

# Adipose Tissue

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# Adipose tissue & adipocytes

- ▶ Connective tissue in which fat-storing cells or **adipocytes** predominate is called **adipose tissue**
- ▶ Adipocytes are metabolically active cells that specialize in storing triglycerides
- ▶ There are two major types of adipose tissue with different locations, structures, colors, and functions.
  - ▶ **White adipose tissue**
  - ▶ **Brown adipose tissue**

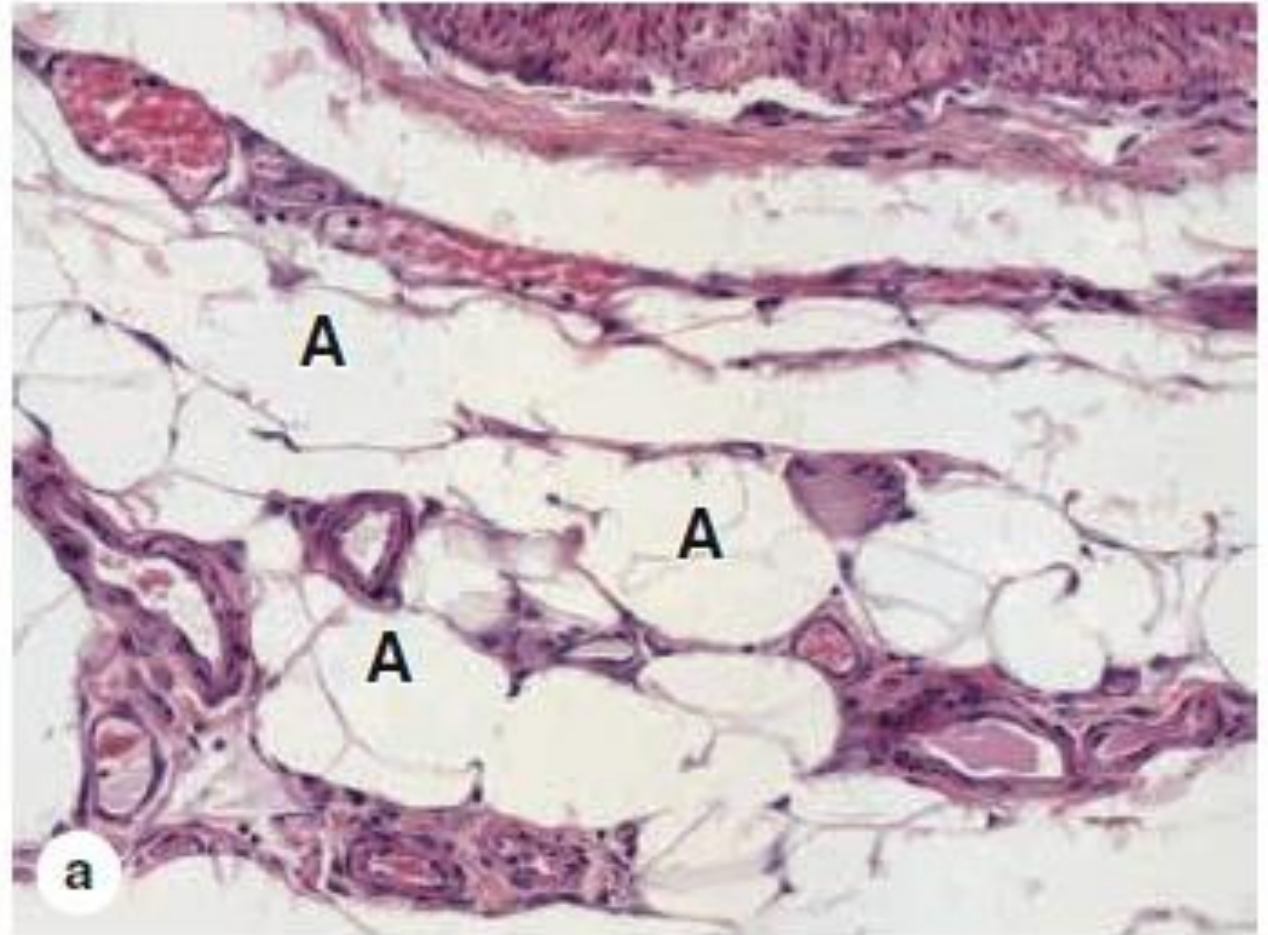
# White Adipose Tissue

- ▶ The more common type
- ▶ Specialized for fat storage
- ▶ Consists of cells each containing one large cytoplasmic droplet of whitish-yellow fat (white adipocytes)
- ▶ Subdivided into incomplete lobules by partitions of connective tissue containing a vascular bed and nerve network
- ▶ Reticular fibers form a fine network that supports individual fat cells and binds them together

