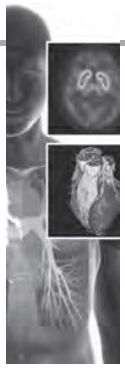

Current State-Of-Art and Future Perspectives in Diagnostics: Raman Studies of the Adipose Tissue

The adipose tissue has been shown to have untapped medicinal promise in recent decades. Targeting the perivascular adipose tissue, which surrounds blood arteries, can help avoid cardiovascular diseases, and browning of the adipose tissue can be a useful weight-loss tactic. Therefore, to examine this tissue, new analytical methods are required. In comparison to traditional analytical approaches, this study discusses the most recent advancements in a number of Raman-based techniques for the identification and quantification of adipose tissue. Analysis of PVAT, examination of adipose tissue pathological alterations in model systems, and potential applications for its characterisation in the clinical setting are of special focus. The paper critically examines the possibilities and restrictions of Raman methods in adipose tissue-targeted diagnostics and prospective future applications in general.

KEYWORDS: Adipose tissue • Perivascular adipose tissue • Browning; Spectroscopy • Raman spectroscopy • Imaging • *In vivo* analysis

Introduction

Treatments to combat obesity since a Swiss naturalist named Konrad Gessner first defined the brown adipose tissue, showing various types of AT, researchers have focused on the structural variety, physiological diversity, and peculiar usefulness of the adipose tissue. Today, 470 years later, scientists are beginning to learn the mysteries of this loose connective tissue owing to cutting-edge research methods that offer in-depth spectroscopic analysis and high-resolution microscopic photographs. Adipocytes, which are lipid-rich cells, make up the majority of AT, together with cells from the stromal vascular fraction, which also contains diverse populations of preadipocytes, mesenchymal progenitor/stem cells, fibroblasts, vascular endothelial cells, and T cells and macrophages M2 [1]. White, brown, beige, and pink are the four categories into which AT may be split. Possess a variety of morphologies and functional traits. AT is engaged in a variety of crucial processes that impact how the body as a whole works [2]. One of the key organs in the control of metabolism, its primary function is the storage of energy through the accumulation of lipids and preserving the appropriate body temperature. It has recently been shown that AT performs endocrine and paracrine roles by producing a variety of bioactive chemicals, such as adipokine, cytokines/chemokines, and vasoactive molecules, whose overexpression results in a number of metabolic disorders [3]. The perivascular adipose tissue, which surrounds arteries and directly affects vascular tone and homeostasis, is where the endocrine activity is most pertinent [4].

Discussion

PVAT governs vascular function along with the endothelium, and its malfunction results in cardiovascular diseases [5]. Numerous illnesses that affect lipid metabolism are linked to AT dysfunction. These include atherosclerosis, cancer, type 2 diabetes, hypertension, cardiopathy, and obesity [6]. Obesity is seen as a worldwide epidemic [7]. According to statistics, more than 50% of people in Europe are overweight, and around 30% are obese. 366 million persons worldwide had type 2 diabetes or other obesity-related comorbidities identified in 2011 [8]. According to predictions, the number of diabetics would rise by 50% by 2030, with Asia accounting for 50% of the cases [9]. Additionally, type 2 diabetes and obesity raise the risk of atherosclerosis development and cardiovascular consequences including heart attack and stroke [10]. As a result of AT's and PVAT's significance in the pathophysiology of Understanding the processes relating PVAT to vascular function, inflammation, and insulin

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sensitivity is crucial since there is a continuing need for novel analytical methods to describe PVAT and assess its condition non-invasively. Designing innovative medicinal and diagnostic approaches incorporating this tissue requires improved understanding of PVAT's involvement in cardiovascular and metabolic diseases. With an emphasis on methodologies capable of PVAT analysis and methods that may be employed in biomedicine, we critically assess numerous more traditional and contemporary ways for examining AT in diverse situations. In addition to other methods based on image capture and positron emission tomography PET imaging and computed tomography A variety of more established as well as cutting-edge vibrational techniques are being used to study AT, including magnetic resonance imaging and ultrasonography. These instruments (Raman and infrared spectroscopy, fiber-optic Raman spectroscopy, spatially offset Raman spectroscopy, coherent anti-Stokes Raman scattering) demonstrate novel capabilities and provide a wide range of analytical and biological applications. The majority of analyses are carried out using a combination of PET and CT, a molecular imaging method that enables the visualisation and measurement of changes in metabolic processes, among the very few established approaches to explore AT in humans. PET works by isotope-labeled molecules emitting positrons after radiotracers are injected.

Conclusion

The registration of PET images involves the detection of photons produced by the annihilation of released positrons interacting with tissue-bound electrons. Using CT X-rays are used to create pictures depending on how well various tissues attenuate the X-ray beam. Since AT has a distinct X-ray attenuation from other soft tissues compared to them, it may be recognised in CT scans despite having a relatively loose density. In PET, it is essential to maintain the radiation exposure period short enough to allow for the transit of the patient to the imaging region while also reducing it owing to the gamma-ray emission. The most widely used radiotracer is flour-D-glucose, an analogue of glucose with an 18F radioisotope with a half-life of 110 minutes. Different tracers are employed for different imaging applications. Due to the absorption of the labelled glucose, BAT has been frequently detected using the PET/CT combo. In about 5 to 8% of individuals, 18F-FDG PET/CT detects BAT. Applications like the investigation of fatty acids uptake via BAT or, using tracers other than 18F-FDG, the monitoring of lipid metabolism or oxygen consumption are possible where it enables visualisation of its depots in the human body and correlation of BAT content with various factors including drugs, glucose level, total body fat, and expression of uncoupling protein. However, the large radiation doses produced in tests by tracer-based techniques like PET/CT or single-photon emission computed tomography preclude their use in clinical human research, particularly longitudinal ones.

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