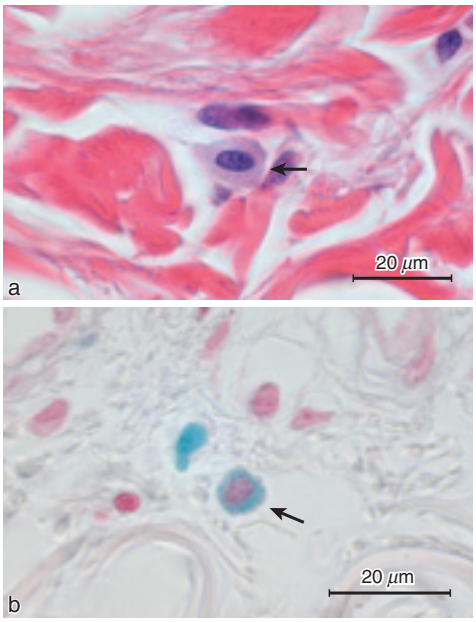

Fig. 1.27 Mast cells.
a: Hematoxylin and eosin staining. b: Metachromasia is seen by toluidine blue staining.

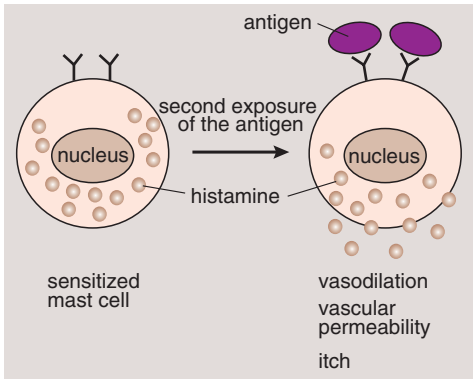

Fig. 1.28 Sensitization by mast cells.

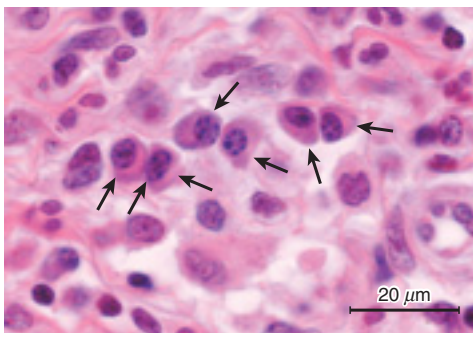

Fig. 1.29 Plasma cells (arrows).

various enzymes, including neutrophil chemotactic factors (NCF), eosinophil chemotactic factors of anaphylaxis (ECF-A), tryptase, chymase and tumor necrosis factor (TNF)-like substances. The mast cell may produce and release inflammatory substances such as prostaglandins, leukotorienes and platelet-activating factors.

4. Plasma cell ★

The plasma cell is a differentiated B cell that has been stimulated by an antigen. It produces antibodies and is involved in humoral immunity. The shape of the plasma cell varies from circular to pear-shaped, and the diameter ranges from 8 μm to 14 μm, which is twice as large as a leukocyte. It has a wheel-shaped nucleus with peripheral chromatin (**Fig. 1.29**).

5. Dermal dendrocyte

The dermal dendrocyte is found in the dermal upper layer (in and between the papillary layer and the reticular layer). It is thought to be an immunocompetent cell (Chapter 3), and it is characterized by containing clotting factor XIIIa.

d. Vascular channels and nerves

1. Blood vessels ★★

Multiple branches of arteries distributed in skin (**Figs. 1.30** and **1.31**) are connected with each other in the dermal deep layer to form a horizontal network (subcutaneous plexus). With numerous branches ascending from the subcutaneous plexuses, the arteries form a second network in the papillary lower layer (subpapillary plexus). The arterioles ascend through the papillary layer, forming capillary loops in the dermal papillaries before moving to venules that connect to each other to form two kinds of plexuses, whereby the blood flows into the cutaneous veins (**Fig. 1.30**). There are also characteristic plexuses in the periphery of the cutaneous appendages. The peripheral regions of the eccrine glands are particularly rich in vascular networks, which control blood flow volume and body temperature by perspiration. Moreover, hair follicles in the anagen (growth) stage are also richly supplied with blood vessels, present in the surrounding dermal tissue.

