

CONTENTS

SPLANCHNOLOGY (THE STUDY OF INTERNAL ORGANS)	5
General splanchnology	5
<i>The principles of visceral structure</i>	5
Special splanchnology	8
<i>Alimentary system</i>	8
Development of the alimentary system	9
The mouth	18
Oral fissure	18
The oral cavity	19
Oral vestibule	19
The oral cavity proper	22
The tongue	25
Glands of the mouth	30
Teeth	33
The pharynx	38
The oesophagus	43
The stomach	46
The small intestine	50
The large intestine	56
The liver	63
The gallbladder and bile ducts	69
The pancreas	71
The abdominal cavity and peritoneum	72
<i>Respiratory system</i>	81
Development of the respiratory system	82
The nose	82
The external nose	82
The nasal cavity	83
The nasal mucosa	86
Radiological anatomy	86
Rhinoscopy	86
Paranasal sinuses	86
Radiological anatomy of the sinuses	88
The larynx	88
Laryngeal cartilages	88
Laryngeal joints	92
Laryngeal muscles	93
Constrictors	94
Dilatators	95
Muscles changing tension of the vocal folds	95
The wall of the larynx	96
The laryngeal cavity	97
Topography of the larynx	99
Age-related features of the larynx	99
Radiological anatomy of the larynx	100

The trachea	100
Structure of the trachea	101
Topography of the trachea	101
Main bronchi	101
Structure of the bronchi	102
Topography of bronchi	102
Radiological anatomy of the trachea and main bronchi	103
The lungs	103
Topography of the lungs	108
Radiological anatomy of the lungs	109
The thoracic cavity, pleural cavity, mediastinum	109
<i>Urinary system</i>	113
Development of urinary organs	115
The kidney	116
The ureter	124
The urinary bladder	125
<i>Male reproductive system</i>	128
Development of the male reproductive system	128
Descent of the testis	132
The testis	133
The epididymis	135
Rudimentary formations of the testis and epididymis	136
The ductus deferens	136
The spermatic cord	137
The seminal vesicles	138
The prostate	140
The bulbo-urethral glands	141
The scrotum	142
Fascial layers of the testis and spermatic cord	142
The penis	143
The male urethra	146
<i>Female reproductive system</i>	150
Development of the female reproductive system	150
Female external genitalia	152
The female urethra	154
Female internal genitalia	155
The ovary	155
The uterus	157
The uterine tubes	161
The vagina	162
<i>The perineum</i>	164
Features of the female perineum	170
<i>Endocrine glands (endocrinology)</i>	171
General endocrinology	171
The thyroid gland	173
The parathyroid glands	174
The endocrine portion of the pancreas	175
The pituitary gland	175
The pineal gland (epiphysis)	177
The adrenal glands	178
The genital gonads	180
<i>Lymphoid (immune) system</i>	181
Classification	181
General structure	181
Functioning of lymphoid (immune) formations	182
Features of location	182

Features of ontogenesis	183
Structural features of lymphoid (immune) organs	183
<i>Cardiovascular system</i>	190
General information	190
Circulation	193
Development of the cardiovascular system	194
Placental circulation	197
Congenital malformations of the heart and major blood vessels	199
Regularities of distribution of arteries and veins	199
Anastomoses and collateral circulation	200
The heart	201
Structure of the heart walls	202
Chambers of the heart	204
Topography of the heart	209
Radiological anatomy of the heart	212
Vessels of the heart	212
The pericardium	215
Arteries	217
Arteries of the pulmonary circulation (lesser circle)	217
Arteries of the systemic circulation (greater circle)	218
The aorta and its branches	218
The ascending aorta and its branches	218
The aortic arch and its branches	220
Arteries of the head and neck	220
Arteries of the upper limb	241
The axillary artery and its branches	241
The brachial artery and its branches	243
The descending aorta and its branches	249
Branches of the thoracic aorta	249
Branches of the abdominal aorta	250
Iliac arteries and their branches	256
Arteries of the lower limb	260
Branches of the femoral artery	261
Veins (Venous system)	268
Veins of the pulmonary circulation (lesser circle)	268
Veins of the systemic circulation (greater circle)	268
The system of the superior vena cava	270
Veins of the head and neck	270
Veins of the upper limb	285
Veins of the thoracic cage	288
The system of the inferior vena cava	290
Abdominal veins	290
The hepatic portal vein	292
Pelvic veins	295
Veins of the lower limb	296
Lymphatic vessels, trunks and ducts	303
Development of lymph drainage pathways	308
Lymph vessels and lymph nodes of the head	308
Lymph vessels and nodes of the neck	310
Thoracic lymphatic vessels and nodes	311
Abdominal lymph vessels and nodes	313
Pelvic lymph vessels and nodes	314
Lymph vessels and nodes of the upper limb	314
Lymph vessels and nodes of the lower limb	316

