Adipose tissue

Adipocyte

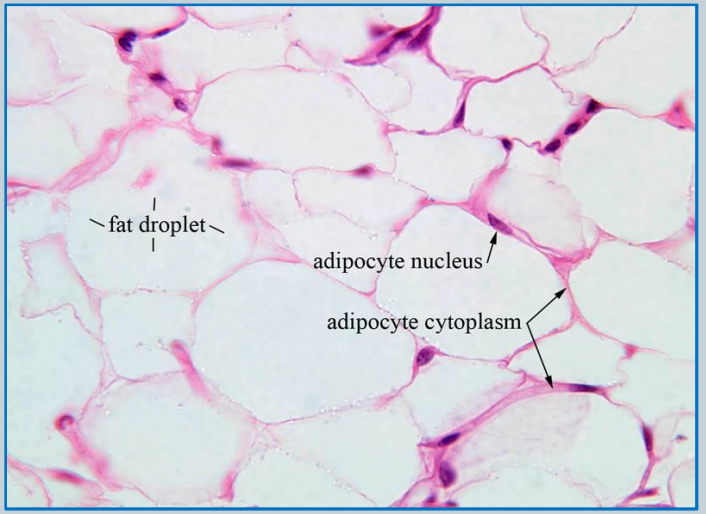
- Large cells

1. Isolated or in small group(In loose or irregular connective tissues)
2. Large aggregation as adipose tissue or fat

- 15-20% in men
- Storage of neutral fat
- Key regulator of body energy metabolism

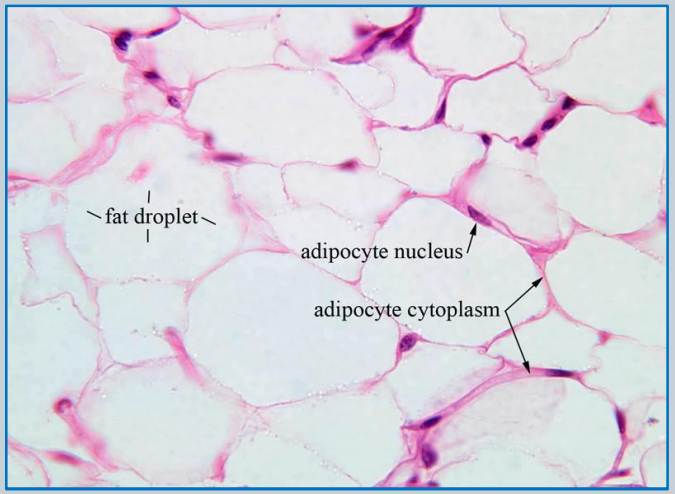
Why fat is chosen as nutrient storage?

1. Insoluble in water(no adverse osmotic effects)
2. High caloric density of triglycerides



Adipocyte

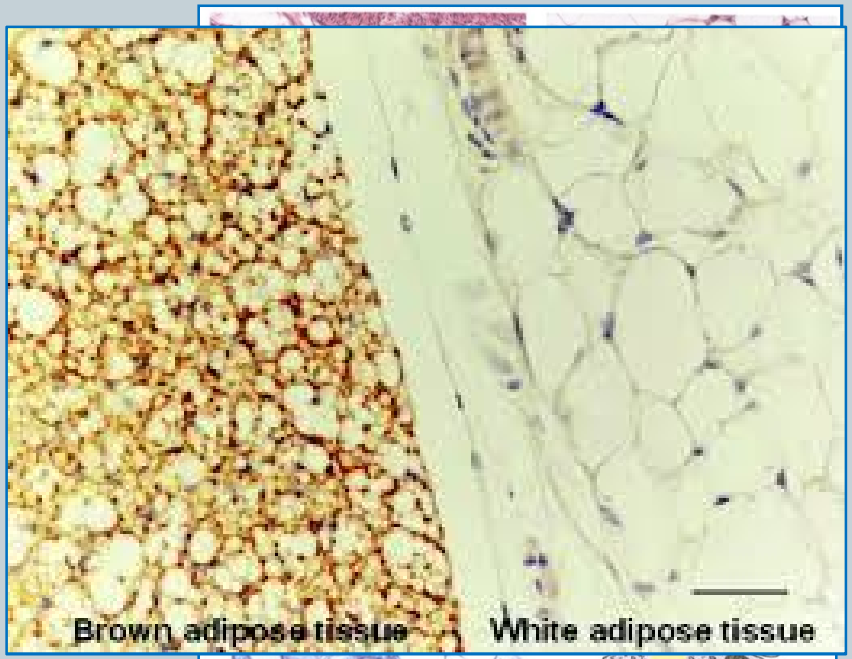
Adipocyte function:

