Usefulness of the Measurement of the Psoas and Paraspinal Muscles by Computed Tomography and Magnetic Resonance

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ABSTRACT

Background: Sarcopenia is becoming increasingly significant in the research of various diseases to predict morbidity and mortality in the perioperative period. **Objectives:** The objectives of this study were to evaluate the efficacy of computed tomography and magnetic resonance imaging in measuring the psoas and paraspinal muscles and to compare these indexes with age, sex, and pathology. **Materials and Methods:** Computed tomography and magnetic resonance imaging of outpatients were used. Muscle measurements were taken at the L3 and L4 pedicles. **Results:** The study included 18 CT and 34 MRI scans. The patients were divided into groups based on their age range, which was 15 to 80 years. In the overall averages, males were above the global average in both studies. Regarding age ranges, it was observed that the first group (15–29 years) had a higher muscle volume and Hounsfield units in the psoas compared to the >60 age group. Patients consulting for spondylolisthesis had less muscle mass than those with discopathy. **Conclusions:** There is no difference between magnetic resonance imaging and computed tomography in measuring the paraspinal and psoas muscles. It is evident that the decrease in muscle volume is common in older patients and those with diseases that affect spinal balance.

Keywords: Sarcopenia; Hounsfield units; spine; psoas; multifidus; fat infiltration.

Level of Evidence: IV

Utilidad de la medición de los músculos psoas y paraespinales mediante tomografía computarizada y resonancia magnética

RESUMEN

Introducción: La sarcopenia está revistiendo importancia en el estudio de diferentes enfermedades para predecir la morbimortalidad en el perioperatorio. Los objetivos de este estudio fueron evaluar la eficacia de la tomografía y la resonancia en la medición de la musculatura del psoas y los paraespinales, y comparar estos índices con la edad, el sexo y la enfermedad. **Materiales y Métodos:** Se utilizaron las tomografías computarizadas y las resonancias magnéticas de pacientes ambulatorios. La medición de los músculos se realizó en los pedículos de L3 y L4. **Resultados:** El estudio incluyó 18 tomografías y 34 resonancias. El rango de edad de los pacientes era de 15 a 80 años, divididos en grupos etarios. En los promedios globales, en ambos estudios, el sexo masculino estaba por encima del promedio global. Con respecto a los rangos etarios, se observó que el primer grupo (15-29 años) tenía un mayor volumen muscular y de unidades Hounsfield en el psoas comparado con el grupo >60 años. Los pacientes que consultaron por espondilolistesis tenían menos masa muscular que aquellos con discopatías. **Conclusiones:** No existe diferencia entre la resonancia magnética y la tomografía computarizada en cuanto a la medición de los músculos paraespinales y psoas. Queda en evidencia que la disminución del volumen muscular es común en pacientes de mayor edad y con enfermedades que afectan el balance espinal.

Palabras clave: Sarcopenia; unidades Hounsfield; columna; psoas; multífidos; infiltración grasa.

Nivel de Evidencia: IV

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INTRODUCTION

Sarcopenia is defined as the progressive and generalized loss of skeletal muscle mass and strength as a consequence of a sedentary lifestyle, poor diet and various diseases that force a reduction in physical activity.[1]

The size of the psoas muscle is used as a sarcopenia parameter rather than that of the paravertebral musculature, which does not appear to decrease in size but is replaced by fatty tissue in what is known as "fatty degeneration".[1]

Muscle mass indexes are described in numerous articles as a predictor of morbidity and recovery in patients undergoing various types of treatments or surgical interventions, not only spinal. Likewise, the results of other scientific studies are not conclusive regarding whether sarcopenia can influence the prognosis of each individual in particular.[1-8]

The objectives of this study were: to assess the efficacy of computed tomography and magnetic resonance imaging in measuring the psoas and paraspinal muscles, and to compare these indexes with age, sex, and disease.

