

TEXTBOOK

V.V. Chebotarev, M.S. Askhakov

DERMATOVENEROLOGY



Moscow
«GEOTAR-Media»
PUBLISHING GROUP
2020

CONTENTS

Preface.....	15
List of abbreviations and symbols.....	17
Introduction.....	18
Chapter 1. An overview of skin and its appendages. Morphological elements of skin rash.....	21
1.1. The structure of the skin and its appendages.....	22
1.1.1. Epidermis.....	22
1.1.2. Dermis.....	28
1.1.3. Subcutaneous fat (hypodermis).....	32
1.1.4. Skin muscles.....	33
1.1.5. Innervation of the skin.....	34
1.1.6. Appendages of the skin.....	35
1.1.7. Physiological functions of the skin.....	43
1.2. Understanding the ethiology and pathogenesis of skin diseases.....	47
1.2.1. Ethiology of skin diseases.....	47
1.2.2. Pathogenesis of skin diseases.....	52
1.3. Pathohistology of the skin.....	56
1.4. Morphological elements of skin rashes.....	59
1.4.1. Primary morphological elements.....	61
1.4.2. Secondary morphological elements.....	71
Answers to the introduction task and Chapter 1.....	81
Chapter 2. General principles of diagnosis and treatment of skin and venereal diseases.....	85
2.1. Methods of examination of patients with skin and venereal diseases.....	86
2.1.1. Examination of patients with skin diseases.....	86
2.1.2. Examination of a patient with venereal disease.....	97
2.1.3. Features of examination of children.....	98
2.1.4. Examination of newborns.....	100
2.2. Basic principles in the treatment of skin patients.....	103
2.2.1. Principles of skin disease therapy.....	104
2.2.2. Types of general therapy for patients with dermatoses.....	104
2.2.3. Methods and means of general therapy.....	105
2.2.4. Extrinsic (local) therapy for skin dermatosis.....	113
2.2.5. Features of therapy in children with skin diseases.....	125
Answers to the tasks of Chapter 2.....	129

Chapter 3. Skin disorders in newborns.....	131
3.1. Skin disorders.....	131
3.2. Diseases of the umbilical wound.....	134
3.3. Dermatitis of anogenital region.....	136
3.4. Diseases associated with hyperplasia of the sebaceous glands in infants.....	138
Answers to the tasks of Chapter 3.....	141
Chapter 4. Pyoderma and parasitic skin diseases.....	143
4.1. Bacterial skin infections (pyoderma).....	144
4.1.1. Etiology.....	144
4.1.2. Pathogenesis.....	144
4.1.3. Classification.....	147
4.1.4. Staphylococcal pyoderma (<i>staphyloidermia</i>).....	148
4.1.5. Streptococcal pyoderma (<i>streptodermia</i>).....	163
4.1.6. Mixed strepto-staphylococcal pyoderma (<i>strepto-staphyloidermia</i>).....	175
4.1.7. Other bacterial processes.....	180
4.1.8. Features of the pyoderma course in children.....	182
4.1.9. Consulting patients with pyoderma.....	182
4.2. Parasitic skin diseases.....	183
4.2.1. Scabies (<i>scabies</i>).....	184
4.2.2. Head lice (<i>pediculosis</i>).....	202
Answers to the tasks of Chapter 4.....	206
Chapter 5. Mycosis.....	211
5.1. Superficial mycoses of the skin and appendages.....	211
5.1.1. Keratomycosis.....	212
5.1.2. Dermatophytosis.....	216
5.1.3. Mycoses of the hairy part of the head and smooth skin.....	230
5.1.4. Superficial candidiasis of the skin and mucous membranes.....	246
Answers to the tasks of Chapter 5.....	254
Chapter 6. Diseases manifested by the papulo-squamous rash.....	257
6.1. Psoriasis (<i>psoriasis</i>).....	257
6.1.1. Etiology and pathogenesis.....	257
6.1.2. Clinical picture.....	259
6.1.3. Diagnostics.....	270
6.1.4. Differential diagnostics.....	270
6.1.5. Treatment.....	270

6.1.6. Consulting.....	272
6.2. Lichen planus (<i>lichen ruber planus</i>).....	274
6.2.1. Etiology and pathogenesis.....	274
6.2.2. Clinical picture.....	275
6.2.3. Diagnostics.....	281
6.2.4. Differential diagnostics.....	281
6.2.5. Treatment.....	282
6.2.6. Consulting.....	282
6.3. Pink lichen (<i>pityriasis rosea</i>).....	283
6.3.1. Etiology and pathogenesis.....	283
6.3.2. Clinical picture.....	283
6.3.3. Diagnostics.....	284
6.3.4. Differential diagnostics.....	284
6.3.5. Treatment.....	284
6.3.6. Consulting.....	285
Answers to the tasks in Chapter 6.....	287
Chapter 7. Connective tissue disease.....	288
7.1. Lupus erythematosus.....	288
7.1.1. Etiology and pathogenesis.....	288
7.1.2. Clinical picture.....	289
7.1.3. Diagnostics.....	292
7.1.4. Differential diagnostics.....	293
7.1.5. Treatment.....	293
7.1.6. Consulting.....	293
7.2. Scleroderma.....	294
7.2.1. Etiology and pathogenesis.....	294
7.2.2. Clinical picture.....	294
7.2.3. Diagnostics.....	301
7.2.4. Differential diagnostics.....	301
7.2.5. Treatment.....	301
7.2.6. Consulting.....	302
7.3. Dermatomyositis.....	302
7.3.1. Etiology and pathogenesis.....	303
7.3.2. Clinical picture.....	303
7.3.3. Diagnostics.....	304
7.3.4. Differential diagnostics.....	305
7.3.5. Treatment.....	305
7.3.6. Consulting.....	305

