2- Elastic fibers (yellow fibers)

They are consist of protein called **elastin**. In fresh state, these fibers appear yellowish color and therefore called yellow fibers. These fibers are thin, long, wavy, run singly and branching forming an irregular network in the tissue (Figure.1). Elastic fibers composed of central core of **elastin** and is surrounded by a sheath of **microfibrils** (Figure.2).

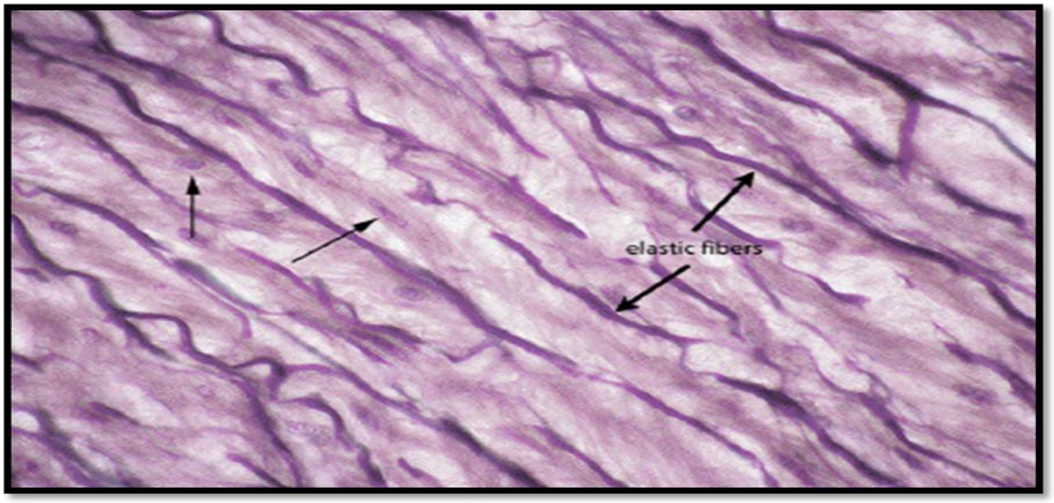


Figure (1): The characteristic features of elastic fibers.

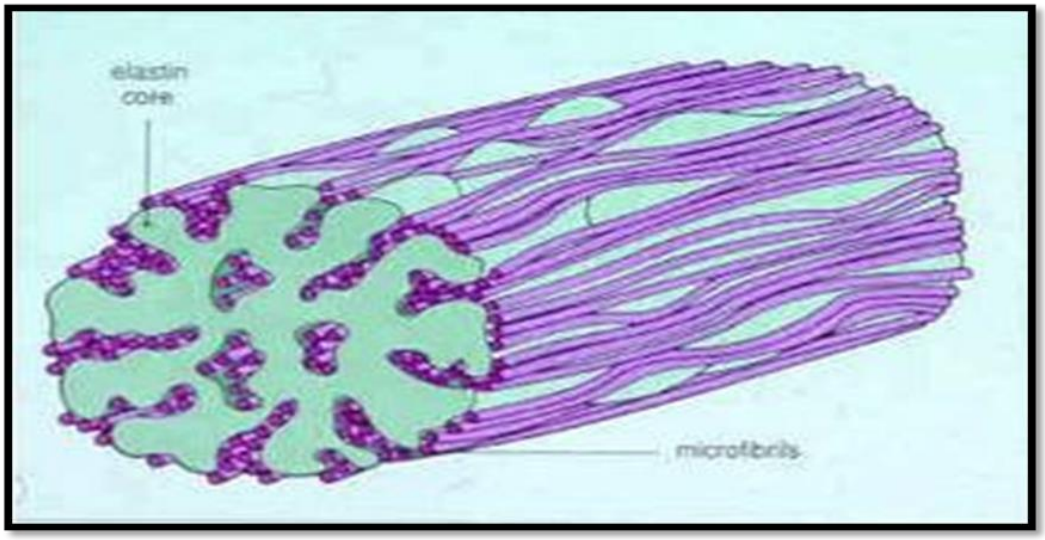


Figure (2): The structure of elastic fiber.

There are three types of fibers: **oxytalan**, **elaunin**, and **elastic fibers**. The structure of these fibers develop through three successive stages during synthesis of elastic fibers. In the **first stage**, the fiber consists of a bundle of microfibrils that composed of various glycoprotiens. These **oxytalan fibers** can be found in the dermis of skin.

