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The Gravity of Weight

Heavy: Uneasy Lies the Fat that Wears a Crown

The "crown-like structures" of dying white fat cells that 'flesh is heir to'

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Overweight or obesity is an excess accumulation of fat. The greater the amount of fat, the worse the level of obesity. Other than an excess accumulation of fat, as I have said in my last blog entry, there is no other sign or symptom that is present in everyone who is obese or even overweight. So let's wax a bit Shakespearean (e.g *Henry IV, Part II* and *Hamlet)* and ask what do we really know about fat?

Fat, or more technically, adipose tissue, was long thought to be an inert substance whose sole purpose was to cushion and support our other organs, as well as provide insulation against the cold. Our body has white fat, browned white fat (also known as "beige fat"), and brown fat. For those interested in beige and brown fat, please see my blog: *Special Delivery: What Can (Brown) Fat Do for You?*

The primary function of white adipose tissue is energy storage. We now now that white fat is quite a remarkable substance and far from inert: it is a highly metabolically active endocrine organ that secretes about 100 substances, including the hormones leptin and adiponectin, and dangerous "pro-inflammatory" substances such as tumor necrosis factor alpha and interleukin-6, as well as many so-called *adipokines* whose functions are still unknown. What is fascinating is that white fat is an organ found in multiple places all over our body and is constantly undergoing remodeling.

"crown-like structures" of macrophages form on top of dead fat cellsSource: istock.com/aweibel, used with permission

Heavy is he who wears the crown!

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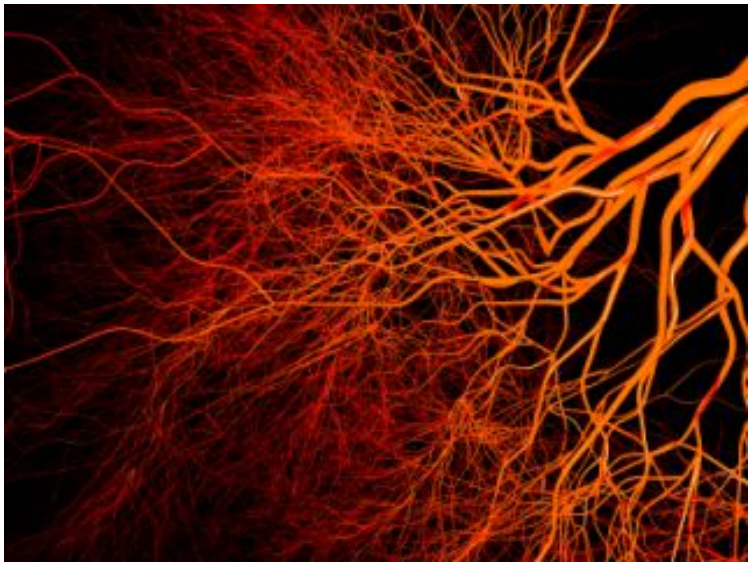
White fat and the pattern of its distribution can have a “profound influence” on our health and the risk for disease, according to researchers Lee and colleagues, writing in the journal *Molecular Aspects of Medicine* (2013). White fat that is found in the areas of the upper body around the abdomen just below the skin (i.e., subcutaneous) and particularly, viscerally (i.e., abdominal fat that encases our internal organs) results in a large waist and the “apple” shape appearance more commonly seen in men. Fat in this central location is potentially the most dangerous kind and is more likely associated with metabolic abnormalities such as insulin resistance, glucose intolerance, abnormal levels of trigylcerides and cholesterol, hypertension, and ultimately cardiovascular disease. Subcutaneous fat found in the gluteo-femoral areas (i.e,. the “pear” body shape of fat located predominantly on the hips) may even be somewhat protective of metabolic disturbances and is more commonly seen in women. Where our fat accumulates when we gain weight is most likely genetically based. With obesity, adipose tissue can also accumulate in other organs, forming so-called “ectopic” fat deposits, such as in the liver (e.g. fatty liver as a precursor to cirrhosis), skeletal muscles, heart, and blood vessel walls and cause substantial damage to these organs.



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Polish researchers, Wronska and Kmiec, in the journal *Acta Physiologica* in 2012 note that white fat is composed predominantly of spherical adipocytes that are lipid (i.e., trigylceride)-filled cells, but it also contains precursor cells, or pre-adipocytes, that do not contain lipid but have that potential to become lipid-filled, as well as endothelial cells of blood vessels and lymph tissue, nerve fibers, and macrophages that are cells involved in inflammation. White fat tissue also contains stem cells that can differentiate into other kinds of cells, including neurons and even liver cells. Adipose tissue depends on a rich network of blood vessels to transport oxygen and other substances to it and provide a route away for its many secretory adipokines. When we gain weight initially, we get “enhanced angiogenesis” (i.e., more blood

vessels are created) and when we lose weight, these blood vessels regress. It is “is probably the most highly vascularized tissue in the body.” (Lemoine et al, *Thrombosis and Haemostasis*, 2013) There is speculation that when fat cells become too massively enlarged, their blood supply becomes insufficient, hypoxia (lack of oxygen) develops, and there occurs an infiltration of macrophages and subsequent inflammation. With obesity, when white fat cells are dying or die, they become surrounded by macrophages that create the so-called “crown-like structures” around the top of the fat cells. These crown-like structures around dying or dead (necrotic) fat cells are more common in visceral fat than subcutaneous fat and are thought related to the development of the metabolic disturbances. In fact, obesity has been described as a chronic low-grade inflammatory and metabolic disease. (Suganami and Ogawa, *Journal of Leukocyte Biology,* 2010) Adipose tissue enlarges primarily by hypertrophy (i.e., increased size of an individual fat cell) or, if the obesity is severe, by hyperplasia (i.e., increasing the actual number of fat cells.) There is significant turnover of fat cells, but unfortunately, even when we lose considerable weight by diet or bariatric surgery, our fat cell numbers remain the same; they just shrink in volume.

It is possible that eventually interfering with the blood supply of fat tissue will be a treatment for some forms of obesity.

About the Author

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In Print: *The Gravity of Weight: A Clinical Guide to Weight Loss and Maintenance*

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