Krasnoyarsk State Medical University Named After Professor V.F. Voino-Yasenetsky
Department of Pathological Anatomy Named After Professor P.G.Podzolkov

Lecture 1.
Pathological Anatomy (Pathology) as a Science. Tasks and Subject of Study. Introduction to Pathology.

Contents:

- Tasks of pathology as science, subject, specialty;
- Introduction to pathology;
- General and private pathological anatomy;
- Objects, levels and methods of pathologoanatomical investigations.

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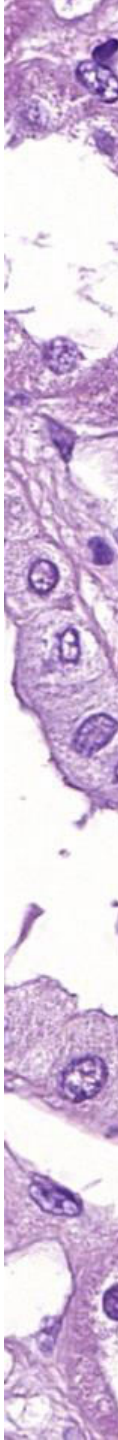


“**Pathological anatomy**” (Pathology)

- is a scientific-applied discipline that studies the structural basis of the diseases.

- This is the science of changes in the architecture of the cells, tissues, and organs in pathological conditions (disorders).
- Pathological anatomy is strongly associated with other medical and biological disciplines.
- **Pathology** is the science of the patterns of occurrence and development of diseases.
- Pathological anatomy has both scientific and practical significance and it is one of the clinical disciplines in healthcare.

Own data

The content of pathological anatomy:

- **General pathological processes** – such as injury of local and general blood circulation, inflammation, tumors and so on;
- **Etiology** (causes of the diseases);
- **Pathogenesis** (mechanism of pathological processes development);
- **Morphogenesis** (development of structural changes in diseases step by step);
- **Pathomorphosis** (changes in the diseases, morbidity, mortality, and disease course);
- **Iatrogenies** (pathology as a result of medical intervention).

Own data

General pathological anatomy includes General pathological processes underlying all diseases:

- Alteration;
- Dystrophies (Injury);
- Blood and lymph circulation disturbances;
- Necrosis;
- Inflammation;
- Immunopathological processes;
- Regeneration;
- Adaptive and compensative processes.

Own data

The objects of study are:

- Organs and tissues biopsies;
- Operational material;
- Cytological material;
- Postmortem material;
- Experimental material.

Own data

Biopsy

is an intravital tissue resection from a patient for diagnostic purposes.

It serves as the main method of establishing a diagnosis.

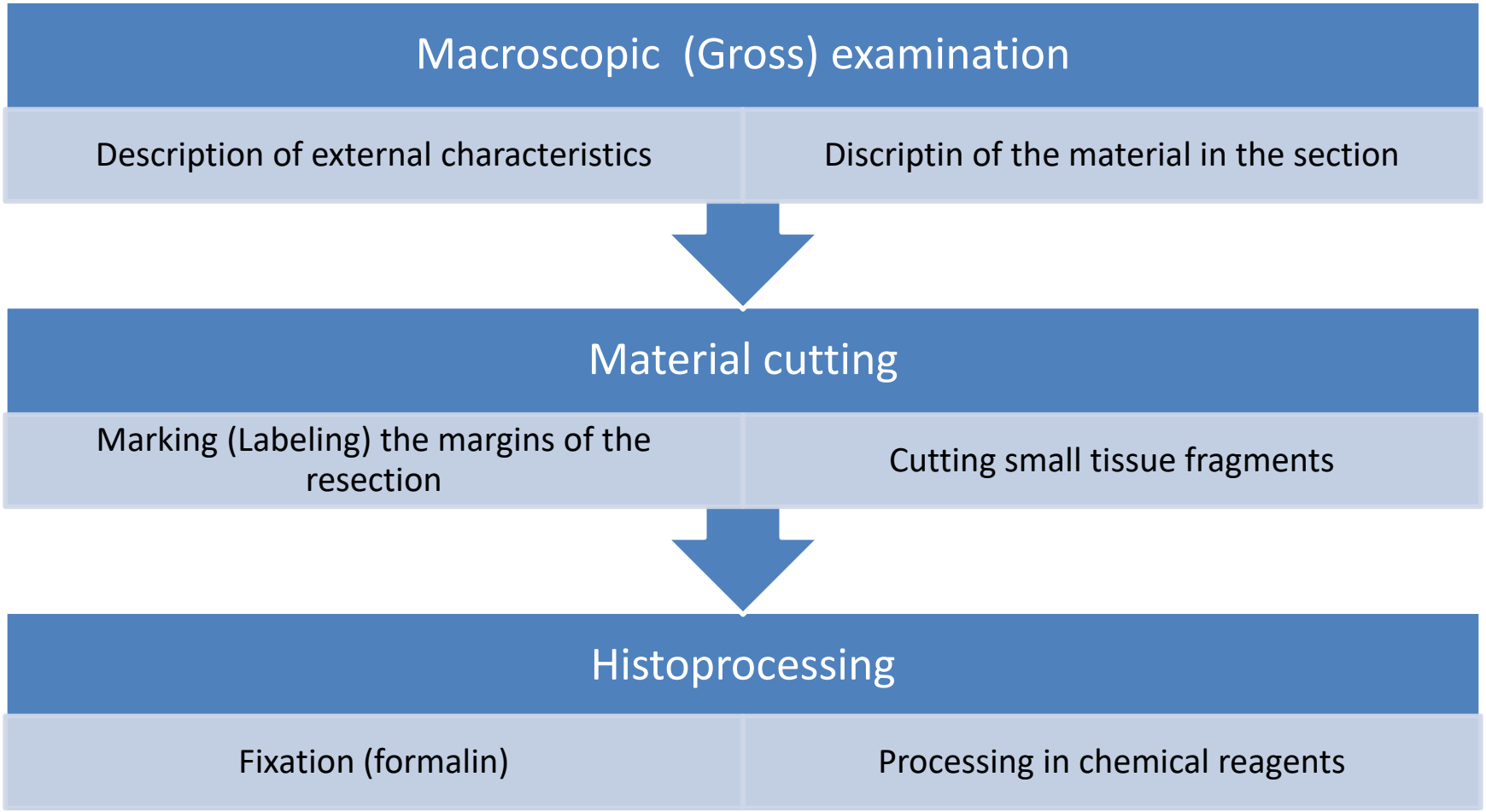
Modern instrumental and diagnostic capabilities make it possible to obtain biological material for research from almost any part of the patient's body.

