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Original article

Epicardial Adipose Tissue Is Associated With Visceral Fat, Metabolic Syndrome, and Insulin Resistance in Menopausal Women

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ABSTRACT

Introduction and objectives: Epicardial adipose tissue has been associated with several obesity-related parameters and with insulin resistance. Echocardiographic assessment of this tissue is an easy and reliable marker of cardiometabolic risk. However, there are insufficient studies on the relationship between epicardial fat and insulin resistance during the postmenopausal period, when cardiovascular risk increases in women. The objective of this study was to examine the association between epicardial adipose tissue and visceral adipose tissue, waist circumference, body mass index, and insulin resistance in postmenopausal women.

Methods: A cross sectional study was conducted in 34 postmenopausal women with and without metabolic syndrome. All participants underwent a transthoracic echocardiogram and body composition analysis.

Results: A positive correlation was observed between epicardial fat and visceral adipose tissue, body mass index, and waist circumference. The values of these correlations of epicardial fat thickness overlying the aorta-right ventricle were $r = 0.505$ ($P < .003$), $r = 0.545$ ($P < .001$), and $r = 0.515$ ($P < .003$), respectively. Epicardial adipose tissue was higher in postmenopausal women with metabolic syndrome than in those without this syndrome (mean [standard deviation], 544.2 [122.9] vs 363.6 [162.3] mm^2; $P = .03$).

Conclusions: Epicardial fat thickness measured by echocardiography was associated with visceral adipose tissue and other obesity parameters. Epicardial adipose tissue was higher in postmenopausal women with metabolic syndrome. Therefore, echocardiographic assessment of epicardial fat may be a simple and reliable marker of cardiovascular risk in postmenopausal women.

La grasa epicárdica se relaciona con la visceral, el síndrome metabólico y la resistencia a la insulina en mujeres menopáusicas

Palabras clave:
Menopausia
Síndrome metabólico
Tejido adiposo epicárdico
Factores de riesgo cardiovascular
Ecocardiografía

RESUMEN

Introducción y objetivos: El tejido adiposo epicárdico se ha asociado con diversos índices de adiposidad y resistencia a insulina. La medición de este tejido por ecocardiografía se considera una herramienta útil y accesible para valorar factores de riesgo cardiometabólico; no obstante, aún no existen suficientes estudios en mujeres posmenopáusicas, que es una etapa en la que se presenta un incremento del riesgo cardiovascular. El objetivo del estudio es analizar la relación entre las mediciones del tejido adiposo epicárdico y tejido adiposo visceral, perímetro de cintura, índice de masa corporal y resistencia a insulina en mujeres posmenopáusicas.

Métodos: Estudio transversal comparativo en 34 mujeres posmenopáusicas con y sin síndrome metabólico a las que se realizó ecocardiograma transtorácico y análisis de composición corporal.

Resultados: Se encontró asociación positiva de las medidas de grasa epicárdica con el tejido adiposo visceral, el índice de masa corporal y el perímetro de cintura; en el surco aortoventricular derecho, las correlaciones fueron $r = 0{,}505$ ($p < 0{,}003$), $r = 0{,}545$ ($p < 0{,}001$) y $r = 0{,}515$ ($p < 0{,}003$) respectivamente. También se observó que las mujeres posmenopáusicas con síndrome metabólico presentaban aumento del tejido adiposo epicárdico en comparación con las que no tienen el síndrome ($544{,}2 \pm 122{,}9$ frente a $363{,}6 \pm 162{,}3$ mm^2; $p = 0{,}03$).

Conclusiones: El tejido adiposo epicárdico medido por ecocardiografía se asocia con el tejido adiposo abdominal y corporal en las mujeres posmenopáusicas. Las posmenopáusicas con síndrome metabólico

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presentan mayor cantidad de grasa epicárdica. La medición del tejido adiposo epicárdico por ecocardiografía puede ser un método de utilidad para evaluar el riesgo cardiovascular en la posmenopausia.

