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Short Communication

Marrow Adipose Tissue Role in Bone Metabolism

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DESCRIPITION

Adipose tissue, which is found throughout the body in various depots, may have an impact on general health through endocrine activity. Brown Adipose Tissue (BAT), which specialises in using energy to produce heat, is largely present above the clavicle and in the subscapular region of the back. White Adipose Tissue (WAT), which serves as an energy-storing reservoir, is primarily found in the subcutaneous and visceral depots. Bright/beige adipocytes, which also express the Uncoupling Protein (UCP), are similar to brown adipocytes in that they primarily store lipids and can be induced to transdifferentiate into a "brown-like" state with a well-defined thermogenic activity [1]. The presence of brite/beige fat in WAT in response to stimuli like exposure to cold weather suggests that sympathetic signalling is involved. The Bone Marrow (BM) contains adipocytes as well, and this Marrow Adipose Tissue (MAT) makes up more than 10% of the mass of all adipose tissue in humans. MAT had long been viewed as a largely passive and underestimated part of the BM microenvironment, but more lately, its potentially important and varied roles have come to light.

The widely held belief is that ageing, obesity, and various metabolic conditions increase the quantity of MAT in the body. It is important to describe the characteristics and roles of MAT because it is one of the major components in the BM niche. The majority of earlier reviews of the literature were concerned with the connection between MAT and bone metabolism/hematopoiesis [2]. The potential of MAT to secrete conventional adipokines (such as leptin and adiponectin) has been reported; however, this review, which incorporates the most recent data, has examined the control of other small molecules generated from MAT, such as inflammatory agents and cytokines. Additionally, we have examined the internal connections between MAT and some metabolic processes and summarised the current research on the fundamental characteristics and regulatory elements of MAT and some metabolic disorders.

MAT and energy metabolism

The enormous capacity of lipid storage is shown in WAT. The ability to retain lipids is not a unique property of WAT, as evidenced by the transfer of lipids from WAT to other depots. Significant amounts of fat are stored by marrow adipocytes, which also express the Insulin Receptor (InsR) and react to anti-diabetic Thiazolidinediones (TZDs) that increase insulin sensitivity [3]. This data clearly connects MAT to the energy metabolism. The tricarboxylic acid cycle can be used by fatty acids and lipids to produce Adenosine Triphosphate (ATP) for osteoblasts, albeit much less is known about how they are employed. Studies have shown that fatty acids can also be processed to produce ATP in osteoblasts by activating Wnt signaling pathway [4]. Fatty acids and lipids are constantly circulated and are also present in BM sera, even if the relative quantities and degrees of saturation may differ. This favours MAT as energy storage in bone.

The growth of bone MAT is facilitated by High Functioning Depression (HFD) in mice and obesity in humans, suggesting a stage of energy reserve. According to a recent study, HFD dramatically enhanced the expression of the lipid storage Markers Perilipin (PLIN), *LepR*, and Fat-Specific Protein (FSP) in all bone tissue. According to this information, MAT is storing more lipids. Running can also lower the size and number of marrow adipocytes and increase bone density and quality in obese mice [5]. According to reports, *PLIN3* is crucial for both boosting basal lipolysis and the oxidation of lipids. After running, MAT exhibits an increase in *PLIN3* expression. In conclusion, these results suggest that bone growth may be aided by using marrow fat as fuel.

CONCLUSION

There is strong evidence that MAT secreted Extracellular Vesicles (EVs), leptin, adiponectin, inflammatory cytokines like IL-6 and *TNF*, *RANKL*, as well as *DPP4* and other hormones. It has not yet been established that these substances, which also control glucose, energy, and bone metabolism, are both sourced from BM fat cells. Since the progenitor cells for both BM adipocytes and osteoblasts exhibit a push-pull relationship under most circumstances. However, some research has also indicated a favourable relationship between adipocytes and osteoblasts. There

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hasn't been a thorough investigation of the causes of these conflicting outcomes. While the concept that MAT acts as an energy source has been questioned because MAT increases during caloric restriction and HFD, the existing research has demonstrated that MAT can provide energy for osteoblasts during exercise. Studies on both humans and animals have discovered an unbreakable relationship between MAT and IR. We conclude that whereas adiponectin and leptin promote insulin sensitivity, *DPP4* and *TNF-* produced by MAT may increase Insulin Resistance (IR). Studies have produced a variety of outcomes because of these hormones' diametrically opposed effects. As discussed above, MAT is an unique endocrine organ that may have an impact on global metabolism. Future research will be essential to understand the function of MAT and how it connects to bone and overall metabolism.

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