Utility of dual X-absorptiometry (DXA) in the evaluation of cardiovascular risk. Relationship between pelvic fat distribution and serum homocystein

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Learning objectives

1. To review the use of DXA in the evaluation of abdominal fat distribution
2. To determine the possible relationship between pelvic fat distribution measured with DXA and homocystein blood level.

Background

According to the Study of Nutrition and Cardiovascular Risk in Spain (ENRICA), the estimated prevalence of weight excess in the Spanish population is 62%, consisting in overweight (body mass index [BMI] 25-29,9 kg/m2) 39% and obese (BMI#30 kg/m2) 23%. Obesity frequency is higher among men than among women (except for those older than 65), and increases with age. Abdominal obesity frequency (taking into account only waist circumference larger than 102 cm for men and 88 cm for women) accounts for 32% among men and 40% among women.

However, increased morbidity and mortality are the most important factors related to obesity, and that is specially important for obese patients of metabolic cause. Metabolic syndrome, X syndrome, insulin resistance syndrome, are different names referring to visceral obesity associated to other entities (hyperinsulinism, hyperglucemia, abnormal lipidic serum profile, arterial hypertension, proinflammatory and procoagulant status) causing increased cardiovascular risk and type 2 diabetes mellitus.

An increased abdominal fat rate (android distribution) is a well-recognized factor related to increased cardiovascular risk. So, visceral obesity is thought to be among the factors involved in the pathogenesis of metabolic and insulin resistance syndromes. Fatty tissue is not only a passive energy warehouse with triglicerids, it also produces peptides, called adipokines, with hormone both paracrine and autocrine function. Adipokines play a basic role in energy homeostasis by acting on sensibility to insuline, glicidic and lipidic metabolism, food intake, and blood coagulation and inflammatory response. This may be the link among obesity, insuline resistance and cardiovascular risk.

Homocystein (Hcys) is the aminoacid involved in metionin metabolism and different metilation reactions in the process of DNA synthesis and reparation. Epidemiological studies revealed that high serum Hcys levels are associated with an increased rate of cardiac ischemic events, stroke and thrombi. Increased serum Hcys levels appear in B12 vitamin and folic acid shortage.

Imaging findings OR Procedure details
A. BODY COMPOSITION (TOTAL BODY) DENSITOMETRY

Body composition densitometry (DXA) allows an estimation of whole body and regional body composition, of regional fat mass distribution and total fat and bone mineral density of the whole body.

The technique is based on X-ray absorption by the different tissues. The accuracy of DXA is high with an error of estimation of 2-6% for body composition.

The radiation doses to patients and staff are very low, and protection for the operator is not needed for most scanners. The entrance surface doses in body composition studies were measured to be around 75 microSv for fan-beam systems and even lower for pencil-beam systems.

The time required for the examination is approximately 10 minutes, including patient positioning, image acquisition and automatic analysis. The medical time is around 5 minutes, including evaluation of appropriate technical performance and presence of pitfalls, review of the automatic analysis and report.

-**Patient positioning**

The patient is placed in the supine position, with extended arms along the body, palms facing but not touching the legs, and thumbs upwards. Half body is analysed in obese patients wider than the examination table, including head and neck, and half body with
arm and lower limb completely included. Results for the complete body are estimated by the densitometer.

- **Image analysis**
  The regions of interest (ROIs) are automatically placed by the densitometer, although adequate location should be reviewed by radiographer and radiologist.
  - Head. ROI immediately below the chin.
  - Arm and forearm. ROI through axilla and near the trunk and leg.
  - Spine. ROIs at both sides of the spine.
  - Pelvis. ROIs through both femoral necks, not involving the pelvis.
  - Upper pelvis. ROI immediately over the upper surface of the pelvis.
  - Legs. Separating elbows and hands from legs.
  - Centre of legs. Separating right and left legs.

- **Parameters**
  The densitometer obtains several parameters from data analysis:
  - Percentage of fat (fat mass), muscle and soft tissue (lean mass) and bone (BMD) total and regional measurements.
  - Fat distribution in pelvic area (Fig. 2 on page 10):

![TOTAL BODY. A/G](image)

- **Regions**
  - **Android.** Inferior limit: pelvis, lateral: arms.
  - **Ginoid.** Lateral limits: external region of the leg.

- **A/G Ratio:** relationship between % of fat in android (central) and ginoid (hip and thigh) regions.

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**Fig. 2**

**References:** Radiodiagnóstico, UCR de la CAM. Hospital Infanta Leonor - Madrid/ES
• **android** (central). Lower limit is the pelvis, upper limit is a line 20% of distance between the lines of pelvis and neck and lateral limit the arms.
• **ginoid** (hip and thigh). Lateral limit is the outer surface of leg, upper limit is a line under the pelvis line 1.5 times the height of the android region and lower limit is the line under twice the height of the android region.
• **A/G ratio**. The rate between android and ginoid (A/G) areas of pelvic fat
  - Body mass index (BMI)

**B. STUDY DESIGN**

We performed a prospective study during 2010 in adult patients attending the Nutrition Area of the Endocrinology Department of our Institution referred for body composition densitometry. Total body DXA (Lunar Prodigy, GE) was performed, as well as serum B12 vitamin, folic acid and homocystein level determination. No patient suffered from severe diseases (cardiovascular disease, renal or liver failure or neoplasms). The parameters that were evaluated in DXA exams were: total body fat, distribution of fat in pelvic area: android, ginoid, android/ginoid (A/G) ratio. Serum levels of homocystein (Hcys) were also obtained.