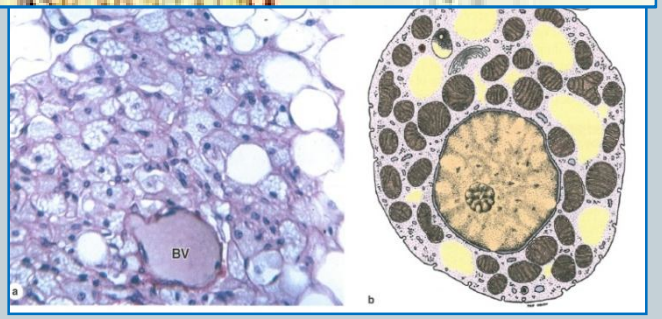


- Concenterate Lipid droplet
- High Metabolic activity
- Response to both hormonal & nervous stimuli
- Release hormone & important substances
- Thermal insulator of body
- Cushion & keep organs in their sites
- Subcutaneous adipose layer shape the body surface
- Pad-like deposits in palms & soles act as shock absorb

Adipose tissue types

- **White adipose tissue**
- **Brown adipose tissue**



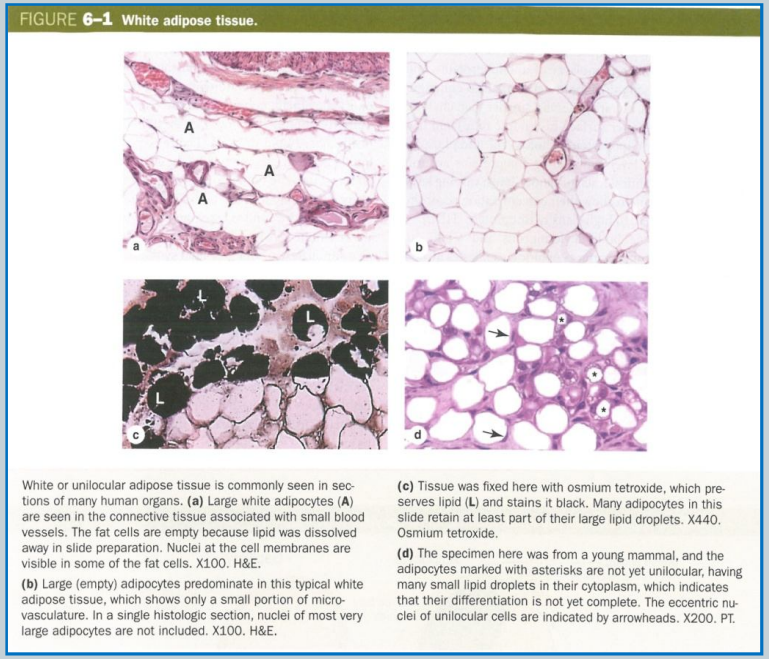


White adipose tissue
- More common
- One large whitish-yellow lipid droplet

Brown adipose tissue
- Multiple lipid droplets
- Mitochondria association then darker appearance