MATERIALS AND METHODS

A prospective study was conducted using computed tomography and magnetic resonance imaging images of patients who attend daily consultations for various spinal conditions. 52 imaging studies were loaded into the Excel program. The computer programs used for data collection were KPACKS and DICOM. The volume of the psoas muscle and paraspinal muscles was measured in millimeters and Hounsfield units (HU). Measurements were made at L3 and L4, the level of the vertebral pedicles. A transverse line was drawn in the widest area of both muscles and a perpendicular line was drawn at the widest level of the psoas and at the base of the transverse process in the paravertebral gutter (Figure 1).

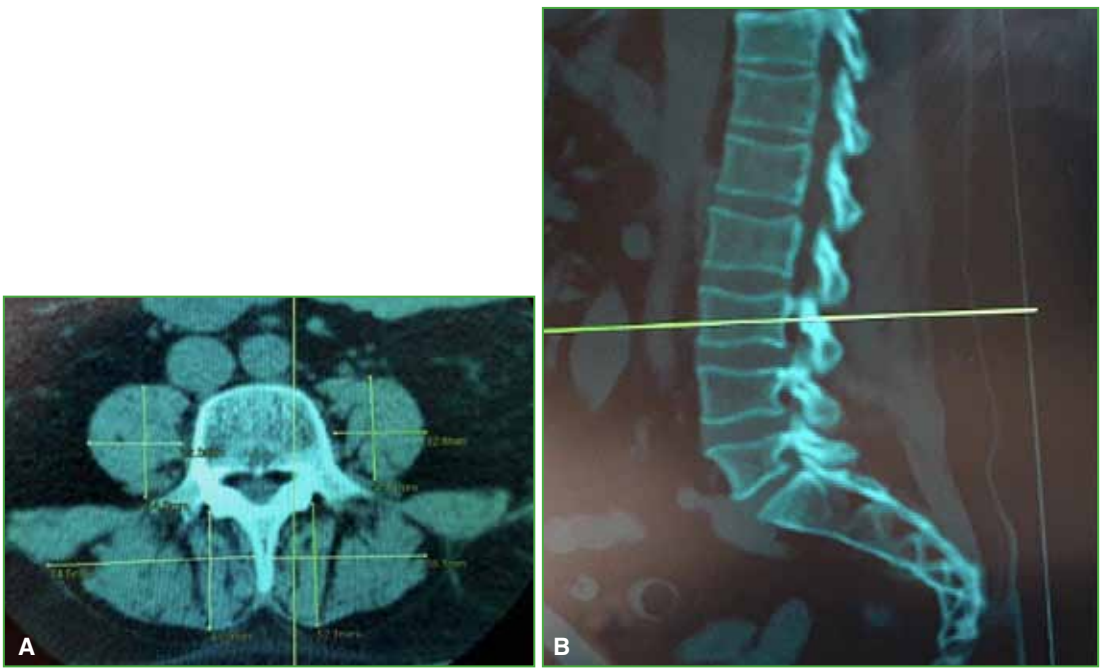

Figure 1. CT scan showing measurement of psoas muscles and paravertebral gutter muscles. **A.** Axial section. **B.** Sagittal section. Level where the measurements are made (height of the pedicles).

Muscle volume was obtained by multiplying these two parameters in both muscle groups, adding them and dividing by the squared height (right psoas + left psoas/height^2); and the HUs at the intersection of both lines. The data was discriminated by sex, age range, disease and type of complementary study used. Patients with deformities (scoliosis) or previous spinal surgeries were excluded.

RESULTS

Measurements were taken in 18 CT and 34 MRI scans of male and female patients. The participants ranged in age from 15 to 80 years. In terms of muscle volumes and density using the HU, the group of male patients was above the global average in both MRIs and CTs, while the group of female patients was below (Figures 2, 3 and 4).