7.4. Granuloma annulare (<i>granuloma anulare</i>).....	305
7.4.1. Etiology and pathogenesis.....	305
7.4.2. Clinical picture.....	306
7.4.3. Diagnostics.....	307
7.4.4. Differential diagnostics.....	308
7.4.5. Treatment.....	308
7.4.6. Consulting.....	308
Answers to the tasks of Chapter 7.....	309
Chapter 8. Infectious erythema.....	311
8.1. Exudative erythema multiforme (<i>erythema exudativum multiforme</i>).....	311
8.1.1. Etiology and pathogenesis.....	311
8.1.2. Clinical picture.....	311
8.1.3. Diagnostics.....	314
8.1.4. Differential diagnostics.....	314
8.1.5. Treatment.....	314
8.1.6. Consultancy.....	314
8.2. Erythema nodosum.....	314
8.2.1. Etiology and pathogenesis.....	314
8.2.2. Clinical picture.....	315
8.2.3. Diagnostics.....	316
8.2.4. Differential diagnostics.....	316
8.2.5. Treatment.....	316
8.2.6. Consultancy.....	316
8.3. Borreliosis.....	317
8.3.1. Etiology and pathogenesis.....	317
8.3.2. Epidemiology.....	318
8.3.3. Clinical picture.....	318
8.3.4. Laboratory diagnostics.....	320
8.3.5. Differential diagnostics.....	321
8.3.6. Treatment.....	321
8.3.7. Consultancy.....	322
Answers to the tasks of Chapter 8.....	323
Chapter 9. Cystic dermatoses.....	324
9.1. True pemphigus (<i>pemphigus verse</i>).....	324
9.1.1. Etiology and pathogenesis.....	324
9.1.2. Clinical picture.....	325
9.1.3. Diagnostics.....	328

9.1.4. Differential diagnostics.....	328
9.1.5. Treatment.....	329
9.1.6. Prophylactic medical examination.....	330
9.1.7. Consulting.....	330
9.2. Duhring's Disease (<i>dermatitis herpetiformis Duhring</i>).....	330
9.2.1. Etiology and pathogenesis.....	330
9.2.2. Clinical picture.....	331
9.2.3. Diagnostics.....	332
9.2.4. Differential diagnostics.....	332
9.2.5. Treatment.....	333
9.2.6. Specialist consulting.....	333
9.3. Pemphigoid (<i>pemphigoid</i>).....	334
9.3.1. Etiology and pathogenesis.....	334
9.3.2. Clinical picture.....	334
9.3.3. Diagnostics.....	335
9.3.4. Differential diagnostics.....	335
9.3.5. Treatment.....	335
9.3.6. Consulting.....	335
Answers to the tasks of Chapter 9.....	337
Chapter 10. Dermatitis and toxicodermas.....	338
10.1. Simple contact dermatitis (<i>dermatitis contacta</i>).....	338
10.1.1. Etiology and pathogenesis.....	338
10.1.2. Clinical picture.....	340
10.2. Allergic contact dermatitis.....	343
10.2.1. Etiology and pathogenesis.....	343
10.2.2. Clinical picture.....	346
10.2.3. Special features of dermatitis course in children.....	346
10.2.4. Diagnostics.....	347
10.2.5. Differential diagnostics.....	348
10.2.6. Treatment.....	349
10.2.7. Consulting.....	349
10.3. Toxicodermia.....	350
10.3.1. Etiology and pathogenesis.....	350
10.3.2. Clinical varieties.....	351
10.3.3. Diagnostics.....	356
10.3.4. Differential diagnostics.....	356
10.3.5. Treatment.....	356
10.3.6. Consulting.....	357

10.4. Perioral dermatitis (<i>periorifical dermatitis</i>).....	359
10.4.1. Etiology and pathogenesis.....	359
10.4.2. Clinical picture.....	359
10.4.3. Diagnostics.....	360
10.4.4. Differential diagnostics.....	360
10.4.5. Treatment.....	360
10.4.6. Consulting.....	361
Answers to the tasks of Chapter 10.....	362
Chapter 11. Diseases of the mucous membranes of the oral cavity.	
Cheilites.....	363
11.1. Primary cheilites.....	363
11.1.1. Contact cheilites.....	363
11.1.2. Exfoliative cheilitis.....	366
11.1.3. Actinic cheilitis.....	367
11.1.4. Glandular cheilitis.....	369
11.1.5. Chronic recurrent lip cracks.....	369
11.2. Symptomatic cheilites.....	371
11.2.1. Atopic cheilitis.....	371
11.2.2. Cheilites on various diseases.....	372
11.2.3. Drug induced cheilites.....	373
11.2.4. Chronic/recurrent aphthous stomatitis.....	374
Answers to the tasks of Chapter 11.....	377
Chapter 12. Neurodermatoses.....	378
12.1. Skin itch (<i>pruritus cutaneus</i>).....	378
12.1.1. Etiology and pathogenesis.....	378
12.1.2. Clinical picture.....	379
12.1.3. Diagnostics.....	380
12.1.4. Differential diagnostics.....	380
12.1.5. Treatment.....	380
12.1.6. Consulting.....	380
12.2. Atopic dermatitis.....	380
12.2.1. Etiology and pathogenesis.....	381
12.2.2. Classification.....	383
12.2.3. Clinical picture.....	384
12.2.4. Diagnostics.....	397
12.2.5. Differential diagnostics.....	398
12.2.6. Treatment.....	398
12.2.7. Consulting.....	403