White adipose tissue

- More common
- One large whitish-yellow lipid droplet
- Long term energy storage
- Very large cell (50-150µ)
- Spherical isolated cells & polyhedral in cellular packs
- Single huge droplet (unilocunar)
- Signet-ring appearance
- Nucleus, Golgi Ap., RER. SER
- Lipid droplet-cytoplasm interface is reinforced by vimentin
- Adypocyte is surround by external lamina (coll. IV)
- Incompletely lobulation by Connective tissue Partitions
- Connective tissue Partitions supply blood & innervate it
- Fibroblast. macrophage & other cell (50%)
- Reticular fibers make a fine network for isolated adipocyte
- White adipose tissue distribution depends on sex hormones



>> MEDICAL APPLICATION

Unilocular adipocytes can generate benign tumors called **lipomas** that are relatively common, although malignant adipose tumors (**liposarcomas**) occur infrequently. Fetal lipomas of brown fat are sometimes called **hibernomas.**

Lipid storage & mobilization

- **Triglyceride**

1. Chylomicrons (triglyceride & cholesterol esters from digested food)
2. VLDLs synthesized in liver
3. Local biosynthesis (free fatty acid & glycerol)

Covered by apolipoproteins, phospholipids & cholesterol monolayer
Chylomicron & VLDL are hydrolyzed capillary 's lumen by lipoprotein lipase

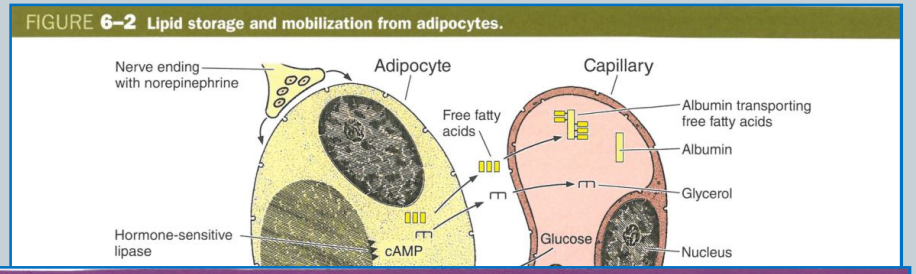
Insulin

1. Accelerated fatty acids synthesis in adipocytes
2. Stimulate glucose uptake
3. Increase lipoprotein lipase synthesis

Nervous & hormonal stimuli:
hydrolyze lipids released glycerol & fatty acid in blood
Norepinephrone of post ganglionic sympatetic
activate hormone –sensitive lipase
that break triglycerides in lipid droplets
In blood bind to carrier protein albumin

Glucagon
Growth factor

Leptin (satiety factor for hypothalamus)



» MEDICAL APPLICATION

Leptin was discovered and is well studied in genetically obese mice, but such studies have not led to new treatments for human obesity. In most obese humans adipocytes produce adequate or excess quantities of leptin, but target cells are not responsive due apparently to insufficient or defective receptors or postreceptor signal transduction.

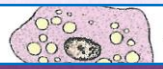
White adipose tissue histogenesis

- Embryonic mesenchymal cell
- Preadipocytes
- Fibroblast like cells
- Lipid storage in their cytoplasm
- Many droplets
- One droplet

- 30 week of pregnancy
- Before birh visceral & subcutaneous deposition
- Adipocyte formation after birth
- Around small blood vessels (mesenchymal cells)

>> MEDICAL APPLICATION

In addition to leptin, white adipose tissue secretes numerous other cytokines and other factors with paracrine and autocrine activity, including many proinflammatory cytokines. It is not clear whether these are produced by adipocytes or other cells of the tissue such as macrophages or fibroblasts. With its increased amounts of white adipose tissue, obesity is characterized by a state of chronic mild inflammation. Proinflammatory factors released from visceral fat are being investigated for links to the **inflammation-related disorders associated with obesity**, such as diabetes and heart disease.



>> MEDICAL APPLICATION

Adult-onset obesity is very often associated with age-related metabolic changes and may involve reduced activity of the hormone-sensitive lipases of adipocytes, causing less effective fat mobilization out of the cells. The increased number of adipocytes produced during **childhood obesity** predisposes an individual to obesity in later life. Despite claims of various fad **diets**, there is no evidence that any particular type of caloric restriction is more effective than others; rather, any intake of calories that is lower than the energy expenditure will result in loss of adipose tissue.