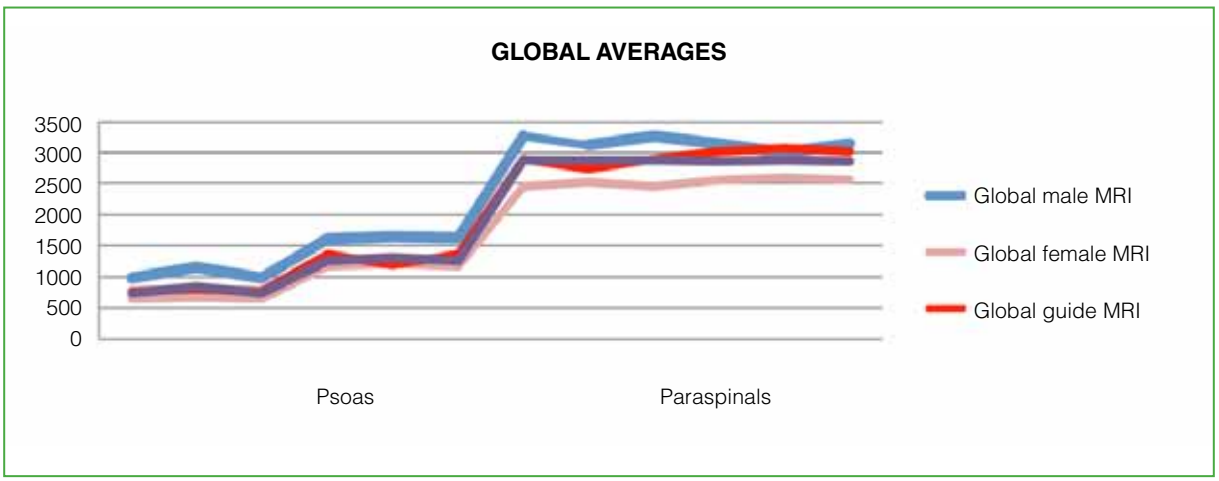

Figure 2. Difference in the volume of the psoas and paraspinal muscles in magnetic resonance imaging, comparing males and females.

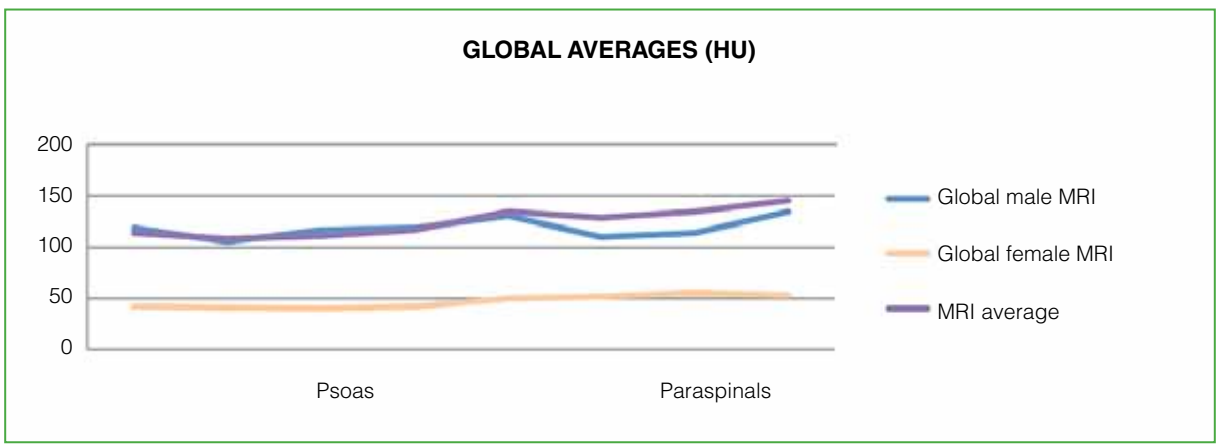

Figure 3. Comparison of Hounsfield unit measurement between psoas muscle and paraspinal muscles.