In the **second stage** of development an irregular deposition of protein elastin appears between the oxytalan fibers, forming **elaunin fibers**. These fibers found around sweat glands and in the dermis of the skin. During the **third stage**, elastin gradually accumulates until it occupies the center of these fibers which are surrounded by thin sheath of microfibrils, these fibers called **elastic fibers**.

Elastic fibers found in the skin, ligaments, blood and lymphatic vessels. Elastic fibers are very elastic and highly retractile fibers.They can be stretched and confer elasticity to tissues and allow them to stretched (1-1.5 times) their length and then to recoil to its original state when exposed to forces. Also the presence of these fibers in blood vessels large contribute to the efficiency of blood circulation..

Elastic fibers are produced by fibroblast, the microfibrils are formed first and then the elastin is deposited into the space surrounded by these microfibrils. Elastic fibers are produced as proelastin that polymerizes producing amorphous rubber-like glycoprotein called elastin.

3- Reticular fibers

These fibers are thin with diameter (0.5-2µm), that branch to form extensive network in certain organs (Figure.3). These fibers composed mainly of **type III collagen**. These fibers not visible in hematoxylin and eosin

preparation but can be easily stained black by staining with silver salts. Because of their affinity for silver salts these fibers are called **argyrophilic fibers**.

Reticular fibers are particularly abundant in smooth muscle, and the framework of hemopoietic organs (e.g. spleen, lymph nodes, and red bone marrow), and constitute a network around the cells of parenchymal organs (e.g. liver and kidney). Reticular fibers provide a supporting framework for the tissues and organs. These fibers create a flexible network in organs that are subjected to changes in forms or volume such as arteries, liver and spleen, also act as supporting stroma in hemopoietic tissues.

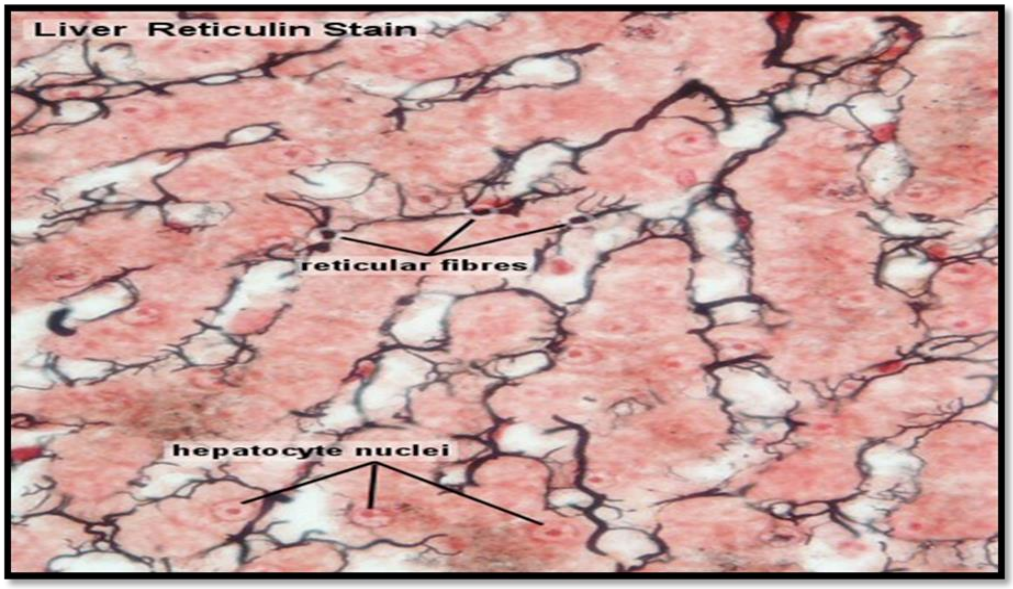


Figure (3): The reticular fibers in liver

Connective tissue cells

A variety of cells are found in connective tissue, which differ according to their origin and function (Figure.4). These cells are grouped into two categories, these are:

1-Fixed cells (resident cells)

These cells differentiate from **mesenchymal cells** such as **fibroblasts** and **adipocytes**. These cells are formed and reside in the connective tissue.

2- Wandering cells (free cells)

These cells arise from hematopoietic stem cells in the bone and circulate in the blood, differentiate in the bone marrow and migrate from the blood circulation into connective tissue where they remain and perform their functions. These cells include **mast cells**, **macrophages**, **plasma cells**, and **leukocytes**.