Veins (Venous system)

Venous vessels — **veins** (*venae*) — are usually located along the arteries as far as their smallest branches. Like arteries, veins can be divided into cardiac veins, veins of the pulmonary circulation and systemic circulation; regarding their association with major venous systems they can be divided into venous groups on the superior and inferior vena cava; and regarding their topography, there are veins of the body, limbs, head and neck.

Veins of the pulmonary circulation (lesser circle)

Pulmonary veins flowing into the left atrium constitute the venous part of the pulmonary circulation. These veins take away oxygenated blood from the capillary network of alveoli.

Two **pulmonary veins** (*venae pulmonales*) go out of the roots of the right and left lungs; they are named the *right superior pulmonary vein* (*vena pulmonalis dextra superior*), *right inferior pulmonary vein* (*vena pulmonalis dextra inferior*), *left inferior pulmonary vein* (*vena pulmonalis sinistra inferior*), and *left superior pulmonary vein* (*vena pulmonalis sinistra superior*).

They are formed from lobar veins organized from segmental veins. Pulmonary veins occupy the lowest position in relation to the pulmonary artery and main bronchus at the hilum of the right and left lungs and flow into the left atrium separately.

Microcirculation in the pulmonary acinus is the site of origin for pulmonary and bronchial veins, that is why there are intersystemic anastomoses between the veins of the pulmonary circulation and veins of the systemic circulation (bronchial veins).

Veins of the systemic circulation (greater circle)

Veins of the systemic circulation comprise two venous groups (systems); here the blood outflow takes place along two largest venous vessels — the superior and inferior venae cavae (Figs. 200, 201).

The system of the superior vena cava includes veins of the trunk: the azygos vein, hemiazygos vein, posterior intercostal veins, veins of the vertebral column, brachiocephalic veins, internal tho-

racic vein, veins of the head and neck, veins of the upper limb.

The tributaries of the inferior vena cava are the veins of the abdomen, paired organs of the abdominal cavity, hepatic portal vein, veins of the pelvic girdle and pelvic organs, veins of the lower extremity.

The **superior vena cava** (*vena cava superior*) is formed behind the anterior end of the first right ribs at the confluence of the right and left brachiocephalic veins. This vessel is valveless, its length is 7–8.5 cm, diameter of the lumen is 2.0–2.5 cm. It is situated in the superior mediastinum between the mediastinal pleura to the right, and the ascending aorta to the left. It descends vertically behind the first and second intercostal spaces. The vein has a superior extrapericardial and an inferior intrapericardial parts and flows into the right atrium. The superior vena cava returns blood to the heart from the tissues above the diaphragm. Tributaries of the superior vena cava are the azygos vein and small veins from the pericardium and other mediastinal structures.

The **inferior vena cava** (*vena cava inferior*) is the largest (about 20 cm in length, lumen diameter to 3.5 cm), valveless vein. It is located to the right of the abdominal aorta and is formed at the level of IV–V lumbar vertebrae by confluence of the right and left common iliac veins, slightly below the bifurcation of the aorta. There are the right sympathetic trunk and right lumbar and renal arteries behind the vein. Its superior part is situated behind the horizontal part of the duodenum and the head of the pancreas, in the sulcus of the liver, and then it passes into the thoracic cavity through the caval opening of the diaphragm. The extrapericardial part is separated from the right pleura and lung by the right phrenic nerve, and the intrapericardial part is covered, except posteriorly, by inflected serous pericardium and flows into the right atrium immediately. The inferior vena cava returns blood to the heart from the tissues below the diaphragm.