12.3. Eczema.....	404
12.3.1. Etiology and pathogenesis.....	404
12.3.2. Classification.....	405
12.3.3. Clinical picture.....	406
12.3.4. Diagnostics.....	413
12.3.5. Differential diagnostics.....	414
12.3.6. Treatment.....	414
12.3.7. Consulting.....	416
12.4. Neurodermitis.....	416
12.4.1. Etiology and pathogenesis.....	416
12.4.2. Clinical picture.....	416
12.4.3. Diagnostics.....	418
12.4.4. Differential diagnostics.....	418
12.4.5. Treatment.....	418
12.4.6. Consulting.....	418
12.5. Prurigo.....	420
12.5.1. Etiology and pathogenesis.....	420
12.5.2. Clinical picture.....	420
12.5.3. Diagnostics.....	422
12.5.4. Differential diagnostics.....	422
12.5.5. Treatment.....	422
12.5.6. Consulting.....	422
12.6. Urticaria.....	422
12.6.1. Etiology and pathogenesis.....	422
12.6.2. Clinical picture.....	423
12.6.3. Diagnostics.....	424
12.6.4. Differential diagnostics.....	424
12.6.5. Treatment.....	424
12.6.6. Consulting.....	424
12.7. Urticaria pigmentosa (mastocytosis).....	424
12.7.1. Clinical picture.....	425
12.7.2. Prognosis.....	426
12.7.3. Diagnostics.....	426
12.7.4. Treatment.....	426
12.7.5. Consulting.....	427
Answers to the tasks of Chapter 12.....	429
Chapter 13. Diseases of skin appendages.....	432
13.1. Hair diseases.....	432

13.1.1. Etiology and pathogenesis.....	432
13.1.2. Clinical picture.....	433
13.1.3. Prognosis.....	436
13.1.4. Treatment.....	436
13.2. Trichotillomania.....	437
13.2.1. Treatment.....	437
13.3. Hereditary alopecia.....	438
13.4. Acne.....	439
13.4.1. Etiology and pathogenesis.....	440
13.4.2. Clinical picture.....	442
13.4.3. Diagnostics.....	447
13.4.4. Differential diagnostics.....	447
13.4.5. Treatment.....	448
13.4.6. Consulting.....	450
13.5. Seborrheic dermatitis (<i>dermatitis seborrhoicum</i>).....	451
13.5.1. Etiology and pathogenesis.....	451
13.5.2. Clinical picture.....	451
13.5.3. Diagnostics.....	452
13.5.4. Differential diagnostics.....	452
13.5.5. Treatment.....	452
13.5.6. Consulting.....	453
13.6. Nail pathology.....	453
13.6.1. Treatment.....	457
13.6.2. Consulting.....	457
13.7. Dyschromiae.....	457
13.7.1. Etiology and pathogenesis.....	459
13.7.2. Clinical picture.....	459
13.7.3. Diagnostics.....	461
13.7.4. Differential diagnostics.....	461
13.7.5. Treatment.....	461
13.7.6. Consulting.....	462
Answers to the tasks of Chapter 13.....	463
Chapter 14. Mycobacterial infections.....	465
14.1. Skin tuberculosis.....	465
14.1.1. Etiology and pathogenesis.....	465
14.1.2. Clinical picture.....	466
14.1.3. Diagnostics.....	469
14.1.4. Differential diagnostics.....	470

14.1.5. Treatment.....	470
14.1.6. Consulting.....	470
14.2. Leprosy.....	471
14.2.1. Ethiology and pathogenesis.....	471
14.2.2. Clinical picture.....	472
14.2.3. Diagnostics.....	474
14.2.4. Differential diagnostics.....	474
14.2.5. Treatment.....	474
14.2.6. Consulting.....	474
14.3. Skin leishmaniosis (<i>leishmaniosis cutis</i>).....	475
14.3.1. Ethiology and epidemiology.....	476
14.3.2. Clinical picture.....	476
14.3.3. Diagnostics.....	478
14.3.4. Differential diagnostics.....	478
14.3.5. Treatment.....	478
14.3.6. Consulting.....	479
Answers to the tasks of Chapter 14.....	481
Chapter 15. Viral diseases of skin.....	482
15.1. Herpes simplex virus.....	482
15.1.1. Clinical picture.....	483
15.1.2. Diagnostics.....	486
15.1.3. Differential diagnostics.....	486
15.1.4. Treatment.....	486
15.1.5. Consulting.....	487
15.2. Shingles (<i>herpes zoster</i>).....	487
15.2.1. Ethiology and pathogenesis.....	487
15.2.2. Clinical picture.....	488
15.2.3. Diagnostics.....	491
15.2.4. Differential diagnostics.....	491
15.2.5. Treatment.....	491
15.2.6. Consulting.....	491
15.3. Papilloma viral infection.....	492
15.3.1. Ethiology.....	492
15.3.2. Clinical picture.....	492
15.3.3. Diagnostics.....	498
15.3.4. Differential diagnostics.....	498
15.3.5. Treatment.....	499
15.3.6. Consulting.....	499

