

An automatic method for visceral adipose tissue measurement in the metabolic syndrome

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Purpose:

The metabolic syndrome is pathology on strong increase. The ratio between the surface of intra-abdominal fat and the subcutaneous fat appears as a good predictor of this pathology [1,2]. The measure of this ratio by MRI is a non-invasive technique which requires a long and tedious manual segmentation. In this paper, we propose an automatic method to measure this ratio.

Material & Methods:

Examinations were performed on a 1.5T whole body MRI (Excite, GEHT, Milwaukee) with a 8-channel body array. In and out of phase gradient echo scans were acquired axially in cuts L3 during 20 second breath holds. 10 patients with metabolic syndrome were included in the protocol. The image parameters were: $N_x=512$, $N_y=512$, slice thickness= 6mm, FOV = 44-48cm, TR=145ms, flip=75°, TE=2,2 and 4,4ms. Two radiologists quantified manually the subcutaneous and intra-abdominal fat. The software that we have implemented is based on two fuzzy algorithms. The first is a fuzzy c-means clustering [3] which allows to each pixel to belong into two or more clusters. The second algorithm, fuzzy connectedness [4], is based on the possibility to link two clusters by the whole of possible paths and to choose the path with the minimal cost.

Results:

The segmentation of visceral fat and subcutaneous fat requires an image without artifact (like breath hold artifact). Some results are presented in Figure 1. Comparison between the quantification of the intra-abdominal (IA) fat by the software and by the radiologist (Figure 2) showed a good correlation ($r^2 = 0.90$, $P<0.05$). It is better when we quantify the subcutaneous (SSC) fat (Figure 3) ($r^2 = 0.99$, $P<0.05$) because there was no structures like aorta, intestine or colon in the subcutaneous fat. We observed similar coefficient between the intra and inter expert analyses (IA 0.99, 0.98 and SSC 0.99, 0.99).

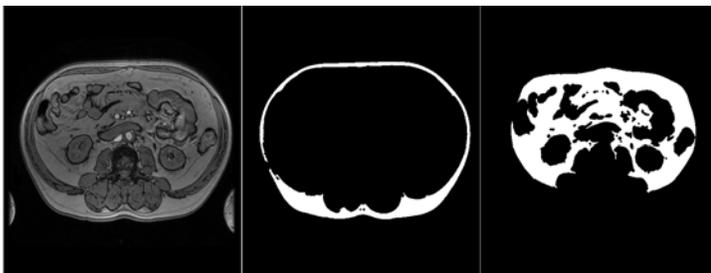


Figure 1 : Left : Original Image. Middle : Subcutaneous fat segmentation. Right : Visceral fat segmentation

Conclusion & Perspectives:

In this paper, we propose an automatic, reliable, reproducible and non-invasive method to quantify the abdominal fat and so to evaluate the metabolic syndrome.

The results should be improved by taking into account the inhomogeneity of the signal intensity.

References:

- [1] Chan *et al*, *Diab. Res. And Clin. Pract.* (2004)
- [2] Positano *et al* *JMRI* (2004)
- [3] Bezdek, *Plenum Press* (1981)
- [4] Udupa *et al*, *Graph. Models and Im. Proc.* (1996)

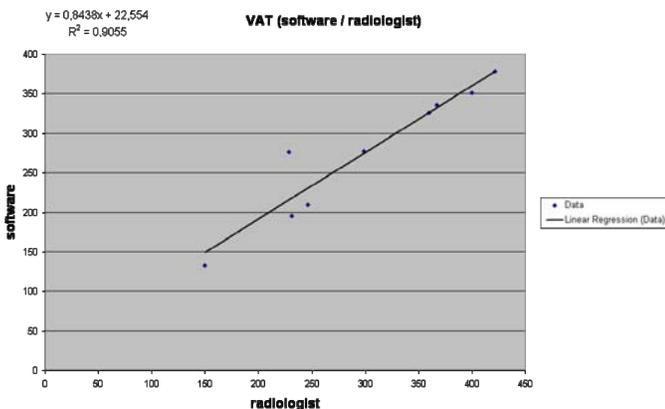


Figure 2: Comparison between the results of the software and the results of the radiologist for the VAT segmentation

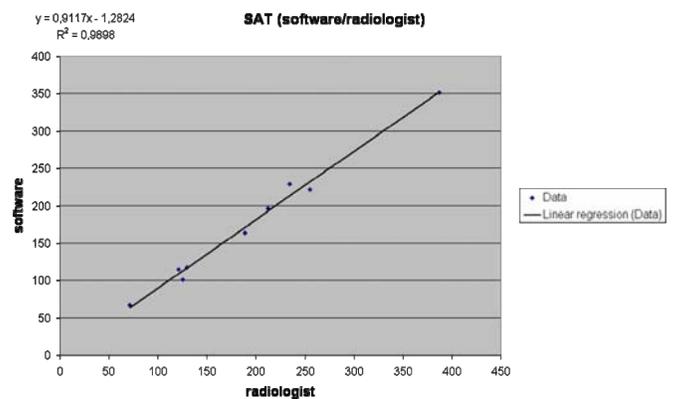


Figure 3: Comparison between the results of the software and the results of the radiologist for the SAT segmentation