Diagnostic work of a clinicians is **impossible without the participation of a pathologist.**

Any biological material obtained during a biopsy or surgical intervention is subject to mandatory histological examination, regardless of the disease for which the operation was performed.

Own data

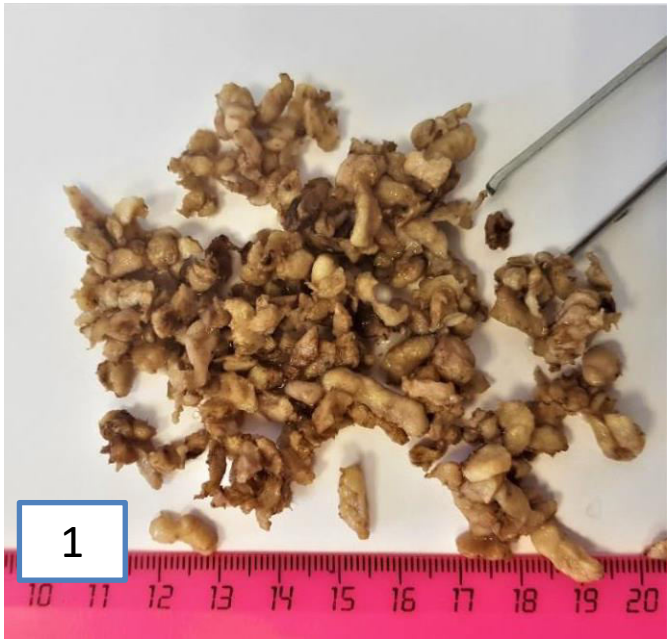
The main stages of pathological examination

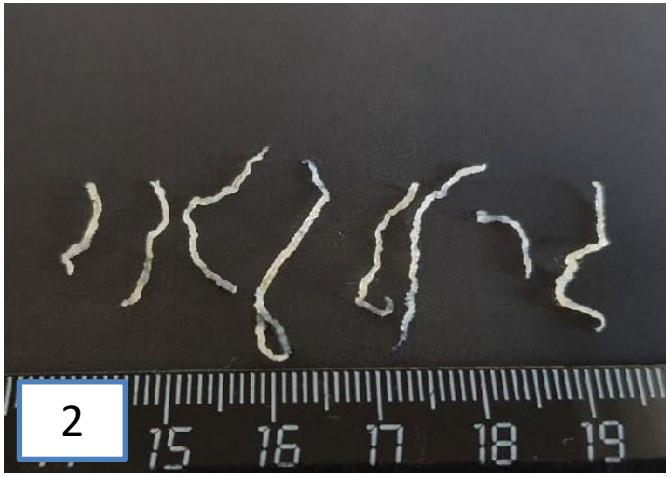


Preparation of histological slides and microscopic examination

Own data

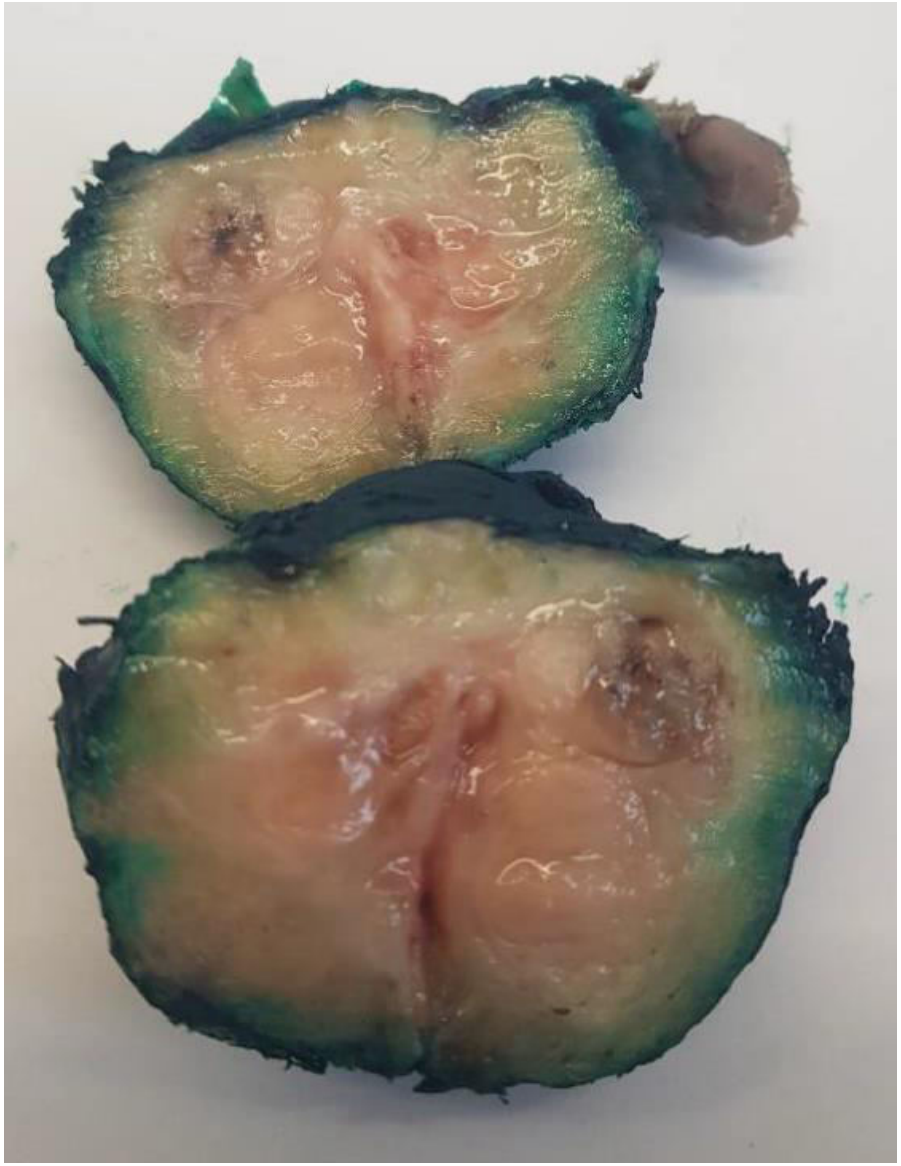
Gross examination and labeling





Own data

Cutting



- For microscopic examination, a pathologist cuts out individual small fragments.
- There are special protocols and recommendations governing the rules of the gross examination of organs and tissues.