15.4. Molluscum contagiosum.....	500
15.4.1. Etiology and pathogenesis.....	500
15.4.2. Clinical picture.....	501
15.4.3. Diagnostics.....	502
15.4.4. Differential diagnostics.....	502
15.4.5. Treatment.....	502
15.4.6. Consulting.....	503
15.5. Viral pemphigus of the oral cavity and extremities.....	503
15.5.1. Etiology and pathogenesis.....	503
15.5.2. Clinical picture.....	503
15.5.3. Differential diagnostics.....	504
15.5.4. Treatment.....	504
15.5.5. Consulting.....	504
Answers to the tasks of Chapter 15.....	507
Chapter 16. Genodermatoses.....	508
16.1. Ichthyosis (<i>ichthyosis</i>).....	508
16.1.1. Etiology and pathogenesis.....	508
16.1.2. Clinical picture.....	509
16.1.3. Differential diagnostics.....	514
16.1.4. Treatment.....	514
16.1.5. Consulting.....	515
16.2. Bullous epidermolysis (<i>epidermolysis bullosa congenita</i>).....	515
16.2.1. Etiology and pathogenesis.....	515
16.2.2. Clinical picture.....	515
16.2.3. Differential diagnostics.....	519
16.2.4. Treatment.....	519
16.2.5. Consulting.....	519
16.3. Neurofibromatosis.....	521
16.3.1. Etiology and pathogenesis.....	521
16.3.2. Clinical picture.....	521
16.3.3. Differential diagnostics.....	526
16.3.4. Treatment.....	526
16.3.5. Consulting.....	526
16.4. Enteropathic acrodermatitis (<i>acrodermatitis enteropathica</i>).....	526
16.4.1. Etiology and pathogenesis.....	526
16.4.2. Clinical picture.....	527
16.4.3. Laboratory diagnostics.....	528

16.4.4. Differential diagnostics.....	528
16.4.5. Treatment.....	528
16.4.6. Prognosis.....	528
16.4.7. Consulting.....	528
Answers to the tasks of Chapter 16.....	530
Chapter 17. Allergic vasculites of skin (<i>vasculitis</i>).....	532
17.1. Henoch–Schonlein purpura.....	533
17.1.1. Etiology and pathogenesis.....	534
17.1.2. Clinical picture.....	534
17.1.3. Laboratory diagnostics.....	535
17.1.4. Diagnostics.....	536
17.1.5. Differential diagnostics.....	536
17.1.6. Treatment.....	536
17.2. Chronic pigmented purpura of Schamberg–Majocchi.....	536
17.2.1. Etiology and pathogenesis.....	537
17.2.2. Clinical picture.....	537
17.2.3. Diagnostics.....	537
17.2.4. Differential diagnostics.....	538
17.2.5. Treatment.....	538
17.2.6. Consulting.....	538
Answers to the tasks of Chapter 17.....	539
Chapter 18. Syphilis.....	541
18.1. Etiology.....	542
18.2. Laboratory diagnosis of syphilitic infection.....	581
18.3. Diagnostics of syphilitic infection.....	583
18.4. Treatment of adults with syphilis.....	586
18.5. Consulting.....	588
Answers to the tasks of Chapter 18.....	593
Chapter 19. Human immunodeficiency virus infection.....	596
19.1. Etiology.....	596
19.2. Epidemiology.....	597
19.3. Pathogenesis.....	598
19.4. Laboratory investigations.....	603
19.5. Diagnostics.....	603
19.6. Treatment.....	603
19.7. Consulting.....	604
Answers to the tasks in Chapter 19.....	605

Chapter 20. Sexually transmitted infections.....	607
20.1. Gonococcal infection.....	607
20.1.1. Etiology.....	607
20.1.2. Clinical picture.....	608
20.1.3. Diagnostics.....	609
20.1.4. Treatment.....	610
20.2. Urogenital trichomonas infection.....	610
20.2.1. Etiology.....	611
20.2.2. Clinical picture.....	611
20.2.3. Diagnostics.....	612
20.2.4. Treatment.....	612
20.3. Urogenital chlamydia infection.....	613
20.3.1. Etiology.....	614
20.3.2. Clinical picture.....	614
20.3.3. Diagnostics.....	615
20.3.4. Treatment.....	615
20.4. Urogenital mycoplasmic infection.....	617
20.4.1. Etiology.....	618
20.4.2. Clinical picture.....	618
20.4.3. Diagnostics.....	618
20.4.4. Treatment.....	619
20.5. Vulvovaginitis in girls and other lesions of urogenital organs and systems.....	619
20.5.1. General characteristic of vulvovaginitis.....	619
Answers to the tasks of Chapter 20.....	626

Chapter 1

AN OVERVIEW OF SKIN AND ITS APPENDAGES. MORPHOLOGICAL ELEMENTS OF SKIN RASH

This is the most important chapter of this textbook. Why?

Because if the information in this chapter is well understood and mastered, all tasks are completed, it will be understood that, the whole foundation of this discipline is found in this chapter, especially the basis and fundamental knowledge of skin pathologies.

Firstly, you will be introduced to (or reminded of) the structure of the skin and its appendages. This will help you get a good idea of the ethiology and pathogenesis of dermatoses, and then proceed to the study of a completely new and very interesting subsection about the morphological elements of skin rashes.

In your training, you are now perhaps familiar with or might have heard in other medical disciplines the expressions for practicing doctors: “spot diagnosis” or “diagnosis at first sight”.

In dermatovenerology, this is only possible with a good knowledge of the morphological elements of the skin rash, i.e. it will help you in the future to recognize certain diseases in one clinical picture or conduct a differential diagnosis between them. In other words, for dermatovenerologist the ability to perform careful visual analysis is of utmost importance. Abu Ali Ibn Sina also said, “a Doctor must have the eye of a Falcon”.

However, before you start reading, kindly note the following important points:

- ▶ When reading this chapter and all subsequent chapters do not skip, rather, carefully study all the text, drawings, diagrams and figures.
- ▶ Try as much as possible to solve all the tasks and assignments at the end of each chapter.