The roots of the inferior vena cava are the common iliac veins, which are located retroperitoneally with common iliac arteries. The common iliac vein is formed at the level of the sacroiliac joint by fusion of the internal and external iliac veins.

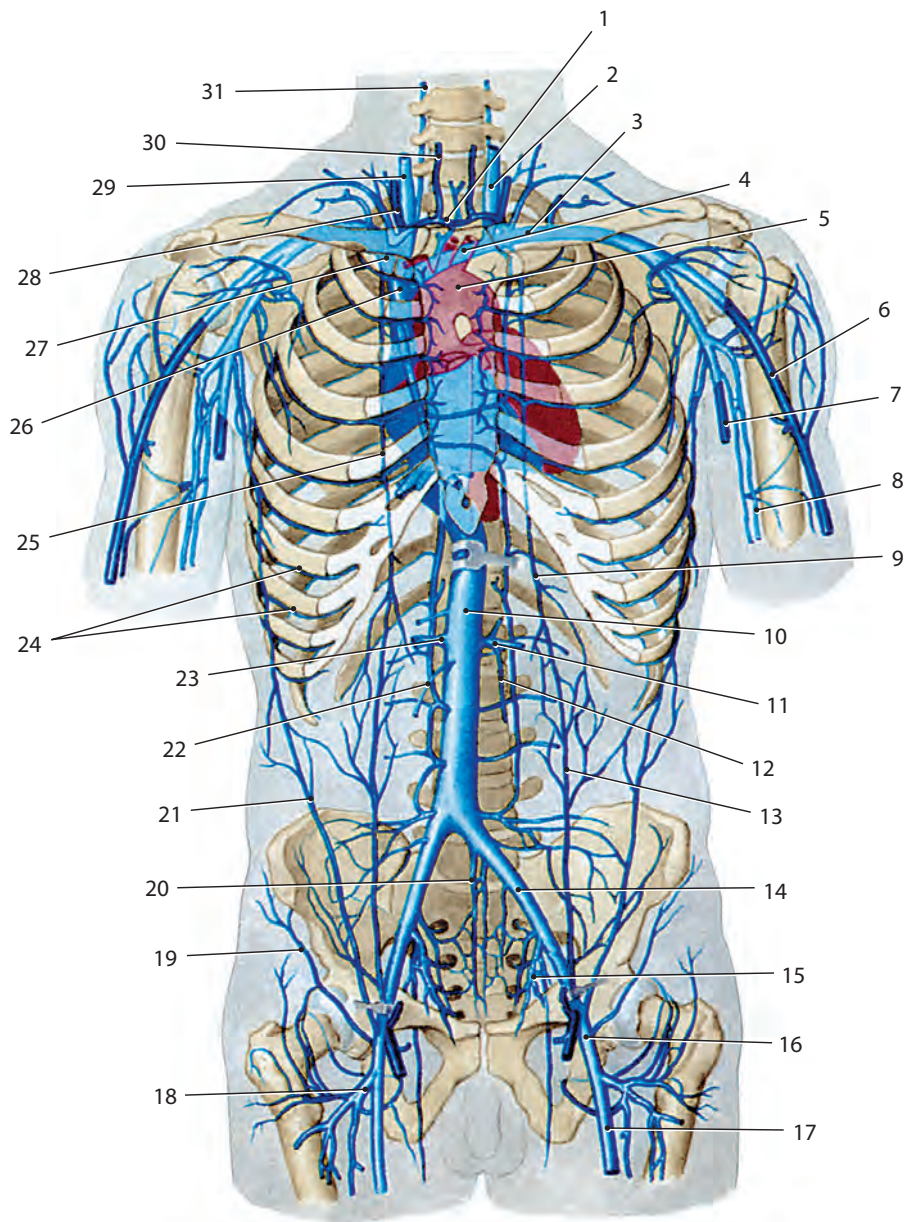


Fig. 200. Superior and inferior venae cavae and their tributaries, anterior aspect: 1 — jugular venous arch; 2 — internal jugular vein; 3 — subclavian vein; 4 — left brachiocephalic vein; 5 — arch of the aorta; 6 — cephalic vein; 7 — basilic vein; 8 — brachial vein; 9 — superior epigastric vein; 10 — inferior vena cava; 11 — renal vein; 12 — left ovarian (testicular) vein; 13 — inferior epigastric vein; 14 — common iliac vein; 15 — internal iliac vein; 16 — external iliac vein; 17 — femoral vein; 18 — deep vein of the thigh; 19 — superficial circumflex iliac vein; 20 — median sacral vein; 21 — superficial epigastric vein; 22 — right ovarian (testicular) vein; 23 — renal vein; 24 — posterior intercostal veins; 25 — internal thoracic vein; 26 — superior vena cava; 27 — right brachiocephalic vein; 28 — right external jugular vein; 29 — internal jugular vein; 30 — anterior jugular vein; 31 — vertebral vein

