The epicardial adipose tissue (EAT) constitutes visceral fat located around the myocardium and epicardial segments of the coronary arteries. Prior studies demonstrate a static correlation between EAT and left ventricular mass, with a constant EAT to myocardial mass ratio in normal, hypertrophic, and ischemic hearts. However, EAT is a dynamic fat depot, with incompletely understood temporal changes in its morphologic and functional characteristics. An increased EAT volume may be the result of adipocyte proliferation (presumably early in life) or adipocyte hypertrophy, with accompanying changes in the EAT microvasculature, and stromal framework. The effect of the EAT on the myocardium and coronary arteries is of increasing scientific interest, as it appears to provide insights into the mechanisms related to the progression of ischemic heart disease (IHD). Prior studies consistently show a relationship between larger EAT volume, increased release of inflammatory molecules, and more advanced stages of IHD, manifested by (calcified) coronary plaque, angiographic coronary stenosis (coronary artery disease [CAD]), diastolic dysfunction, myocardial ischemia, and adverse clinical outcomes.

In contrast, there is comparably little data describing a relationship between decreased amount of ETA and cardiac function. Previous papers have demonstrated that significant weight loss in obese but otherwise healthy persons is associated with a corresponding reduction in the epicardial fat volume. In patients with symptomatic ischemic and non-ischemic cardiomyopathy (CMP, LVEF <35%), previous postmortem and CMR data have demonstrated that EAT is significantly reduced in comparison with healthy controls.

In this issue of the Journal, Doesch et al. further examine potential determinants of EAT volume in 158 patient with CAD and 40 healthy control subjects. With EAT and left ventricular function (LVEF) ≥50% had significantly elevated EAT (36±11 g/m²) compared with the patients with LVEF <50% (26±8 g/m²) and healthy controls (31±8 g/m²). In the whole study population, LVEF (P=0.003), body mass index (BMI) (P=0.004), and left ventricular enddiastolic diameter (LVEDD) (P=0.004) were significantly associated with EAT in the multivariate analysis. Subgroup analysis of patient with CAD and LVEF ≥50% showed that BMI (P=0.03) was the only correlate of EAT. In contrast, in patient with CAD and LVEF <50%, indexed LV enddiastolic mass (LVEDMI) (P=0.003) and the extent of late gadolinium enhancement (LGE%) (P=0.03) remained significantly correlated with EAT in the multivariate analysis.

The data suggest that shrinkage of the EAT volume correlates with advanced stages of ischemic cardiomyopathy. However, there is little mechanistic data supporting a causal relationship between shrinking of the EAT volume and LV dysfunction. Imbalances between physiologic and pathologic paracrine effects of the EAT have been implicated in the development and progression of IHD. Under physiological conditions, the epicardial fat has a protective effect, acting as an energy source and buffering system. In contrast, in the early stages of atherosclerotic disease, an increased EAT volume is associated with excessive production of inflammatory adiponectin, adipokines, and cytokines, predisposing to impaired endothelial function and the progression of atherosclerosis. In the later phases if IHD, the loss of the favorable effects of EAT acting as a local energy resource for cardiac muscle in times of high demand, a decreased amount of protective cytokines, such as adiponectin, and loss of the protection from fatty acid-induced cardiotoxicity may be dominant.

Rather than fat volume alone, it is necessary to describe the composition and paracrine activity of the EAT in order to understand the mechanisms that translate into potential adverse, detrimental effects on cardiac function. Imaging can provide insights into the anatomy of epicardial fat beyond its volume. A recent experimental study in a mouse model validated a novel CT scanner model for the quantification of fat depots. There were significant correlations between postmortem fat weight and the weights determined by CT for subcutaneous, visceral, and brown adipose tissue. Intrahepatic fat content estimated by CT was linearly related to biochemical analysis. Short-term cold-exposure led to alterations in brown adipose tissue and was reflected by an increase in CT Hounsfield units (HU). Those authors suggested that in-vivo 3D imaging of fat amount and composition by CT is feasible in animal models, which will allow non-invasive longitudinal assessment of fat depots.

A clinical paper previously published in the Journal described differences in EAT radiodensity (HU), demonstrating that increased EAT radiodensity is independently associated with coronary atherosclerosis. Those authors hypothesized that this increase may reflect the unfavorable, pro-atherosclerotic metabolic properties of more radiodense epicardial fat. However, although CT imaging can likely capture more than...
just EAT volume, it is limited for several reasons. The volumetric measurements are based on the HU range, which is not well standardized. At the same time, attenuation of the EAT is not only dependent on its own characteristics but also on the scan protocol (eg, 100 vs. 120kV tube voltage) and the patient’s characteristics. In general, the HU of a tissue are a relatively coarse reflector of its composition and activity.

In order to gain further insight into the biology and pathophysiology of the EAT, more consistent measurement of its radiodensity and/or molecular imaging will be necessary. Specifically, existing data do not allow conclusion on the causality of the observed relationship. There is a need for further prospective longitudinal studies with biochemical correlation to evaluate the dynamic course of EAT volume and composition. Such data will eventually elucidate its potential effect in the pathogenesis of ischemic cardiomyopathy.

References


