obesity, Inflammation, and Autoimmunity. *Clinical Science*, **135**, 731-752. https://doi.org/10.1042/cs20200895

[5] Piqueras, P., Ballester, A., Durá-Gil, J.V., Martinez-Hervas, S., Redón, J. and Real, J.T. (2021) Anthropometric Indicators as a Tool for Diagnosis of Obesity and Other Health Risk Factors: A Literature Review. *Frontiers in Psychology*, **12**, Article 631179. https://doi.org/10.3389/fpsyg.2021.631179

[6] Zelenkova, H. and Wollina, U. (2023) Carboxytherapy in Esthetic Medicine—A Review. *Cosmoderma*, **3**, 108. https://doi.org/10.25259/csdm_119_2023

[7] Ahramiyanpour, N., Shafie'ei, M., Sarvipour, N., Amiri, R. and Akbari, Z. (2022) Carboxytherapy in Dermatology: A Systematic Review. *Journal of Cosmetic Dermatology*, **21**, 1874-1894. https://doi.org/10.1111/jocd.14834

[8] World Health Organization (2011) Waist Circumference and Waist-Hip Ratio:

Report of a WHO Expert Consultation. World Health Organization.

[9] Calle, E.E., Teras, L.R. and Thun, M.J. (2005) Obesity and Mortality. *New England Journal of Medicine*, **353**, 2197-2199. https://doi.org/10.1056/nejm200511173532020

[10] Braet, C., Tanghe, A., Decaluwé, V., Moens, E. and Rosseel, Y. (2004) Inpatient Treatment for Children with Obesity: Weight Loss, Psychological Well-Being, and Eating Behavior. *Journal of Pediatric Psychology*, **29**, 519-529. https://doi.org/10.1093/jpepsy/jsh054

[11] Maraee, A.H., Zytoon, A.A., Farag, A.G. and Essa, S.A. (2020) Evaluate the Efficacy of Carboxytherapy for Localized Lipolysis in a Sample of Egyptian Patients. *Menoufia Medical Journal*, **33**, 1045-1049.

[12] Sadala, A.Y., Machado, A.F.P. and Liebano, R.E. (2018) Effects of Transcutaneous Electrical Nerve Stimulation on Pain Intensity during Application of Carboxytherapy in Patients with Cellulite: A Randomized Placebo-Controlled Trial. *Journal of Cosmetic Dermatology*, **17**, 1175-1181. https://doi.org/10.1111/jocd.12489

[13] Piazzolla, L.P., Louzada, L.L., Scoralick, F.M., Martins, M.E.G. and de Sousa, J.B. (2012) Preliminary Experience with Carbon Dioxide Therapy in the Treatment of Pressure Ulcers in a Bedridden Elderly Patient. *Journal of the American Geriatrics Society*, **60**, 378-379. https://doi.org/10.1111/j.1532-5415.2011.03806.x

[14] Costa, C.S., Otoch, J.P., Seelaender, M.C.L., Neves, R.X.d., Martinez, C.A.R. and Margarido, N.F. (2011) Avaliação citométrica dos adipócitos localizados no tecido subcutâneo da parede anterior do abdome após infiltração percutânea de CO_2. *Revista do Colégio Brasileiro de Cirurgiões*, **38**, 15-23. https://doi.org/10.1590/s0100-69912011000100004

[15] Lee, G.S.K. (2016) Quality Survey on Efficacy of Carboxytherapy for Localized Lipolysis. *Journal of Cosmetic Dermatology*, **15**, 484-492. https://doi.org/10.1111/jocd.12242