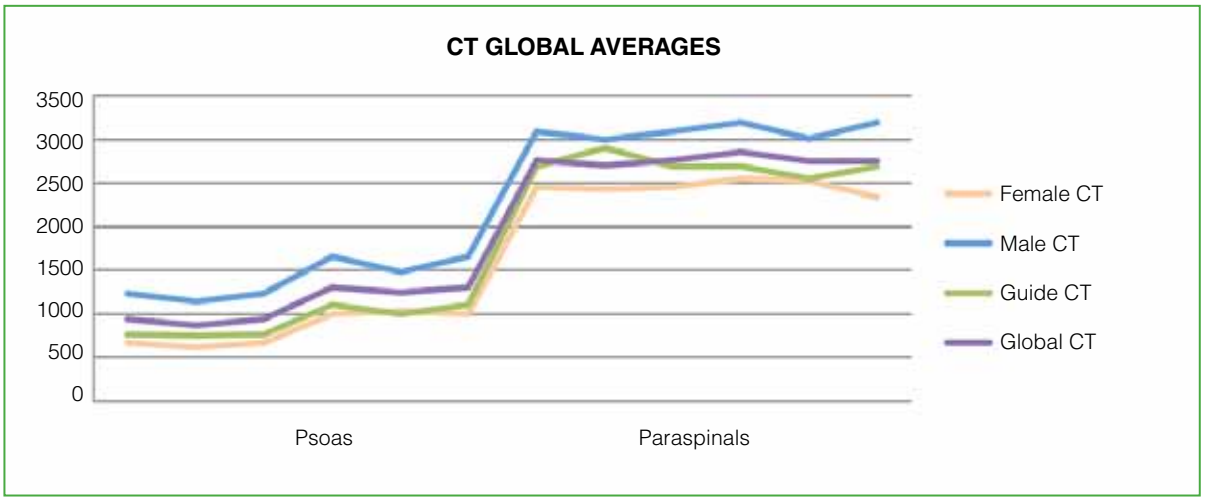

Figure 4. Comparison of muscle volumes measured by computed tomography, comparing males and females.

Three patients who had both complementary studies were taken as reference, and their layout on the graphs was similar to that of the overall group. Regarding the age ranges, it was observed that the first group (15-29 years) had a greater muscle volume and HU in the psoas compared to the group >60 years, the two remaining groups of 30-44 years and ages 45-59 remained close to the global averages (Figure 5).

Likewise, the patients in the younger age range had a greater volume of the psoas than of the paravertebral muscles with respect to the last age group. Patients who consulted for spondylolisthesis had less muscle mass than those with disc disease (Figure 6).

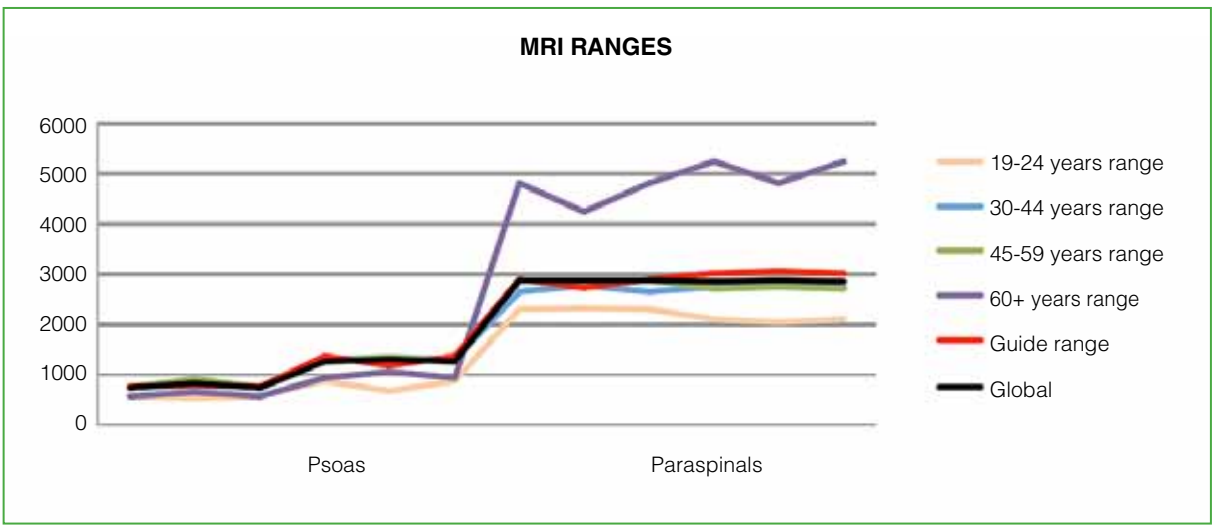

Figure 5. Comparison of muscle volumes measured by magnetic resonance imaging and divided by age range.