Own data

An example of a macroscopic examination of the prostate gland

Own data

Standard stages of histological processing

STAGE 1

- **Fixation in formalin** (at least 24 hours).
- This is the most critical stage, violation of which leads to irreversible damage of the tissue.
- Haste at this stage is unacceptable.

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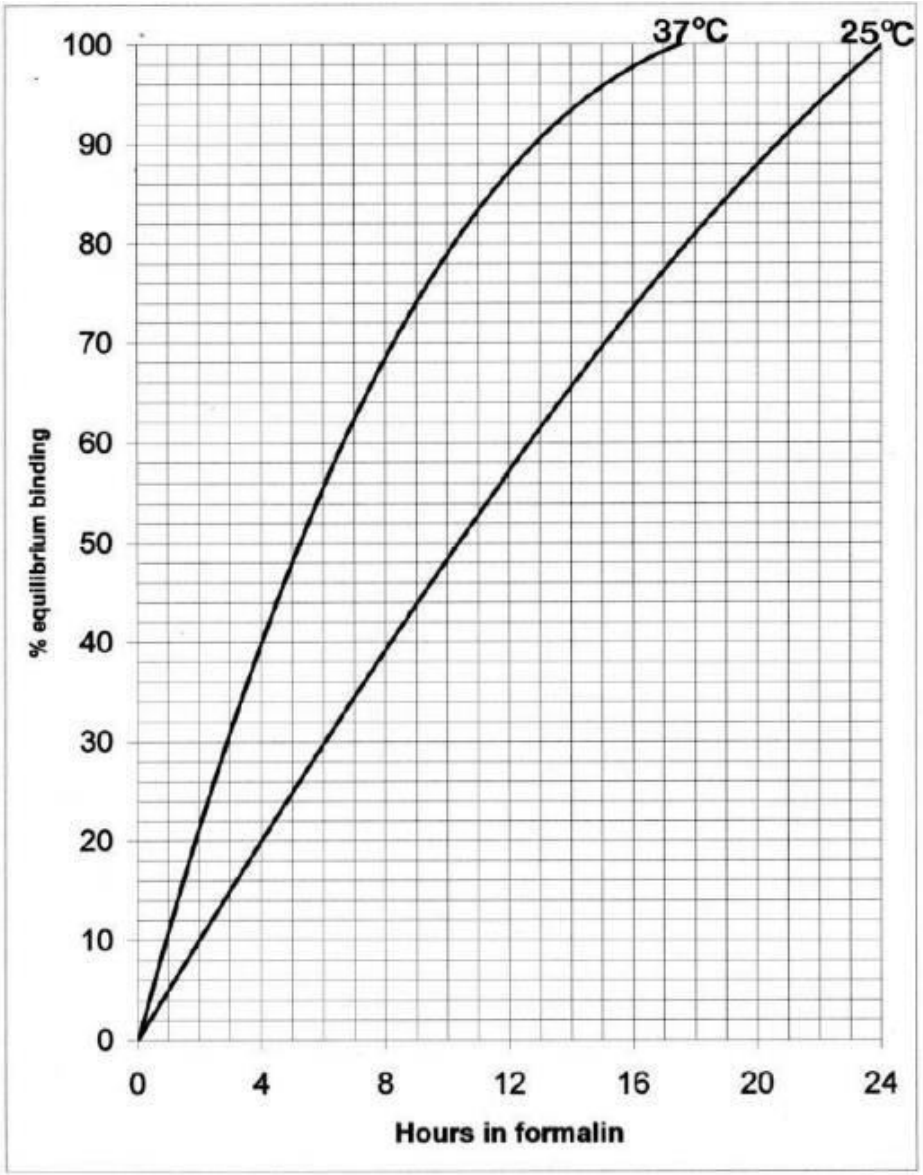


Fox CH, Johnson FB, Whiting J, Roller PP: Formaldehyde fixation. J Histochem Cytochem, 1985; 33(8):845-853

Stage 2

- **Processing in alcohols, xylene.**

Stage 3

- **Paraffin impregnation**

Stages of histological processing are carried out either in containers (jars) placed in thermostats or in histoprocessors

Own data

Histological blocks - plastic cassettes in which biological tissue fragments are imbedded with paraffin

- paraffin blocks are installed in the microtome and thin sections with a thickness of 2 to 5 microns are made from them, which are applied to the histological glass.