There is another apparatus that circulates the blood directly from arteries to blood vessels: This is the arteriovenous anastomosis, which is controlled by sympathetic nerves. The arteriovenous anastomosis controls the peripheral blood flow and is involved in body temperature regulation. Glomus apparatuses, which have spherical anastomotic branches, are seen everywhere in the skin. They are particularly well developed in the fingers, at apical ends of the toes, and below the nails. Many layers of

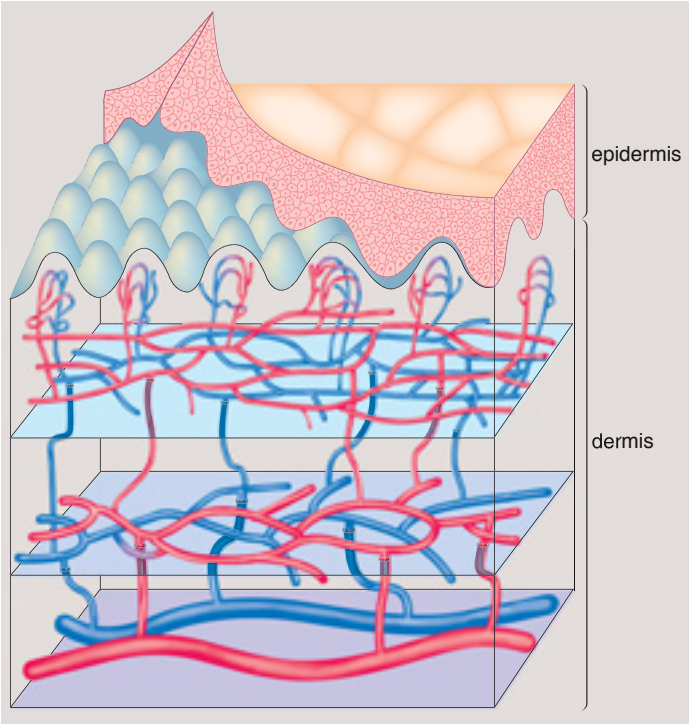

Fig. 1.30 Distribution of blood vessels in the dermis.

smooth muscle cells (epithelial cells or glomus cells) cover the peripheral walls of the endothelial cells.

Under the electron microscope, endothelial cells, pericytes, and the multilayered basement membrane (lamina densa) in the peripheral interstitium may be observed in the capillaries. The stick-shaped Weibel-Palade granule, which has a diameter of 200 nm and a length of 1 μm or less, contains factor VIII associated with histamines and blood coagulation. It is found in the endothelial cell. Pericytes have a vasoconstrictive effect, and they are seen on the perimeter of the walls of the endothelial cells.

2. Lymphatic vessel ★

Lymph vessels are distributed around the subpapillary layer region and extend through the postcapillary lymph vessels to the dermal and subcutaneous lymph vessels. The endothelial cells of the lymph capillaries are thin, without pericytes or lamina densa. They are partly ruptured and are surrounded by loose collagen fibers and elastic fibers (**Fig. 1.32**). The closer the endothelium is to the dermal deep layer, the more continuous it becomes with the valva in the lumen. The structure of lymph vessels is not as regular as that of the blood vessels. Aggregated cutaneous lymphatic fluid passes through the regional lymph nodes and flows into the blood vessels.

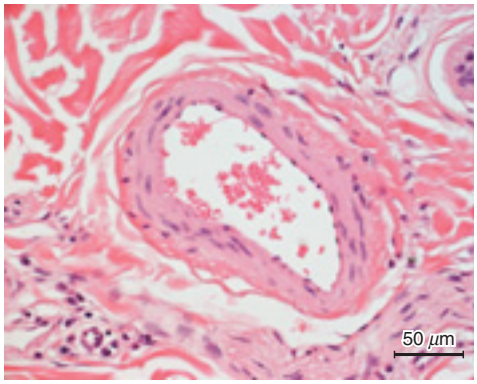

Fig. 1.31 Blood vessels (hematoxylin and eosin).