**C. RESULTS**

During 2010, 109 patients from the Nutrition Area of the Endocrinology Department were referred for body composition densitometry in the study of increased weight (overweight BMI 25-30, or obesity, BMI >30) or underweight (BMI < 18.5). Seven patients could not undergo the examination due to weight over the equipment limit (150 Kg). The remaining 102 underwent DXA exam, but some of them could not be included in the study due to different causes. Finally 64 patients were included (Fig. 3 on page 11):
Fig. 3

References: Radiodiagnóstico, UCR de la CAM. Hospital Infanta Leonor - Madrid/ES
3.1% with normal weight (mean BMI 19.3)
3.1% overweight (BMI 25-30; mean 27)
93.8% obese, 50% morbidly obese patients (BMI ≥ 40; mean 44). Mean BMI of the remaining 50% was 35.
Age and sex distribution was: 65% women with mean age 44 year old (range 17-72 years) (Fig. 4 on page 11).
Fig. 4

References: Radiodiagnóstico, UCR de la CAM. Hospital Infanta Leonor - Madrid/ES

Total and pelvic fat distribution in groups, represented as mean and interquartile range were:

- Normal weight (Fig. 5 on page 12):
  - Total fat mass: 23.3% (18.9-27.6%)
  - Android pelvic fat: 23.1% (18.0-28.2%)
  - Ginoid pelvic fat: 34.4% (31.8-37%)
  - A/G Ratio: 0.68 (0.57-0.78)

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Fig. 5
References: Radiodiagnóstico, UCR de la CAM. Hospital Infanta Leonor - Madrid/ES
-Overweight (Fig. 6 on page 12):
Total fat mass: 47,6% (43,3-51,8%)
Android pelvic fat: 53,0% (46,9-59,1%)
Ginoid pelvic fat: 53,0% (50,1-55,1%)
A/G Ratio: 1,00 (0,92-1,07)

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Fig. 6
References: Radiodiagnóstico, UCR de la CAM. Hospital Infanta Leonor - Madrid/ES
-Obese patients (BMI 30-40) (Fig. 7 on page 13):
Total fat mass: 46,4% (40,7-52,1%)
Android pelvic fat: 53,1% (48,3-57,5%)
Ginoid pelvic fat: 49,4% (43,4-56,9%)
A/G Ratio: 1,10 (0,97-1,18)

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Fig. 7
References: Radiodiagnóstico, UCR de la CAM. Hospital Infanta Leonor - Madrid/ES
-Morbidly obese patients (Fig. 8 on page 13):
Total fat mass: 51,4% (47,3-55,4%)
Android pelvic fat: 58,6% (56,0-62,0%)
Ginoid pelvic fat: 54,0% (49,8-59,4%)
A/G Ratio: 1,09 (1,02-1,14)

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Fig. 8

**References:** Radiodiagnóstico, UCR de la CAM. Hospital Infanta Leonor - Madrid/ES

**D. DISCUSSION**

All the patients in our study (100 %) presented with normal B12 vitamin levels. Only two patients had low folic acid levels.

In patients with normal homocystein (< 13,9 microM/l), mean A/G ratio was 1,07 (interquartile range 1,01-1,12), without significative differences in the group of patients with increased homocystein (> 13,9 microM/l), with mean A/G ratio 1,09 (1,04-1,14).

Previous studies reported a relationship, but in the patients in our study an association between homocystein level and pelvic fat distribution, evaluated as A/G ratio, is not evident. Further studies are needed to confirm findings.

**Images for this section:**
Table of contents:

1.- Introduction

2.- Total body absorptiometry:
   - Patient position
   - Image analysis
   - Parameters

3.- Study design

4.- Results

Fig. 1

![TOTAL BODY. A/G](image)

- Regions
  - **Android**: Inferior limit: pelvis, lateral: arms
  - **Ginoid**: Lateral limits: external region of the leg

- **A/G Ratio**: relationship between % of fat in android (central) and ginoid (hip and thigh) regions

Fig. 2
Fig. 3
Sex distribution (n=64)

Mean 44 years of age (range 17-72 years).

Fig. 4

Patients with normal weight:

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Fig. 5
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**Fig. 6**

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**Fig. 7**

### Patients with morbid obesity:

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**Fig. 8**
Conclusion

1. DXA determination of A/G ratio is a simple practical tool in the evaluation of pelvic fat distribution.
2. DXA may be a useful technique in the evaluation of cardiovascular risk in patients with increased or low weight.
3. In the patients in our study an association between homocystein level and pelvic fat distribution, evaluated as A/G ratio, is not evident.

References


Personal Information

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