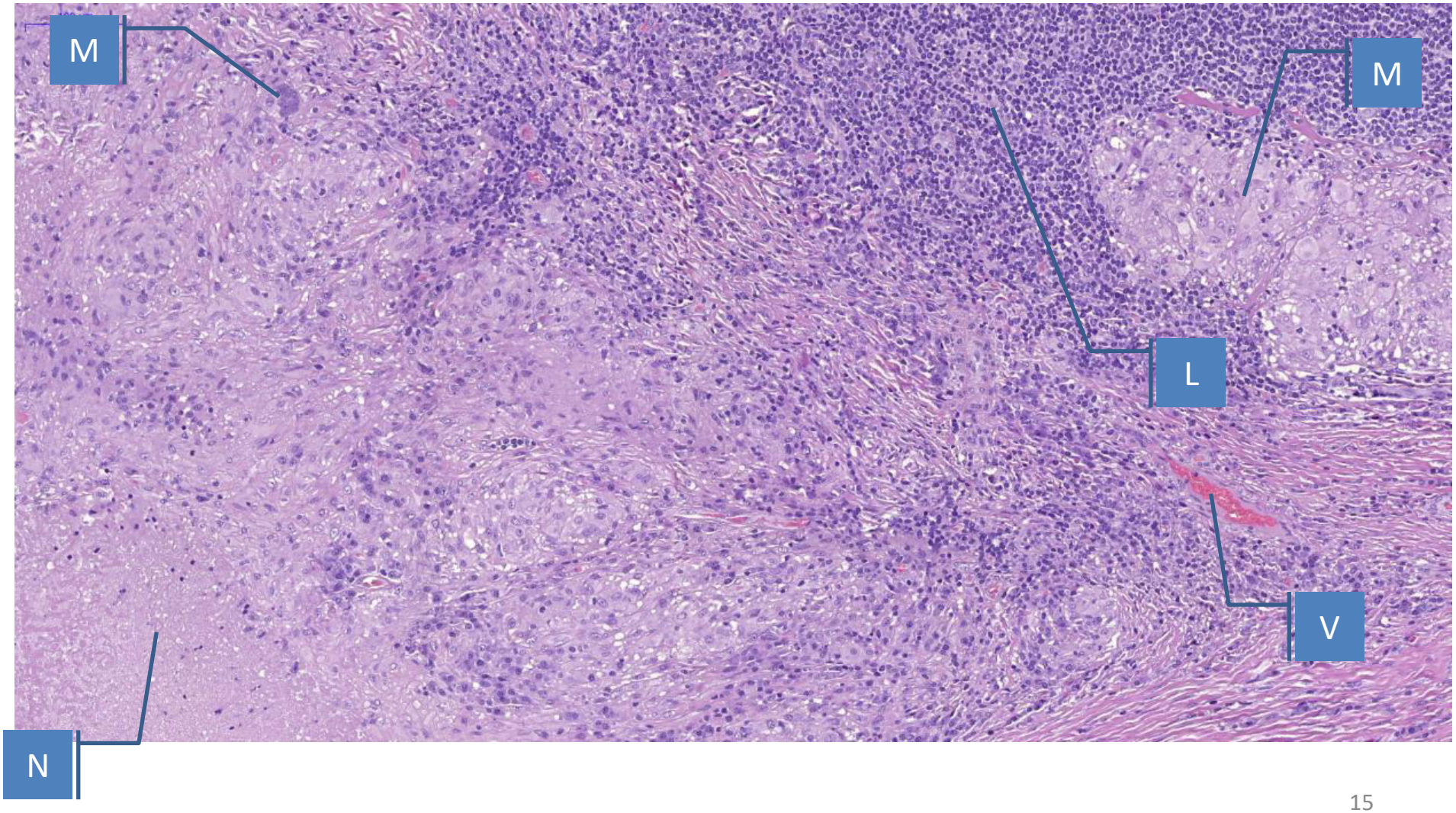
Depending on the objectives of the study, slides are stained with histochemical dyes (there are hundreds of stains and their modifications).

Own data

Hematoxylin-Eosin

Hematoxylin stains nuclei in shades of blue and purple (basophilic structures).

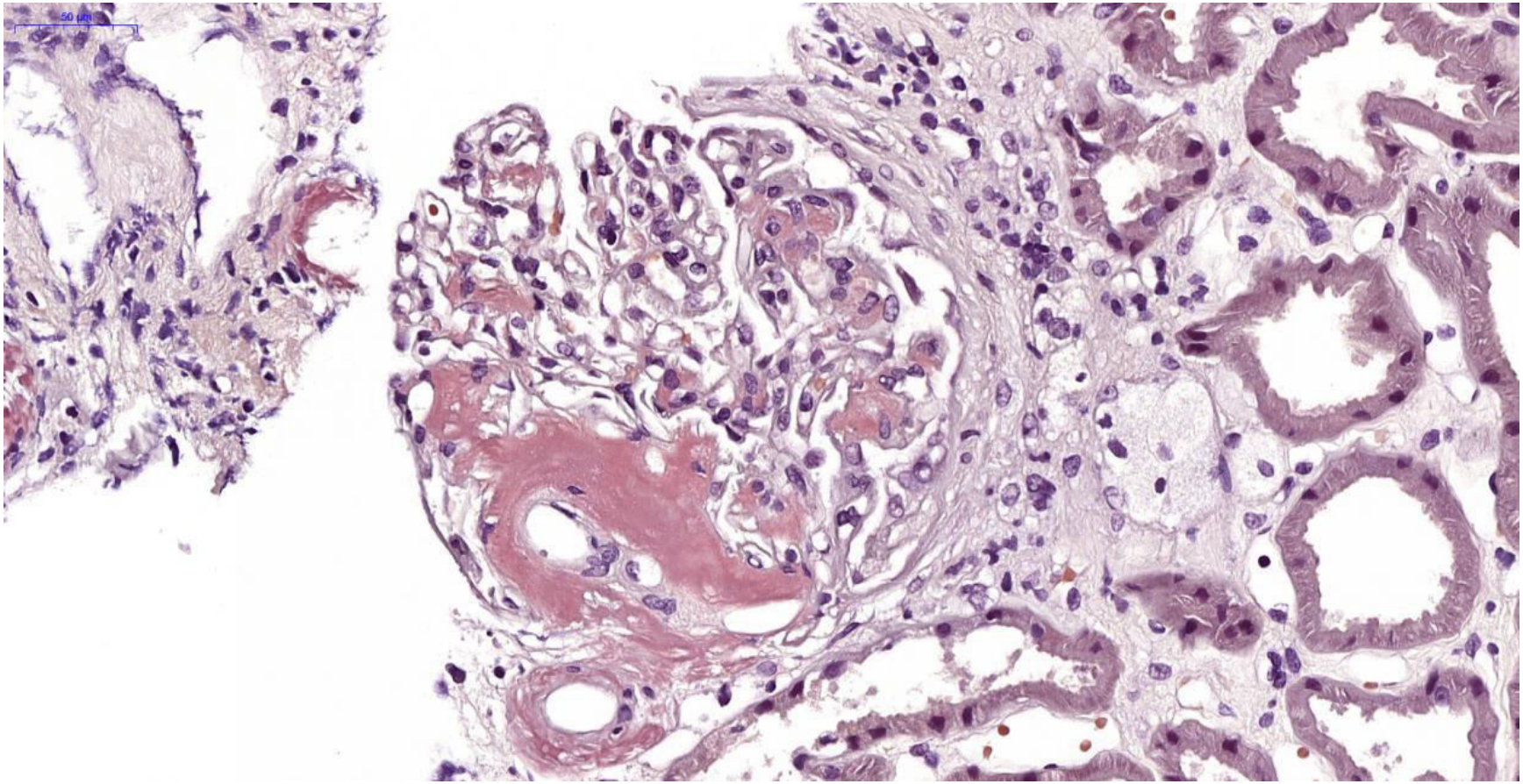
Eosin stains the cytoplasm, basement membranes, fibrous elements of the stroma in shades of pink, erythrocytes in orange-red color (eosinophylic structures).