- ▶ Do not proceed to the next chapter without ensuring that the previous chapter (materials) has been well assimilated. This can be ascertained if one can correctly answer all tasks and assignments (i.e. your answers coincide with answers provided in the book). **If you make a mistake, read this section again.**

If there is no desire to re-read, return to this page and reread this phrase of I.P. Pavlov (Nobel laureate in medicine and physiology): “Think, think: if you do not get used to thinking and making a living organism and the whole course of life the subject of persistent and passionate thinking, all your future activities will be reduced to just craft which will disappoint you and lead to despair”.

1.1. THE STRUCTURE OF THE SKIN AND ITS APPENDAGES

The skin is multifunctional and is the largest organ of the human body. It covers/protects the body, serves as a boundary separating it from the external environment, and is closely interconnected with all other organs and systems. In this regard, and to a certain extent, the skins plays an important role in a variety of physiological and pathological processes.

The skin covers the entire surface of the body. In the areas of natural openings (mouth, nose, urethra, vagina and anus) the skin thins into a mucous membrane.

The total area of the skin of an adult is 1.5–1.8 m². In a child, however, this depends on the age. In general this is about 18% of the body weight of an adult and 20% of the body weight of a new-born.

In the process of ontogenesis, the skin develops from two embryonic leaves — **outer (ectoderm)** and **middle (mesoderm)** and consists of two types of closely related tissue — **epidermal** and **connective**.

There are three parts of the skin (fig. 1.1):

- ▶ epidermis (epidermis);
- ▶ derma (derma);
- ▶ subcutaneous fat (subcutis), or hypodermis (hypodermis).

1.1.1. Epidermis

The epidermis and its appendages (hair, nails, sweat and sebaceous glands) develop from ectoderm. In the 2nd week of embryogenesis melanocytes penetrate into the basal layer of the epidermis from the neural crest.

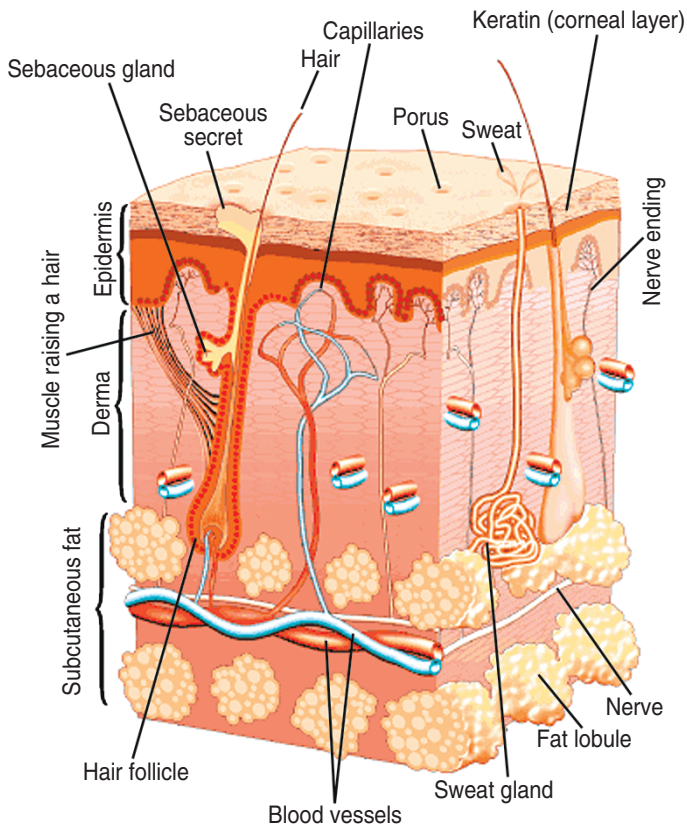


Fig. 1.1. The structure of the skin and appendages

In the epidermis there are three mandatory types of cells.

- ▶ Keratinocytes (epidermocytes) are presented in various evolutionary forms and make up the main cellular mass of the epidermis.
- ▶ Pigment cells (melanocytes).
- ▶ Immune cells (intra-epidermal macrophages).

In the epidermis, there are also Merkel cells, but they are neuro-receptor structures and are associated with nerve endings penetrating from the dermis.

The epidermis is a multi-layered flat keratinous epithelium, the thickness of which is 0.04 mm in the most tender places (eyelids), however, on rough surfaces (palms, soles) it may be up to 1.6 mm.

Layer of epidermis

In the epidermis there are five layers (fig. 1.2):

- ▶ *stratum corneum*;
- ▶ *stratum lucidum*;
- ▶ *stratum granulosum*;
- ▶ *stratum spinosum*;
- ▶ *stratum basale*.