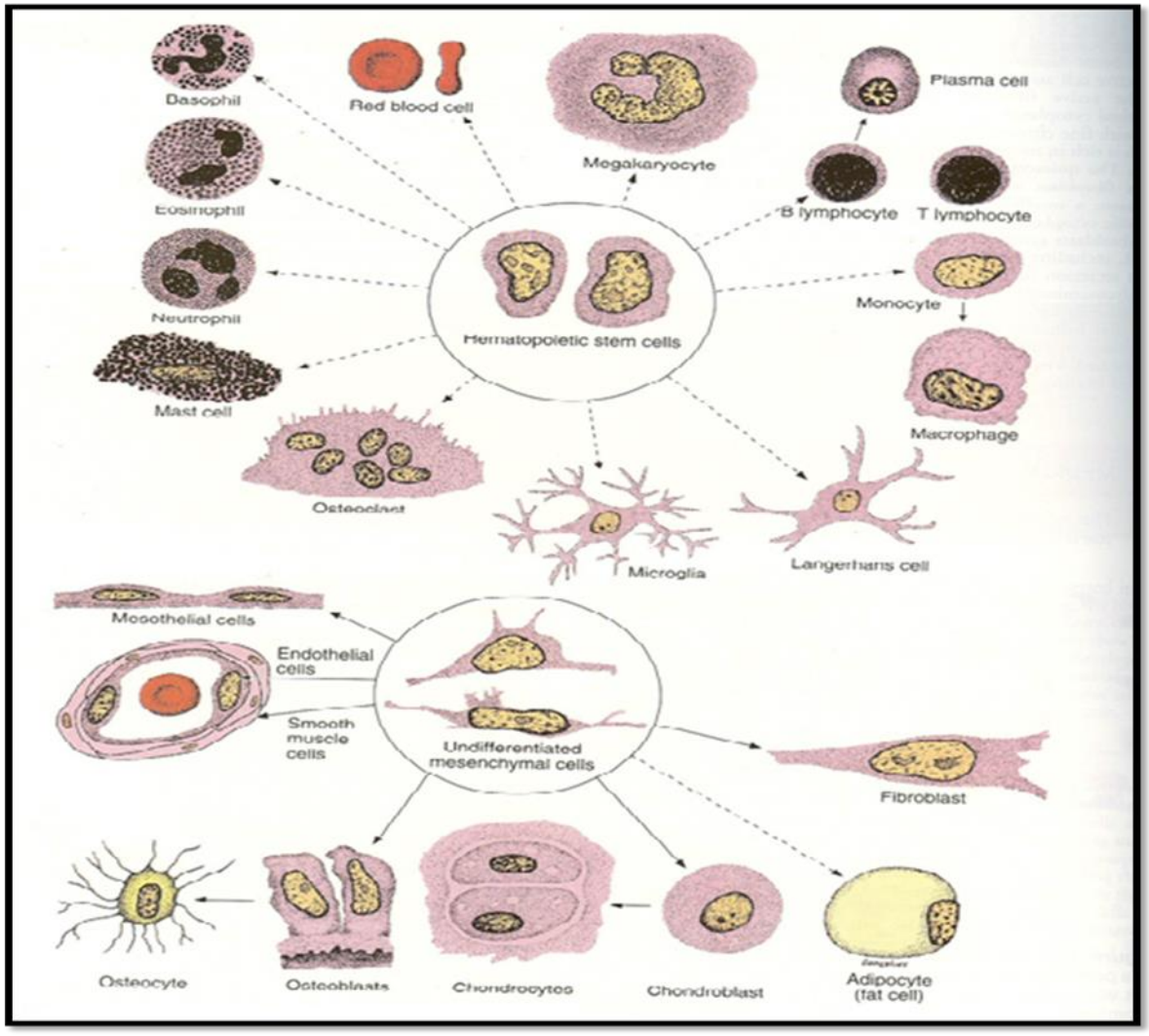


Figure (4): The types of cells in connective tissue.

Fibroblasts

These cells are the most common cells in connective tissue and widely distributed connective tissue types. These cells are fusiform in shape with slender cytoplasmic process. These are responsible for the synthesis and maintenance of fibers and ground substance. These cells are derived from undifferentiated mesenchymal cells.