Own data

Congo-red stain

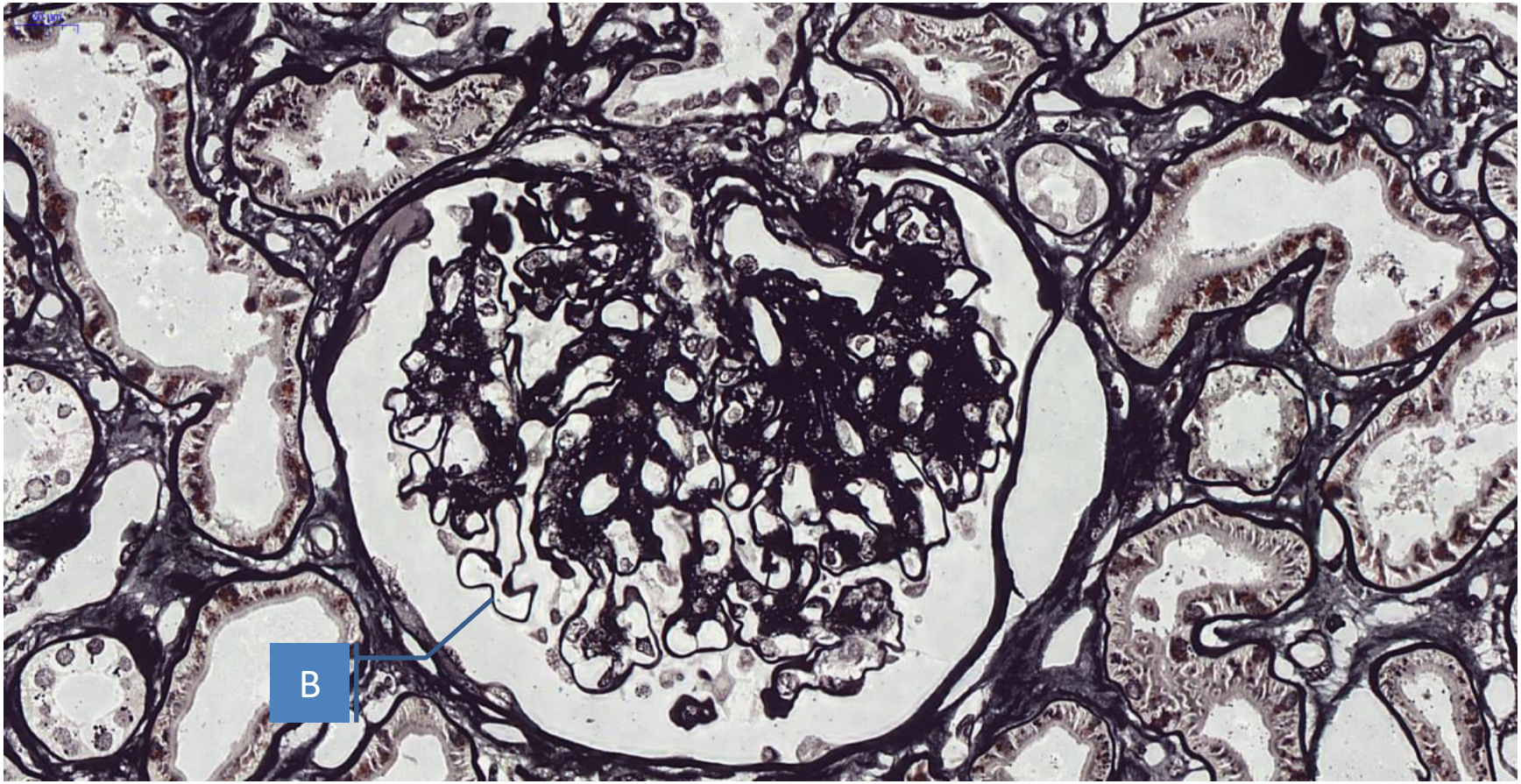
Positively colored areas, when examined in polarized light, acquire an apple-green stain.



Own data

Impregnation with silver salts
(Silver stain)

- staining reticulin fibers in various localizations (basement membranes),
- staining organelles

