Perivascular adipose tissues and atherosclerosis

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Abstract

There is a close anatomical and functional relationship between adipose tissue and blood vessels. The crosstalk between these two organs is vital to both metabolic and vascular homeostasis. Almost all blood vessels are surrounded by perivascular adipose tissue (PVAT), which regulates vascular function by producing a large number of "vasocrine" molecules. Notably, PVAT exhibits striking similarity to brown adipocytes with high expression of uncoupling protein-1 (UCP1), a mitochondrial inner membrane protein which dissipates energy into heat. We found that obesity-induced endothelial dysfunction and vascular inflammation are associated with reduced browning of PVAT, but are revered by cold exposure-induced conversion of white to brown phenotype of PVAT. Likewise, UCP1 deficiency renders apoE$^{-/-}$ mice more susceptible to dietary fat-induced endothelial damage and atherosclerosis, without obvious effects on glucose, lipid metabolism and adiposity. Mechanistically, UCP1 exerts anti-oxidant and anti-inflammatory activities by reducing mitochondrial membrane potential (MMP) in PVAT, independent of its thermogenic activities. Treatment with a chemical uncoupler is sufficient to reduce reactive oxygen species and reverse atherosclerosis in UCP1 and apoE double deficient mice. Thus, the brown phenotype of PVAT is protective against vascular disease through a mechanism independent of thermogenesis. (Acknowledgement: supported by Hong Kong Research Grant Council C7030-17G)

Keywords

Perivascular fat; atherosclerosis; inflammation; cytokines; brown fat, mitochondria