There are two differentiated morphologic types of fibroblasts according to their activity stage, active fibroblasts and quiescent fibroblasts. The **active fibroblast** is large, elongated, fusiform cells with abundant irregularly branched cytoplasmic processes (Figure 5). Its nucleus is ovoid, large in shape and pale-staining. The cytoplasm is basophilic rich in rough endoplasmic reticulum and the Golgi apparatus is well-developed.

The **inactive (quiescent) fibroblast** also called **fibrocyte** is smaller than active fibroblast with fewer cytoplamic processes. The nucleus is smaller, darker and elongated. The cytoplasm is acidophilic which has small amount of rough endoplasmic reticulum (Figure 6).

Fibroblasts become very active during wound repair and healing process. Fibroblasts synthesize most components of connective tissue including collagen, elastic and reticular fibers, and the glycosaminoglucans, proteoglycans and glycoproteins of the ground substance. In general, fibrocytes are fewer in number in circulation but have been shown to increase in quantity due to any pathology such as tissue damage. The fibrocyte reverts to the fibroblast state and its synthetic activities are reactivated, under stimulation such as during wound healing. These cells undergo cell division (mitosis) when the organ requires additional fibroblasts. Also may differentiate into certain other types of connective tissue cells.

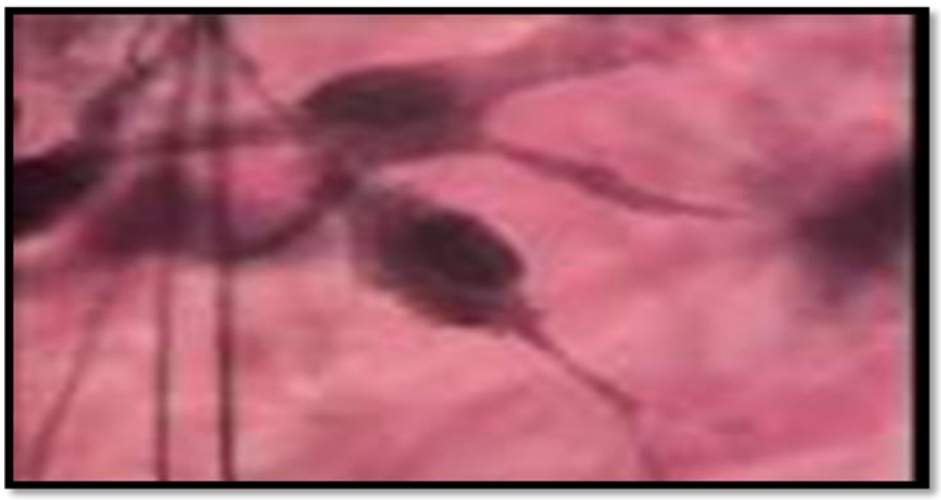


Figure (5): The characteristic features of fibroblast.