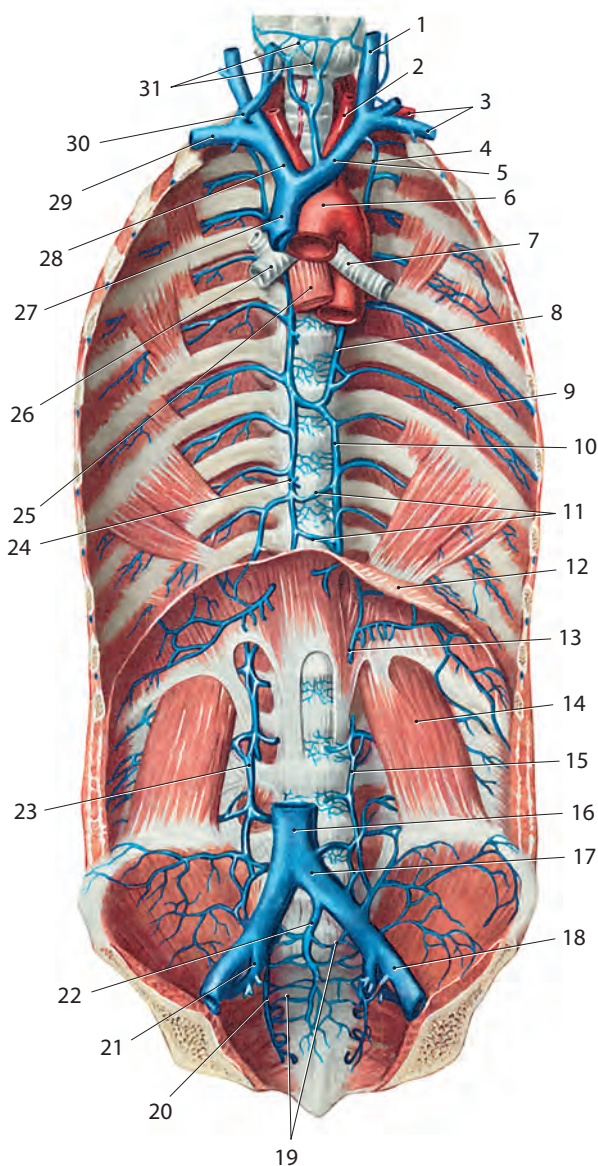


Fig. 201. Superior and inferior venae cavae and their tributaries, anterior aspect (internal organs of thoracic, abdominal and pelvic cavities are removed): 1 — internal jugular vein; 2 — left common carotid artery; 3 — left subclavian artery and vein; 4 — left supreme intercostal vein; 5 — left brachiocephalic vein; 6 — arch of aorta; 7 — left main bronchus; 8 — accessory hemi-azygos vein; 9 — posterior intercostal vein; 10 — hemi-azygos vein; 11 — anastomosis between azygos and hemi-azygos veins; 12 — diaphragm; 13 — inferior phrenic vein; 14 — quadratus lumborum; 15 — ascending lumbar vein; 16 — inferior vena cava; 17 — common iliac vein; 18 — external iliac vein; 19 — sacral venous plexus; 20 — lateral sacral vein; 21 — internal iliac vein; 22 — median sacral vein; 23 — right ascending lumbar vein; 24 — azygos vein; 25 — esophagus; 26 — right main bronchus; 27 — superior vena cava; 28 — right brachiocephalic vein; 29 — right subclavian vein; 30 — right external jugular vein; 31 — unpaired thyroid plexus

