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Bone Marrow Adipose Tissue: White, Brown or Beige?

Hero Robles

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The role and regulatory mechanisms of white (WAT) and brown adipose tissues (BAT) have been extensively explored. Previous research has also identified adipocytes within the skeleton known as bone marrow adipose tissue (BMAT). These cells comprise approximately 60-70% of bone marrow in an average adult human. However, despite their prevalence, the function and regulation of BMAT remains poorly characterized. A key question concerning BMAT function is whether it is capable of induced thermogenesis, multilocularity, and UCP1 expression, also known as beiging. Reconstruction of the bone marrow niche via 3D electron microscopy suggests MAT has an extensive mitochondrial network interspersed around lipid droplets. We also found that BMAT adipocytes in 3-week-old mice are multilocular and resemble BAT. Lastly, we found that CL316,243, a β3-adrenergic agonist, is capable of inducing lipid remodeling in a subset of BMAT adipocytes. Thus, we hypothesized that BMAT has a distinctive phenotype which, like beige and brown adipocytes, may undergo induced UCP1 expression. To address this, we developed two mouse models of inducible UCP1 expression. In the first, UCP1-Cre drives DTA expression and cell death after β3-agonist stimulation. In the second, UCP1-Cre drives green fluorescent protein expression (GFP) allowing us to track cells expressing this protein. We found that treatment of adult UCP1-Cre/DTA mice with CL316,243 was associated with loss of inguinal WAT (iWAT) mass, however, we did not observe an increased loss of BMAT compared to control mice with this treatment. Similarly, our reporter mouse model demonstrated that CL316,243 selectively activated GFP in iWAT but not in BMAT. Overall, the data suggests that BMAT adipocytes are capable of induced remodeling, however, they are not true UCP1-expressing beige adipocytes. This supports the paradigm that BMAT adipocytes are a unique subpopulation between white and beige cells and are likely specialized to support cells within the skeletal niche.