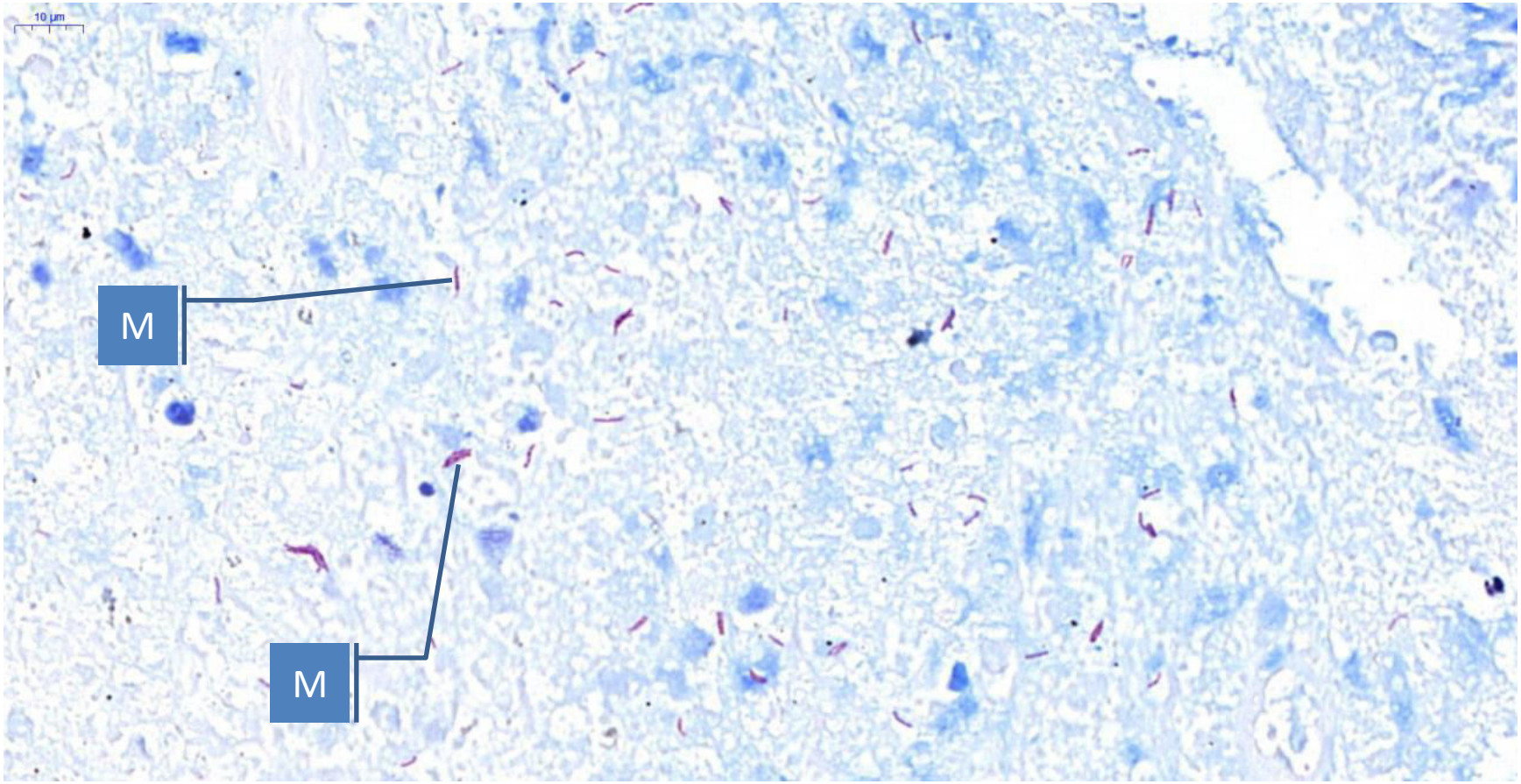


result of methenamine-silver staining of the basement membranes of the glomerular capillaries.

Own data

Ziehl-Nielsen stain

Bright red (fuchsin) staining of acid-fast Mycobacterium tuberculosis (Koch's sticks).



Own data

Cryostat microtomy

•A method used for express diagnostics.

•tissue immediately after cutting by a pathologist is placed in special cryostat microtomes.

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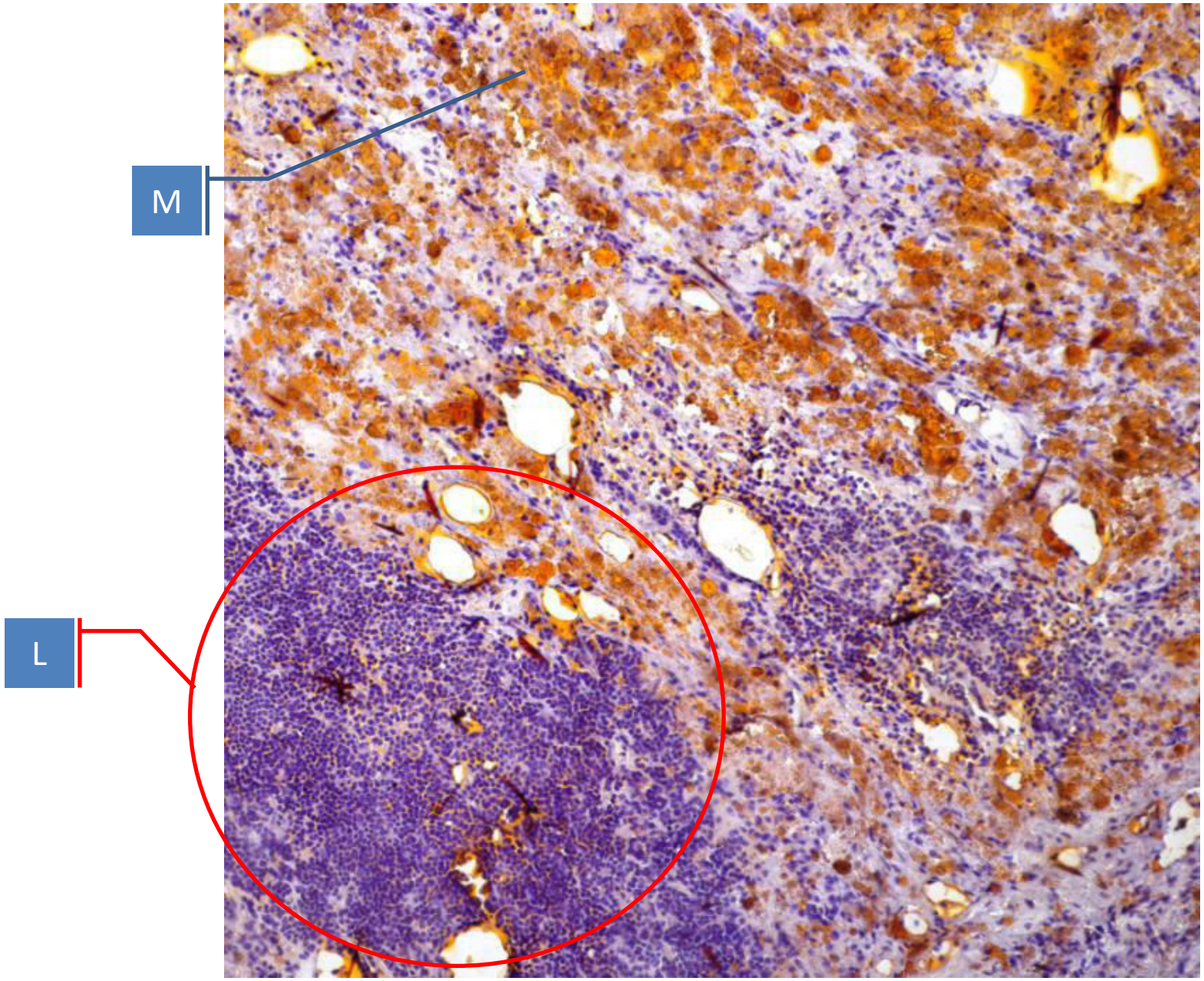
•This technique allows a preliminary diagnosis to be obtained within 20 minutes.

