Pericardial fat overlaying the left ventricle: A better indicator of left ventricular function

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Introduction: The total volume of pericardial fat has been associated variation in left ventricular (LV) function (Ruberg *et al*). Fat contained in the pericardial space is a continuous structure overlaying both ventricles and atria; however, it is possible that fat in direct contact with the left and right ventricles (RV) may differentially affect ventricular function possibly through direct anatomic pressure or elaboration of adipokines/free fatty acids (FFA). We hypothesized that fat overlying the LV would be a better indicator of LV function than the total volume of pericardial fat.

Methods: Cardiovascular magnetic resonance imaging using a 3.0T Philips Intera system was performed in 40 obese subjects (female= 37, BMI range=30-47 kg/m^2, age range=19-62 yrs) with metabolic syndrome (MetS) but no known cardiovascular disease as well as 17 health controls (female= 14, BMI range=20-28 kg/m^2, age range=21-64 yrs). To quantify pericardial fat volume, axial continuous slices were obtained from the pulmonary bifurcation to the apex of the heart using ECG gated T1 black blood (T1BB) sequence. The acquisition parameters were: repetition time (TR) = 2 cardiac cycles, echo time (TE) = 13 ms, number of average (NEX) =2, sense factor=2.5, FOV=384x384 mm, matrix= 256x256 and zero filled to 512x512, slice thickness= 4 mm. Then the manual contours were used to select region of interest (ROI) around heart (Fig 1a, yellow line), LV or RV slice by slice. The atrio-ventricular (AV) groove was chosen as the anatomic marker to separate the atria and ventricles, while the septum (Fig 1a, green dotted line) was used to separate LV and RV. A threshold was chosen based on the histogram, and the voxels with intensity above the threshold within each ROI was characterized as the total, LV or RV pericardial fat respectively. The resulted fat volume was normalized to body surface area to compensate for the differences in heart size. To assess cardiac function, short axis cine MRI was performed using steady state free precession (SSFP) sequence with 8-10s breath hold and ECG gating. Continuous slices were obtained from the AV groove to the apex of the heart. Scan parameters were: TR = 3.0 ms, TE =1.6 ms, NEX = 1, sense factor=1.5, FOV=400x400 mm, matrix 256x256, with 26-28 heart phases acquired per slice. LV Stroke volume (SV), cardiac output (CO), ejection fraction (EF), wall mass (WM) and end-diastolic volume (EDV) was determined through ViewForum. In addition, LV diastolic function was assessed from the first derivative of the volume-time curve, yielding Early filling rate (E), Late or Atrial filling rate (A), Early/Late ratio (E/A),time to Early filling (TEF), time between Early and Late filling (TEA), and the Rapid filling fraction (RFF). (Kudelka *et al*)

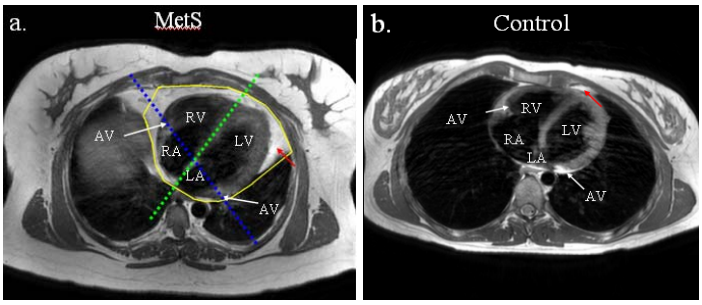

FIG1. *Representative axial Images of the MetS and the control subjects. RV, Right Ventricle; LV, Left Ventricle; LA, Left Atrium; RA, Right Atrium; AV, atrio-ventricular groove; Red Arrow, pericardial fat; Blue dotted line, connects AVs to separate atria and ventricles; Green dotted line, the septum to separate LV and RV.*

Results: Representative axial T1BB images taken at the similar level from two subjects, A (MetS) and B (control) are shown in Fig 1a and 1b. The MetS subjects showed statistically higher amount of LV fat ($p<0.001$), RV fat ($p<0.001$) and total ($p=0.008$) pericardial fat as compared to controls. LV and RV fat were highly correlated in MetS ($r=0.72$, $p<0.001$) and even higher in controls ($r=0.95$, $p<0.001$). In MetS, LV fat was inversely correlated with SV ($r=-0.33$, $p=0.04$), CO ($r=-0.31$, $p=0.05$), WM($r=-0.34$, $p=0.03$), EDV ($r=-0.32$, $p=0.05$) and E-rate($r=-0.49$, $p=0.01$), while total pericardial fat was only related to EDV and E-rate, and no significant correlation was found between RV fat and cardiac function. In controls, CO was correlated with LV fat but not with total or RV pericardial fat.

Discussions and Conclusions: Our results suggest that LV fat might better correlate to LV function as compared to total pericardial fat, as the RV fat included in the total pericardial fat might bias analysis. This may suggest a site-specific influence of pericardial fat upon left ventricular function.

Table1: Correlation between LV/RV/total pericardial fat and cardiac function. Only significant correlation was showed.

	Mets			Controls		
	LV fat (r,p)	RV fat (r,p)	Totol fat (r,p)	LV fat (r,p)	RV fat (rp)	Totol fat (r,p)
WM	-0.34, 0.03	-	-	-	-	-
EDV	-0.32, 0.05	-	-0.35, 0.03	-	-	-
SV	-0.33, 0.04	-	-	-	-	-
CO	-0.31, 0.05	-	-	0.51,0.04	-	-
EF	-	-	-	-	-	-
E	-0.49, 0.01	-	-0.48, 0.02	-	-	-
A	-	-	-	0.61, 0.05	0.64, 0.04	0.62,0.04
ELR	-	-	-	-	-	-
RFF	-	-	-	-	-	-
TEF	-	-	-	-	-	-
TEA	-	-	-	-	-	-