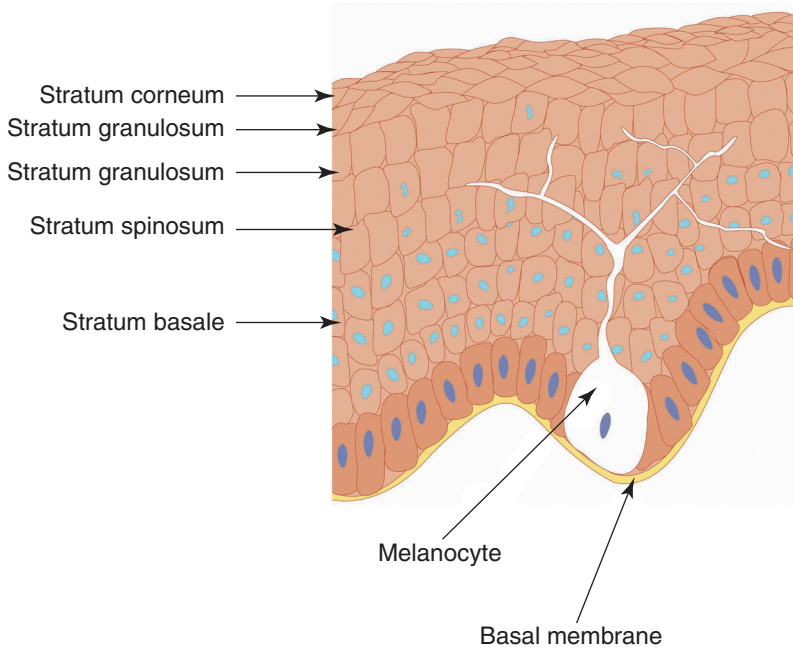


Fig. 1.2. Structure of the epidermis

The basal layer (*stratum basale*)

The basal layer consists of a series of cylindrical cells (basal keratinocytes), having mitotic activity. Among themselves, the keratinocytes of the basal layer are connected by desmosomes, and semi-desmosomes are attached to the basal membrane.

Semi-desmosomes are microscopic cytoplasmic cell outgrowths penetrating into the basal membrane and causing a strong connection of the epidermis with the basal membrane and the dermis.

There are two subpopulations of keratinocytes: one constantly proliferates, the second subpopulation is dormant (reserve). The main function of basal keratinocytes is a constant proliferation and regeneration of epidermal defects.

Melanocytes — are large spinous and pigment cells which lie on the basal membrane and form the basal layer of the epidermis. Melanocytes are in the mucous membrane, except the thick epidermis of the palms and soles, where these cells are absent. In adult humans, the number of melanocytes is approximately 10% of all epidermal cells (in new-borns — 3.7%, and in children — 7%). The number of melanocytic cells does not depend on race or gender. Melanocytes synthesize **melanin** pigment that protects the skin from the harmful effects of UV rays. Melanocytes produce melanin from tyrosine with the participation of the enzyme tyrosinase.

Spinous layer (*stratum spinatum*)

Located above the basal layer, the spinous layer consists of 3–8 rows of cells with “spikes”. Spiked keratinocytes consist of a large number of outgrowths (desmosomes), penetrating into the recesses of neighbouring cells and connecting them like a “lightning” and forming so called **Bizzozero nodules**. All this gives the epidermis its strength and elasticity.

Langerhans cells (intraepidermal macrophages) are also located in the spinous layer and are cells with long processes reaching the basal membrane and granular layer. In the presence of inflammation, they can migrate to the dermis and lymph nodes. The feature that distinguishes Langerhans cells from other macrophages is the presence of special rod-shaped “tennis-racket” cytoplasmic **Birbeck granules** which contain the Kalone — the substance suppressing the proliferation of keratinocytes. Langerhans cells make up 2–7% of all epidermal cells, have mesodermal origin.

Basic functions of Langerhans cells:

- ▶ regulation of keratinocyte population;
- ▶ antigen presentation on t-helpers of lymphocytes, secretion of interleukins-1, -4, interferon, tumor necrosis factor (TNF), etc.;
- ▶ participation in immunopathological processes of the skin.

Granstein cells resemble Langerhans cells but lack Birbeck granules. They number 1–3% of all epidermal cells in total. Their functions include that of antigen-presenting cells for T-suppressors of lymphocytes.

The basal and spinous layers are collectively called **Malpighian layer**, or **germ layer** of the epidermis.

Granular layer (*stratum granulosum*)

It consists of 1–2 rows of cells (2–4 rows on the palms and soles) in the form of an elongated rhombus — granular keratinocytes. The characteristic feature

of the cells of this series is the presence of multiple cytoplasmic keratohyalin granules as well as Orlando granules, a lamellar body with lipid vesicles — keratinose. Later, these substances form a bilipid layer between the sharp pointed scales. The highly specialized epidermal lipids include ceramides, cholesterol, fatty acids, phospholipids and other lipid compounds.

Shiny layer (*stratum lucidum*)

The lucid layer looks like a shiny narrow structureless strip that separates the granular layer from the horny (available on the palms and soles).

Horny layer (*stratum corneum*)

The stratum corneum is the final product of the evolution of keratinocytes, consisting of a plurality of tile-like scales (corneocytes), which are necrotic and keratin-filled remains of keratinocytes. Corneocytes are tightly adjacent to each other, but on the surface, are in contact with the external environment are loosely packed and easily separated — physiological peeling, a process which is invisible to the naked eye. The thickness of the stratum corneum considerably varies on different parts of the skin (the largest — on the soles and palms, in the area of callus).

The corneocytes and the lipid layers of keratinases of the granular layer form a multilayered lipid structure in the stratum corneum and form the **epidermal lipid barrier** that protects the skin from transepidermal water loss and providing a water resistant epidermis. Epidermal lipid barrier also plays the role of a special intercellular cementing substance, providing the strength of adhesion of the structures of the stratum corneum and preserving the integrity of the skin. Epidermal ceramides not only retain water in the skin, but also regulate the rate of desquamation, affecting the differentiation of keratinocytes, and have a pronounced antimicrobial effect.

The cycle of progression of epithelial cells from the cells of the basal layer to the rejected Horny plates is normally 28 days.

The epidermis is separated from the dermis by a **basal membrane**, which is a specialized intercellular matrix. On electron microscopy, the basal membrane emits light and dense plates, as well as a plasmolemma. There are numerous pinocyte 'bubbles'. This indicates that the basal membrane actively participates in the metabolic processes between the epidermis and the dermis. Due to the absence of blood vessels in the epidermis, the epidermis is nourished by diffusion of nutrients through the basal membrane from the dermis.