Abbreviations

BMI: body mass index
EAT: epicardial adipose tissue
MS: metabolic syndrome
VAT: visceral adipose tissue

INTRODUCTION

Cardiovascular risk and the metabolic syndrome (MS) increase after menopause.[1] Changes in sexual hormone concentrations that occur during this period affect insulin resistance and the distribution of visceral and subcutaneous adipose tissue.[1,2]

For many years, adipose tissue was considered to be stored energy. However, in 1994 this concept was revised when adipose tissue was discovered to secrete the hormone leptin; since then, this tissue has been recognized to function as an endocrine organ that produces hormones or adipokines.[3,4] Obesity is characterized by adipocyte hypertrophy and hyperplasia and by changes in adipokine secretion, which contribute to increased insulin resistance and inflammation.[3] Visceral adipose tissue (VAT) is the tissue covering the internal organs and its increase is related to a cardiometabolic risk profile.[4,5]

Epicardial adipose tissue (EAT) has the same embryonic origin as intraabdominal adipose tissue.[6] This type of tissue is localized on the myocardium, in the atrioventricular and interventricular sulci, extends to the apex, and surrounds the coronary arteries.[7] This fatty tissue is highly active and produces numerous adipokines, including proinflammatory and proatherogenic cytokines, such as tumor necrosis factor-alpha, type-1 plasminogen activator inhibitor, interleukin-6, visfatin, leptin, omentin, and angiotensin.[8] Epicardial fat also serves as an energy source for the myocardium and protects it from fatty acid toxicity.[8,9]

Echocardiographic assessment of EAT is directly associated with VAT accumulation, even more so than some anthropometric variables, such as waist circumference (WC).[10]

The aim of this study was to analyze the association among EAT and other obesity-related parameters, such as VAT, WC, body mass index (BMI), and insulin resistance.

METHODS

A cross-sectional, comparative study was performed in 34 postmenopausal women aged 50 to 65 years who consecutively attended the Endocrine Diseases Medical Research Unit of the *Hospital de Especialidades del Centro Médico Nacional IMSS*. Diagnosis of menopause was confirmed by low serum estradiol concentrations and increased follitropin values. None of the participants was receiving hormone replacement therapy. The participants were divided into 2 study groups: patients diagnosed with MS and women without MS. Diagnosis of MS was based on the criteria for clinical practice of the International Diabetes Federation.[11,12] These criteria consist of central obesity (defined as WC $\geq$ 80 cm) in addition to 2 of the following components: triglyceride levels equal to or greater than 150 mg/dL, reduction of high-density lipoprotein cholesterol less than 50 mg/dL, systolic blood pressure equal to or greater than 130 mmHg or diastolic blood pressure equal to or greater than 85 mmHg, and/or fasting glucose equal to or greater than 100 mg/dL.

Women were excluded if they had an established diagnosis of diabetes mellitus, renal or liver failure, chronic infections, endocrine or blood disorders, or a history of cardiovascular disease or thrombosis. Also excluded were women who were receiving anticoagulant therapy. The study protocol was approved by the Ethics Committee of the Mexican Institute of Social Security. Participants were informed about the study and provided their written informed consent.

Clinical Evaluation

A clinical history and anthropometric measurements were taken from all patients. The patients were weighed and measured without shoes and with light clothing on a Bame weight and height scale. Systolic and diastolic blood pressure were determined with an aneroid baumanometer. Hip circumference and WC were measured. Body mass index was calculated as weight in kilograms divided by height in meters squared.

Body Composition Analysis

Body composition was assessed with a 353 ioi JAWON body composition analyzer. Bioelectrical impedance was analyzed in the morning after a 12-hour fast and adequate hydration. Bioelectric impedance was measured with the patient standing up and wearing light clothing, without shoes. The analyzer measured weight with an accuracy of within 0.1 kg, as well as body impedance (in ohms), with calculation of the VAT value and the percentage of total body fat.

Biochemical Analysis

Venous blood samples were drawn from the antecubital veins between 8.00 and 9.00, after a fast equal to or greater than 12 hours. The samples were collected in tubes without coagulant and were centrifuged at 3500 rpm for 20 minutes to separate the serum and prepare 500 μL-aliquots, which were kept frozen at –70 °C until assayed. Glucose, high-density lipoprotein cholesterol, and triglyceride levels were determined in serum through the semiautomatic chemical analyzer Ekem Control Lab. Insulin was measured by a solid-phase radioimmunoassay (Millipore, Billerica; Mississippi, United States); the sensitivity of this assay was 2 μU/mL and the intra- and interanalytic coefficient of variation was 4.0% and 8.6%, respectively. Insulin resistance was evaluated through homeostasis model assessment (HOMA) according to the method of Matthews et al[13]:

$$\text{HOMA-IR} = \text{insulin}\ (\mu\text{U/mL}) \times \text{fasting glucose}\ (\text{mmol/L}) / 22.5$$

Echocardiographic Evaluation of Epicardial Adipose Tissue

To evaluate cardiac structure, all participants underwent transthoracic M-mode, 2-dimensional and Doppler echocardiography (Phillips IE33 echocardiography, version 5.2.0.289). Standard methodology was used to obtain the images, with the patient placed in the left lateral decubitus position and display of images