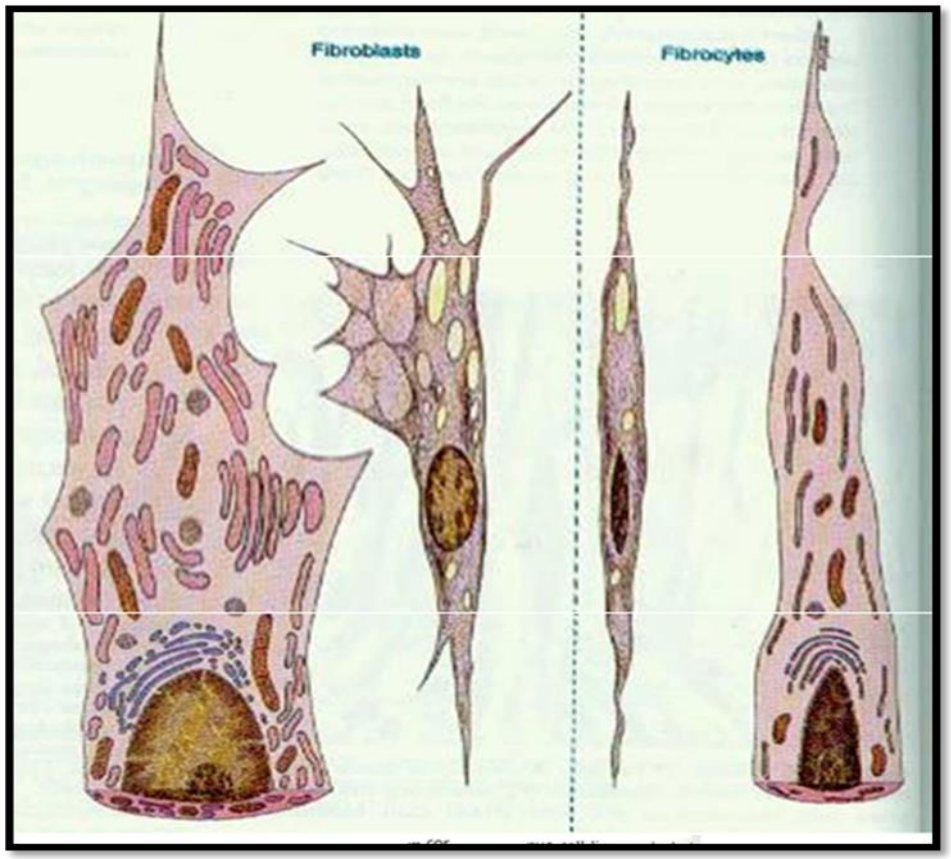


Figure (6): The difference between fibroblast and fibrocyte.

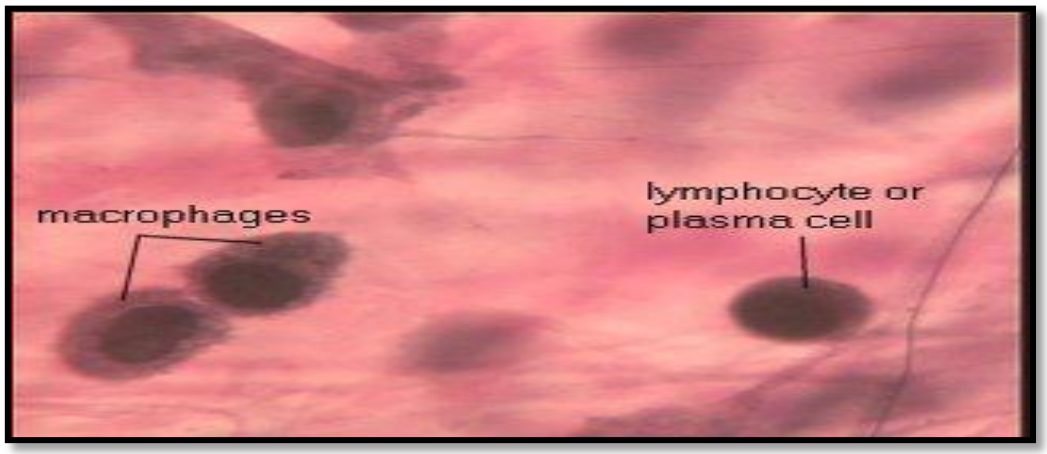
Macrophages

These cells are numerous as fibroblasts in connective tissue. These are abundant in richly vascularized areas and present in most organs and constitute the mononuclear phagocyte system. In certain regions. Macrophages have special names, e.g. **Kupffer cells** in the liver, **microglial cells** in the nervous system, and **osteoclasts** in bone tissue.

They are irregular in shape form rounded to spindle in shape with filopodia processes and are capable of amoeboid movement. The nucleus is eccentric, small, dark, oval or kidney shaped. The cytoplasm is granular and vacuolated and containing large numbers of lysosome (Figure 7).

Macrophages derive from bone marrow from stem cells that divide producing monocytes where circulate in the blood. Some of these cells are migrate from the blood into connective tissues where they differentiate into macrophages.

The main function of the macrophage is **phagocytosis**. Macrophages play an important role in immune defense mechanism to protecting the body against foreign invaders. They are phagocytic cells can engulf a broad variety of foreign materials including microorganisms as bacteria, dead cells, and cellular debris. They phagocytosing and destroying foreign substance through the action of hydrolytic enzymes in their lysosomes.