Brown adipose tissue

- 2-5% body weight
- Bach, neck, shulders
- In adults:
- Around kidney, adrenal, aorta, mediastinum
- Cytochrom of abundant mitochondria & blood vessel
- Many small lipid inclusions
- Heat production

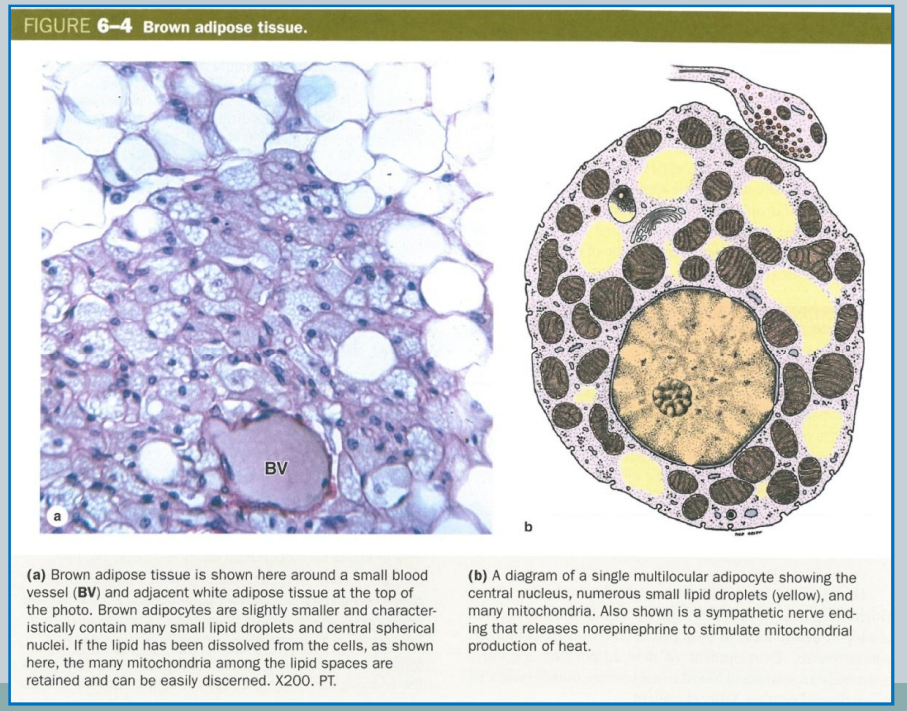


FIGURE **6–4** Brown adipose tissue.

(a) Brown adipose tissue is shown here around a small blood vessel (**BV**) and adjacent white adipose tissue at the top of the photo. Brown adipocytes are slightly smaller and characteristically contain many small lipid droplets and central spherical nuclei. If the lipid has been dissolved from the cells, as shown here, the many mitochondria among the lipid spaces are retained and can be easily discerned. X200. PT.

