Endocrinol Nutr. 2015;62(9):458-464

Endocrinología y Nutrición

www.elsevier.es/endo

SHORT REVIEW

Different adipose tissue depots: Metabolic implications and effects of surgical removal

Aline Marcadenti[a,b,*], **Erlon Oliveira de Abreu-Silva**[c]

[a] *Department of Nutrition, Federal University of Health Sciences of Porto Alegre (UFCSPA), Porto Alegre, Rio Grande do Sul, Brazil*
[b] *Postgraduate Program in Health Sciences: Cardiology, Institute of Cardiology of Rio Grande do Sul (IC/FUC), Porto Alegre, Rio Grande do Sul, Brazil*
[c] *Division of Interventional Cardiology and Postgraduate Program in Cardiology, Federal University of São Paulo (UNIFESP), São Paulo, Brazil*

Received 13 April 2015; accepted 29 May 2015
Available online 20 August 2015

KEYWORDS
Obesity;
Adipose tissue;
Metabolism;
Lipectomy

Abstract Increased adiposity has been associated to worse metabolic profile, cardiovascular disease, and mortality. There are two main adipose tissue depots in the body, subcutaneous and visceral adipose tissue, which differ in anatomical location. A large body of evidence has shown the metabolic activity of adipose tissue; lipectomy and/or liposuction therefore appear to be alternatives for improving metabolic profile through rapid loss of adipose tissue. However, surgical removal of adipose tissue may be detrimental for metabolism, because subcutaneous adipose tissue has not been associated to metabolic disorders such as insulin resistance and type 2 diabetes mellitus. In addition, animal studies have shown a compensatory growth of adipose tissue in response to lipectomy. This review summarizes the implications of obesity-induced metabolic dysfunction, its relationship with the different adipose tissue depots, and the effects of lipectomy on cardiometabolic risk factors.

PALABRAS CLAVE
Obesidad;
Tejido adiposo;
Metabolismo;
Lipectomía

Diferentes depósitos de tejido adiposo: implicaciones metabólicas y efectos de la extirpación quirúrgica

Resumen El aumento de la adiposidad se ha asociado con un peor perfil metabólico, enfermedad cardiovascular y mortalidad. Hay 2 depósitos principales de tejido adiposo en el cuerpo, el tejido adiposo subcutáneo y el tejido adiposo visceral, y difieren en la localización anatómica. Un gran cuerpo de evidencia ha demostrado la actividad metabólica del tejido adiposo; por lo tanto, la lipectomía y/o la liposucción parecen ser alternativas para mejorar el perfil metabólico

* Corresponding author.
E-mail address: marcadenti@yahoo.com.br (A. Marcadenti).

http://dx.doi.org/10.1016/j.endonu.2015.05.010
1575-0922/

a través de la pérdida rápida de tejido adiposo. Sin embargo, la extirpación quirúrgica del tejido adiposo podría ser perjudicial para el metabolismo, ya que el tejido adiposo subcutáneo no ha sido asociado con trastornos metabólicos, tales como resistencia a la insulina y diabetes mellitus tipo 2. Además, estudios en animales han demostrado un crecimiento compensatorio del tejido adiposo en respuesta a la lipectomía. Esta revisión resume las implicaciones de la disfunción metabólica inducida por la obesidad, su relación con los diferentes depósitos de tejido adiposo y los efectos de la lipectomía sobre los factores de riesgo cardiometabólico.

Introduction

Obesity is one of the principal modifiable risk factors for an unhealthy status. It plays an important role on the global disease burden and is associated to both all-cause and cardiovascular mortality.[1] Body mass index (BMI) is the universal method used for characterizing the excess of body mass. It is independent of age and has the same cutoff points for both genders; however, the World Health Organization (WHO) specialists committees have proposed distinct cutoff values for BMI according to ethnics, considering their differences in body composition and body fat distribution[2] (Table 1). Nowadays, the traditional cutoff points for the general population still prevail and it is estimated that by 2030 2.16 billion people worldwide will fit into the ''overweight'' definition, and 1.12 billion will be obese, according to the BMI.[3]

Table 1 Proposed classification of total body adipose tissue.[7]

1. Total adipose tissue
2. Subcutaneous adipose tissue
2.1 Superficial subcutaneous adipose tissue
2.2 Deep subcutaneous adipose tissue
3. Internal adipose tissue
3.1 Visceral adipose tissue
3.1.1 Intrathoracic adipose tissue
3.1.1.1 Intrapericardial
3.1.1.2 Extrapericardial
3.1.2 Intraabdominopelvic adipose tissue
3.1.2.1 Intraperitoneal
3.1.2.2 Extraperitoneal
3.1.2.2.1 Intraabdominal
3.1.2.2.2 Preperitoneal
3.1.2.2.3 Retroperitoneal
3.1.2.3 Intrapelvic
3.2 Nonvisceral adipose tissue
3.2.1 Intramuscular adipose tissue
3.2.2 Perimuscular adipose tissue
3.2.2.1 Intermuscular adipose tissue
3.2.2.2 Paraosseal adipose tissue
3.3 Other nonvisceral adipose tissue

Adapted from Shen et al.[7]

Adipose tissue

Characterization and definition

Adipose tissue has distinct morphological and histological characteristics, and executes a number of activities. In mammals, three types of adipose cells are present: brown, white and beige.

Brown adipose tissue (BAT), full of mitochondria and specialized in heat production, exerts its thermogenic function mainly in the first years of life. Posteriorly, it transforms into white adipose tissue (WAT). However, BAT increased activity has been demonstrated in adults exposed to low temperatures; interestingly, this thermogenic effect is inversely related to age – older subjects have diminished expression of uncoupling protein 1 (UCP1) – and BMI.[4,5]

Beige adipose tissue, still under investigation, has less well-known functions and it is believed that it originates from white adipocytes trans-differentiation within the same cellular lineage (Pax7/myf5-). In animal models, it was demonstrated that these cells, initially, have a reduced UCP1 expression but, if stimulated, attain the capacity to increase the activity of these thermogenesis-related proteins. Genetically, they have an intermediate behavior between brown and white fat tissues; thus, these cells can store the excess of energy – in form of lipids – in situations where energetic balance is positive, and dissipates energy to produce heat in cases of thermogenesis stimulation.[6]

WAT is the most abundant adipose tissue in human organism and is responsible for lipid storage – in the form of triglycerides, mechanical protection and thermic isolation. However, interest lies on its capacity of secrete a number of substances with important roles in cardiovascular risk and protection, the adipokines. There is no consensus about WAT compartments nomenclature. Based on anatomy and functional properties, Shen et al. proposed a classification for body fat with emphasis on internal compartments, detected by image exams (Table 1).[7] On the other hand, Foster et al. propose a visual classification, according to body fat distribution (Fig. 1).[8]

Subcutaneous white adipose tissue (SAT) has different distribution according to gender. In men there is increased accumulation in the trunk compared to limbs, with a decreased rate and a more balanced distribution after the age of 50; in women, accumulation of SAT is similar