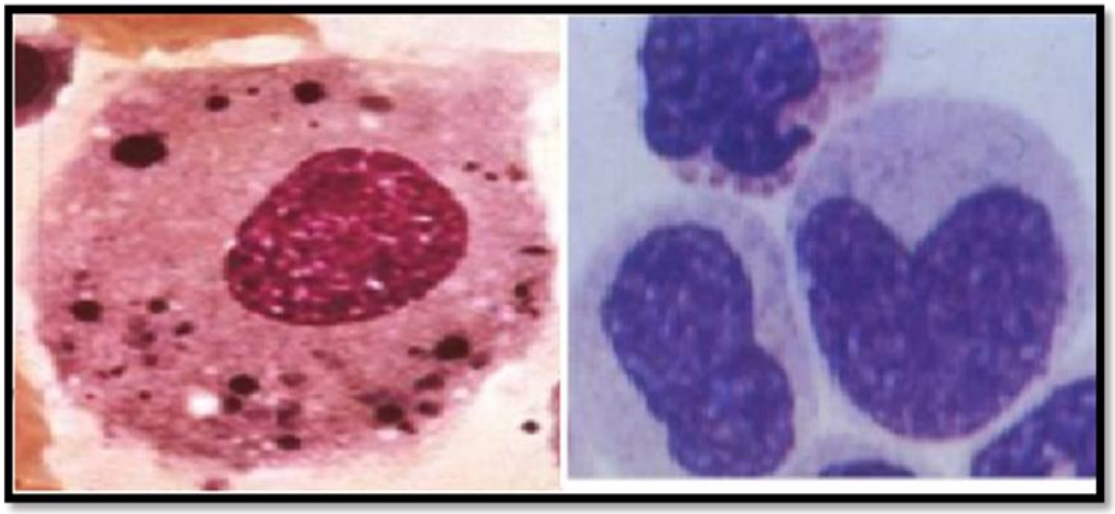


Figure (7): The characteristic features of macrophage

Mast cells

These are widespread in the human body but are particularly abundant in the dermis of skin and in the digestive and respiratory tracts. Most cells are derived from bone marrow from stem cells.

Mast cells are large, ovoid to rounded in shape. The cytoplasm is filled with basophilic granules which contain **heparin** and **histamine** (Figure 9). The nucleus is small, spherical, and centrally placed. It is frequently obscured by the cytoplasmic granules (Figure 9).

The principal function of mast cell is the storage of these substances as chemical mediators of the inflammatory response. Mast cell produces heparin as **blood anticoagulant** and histamine that promote the allergic reactions called **immediate hypersensitivity reaction** which occur after penetration of foreign particles.

Figure (8): The characteristic features of mast cells.

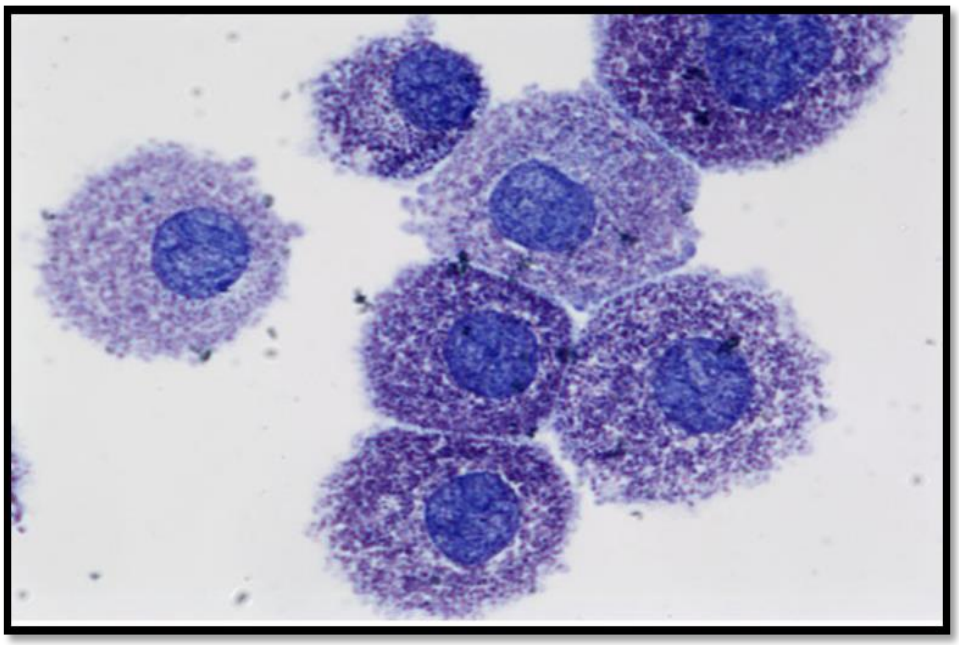


Figure (9): The shape of mast cells.