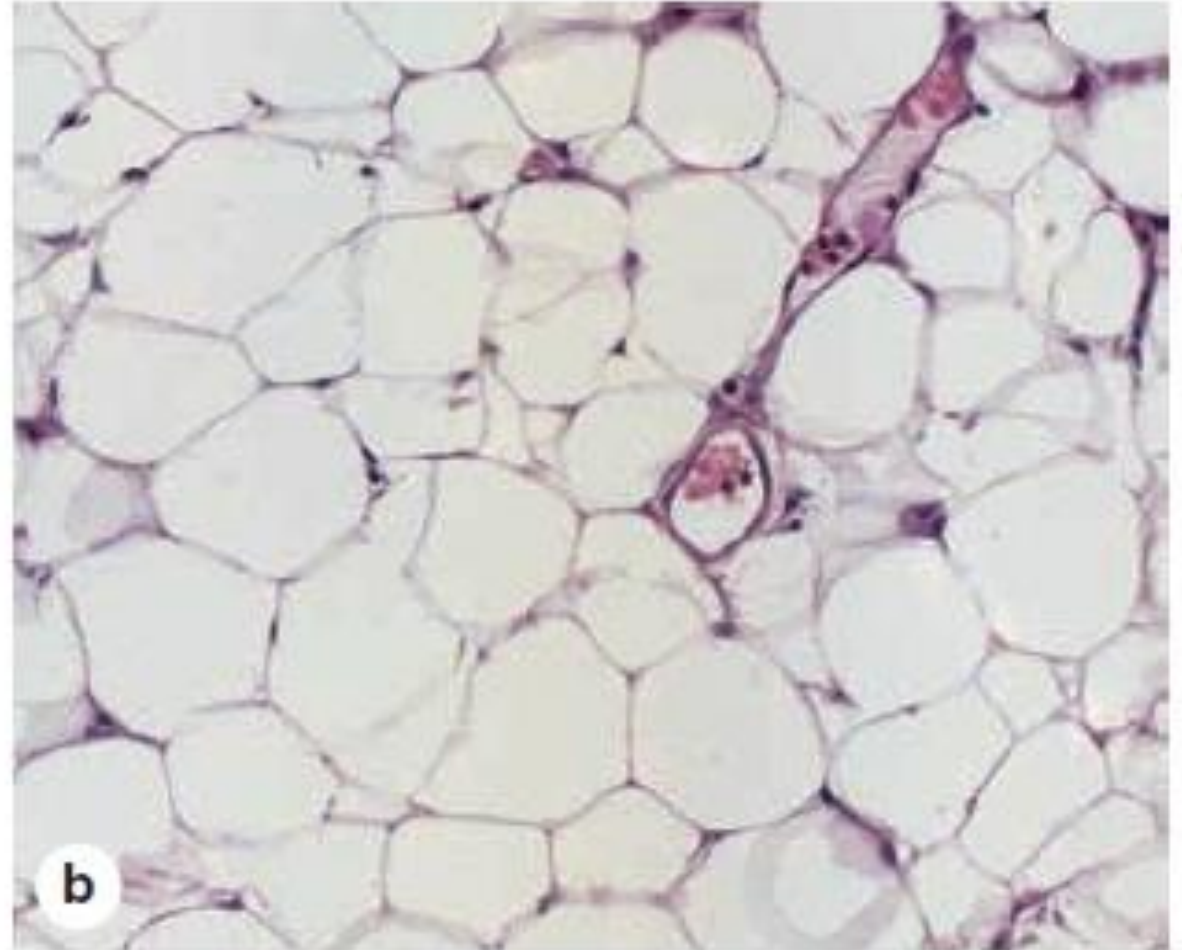
# White adipocyte

- ▶ A white adipocyte is very large
- ▶ It contains a single huge droplet of lipid filling almost the entire cell
- ▶ White adipocytes are also called **unilocular**
- ▶ They often appear empty in standard light microscopy
- ▶ They are said to have a signet-ring appearance