•Also, this method is used to perform some additional stains (for example, staining for fats - Sudan-III, since fats are dissolved in alcohols during routine histoprocessing).

Technician with cryostatic microtome (“C”)

Own data



Fields of macrophages with lipid-containing cytoplasmic inclusions of golden-orange color (Sudan-III stained cryostat section).

Own data

Additional morphological research methods.

Currently, the most common in practice are:

- Immunohistochemical study (IHC);
- In situ hybridization (CISH, SISH or FISH);
- Immunofluorescence analysis (ELISA);
- Electron microscopic examination.

Own data

IHC (**I**mmuno**h**isto**c**hemistry)

- Immunohistochemistry is the use of antibody-based reagents for localization of specific epitopes in tissue sections.

- This method is based on the principle of "antigen-antibody" interaction.

- A positive reaction in this case is denoted by the term "expression", indicating the identified antigen. For example, "cells express CD20".

Own data

The range of indications for IHC investigation is extremely diverse and, among other includes:

- Differential diagnosis of cancer.
- Making an accurate diagnosis in the case of a tumor of unknown origin, including cases with metastasis.
- Assessment of the tumor's malignant potential.
- Determination of target molecules in tumor cells for personalized therapy (especially important for tumors of the breast, lung, brain, cervix, intestines, stomach ...
- Diagnosis of endometrial pathology in infertility...

Own data

A basic principle in diagnostic immunohistochemistry

- the utilization of panels of antibodies, rather than single antibodies directed against markers of the suspected correct diagnosis.

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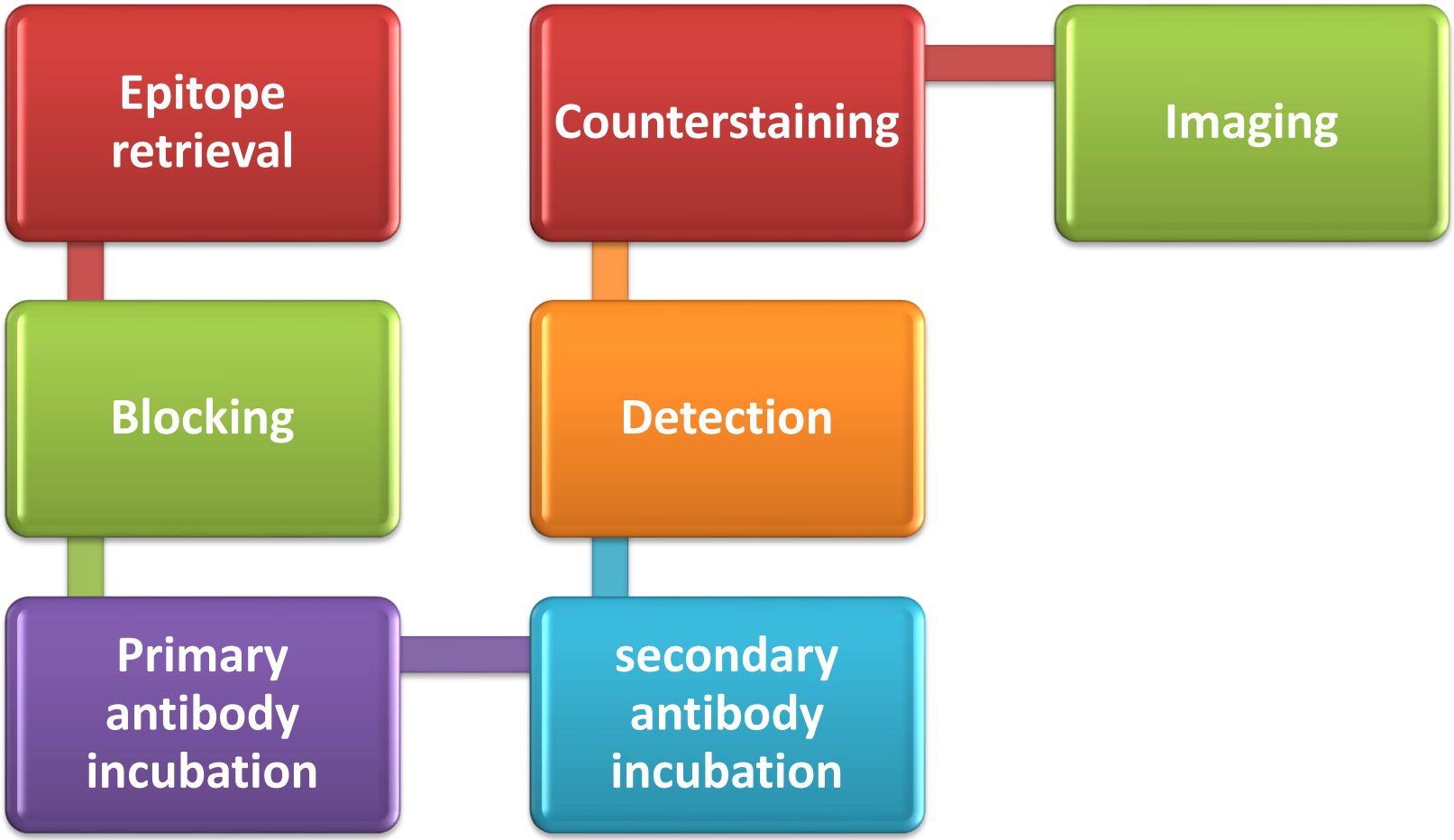
ANTIBODY TO	SMALL CELL CARCINOMA	MELANOMA	LYMPHOMA	EFT	RMS	PDSS	DSRCT
Cytokeratins	Positive	Variable	Negative	Variable	Rare	Positive	Positive
Melanocytic markers	Negative	Positive	Negative	Negative	Negative	Negative	Negative
CD45	Negative	Negative	Positive*	Negative	Negative	Negative	Negative
Desmin	Negative	Variable	Negative	Rare	Positive	Negative	Positive
FLI1/ERG, NKX2.2	Negative	Negative	Negative	Positive	Negative	Negative	Negative
Synaptophysin	Positive	Negative	Negative	Variable	Rare	Negative	Negative