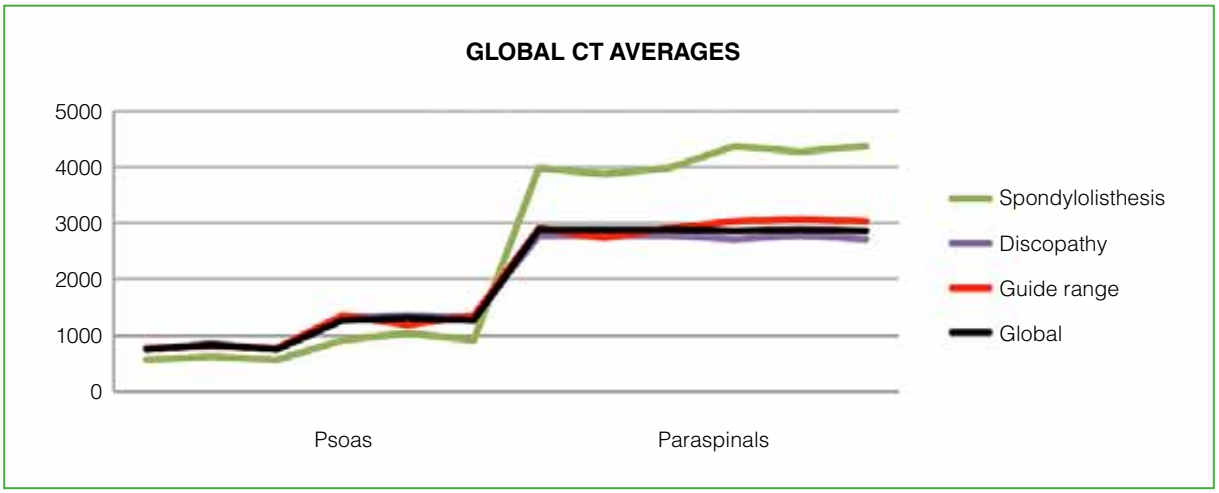

Figure 6. Measurement of muscle volumes comparing spondylolisthesis and disc disease.

DISCUSSION

It is common to detect atrophy of the psoas muscle and fatty degeneration of the paraspinal muscles in elderly patients. These conditions cause alterations in posture and walking, because they modify, to a great extent, the extensor function of the lower spinal part.[3]

Measurement of lumbar muscle density (psoas) could be used as a predictor of poor postoperative outcomes in cardiovascular surgeries[2] and colorectal resection surgery.[4]

Shahidi et al. studied 97 patients who underwent one-level spinal fusion, with a 90-day follow-up, but did not obtain conclusive results regarding the influence of psoas volume in the perioperative period.[6]

Instead, Yoo et al. evaluated 151 patients admitted for trauma to a hospital in Ohio, United States. Psoas muscle density is a significant predictor of poor outcomes after traumatic injury. It is an objective, quick, and easy measure of sarcopenia, and can identify patients who require nutritional and physical therapy to improve prognosis.[1]

In a literature review, Fortin and Gazzi Macedo found a decrease in multifidus and paraspinal volume in patients with chronic low back pain compared with a control group without low back pain or with acute pain.[8]

Moskven et al. carried out a systematic review and did not observe that sarcopenia and frailty could have a significant impact on the postoperative period of spinal surgeries.[9]

Magnetic resonance imaging provides higher image resolution than ultrasound and tomography. In this way, it allows better detection of soft tissues and muscles. Atrophied muscle usually has irregular margins and fatty infiltration.[10,11]

CONCLUSIONS

No differences were found between measurements of the paraspinal muscles and the psoas taken with magnetic resonance or computed tomography; therefore, both studies are effective for such measurements.

The paraspinal muscles do not decrease in size with age, but fatty infiltration is observed, and is generally greater at the lower lumbar levels, such as L4 and L5. MRI has better image resolution.

It is evident that the decrease in muscle volume is frequent in older patients and those with diseases that affect spinal balance, such as spondylolisthesis.

Regarding sex, although the size of the musculature is greater in men than in women, the measurements decrease in both sexes when compared with age and disease.

Conflict of interest: The authors declare no conflicts of interest.

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