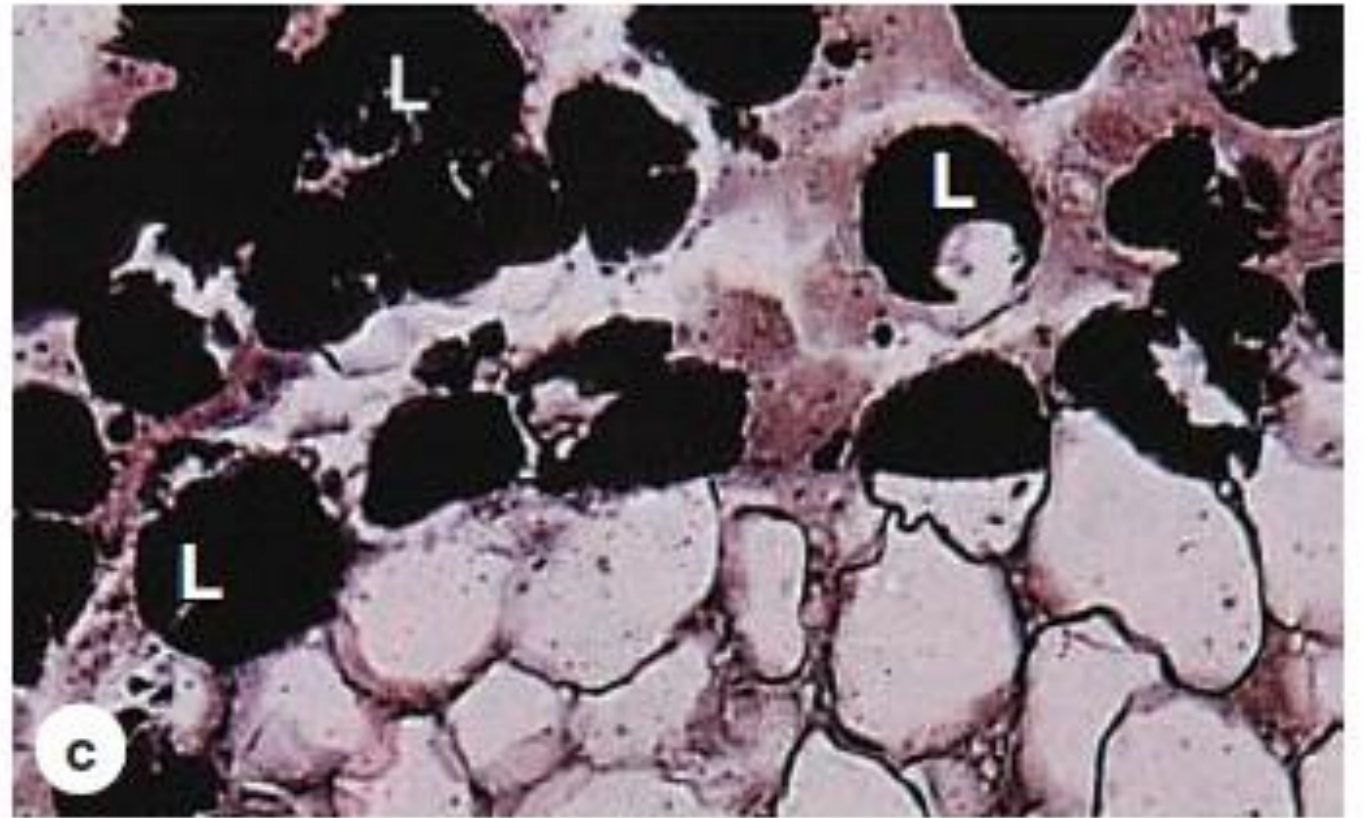
- ▶ Large white adipocytes (A) are seen in the connective tissue associated with small blood vessels.
- ▶ The fat cells are empty because lipid was dissolved away in slide preparation.
- ▶ Nuclei at the cell membranes are visible in some of the fat cells



- ▶ Large (empty) adipocytes predominate in this typical white adipose tissue, which shows only a small portion of microvasculature.



