

Visceral adipose tissue volume measurement using MRI, and its relation with liver elastography and anthropometry, in type 2 diabetic patients.

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OBJECTIVE: Visceral Adipose Tissue (VAT) has been associated with liver fibrosis on patients with Non-alcoholic Fatty Liver Disease (NAFLD) [1]. Additionally, it has been reported that type 2 diabetic patients (DM2) are at higher risk to develop NALFD [2]. In this work, we propose to evaluate the relationship between different biomarkers and liver fibrosis/cirrhosis in type 2 diabetic patients. In particular, we studied the association of liver fibrosis/cirrhosis with both the amount of VAT and liver stiffness. For this purpose, we performed a study that included clinical findings; measurements of VAT and Subcutaneous Adipose Tissue (SAT) volumes using MRI; anthropometric indexes, like Body Mass Index (BMI) and Waist Circumference (WC) and Transient Elastography (TrE) using ARFI (Acoustic Radiation Force Impulse) for measuring liver stiffness. Furthermore, we evaluated the relation between anthropometric indexes and MRI measurement of VAT and the relation between the amount of VAT and the stiffness of the liver.

METHODS: 19 patients (mean age: 62 years, range: 55-75, mean weight: 77.2kg, range: 61.5-97) with DM2 were enrolled. All patients underwent clinical evaluation, anthropometry, ARFI, and MRI. Clinical evaluation included complete medical history, physical exam and laboratory data (hemoglobin, platelet count, complete biochemical workup, HbA1c). Anthropometric data assessed included weight, height, BMI, WC, body fat percentage (BF%), brachial circumference (BC), tricipital fold (TF), bicipital fold (BF), suprailiac fold (SpF) and subscapular fold (SbF). Additionally, 10 TrE measurements were made in the right lobe of the liver.

MRI scans were performed on a Phillips Intera 1.5T MR including the following sequences: half-Fourier single-shot turbo spin-echo, T2 with fat saturation, in-phase and out-of-phase, T1 gradient echo, and diffusion weighted image sequences. We also included a spectral excitation sequence, centered at fat, to assess quantitatively VAT and SAT volumes. The FOV included the diaphragmatic border until below the kidneys. VAT was measured using semi-automatic software (Image J [3]) (**Figure 1**). The presence of hepatic disease was evaluated using morphological criteria over the MRI scans.

We performed different comparisons between abdominal fat, ARFI and anthropometry using the Pearson's correlation statistic.

RESULTS: Clinical diagnosis and MRI findings showed that no subject had clinical or biochemical features of liver cirrhosis. The BMI was 29.3 ± 4.7 (range = 22.6-29), and the WC was $99.7\text{cm} \pm 9.1$ (range = 85-120). The TrE was 1.65 ± 0.8 m/s, (range 0.8-3.4 m/s). The amount of VAT was $2390\text{cc} \pm 801\text{cc}$, (range = 1173-2252) and SAT was $3143\text{cc} \pm 1298\text{cc}$.

We found a poor correlation comparing anthropometric indexes with measurements of VAT (**Figure 2**, left) ($r=0.13$ for BMI), and ($r=0.56$ for WC). Comparing measurements of adipose tissue with ARFI we found that: the correlation between ARFI and VAT was -0.01 ($p=0.94$), between SAT and ARFI was 0.10 ($p=0.66$) and between (VAT+SAT) with ARFI was 0.08 ($p=0.72$). By analyzing the group with ARFI superior to 1.6 m/s (suggestive of advanced liver fibrosis [4]), we found that the correlation was 0.63 between VAT and ARFI ($p=0.12$), 0.66 between SAT and ARFI ($p=0.10$), and 0.94 between (VAT+SAT) with ARFI ($p=0.001$) (**Figure 2**, right). In the group with ARFI inferior to 1.6 m/s the largest correlation was $r=0.33$, between (VAT+SAT) and ARFI ($p=0.29$).

DISCUSSION: We confirmed previous results [5], indicating that BMI and WC are bad predictors of VAT volume in type 2 diabetic patients, independent of the body phenotype. Moreover, we did not find a relation between the stiffness of the liver and the adipose tissue depots in the entire population. However, in those patients with greater liver stiffness we found a good correlation between ARFI values and the amount of VAT and VAT + SAT.

Clinical diagnosis indicated that none of the DM2 patients had diagnosis of liver fibrosis/cirrhosis. We identified a subgroup of patients with ARFI superior to 1.6m/s that are at a greater risk of developing liver fibrosis or cirrhosis. On this group, higher VAT volume was associated with higher liver stiffness. This finding suggests performing further studies of liver fibrosis (e.g. liver biopsy) on those patients with largest ARFI and largest amount of VAT to confirm whether there is a progression of liver fibrosis and begin NASH medical therapy.

CONCLUSION. Because of the implications of developing hepatic disorders due to metabolic diseases, different imaging biomarkers should be used to study the clinical condition of the liver. For this, MR images do not only play a role in liver fibrosis diagnosis, but can also measure VAT volumes, since it has been demonstrated that anthropometric measurements are bad predictors of this fat depot.

REFERENCES. 1. van der Poorten et al Hepatology 2008, 2. Luxmi et al. J LUMHS 2008 3. <http://rsbweb.nih.gov/ij/> 4. Nguyen et al Hepatology 2011, 5. Schwenzer et al Invest Radiol 2010.

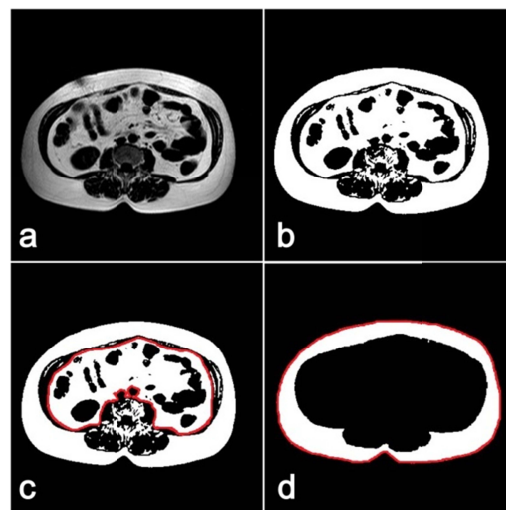


Figure 1. MRI image (a), and binary image (b) visceral adipose tissue (c), and subcutaneous adipose tissue

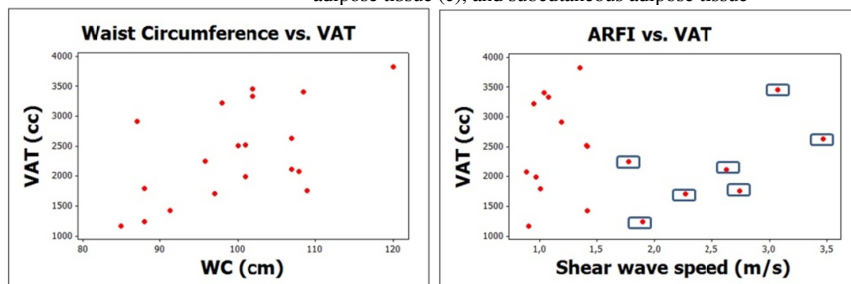


Figure 2. (left) Dispersion graph showing the relation between waist circumference and visceral adipose tissue volume. (right) Dispersion graph showing the relation between ARFI and visceral adipose tissue volume. In blue squares data with direct correlation.