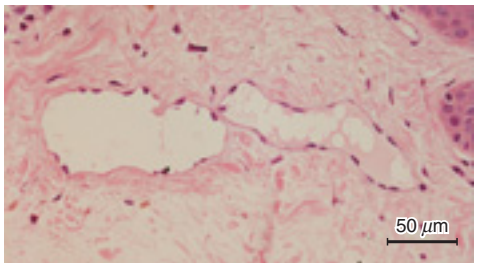

Fig. 1.32 Lymphatic vessels (hematoxylin and eosin).

Discriminating between blood vessels and lymph vessels MEMO

The important points in discriminating between these are tabulated below.

Item	Blood vessel	Lymph vessel
Factor VIII	Positive	Basically negative
Basal layer	Extended and multi-layered	Intermittent
Intercellular connection	Developed	Weak
Lumen shape	Round	Irregular
Elastic fiber stain	Arteries: positive in the internal elastic layer veins: negative	Negative

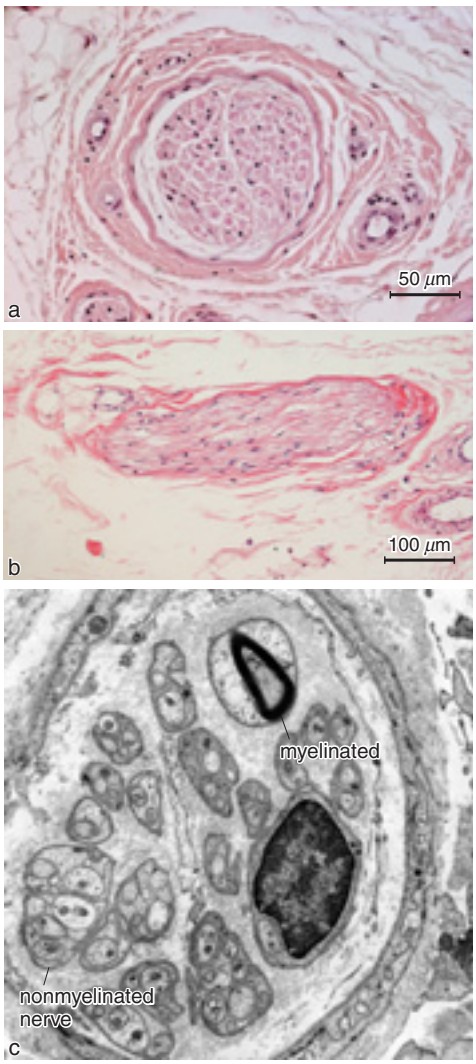

Fig. 1.33 Nerve fibers.
a: Myelinated nerve fibers. b: Unmyelinated nerve fibers. c: Electron microscopy.

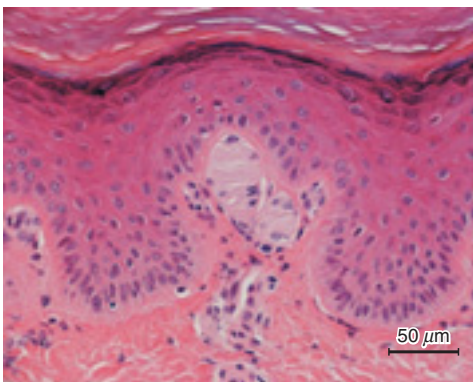

Fig. 1.34 Meissner corpuscle (hematoxylin and eosin).

3. Nervous system ★

The nerve fiber bundle is covered with a membrane in the dermal lower layers. The nerve fibers change from being myelinated to non-myeliated where the nerve bundle branches into many fibers in the dermis, and these branched fibers are distributed within the superficial dermis and peripheral appendages (**Fig. 1.33**). The sensory nerves transmit tactile, pressure, pain and temperature sensation. The autonomic nerves control the blood vessels, sweat glands and other appendages.

1) Sensory nerve ★

The sensory nerve structures include free nerve endings sensing pain, Merkel cells (described above) that perceive tactile sensation in the epidermal basal layer, and nerve end bulbs that accept tactile, pressure and vibration sensation.

①Free nerve ending

The free nerve endings are distributed in the dermal upper and papillary layers. Some of them adhere to Merkel cells in the dermal papillary layer, whereas others infiltrate into the dermis directly. Nonmyelinated nerves transmit pain sensations.

②End corpuscle

The end corpuscle is a specific sensory nerve terminal covered with a membrane. Various end corpuscles are described below.