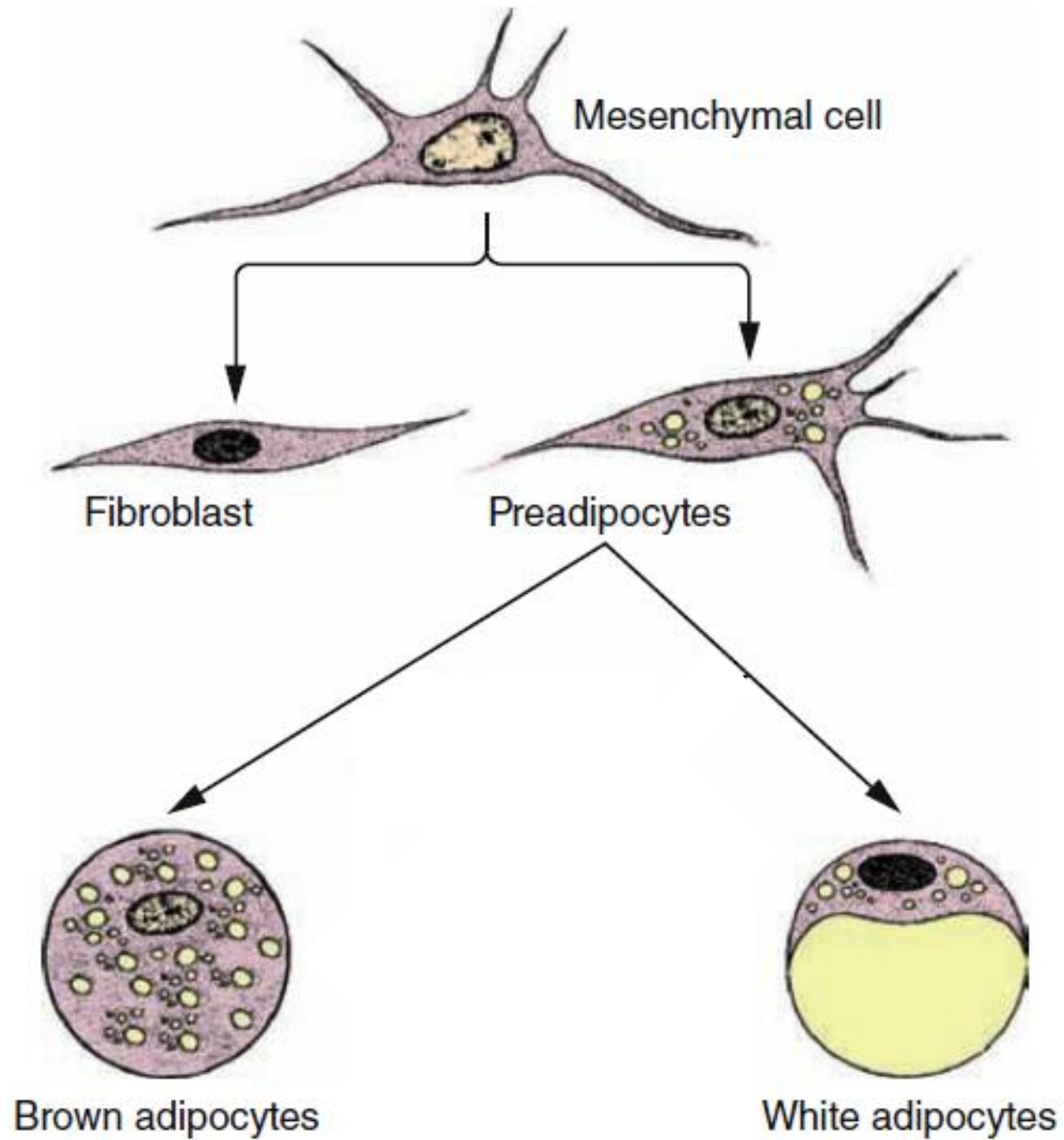
- ▶ Tissue was fixed here with osmium tetroxide, which preserves lipid (L) and stains it black.



# Histogenesis of White Adipose Tissue

- ▶ Adipocytes develop from mesenchymal stem cells
- ▶ Adipose development first produces **preadipocytes**, which look rather like larger fibroblasts with cytoplasmic lipid droplets
- ▶ Initially the droplets of white adipocytes are isolated from one another but soon fuse to form the single large droplet





# Development of White Adipose Tissue

- ▶ Humans are born with stores of white adipose tissue which begin to accumulate by the 14th week of gestation.
- ▶ Proliferation of progenitor cells stops by late gestation
- ▶ After that, adipose tissue increases mainly by the filling of existing adipocytes until around age 10.
- ▶ This is followed by a period of new fat cell differentiation which lasts through adolescence.
- ▶ New adipocyte formation occurs around small blood vessels, where undifferentiated mesenchymal cells are most abundant.