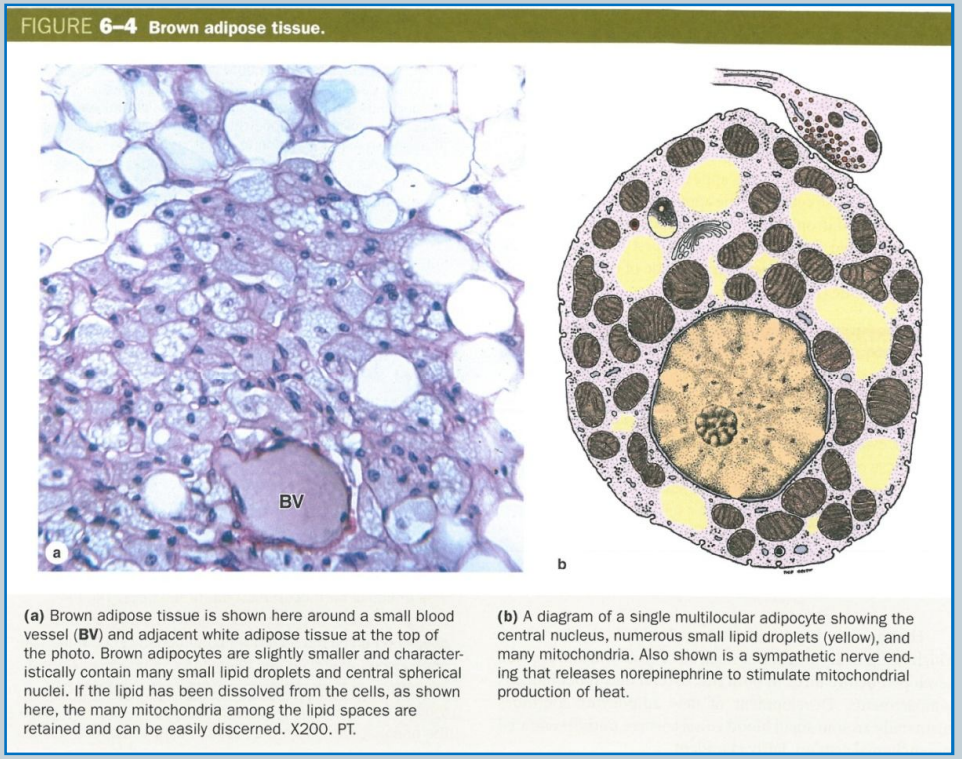
(b) A diagram of a single multilocular adipocyte showing the central nucleus, numerous small lipid droplets (yellow), and many mitochondria. Also shown is a sympathetic nerve ending that releases norepinephrine to stimulate mitochondrial production of heat.

Brown adipose tissue

- Small polyhedral cells
- Centric nucleus
- Lobulated by connective tissue
- Direct enervation by sympatetic

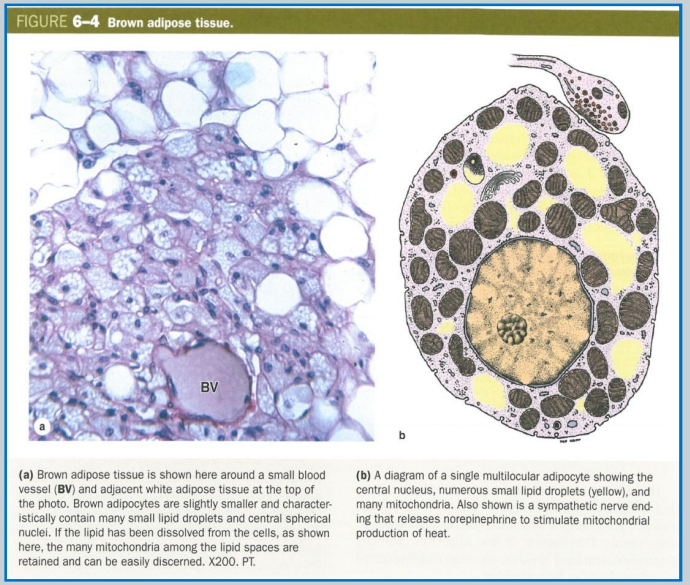
- Thermogenesis
- Hibernating animal & newborn
- Norepinephrine
- Hormone sensitive lipase activation
- Triglyceride hydrolysis
- Fast metabolization
- O2 consuming & heat production

- Thermogenin pr in mitochonrial inner membrane



Brown adipose tissue histogenesis

- Embryonic mesenchymal cell
- Preadipocytes
- Before white adipose tissue
- Weight dependant
- In slime person more active
- Increase in brown adipose tissue in cold period
- Appear in white adipose tissue
- Proliferation & differentiation from progenitor cells or
- Change in differentiation status of white adipose tissue



- **Autonomic nerves:**
- Thermogenic activity
- Brown adipocytes differentiation
- Prevent apoptosis