The system of the superior vena cava

Veins of the head and neck

The topography, organization and direction of blood flow in the veins of the head and neck does not correspond to those in arteries (Fig. 202). Due to the special integrative brain function (as an organ with high demand for energy, working continuously) the blood outflow is multidirectional, providing high reliability. There are special (not deflatable) venous reservoirs, venous sinuses of the cra-

nial dura mater, cerebral veins, veins of the cranial bones (diploic veins). Emissary and orbital veins go through foramina in the bones of the skull. The blood goes to facial, retromandibular and, partially, to the internal jugular vein from the face and vault of the cranium.

Superficial and deep veins are distinguished in the neck, which carry blood to the internal, external jugular and brachiocephalic veins.

I. **Cerebral veins** (*venae encephali*) are divided into superficial and deep veins, veins of the brain-

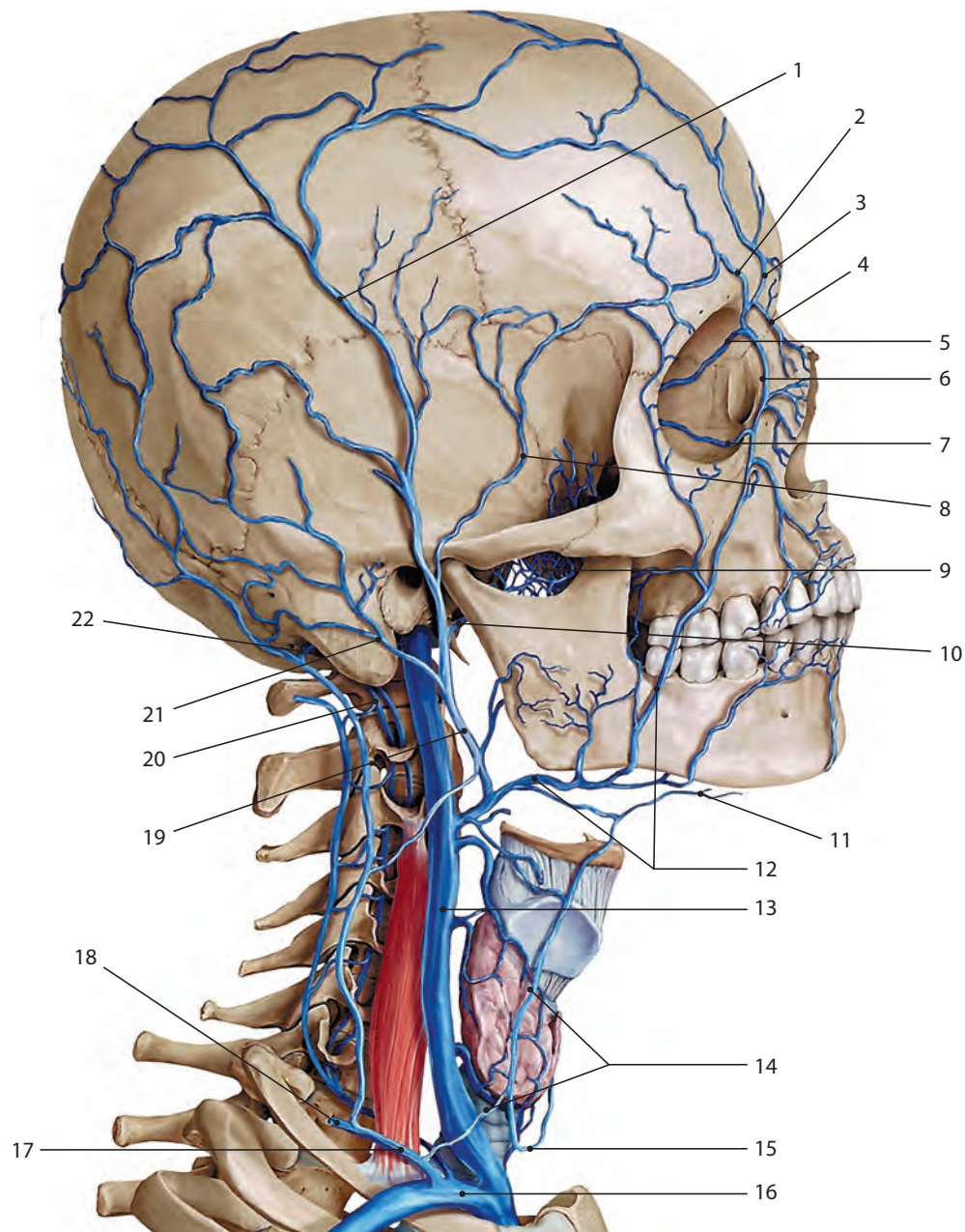


Fig. 202. Veins of the head and neck: 1 — superficial temporal vein; 2 — supra-orbital vein; 3 — supratrochlear vein; 4 — dorsal nasal vein; 5 — superior ophthalmic vein; 6 — angular vein; 7 — inferior ophthalmic vein; 8 — middle temporal vein; 9 — pterygoid plexus; 10 — maxillary vein; 11 — submental vein; 12 — facial vein; 13 — internal jugular vein; 14 — anterior jugular vein; 15 — jugular venous arch; 16 — right subclavian vein; 17 — external jugular vein; 18 — suprascapular vein; 19 — retromandibular vein; 20 — vertebral vein; 21 — posterior auricular vein; 22 — occipital vein

stem and cerebellar veins carrying blood from the respective parts of the brain. These veins possess no valves and have thin walls devoid of muscular tissue. They pierce the arachnoid mater and the inner layer of the dura mater to open into the dural venous sinuses.

1. **Superficial cerebral veins** (*venae superficiales cerebri*). Superficial cerebral veins, bringing blood from the cortex of hemispheres and adjacent white matter, are *superior* and *inferior cerebral veins* (*venae superiores et inferiores cerebri*), *superficial middle cerebral vein* (*vena media superficialis cerebri*) and their anastomoses; the *superior anastomotic vein* (*vena anastomotica superior*) and *inferior anastomotic vein* (*vena anastomotica inferior*) (Fig. 203). Eight to