Meissner end corpuscle: The nerve fiber spirally ascends through the Schwann cell (inner bulb cell) in the dermal papillae of the palms, soles, lips of the mouth, and external genitals, perceiving tactile and pressure sensations (**Fig. 1.34**).

Pacinian corpuscle: It is seen in the dermal deep layer and subcutaneous tissue of the palms, soles, and external genitals. The central nerve fiber is multi-layered with concentric membranes. It is oval, with a major axis of 1 mm, and can be clearly seen by light microscopy (**Fig. 1.35**). It reacts to vibration.

2) Autonomic nerves

The autonomic nerves are principally distributed in the sweat glands, arrector pili muscles, blood vessels and glomus apparatuses, to control the functions of these organs. The cholinergic nonmyelinated sympathetic nerves are distributed in the eccrine sweat glands. Mitochondria, and dense core and non-core vesicles containing chemical substances are observed. The adrenergic sympathetic nerves are distributed in the arrector pili muscles and blood vessels.

Sympathetic nerves distributed in the eccrine sweat gland MEMO

The sympathetic nerve is generally adrenergic; however, that in the eccrine gland is exceptionally cholinergic.

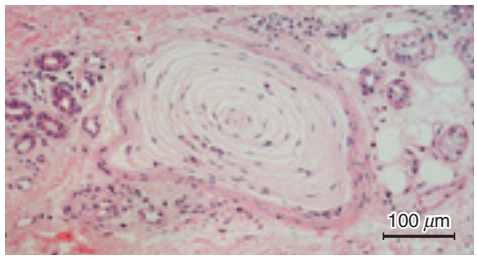

Fig. 1.35 Pacinian corpuscle (hematoxylin and eosin).

D. Subcutaneous fat tissue

The subcutaneous tissue is the layer between the dermis and the fascia. The fat tissue acts to preserve neutral fat, cushion against external physical pressure, retain moisture and generate heat.

The subcutaneous tissue is largely composed of fat cells. Assembled fat cells separated by the connective fibroid fat septum are called fat lobules. Fiber bundles produced in the dermis and firmly connected with the fascia and periostea through the subcutaneous tissue are found throughout this region. These fiber bundles are called retinaculae cutis, and they strengthen the connection between the dermis and deeper tissues.

The main component of the fat droplet is triglyceride, composed of olein acid and palmitin acid. Since a large droplet accounts for most of the contents of the cellular cytoplasm in the fat cell, other cellular organelles are pushed to the edge.

Multiple smooth muscles called tunicae dartoses are characteristically seen in the dermal deep layers and subcutaneous tissues of the scrotum, penis, labia majora and nipples (**Fig. 1.36**).

The boundary between the subcutaneous tissue and skeletal muscle is called the musculus cutaneous. It is not clear in sites with muscles of expression, such as in the face.

The thickness of the subcutaneous tissue depends on the body site, age and other factors. It is particularly thick in the cheeks, breasts, buttocks, thighs, palms and soles; it is thin in the eyelids, dorsal nose, lips of the mouth, and labia minora; subcutaneous tissue is absent in the foreskin. Subcutaneous tissue tends to develop and enlarge in newborn infants and in children at puberty. In embryos and newborn infants, heat is produced at a rapid rate by brown fat tissue in the dorsal region, which contains multiple fat droplets.

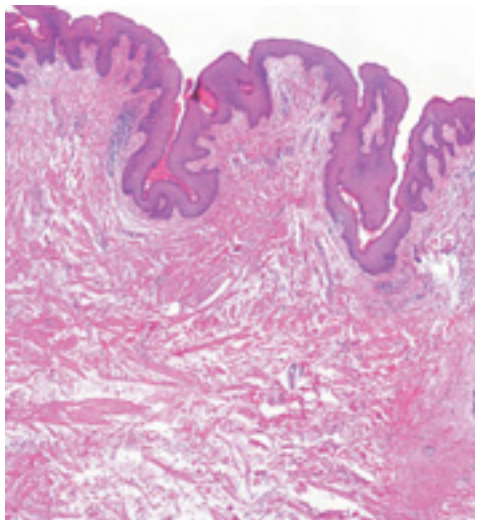

Fig. 1.36 Tunica dartos in the skin of the scrotum.