

## Obesity and systemic lymphedema: New concept evaluated by multisegmental bioimpedance analysis

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**Author Affiliation:**

<sup>1</sup>Cardiology and Cardiovascular Surgery Department of the Medicine School in São José do Rio Preto (FAMERP), CNPq (National Council for Research and Development)-Brazil

<sup>2</sup>Physician, Resident of the Department General Surgery in the Medicine School of São José do Rio Preto-FAMERP and member research group at Clínica Godoy-Brazil

<sup>3</sup>Physician specialized in Unit Care of Pediatric, member research group at Clínica Godoy-Brazil and fellow Unit Intensive Care of Cardiac Surgery in Children Hospital-Medicine School of Sao Jose do Rio Preto (FAMERP), Brazil

<sup>4</sup>Occupational Therapist professor of the Post-Graduate *Stricto Sensu in* Medicine School in São José do Rio Preto (FAMERP) and research group at Clínica Godoy, Sao Jose do Rio Preto, Brazil

**Corresponding author**

Cardiology and Cardiovascular Surgery Department of the Medicine School in São José do Rio Preto (FAMERP), CNPq (National Council for Research and Development)-Brazil  
Email: godoyjmp@gmail.com

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Jose Maria Pereira de Godoy<sup>1✉</sup>, Henrique Jose Pereira de Godoy<sup>2</sup>, Ana Carolina Pereira de Godoy<sup>3</sup>, Maria de Fatima Guerreiro Godoy<sup>4</sup>

**ABSTRACT**

The aim of the present study was to report these changes and correlate edema with the results of animal studies that describe changes in the lymphatic system in obese animals, identifying a new type of lymphedema that we denominate systemic lymphedema. A 31-year-old male patient sought our clinic for a routine evaluation. During the physical examination, obesity was the most important aspect and multisegmental bioimpedance analysis, which demonstrated an increase in total intracellular and extracellular fluid as well as in the limbs and thorax. No other clinical abnormalities were evident at the time. Weight loss and hydro gymnastics were proposed. In some cases of morbid obesity bodily can accumulate liquids beyond the limits of normality which we denominate systemic lymphedema.

**Keywords:** Obesity, systemic lymphedema, morbid.

**1. INTRODUCTION**

Obesity is a chronic public health problem that affects millions of individuals throughout the world. It is recognized as a heterogeneous condition, as individuals with a similar body mass index may have different metabolic and cardiovascular risks (Piché et al., 2018). The main form of therapy is the restriction of calorie intake and the burning of calories through physical activity. Bariatric surgery is an option in select cases. Lymphedema is a clinical condition in which macromolecules accumulate in the interstitial space, resulting in the retention of fluids. The cause may be primary or secondary. Primary lymphedema is due to an abnormality in the lymphatic system since birth. In cases of secondary lymphedema, the lymphatic system is normal at birth, but aggression to this system during one's lifetime results in the deficient formation or drainage of lymph (Pereira de Godoy et al., 2012; Pereira de Godoy et al., 2017).

Animal studies have reported damage to the lymphatic system with the increase in obesity, highlighting changes in the pumping mechanism of the



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system, an inflammatory process as well as changes in capillary permeability and immunological defense. Moreover, a case study correlated obesity with lymphedema of the lower limbs (Blum et al., 2014). Based on our clinical experience; individuals with obesity exhibit important changes in the water content of the total body and segments which is aggravated by the increase in the body mass index. The aim of the present study was to report these changes and correlate edema with the results of animal studies that describe changes in the lymphatic system in obese animals, identifying a new type of lymphedema that we denominate subclinical systemic lymphedema.

## 2. CASE REPORT

A 31-year-old male patient sought our clinic for a routine evaluation presenting obesity and late in the afternoon heavy his legs. During the physical examination, obesity was the most important aspect, body mass index (BMI) 59.5kg/m<sup>2</sup>, figure 1. Multisegmental bioimpedance analysis was performed using the *In body S 10*, which demonstrated an increase in total intracellular and extracellular fluid as well as in the limbs and thorax (Table 1). No other clinical abnormalities were evident at the time. The changes detected in the patient described herein are compatible with changes in the lymphatic system described in animal studies. Weight loss and hydrogymnastics were proposed.