twelve superior cerebral veins include *frontal veins* (*venae frontales*), *parietal veins* (*venae parietales*) and *occipital veins* (*venae occipitales*); they mainly follow the sulci, although some do pass across gyri, they drain the superolateral and medial surfaces of each hemisphere. The inferior cerebral veins consist of *temporal veins* (*venae temporales*), *orbital veins*, and *the vein of the uncus*. Blood outflow from these veins is into the dural venous sinuses. The superficial middle cerebral vein drains most of the lateral surface of the hemisphere, and follows the lateral fissure to end in the cavernous sinus. Inferior cerebral veins on the orbital surface of the frontal lobe join the superior cerebral veins and thus drain to the superior sagittal sinus.

The venous network is formed on the surface of the cerebrum as a result of anastomoses of superficial cerebral veins, in which collateral blood flow is carried out in different directions. The superior anastomotic vein connects the superior sagittal sinus, cavernous sinus, parietal veins and temporal veins; and the inferior anastomotic vein joins the transverse sinus with the cavernous sinus or sphenoid sinus, and temporal and parietal veins with occipital veins.

2. **Deep cerebral veins** (*venae profundae cerebri*). The deep cerebral veins receive the blood from basal nuclei, walls of lateral ventricles, choroid plexuses, and diencephalon (Fig. 204). The deep cerebral veins are divided into superior and inferior groups topographically.

The superior group consists of the *superior thalamostriate vein* (*vena thalamostriata superior*) and its tributaries; *internal cerebral veins* (*venae internae cerebri*) and their tributaries; *veins of the lateral ventricle* (*venae ventriculi lateralis*). The internal cerebral vein drains the deep parts of the hemisphere and the choroid plexuses of the third and lateral ventricles.

The inferior group includes paired basal veins (*venae basales*) and their tributaries. The basal vein begins at the anterior perforated substance by the union of a small *anterior cerebral vein*, which accompanies the anterior cerebral artery, a *deep middle cerebral vein*, which receives tributaries from the insula and neighbouring gyri and runs in the lateral cerebral fissure, and *inferior thalamostriate veins*, which emerge from the anterior perforated substance.

