Obesity is a well-known risk factor for coronary artery diseases. Adipose tissues, which primarily store fats, are present at specific locations in the body; based on these locations, the fats are categorized as subcutaneous, visceral, marrow, or ectopic. The simplest atherosclerosis screening method measures the abdominal circumference, which varies according to the subcutaneous and visceral fat contents. Subcutaneous fat is present directly under the skin layers; its function is to provide protection against external injuries and to store energy; however, its role in atherosclerosis remains controversial. The visceral fat inside the abdominal cavity has been reported to be a predictor of cardiovascular disease and mortality. Compared to these two types of fats, ectopic fat is difficult to study owing to its small volume, which cannot be easily detected by a regular computed tomography slice (> 20 mm).

The two types of cardiac ectopic fats, epicardial and paracardial, are collectively known as pericardial fat (Figure). X-rays can be used to detect pericardial fat. Research on pericardial fat dates way back to that on epicardial fat. In 2001, for the first time, Taguchi, et al. studied the heart using 10-mm-thick computed tomography slices and found that pericardial fat accumulation is a stronger coronary risk factor than subcutaneous or visceral fat accumulation. Further, the analysis of pericardial fat has rapidly progressed with the spread of multi-detector row computed tomography (MDCT), which enables the quick and easy assessment of lipid deposits. In 2008, Gorter, et al. established a method to measure the lipid content around the heart. Rosito, et al. examined 2.5-mm-thick MDCT sections of the hearts of cardiovascular disease-free participants of the Framingham Heart Study and concluded that pericardial fat was associated with vascular calcification. Several case-cohort studies have shown that pericardial fat parameters predict coronary heart disease. The Multi-Ethnic Study of Atherosclerosis, which used cardiac magnetic resonance imaging to accurately detect coronary plaques and coronary artery wall thickness, found that pericardial fat was strongly associated with the coronary atherosclerotic plaque burden.

Epicardial fat is located between the outer wall of the myocardium and the visceral layer of the pericardium. It is the fat closest to the coronary arteries and can be evaluated by echocardiography. In 2007, Jeong, et al. reported that epicardial fat thickness measured by echocardiography is an independent predictor of coronary artery stenosis. Subsequently, many reports have revealed the positive association between epicardial fat and coronary disease. According to Sade, et al., epicardial fat is a predictor of microvascular dysfunction and a marker for the presence and severity of coronary artery disease. Finally, a meta-analysis of epicardial fat near the coronary artery has proved that epicardial fat is an independent predictor of cardiac plaques in patients with less severe or slightly severe cardiovascular disease. In contrast, paracardial fat is located between the visceral and the parietal pericardia. However, clinical reports pertaining to “paracardial fat” alone are rare because a majority of studies collectively assess paracardial and epicardial fats as “pericardial fat.” Thus, this may create ambiguity in defining paracardial fat as pericardial fat.

Although the associations between the types of fats and diverse coronary conditions have become more apparent, the different roles that these fats play remain unclear. Recently, transverse studies of fats according to their deposition sites have become more common. For example, comparative trials between epicardial and paracardial fats have shown that epicardial fat is more related to the coronary artery calcium content or the severity of coronary stenosis. However, a few studies have found no differences between the associations of coronary disease and either epicardial or paracardial fat. Transverse studies of subcutaneous and pericardial fats have claimed that pericardial fat is more closely associated with coronary stenosis than subcutaneous fat.

Ueda, et al. reported the first comprehensive analysis of subcutaneous, visceral, epicardial, and paracardial fats in 300 patients who underwent 0.5-mm-thick slice
MDCT. They evaluated the patients’ fat indexes by MDCT and the atherosclerotic severity of their coronary artery disease by Gensini scoring. They reported that the epicardial, paracardial, pericardial, and visceral fat contents were correlated with the occurrence of coronary stenosis and Gensini scores, but the subcutaneous fat content showed no correlation with coronary stenosis. Precise scatter diagrams revealed that the subcutaneous fat index showed a weaker correlation with ectopic fats of the heart. Their multivariate analysis revealed that paracardial fat was the most sensitive marker of the presence of coronary disease (area under the curve 0.650) and that only paracardial fat was an independent risk factor for the presence of coronary stenosis (odds ratio 1.018 and \( P < 0.015 \)). This manuscript emphasized the importance of paracardial fat content in coronary disease and highlighted subcutaneous fat as different from the other fats.

Some reports on different fats demonstrate that ectopic fat may have a direct effect on adjacent organs. Shimabukuro, et al. have reported that CD68 (+) macrophages, interleukin-1β, and adiponectin expression in human epicardial fat predict coronary disease. According to them, pericardial fat secretes various cytokines that promote focal atherosclerotic changes. In vivo, endovascular injury to mice has been shown to induce the expression of tumor necrosis factor (TNF)-alpha in perivascular adipose tissues, which mediates the upregulation of proinflammatory adipocytokine expression. In vitro, adipocytes stimulated vascular smooth muscle cell proliferation, and their activity was shown to be regulated by TNF-alpha. Taken together, these results indicate that the effect of pericardial fat on coronary arteries is apparent. Future research should focus on pericardial fat reduction. In simple terms, diet may decrease pericardial fat content; however, unfortunately, Foppa, et al. have proved that the reduction of subcutaneous fat by bariatric surgery did not induce a decrease in pericardial fat content. Lipid-lowering drugs, such as statins, may reduce the pericardial fat content. Further research is needed to broaden the focus from visceral fats to find therapies that specifically reduce the pericardial fat content.

Disclosures

Conflicts of interest: None.

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