Features of the epidermis structure in children

- ▶ *In children, the epidermis is thin, consists mainly basal, spiny and Horny layers. The stratum corneum in children is not only thin, but is also loose.*

All rows of cells contain nuclei. The processes of exfoliation of the stratum corneum in young children occur 4–5 times faster than in adults. Due to the absence of a granular layer in the epidermis of the infant skin, ceramides are practically not synthesized and there is a failure of the epidermal lipid barrier. These special structural features lead to the fact that the child's skin is easily vulnerable at the slightest adverse effects (hygiene, frequent bathing and use of soap, tight swaddling) and is prone to maceration.

- ▶ *The process of mitotic division is more intense in a child's skin than adults.* Mitosis not only occurs in the cells of the basal layer, but also appears partially in the spinous layer, which contributes to faster reparative processes (epithelialization) in cases of damage to the epidermis.
- ▶ *The weak connection of keratinocytes of the basal layer with each other,* as well as with the basal membrane associated with a small amount of desmosis and semi-desmosis in these cells is a very important feature of the child's skin. Due to this, the skin of children undergoes epidermolytic processes more often than the adult skin. This leads to a violation of the dermal-epidermal connection and is clinically manifested by bullous dermatoses (pemphigus of new-borns, exfoliative Ritter dermatitis, bullous impetigo, etc.).
- ▶ There are fewer melanocytes in the child skin in comparison to the skin of adults, as well as up to 6 months age melanocytes are functionally inactive and contain a small number of melanin granules, which determines the sensitivity of children's skin to ultraviolet radiation.
- ▶ The pH of skin of new-borns is slightly different than the skin of adult. The skin of the new-borns is almost neutral compared with a slightly acidic nature of the adult skin. However, it is slightly alkaline in seborehmic zones and folds due to the caseous lubrication in those areas. After 2–4 weeks of the child's life, the skin begins to shift into an acidic environment. This feature causes more frequent progression of pyoderma and candida infection in young children.

Task 2. Briefly pause reading and try to remember from histology, which cells are shown in fig. 1.3. In what layer of the epidermis are they located? What is their function? (Answers on p. 82.)

Task 3. Close the book for a while and remember what is the different name of a germinal layer of the epidermis. What layers does it consist of? Take the time to look for the answer in the end of the chapter, first think about it yourself. (Answers on p. 82.)

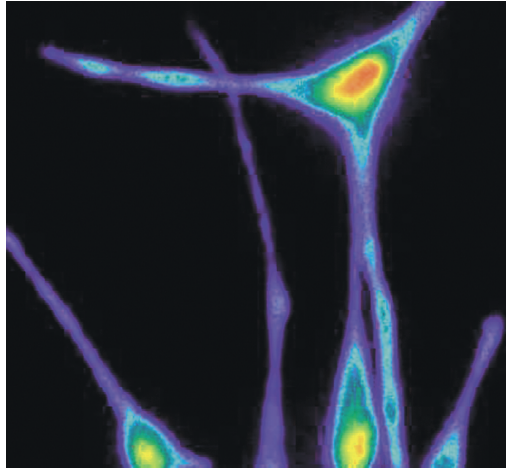


Fig. 1.3. For task 2

1.1.2. Dermis

The dermis consists of two layers: **papillary** and **mesh**.

The papillary layer is formed by loose connective tissue and capillary network, and the mesh layer is formed by dense fibrous unformed connective tissue. Both layers consist of three components:

- ▶ cells’;
- ▶ base material;
- ▶ fibers’.

The dermis contains blood, lymphatic vessels and nerve endings.

The cells of the dermis:

- ▶ **Fibroblasts** are the main cells of the dermis. They provide synthesis of collagen, elastic and reticulin fibers, as well as of the main substance.
- ▶ **Mast cells** (mastocytes, tissue basophils) are precursors of blood stem cells and tissue analogues of basophilic blood leukocytes. The cytoplasm of mast cells contain specific granules with biologically active substances-histamine, heparin, serotonin and hyaluronic acid. These substances have a regulating effect on the vascular permeability of the skin and differentiation of various cells. They also participate in the progression of inflammatory and immune reactions and possess high migration ability.
- ▶ **Histiocytes** (tissue macrophages) carry out phagocytosis. Their cytoplasm has lysosomes containing hydrolytic lysosomal enzymes (colla-

genase, elastase, lysozyme, etc.), under whose effect the destruction of phagocytic particles takes place. Histiocytes secrete mediators-interleukin-1, α -interferon and TNF which activate and suppress the function and division of connective tissue cells and immunocompetent cells.

- ▶ **T-lymphocytes** — blood cells located around the blood and lymph vessels. If necessary, they are capable of quickly migrating to the lower parts of the epidermis through dermal tissue. There are three types of T-lymphocytes — **T-helpers**, **T-suppressors**, **T-killers**:
 - T-helpers activate the production of b-lymphocyte antibodies;
 - T-suppressors inhibit the inclusion of b-lymphocytes in differentiation and delay the production of antibodies;
 - T-killers-lymphocytes, independently carrying out the lysis of foreign cells.
- ▶ **Plasma cells (plasmocytes)** under normal conditions are rare to find in the dermis. They are usually found only around the vessels. *The function of plasma cells is the secretion of antibodies (IgA, IgM, IgG, etc.).*

Task 4. Look carefully at the fig. 1.4. Can you tell which of the above skin cells is depicted in the center? What other skin cells does it look like? How different is it from them? (Answers on p. 82.)