This study was approved Ethical Committee and Research of Medicine School of Sao Jose do Rio Preto-FAMERP-Brazil n<sup>o</sup> 2.906.089 CAAE: 94650318.7.0000.5415.



**Figure 1** First evaluation, obesity body mass index (BMI) 59.5kg/m<sup>2</sup>

**Table 1** Intracellular and extracellular fluid, fluid in limbs and thorax and reference values

	Total	Normal values	Total extracellular water/total body water ratio
Total intracellular water	41.5	26.1 to 31.9	
Total extracellular water	28.1	16.0 to 19.6	
Total extracellular water/total body water ratio	0.403	0.36 to 0.39	
Right arm	3.96	2.51 to 3.07	0.391 limit (0.36-0.39)
Left arm	4.02	2.51 to 3.07	0.392 limit (0.36-0.39)
Trunk	28.8	21.1 to 24.5	0.398 limit (0.36-0.39)
Right leg	12.90	6.95 to 8.54	0.411 limit (0.36-0.39)
Left leg	12.89	6.98 to 8.54	0.416 limit (0.36-0.39)

## 3. DISCUSSION

The present study shows the generalized accumulation of fluid in morbid obesity (body mass index: 59.5 kg/m<sup>2</sup>), which we have denominated systemic lymphedema. This concept has not previously been described in the literature and this study therefore makes a novel contribution to the treatment of both lymphedema and obesity. One study correlated lower limb lymphedema with

obesity, but not generalized lymphedema. What draws the most attention in the patient described herein is the excess of body water evident in the entire body. The multisegmental bioimpedance analysis revealed the extracellular water/total body water ratio is beyond the normal reference values. This ratio is used for the diagnosis of lymphedema and demonstrates that the patient has full body lymphedema. The lymphatic system serves as a functional reserve of the venous system and edema emerges when this reserve is surpassed.

Animal studies report that the progression of obesity leads to a change in the lymphatic system, affecting the lymph pumping mechanism and capillary permeability as well as the inflammatory and immunological processes. The changes detected in the patient described herein are compatible with changes in the lymphatic system described in animal studies. Therefore, such findings in humans allow posing the hypothesis of systemic lymphedema similar to what has been seen in animals (Jose Maria Pereira de Godoy et al., 2018). We denominate the condition subclinical lymphedema because there is generalized edema in the initial phase with no observation of clinical lymphedema. However, we have noticed a pattern composed of three stages. In the first stage, a greater volume of bodily is found involving the trunk and limbs. In the second stage, multisegmental bioimpedance analysis detects the presence of lymphedema and classifies it as clinical stage 0. In the third stage, clinical stage 1 lymphedema is evident. Therefore, this is a chronic, progressive process: damage occurs to the lymphatic system that becomes increasingly evident with the occurrence of aggravating factors, such as interference of gravitational pressure, heat and further harm to the lymphatic system.

Changes in capillary permeability lead to the buildup of fluid in the interstitial space, overloading lymphatic and venous drainage through a hyperdynamic flow mechanism, which, when combined with changes in the pumping mechanism of the lymphatic system, aggravates dynamic flow in the interstitial space. Thus, the accumulation of intracellular and extracellular fluids beyond the threshold of normality occurs, which characterizes systemic lymphedema. The hypothesis is that the inflammatory process is the major contributing factor to these changes that occur in obesity. Therefore, an individual's weight is not only related to fatty tissue, but also the accumulation of fluids.

#### 4. CONCLUSION

In cases of morbid obesity bodily can accumulate beyond the limits of normality, which we denominate subclinical systemic lymphedema.

#### Conflict of Interest

The authors declare no conflict of interest.

#### Funding

This paper received no external funding.

#### Informed consent

Written & Oral informed consent was obtained from the parents of the patient included in the study.

#### Data and materials availability

All data associated with this study are present in the paper.

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