# Adult Vs Childhood Obesity

- ▶ Excessive adipose tissue accumulation, or obesity, occurs when nutritional intake exceeds energy expenditure.
- ▶ Adult-onset obesity mainly involves increasing the size of existing adipocytes (**hypertrophy**).
- ▶ Childhood obesity often involves increases in both adipocyte size and numbers due to the differentiation of more preadipocytes from mesenchymal cells (**hyperplasia**).
- ▶ Weight loss after dietary changes is due to reductions in adipocyte volume, but not their overall number.

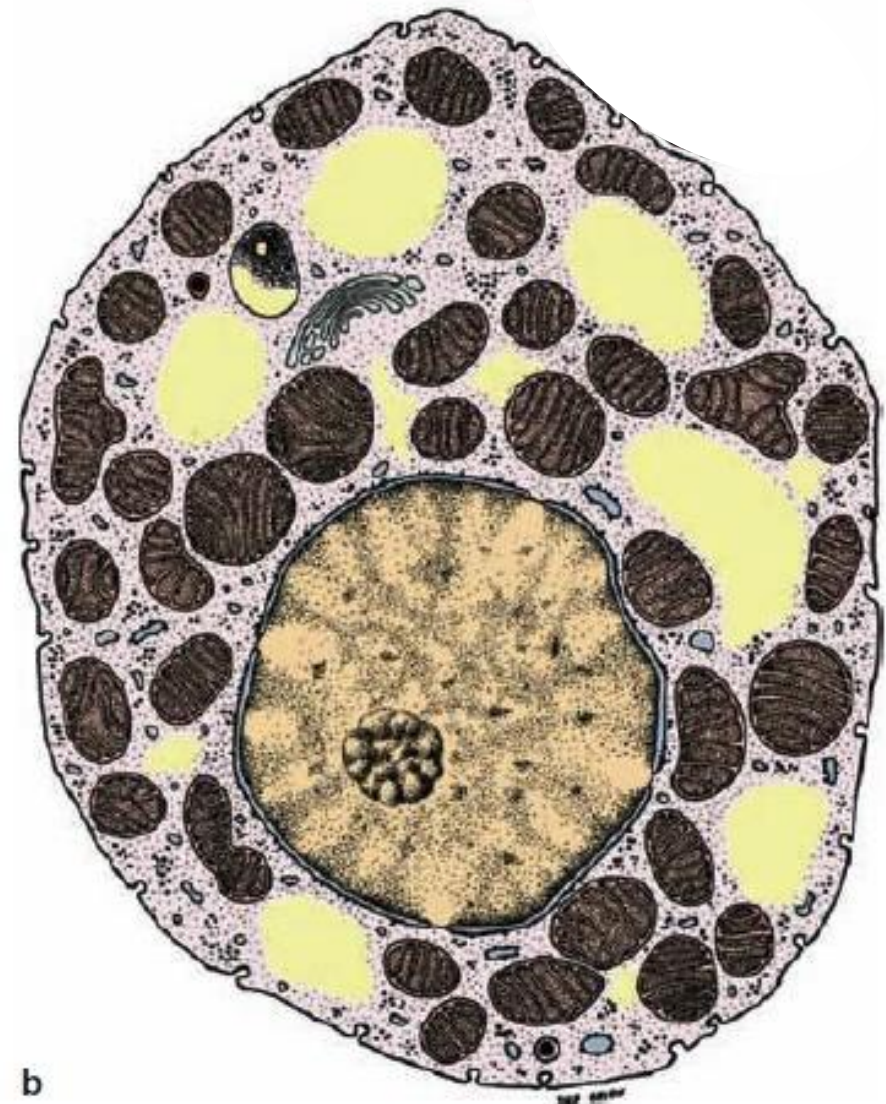
# Brown Adipose Tissue

- ▶ Brown adipose tissue constitutes 2%-5% of the newborn body weight
- ▶ It is located mainly in the back, neck, and shoulders
- ▶ It is greatly reduced during childhood and adolescence.
- ▶ Cells have multiple lipid droplets interspersed among abundant mitochondria
- ▶ Its color is due to the very abundant mitochondria and the large number of blood capillaries in this tissue.
- ▶ Brown adipocytes release heat and function to warm the blood.

