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REVIEW

Omentin, Fat and Heart: Classical Music with New Instruments

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Obesity is a new pandemic and its cardiovascular and metabolic complications will be more evident in the near future. The need to elucidate the structure and function of adipose tissue is becoming more prominent. Body fat mass has long become not just a matter of quantification, but an area of great interest due to the paracrine, endocrine and autocrine properties of its elements. The novel adipokines are under intense investigation and omentin has come into the centre of interest due to its favourable effects on inflammation and glucose homeostasis. Not all aspects of omentin have been clarified. This review tries to focus on the current knowledge of these aspects and the future perspectives of this novel adipokine.

Keywords Obesity • Inflammation • Insulin resistance • Omentin • Novel adipokines • Cardiovascular effects

Introduction

Structure and Function of Adipose Tissue

Obesity is undoubtedly the new epidemic and a major public health concern [1]. The function of adipose tissue is not merely energy storage. Adipose tissue has been recently identified as a very active organ, with endocrine, paracrine and autocrine properties. Body fat is distributed variably and is mainly divided into subcutaneous adipose tissue (SAT), known as non-ectopic fat, and to visceral adipose tissue (VAT), known as ectopic fat which is the cause of more adverse metabolic events [2]. The term lipodystrophy describes the failure of subcutaneous fat to act as a free fatty acids' pool and a metabolic sink. There is a detrimental effect of obesity on the angiogenic property of SAT, which diminishes with increasing BMI, causing hyperoxia and decreased oxygen consumption. Moreover obesity causes adipose tissue dysregulation in VAT, which is infiltrated by macrophages that induce the production and secretion of various adipokines [3]. The effects of the adipose tissue dysregulation can be systemic or localised, if fat is gathered in the adipose tissue near certain organs such as heart, blood vessels or within the renal sinus (Fig. 1) [2,4]. Perivascular fat is another kind of ectopic fat that has anti-contractile properties through endothelium independent pathways and increased nitric oxide bioavailability [5–7], that seem to be lost in obesity.

These observations have lead to the new term, ''adipos-opathy'', which describes the cardiovascular effects of fat, when it becomes ''sick'' [2]. So what matters is not only the amount of total body fat, the regional fat mass should also be considered and its variations could lead to a change in the state of inflammation, metabolism and atherosclerosis [8].

Three types of adipose cells have been recognised, white adipocytes (WA) which function as an energy storage pool among others, brown adipocytes (BA) whose main role is to oxidise glucose and fat, and brown in white adipose tissue (brite or beige) cells that may have an intermediate, thermogenic phenotype between white and brown adipocytes. There are studies showing an improvement in glycaemic

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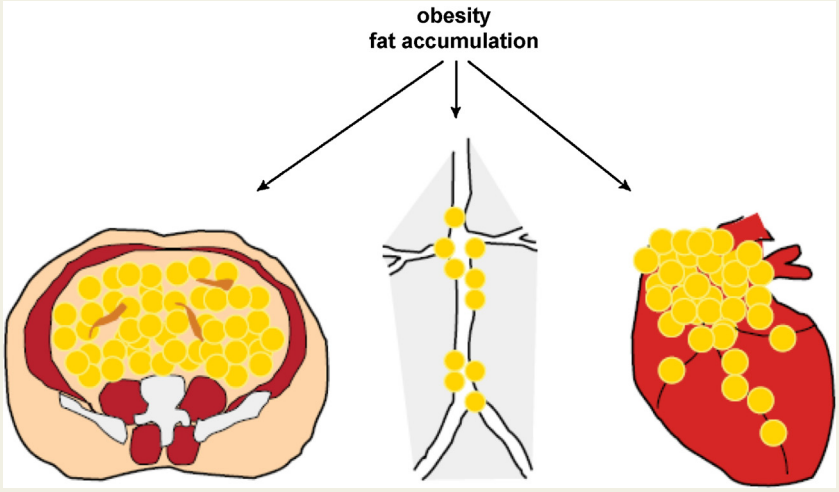

Figure 1 Fat deposition in obesity. Obesity is associated with increased fat deposition within the abdominal cavity, but also around blood vessels or within the pericardium (Hellenic J Cardiol. 2011; 52: 327-336, reproduced with permission).

control and a decrease in diabetes with increases in metabolically active brite cells. Recently the presence and/or functionality of BA have been proved diminished in obese people, suggesting a link between human BA and body weight regulation [9]. Potential regulators that lead to the appearance of active brown adipocytes have been identified [10]. Brown adipocytes may appear after thermogenic (particularly noradrenergic-mediated induction by cold) stimuli at anatomical regions corresponding to white adipose tissue (WAT). This process is called the ''browning'' of WAT [11]. In adult humans, brown adipose tissue is mainly composed of beige/brite adipocytes, although recent data indicate the persistence of classical BAT at some anatomical sites.

The Role of Adipokines

The white adipose tissue has been recently identified as a very active endocrine organ, which releases a number of endocrine and paracrine factors termed adipokines. Adipokines have an important role in the metabolism, inflammation, cardiovascular and endocrine system, mediating crosstalk between insulin-sensitive tissues.

Some of the adipokines taking part in the regulation of adipose tissue having a favourable or/and unfavourable effect on inflammatory, cardiovascular and metabolic status are the following:

Leptin might be both beneficial and detrimental. It controls the food intake and energy expenditure [12]. This hormone consists of 167 amino acids and its levels are increased with overfeeding and decreased with starving, thus regulating appetite. Its receptors are found in the central nervous system and other cells such as adipocytes and endothelial cells. It seems that it increases the production of proinflammatory cytokines by regulating different immune cells [13].

Chemerin's actions are controversial depending on cell types. It was identified in 2007 and consists of 131-137 aminoacids. Its plasma levels are significantly associated with body mass index, blood pressure and triglycerides [14] as it alters the metabolic properties of mature adipocytes [15]. On the other hand it inhibits vascular inflammation response [6].

Resistin is a 12 kDa peptide produced by macrophages of adipose tissue in humans [16]. It appears in two forms: as a trimer (monomeric form of the peptide hormone) and as a hexamer (dimeric form of the peptide hormone). High plasma levels of the hormone are related to increased cardiovascular risk and poor prognosis in coronary artery disease. Resistin levels decrease after rosiglitazone treatment [17].

Vaspin was identified in 2005 and consists of 392-395 amino acids. It is a member of the serine protease inhibitor family [18]. It has a beneficial role in glucose homeostasis by enhancing insulin sensitivity and controlling food intake via mechanisms not fully understood [18]. Furthermore it inhibits the expression of proinflammatory adipocytokines [6].

Visfatin is expressed in many cells and tissues. It is situated in visceral adipose tissue and possesses insulin like functions thus having a favourable profile in glucose homeostasis. On the other hand it can upregulate IL-6 and TNF-a in vivo and in vitro and enhances metalloproteinase-9 activity in monocytes [19] leading to a proinflammatory state.

The detailed description of all adipokines is beyond the scope of this review. The different actions of the novel adipokines are illustrated in Fig. 2.

Omentin

Structure of Omentin-1

Omentin-1-with uniprot code Q8WWAO and gene bank expression number AY549722- is another novel adipokine. Omentin was identified in an omental fat c DNA library in 2005 [20,21] and was initially described in intestinal Paneth