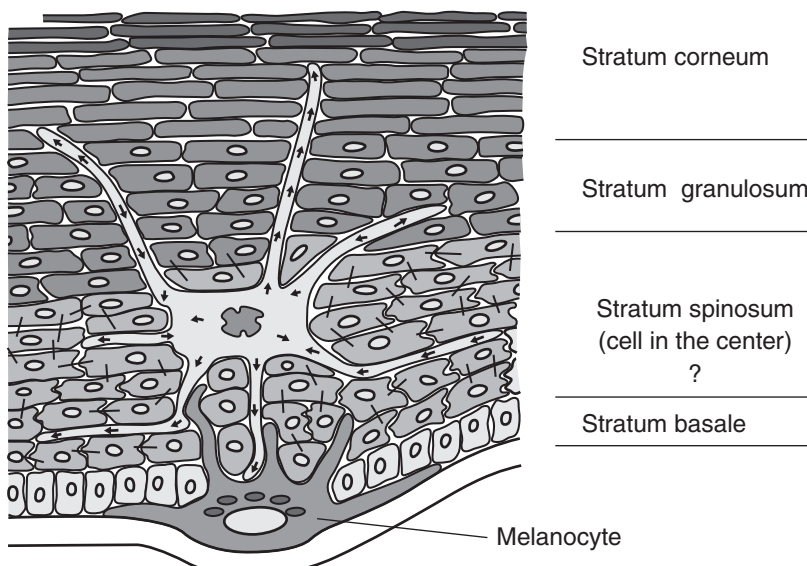


Fig. 1.4. For task 4

Fibers of the dermis

- ▶ **Collagen fibers** — the main fibers of the dermis are built from the same type of protein — collagen, which provides mechanical strength of the dermis.
- ▶ **Elastic fibers** form a vast thin network in the dermis and contain the protein called elastin which has elastic and contraction properties.
- ▶ **Reticular fibers** are located directly under the epidermis, which has a pronounced elastic properties. A lot of them are located especially around skin appendages (hair follicles, sweat glands), where they act as a support.

Connective tissue fibers of the dermis are located in a strictly defined direction, they are linear and form **Langer lines** (fig. 1.5). The skin is stretched more strongly in the direction perpendicular to the course of the fibers, and, therefore, the least noticeable cicatrix after the cut of the skin is formed when there is a wound along the fibers, which must be taken into account during surgery.

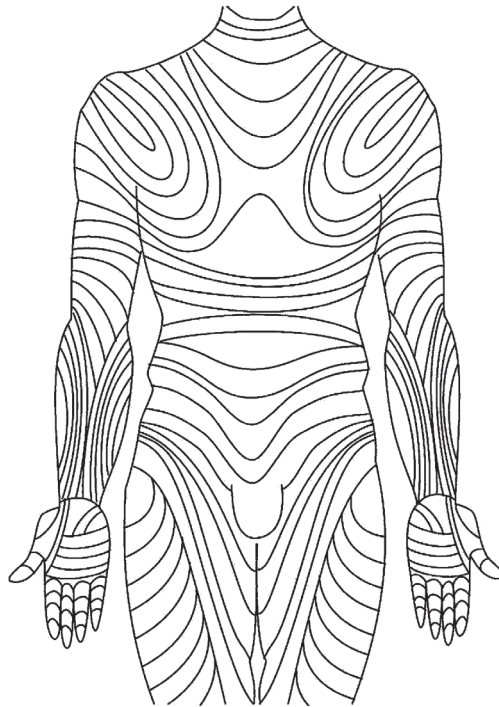


Fig. 1.5. Langer lines

The **main (amorphous) substance** is a gel which contains glycosaminoglycans, proteoglycans, hyaluronic acid, glycoproteins, fats, inorganic substances. They contribute to the absorption and retention of water in the tissues, providing cellular reactions, biochemical processes, and build up strength of the main substance of the connective tissue.

Vessels of the dermis

The boundary of the papillary and mesh layers is considered to be a branch of the superficial network of blood vessels, forming a horizontally positioned network: superficial and deep. The arteries are parallel to the veins.

The superficial plexus is represented by small vessels (capillaries, arterioles, venules) located in the papillary layer of the dermis. Capillaries depart vertically into the papillae, where they form the thinnest vascular branches in the form of loops and are responsible for microcirculation in the skin.

The deep vascular network is located on the border of the dermis with subcutaneous fat. The deep plexus consists of larger vessels in the retinal layer of the dermis and subcutaneous fat. Between the superficial and deep plexuses there are anastomoses.

There is a topographical and functional link between the blood vessels and lymphatics, forming the superficial and deep networks.

The structure of the dermis in children

The dermis as well as other structures in new-borns and infants is much thinner than in adults. The border between the epidermis and the dermis is smooth and has a small dermal papillae (except for the skin of the palms and soles). The dermis is dominated by low-differentiated connective tissue cells and thin collagen fibers.

Among the cellular elements common to the skin: histiocytes, reticulocytes, fibrocytes, plasmocytes, lymphocytes — a lot of mast cells (mastocytes), release biologically active substances and enzymes (histamine, heparin, hyaluronidase, etc.). These substances and enzymes prepare the child's skin physiologically to fight off common allergic and inflammatory reactions. The spaces between the cells and fibers are filled with connective tissue substances, one most important example is mucopolysaccharides (hyaluronic acid and chondroitin sulphate), which has high moisture-retaining properties. These polysaccharides in the skin of children make the infant skin more moisturous than adult skin. Water provides good turgor of children's skin, as well as contributes to a more rapid spread of inflammatory, allergic and intoxication processes.

The blood vessels of the skin in children also have certain characteristics.