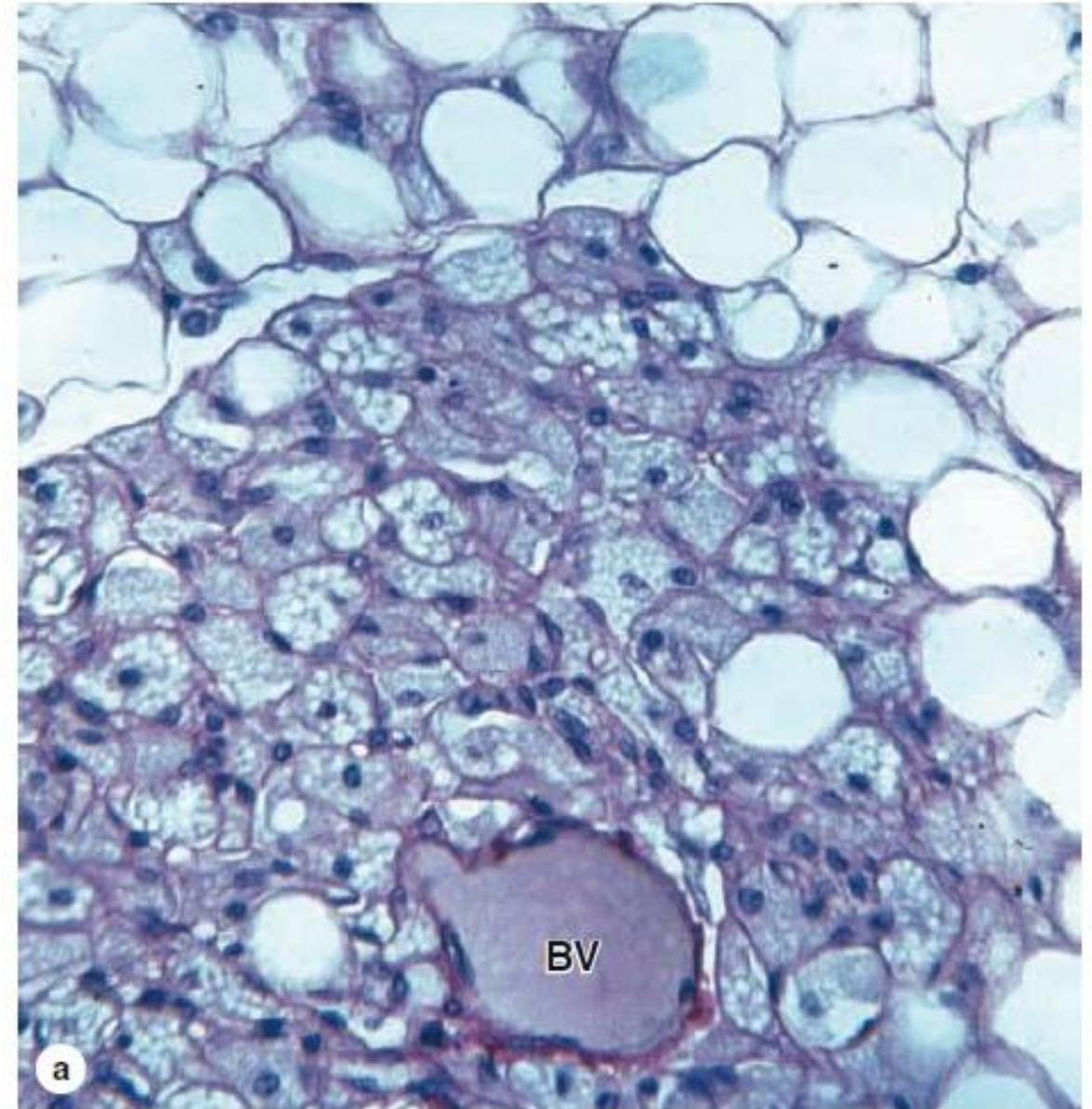
# Brown Adipocytes

- ▶ Brown adipocytes contain many small lipid inclusions
- ▶ They are called **multilocular**
- ▶ The small lipid droplets, abundant mitochondria, and rich vasculature all help mediate this tissue's principal function of **heat production** and warming the blood.
- ▶ Cells of brown fat are polygonal and generally smaller than white adipocytes
- ▶ The nucleus is centrally located
- ▶ Brown adipocytes are often closely packed around large capillaries
- ▶ The tissue is subdivided by connective tissue partitions into lobules

- ▶ A diagram of a single multilocular adipocyte showing the central nucleus, numerous small lipid droplets (yellow), and many mitochondria.



- ▶ 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 seen



# Histogenesis of Brown Adipose Tissue

- ▶ Adipocytes develop from mesenchymal stem cells
- ▶ Adipose development first produces **preadipocytes**
- ▶ In humans the amount of brown fat is maximal relative to body weight at birth, and partially disappears by involution and apoptosis during childhood