EFT, Ewing family of tumors; RMS, rhabdomyosarcoma; DSRCT, desmoplastic small round cell tumor; PDSS, poorly differentiated synovial sarcoma.
*Lymphoblastic lymphomas may be CD45 negative. In children, screen with TdT and CD43 instead of CD45.

* Enzinger and Weiss's soft tissue tumors / John R. Goldblum, Andrew L. Folpe, Sharon W. Weiss.—6th ed.

IHC steps



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automated systems

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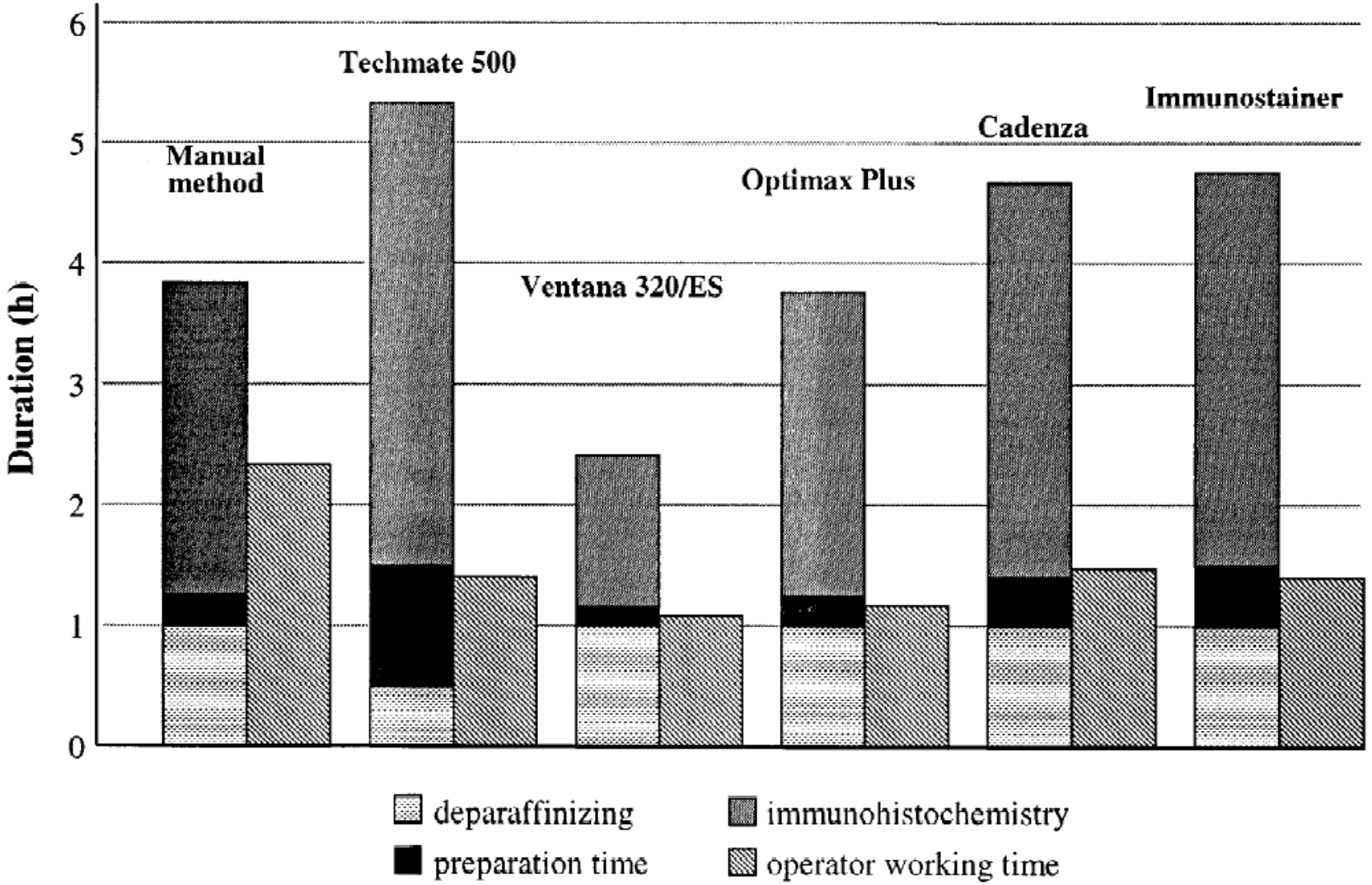

Le Neel, T., Moreau, A., Laboisse, C., & Truchaud, A. (1998). Comparative evaluation of automated systems in immunohistochemistry. Clinica Chimica Acta, 278(2), 185–192. doi:10.1016/S0009-8981(98)00146-6 (https://doi.org/10.1016/S0009-8981(98)00146-6)

Thanks for attention!

Welcome to Pathology ☺