These veins join together to compose the *great cerebral vein* (*vena magna cerebri*). It is a short median vessel which curves sharply up around the splenium of the corpus callosum and opens into the anterior end of the straight sinus.

3. **Veins of the brainstem** (*venae trunci encephali*) take blood from the *pontomesencephalic vein* (*vena pontomesencephalica*); *pontine veins* (*venae pontis*) and *veins of medulla oblongata* (*venae medullae oblongatae*). The veins of the brainstem form a superficial venous plexus deep to the arteries. All these veins carry blood into basal veins.

4. **Cerebellar veins** (*venae cerebelli*) course on the cerebellar surface and are represented by *superior* and *inferior veins of the vermis* (*vena superior vermis et vena inferior vermis*), the *superior* and *inferior veins of the cerebellar hemisphere* (*venae superiores cerebelli et venae inferiores cerebelli*) and *precentral cerebellar vein* (*vena precentralis cerebelli*). They carry blood into the great cerebral vein, as well as straight, transverse and inferior petrosal sinuses.

II. **Dural venous sinuses** (*sinus durae matris*). Dural venous sinuses are the canals formed by the splitting of the cranial dura mater, usually in places of its attachment to the bones of the skull (Fig. 205). The walls are covered with endothelium inside, dense, not deflatable, have no valves which provides for a free flow of blood.

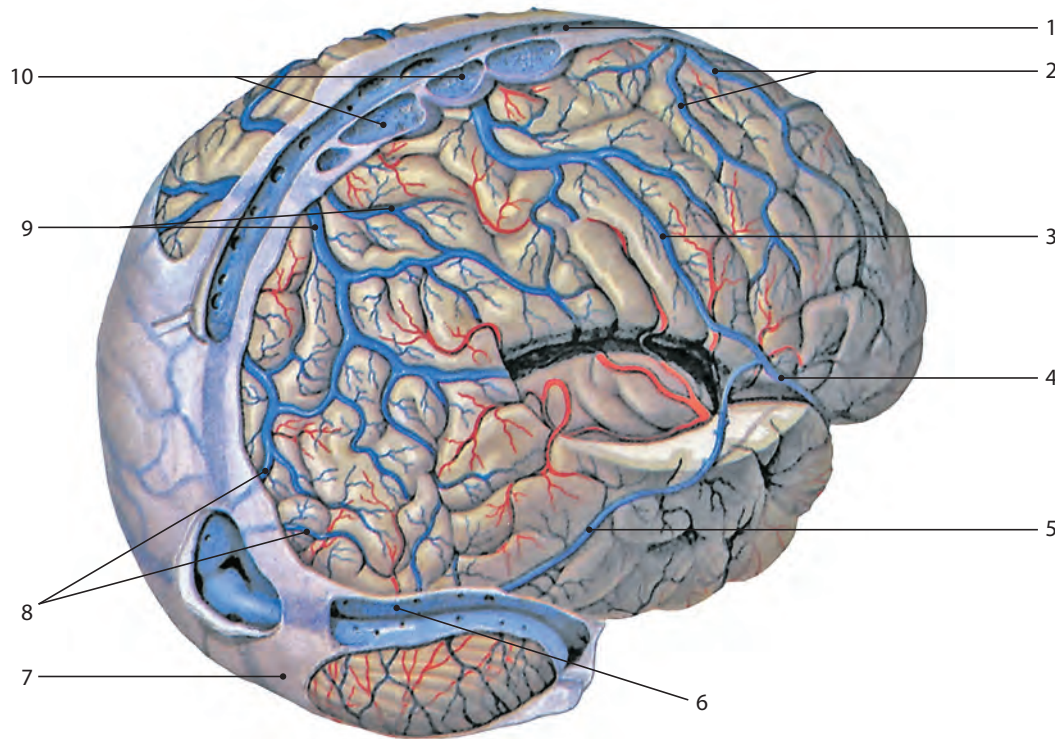


Fig. 203. Superficial cerebral veins: 1 — superior sagittal sinus; 2 — frontal veins; 3 — superior anastomotic vein; 4 — superficial middle cerebral vein; 5 — inferior anastomotic vein; 6 — transverse sinus; 7 — cranial dura mater; 8 — occipital veins; 9 — parietal veins; 10 — lateral lacunae

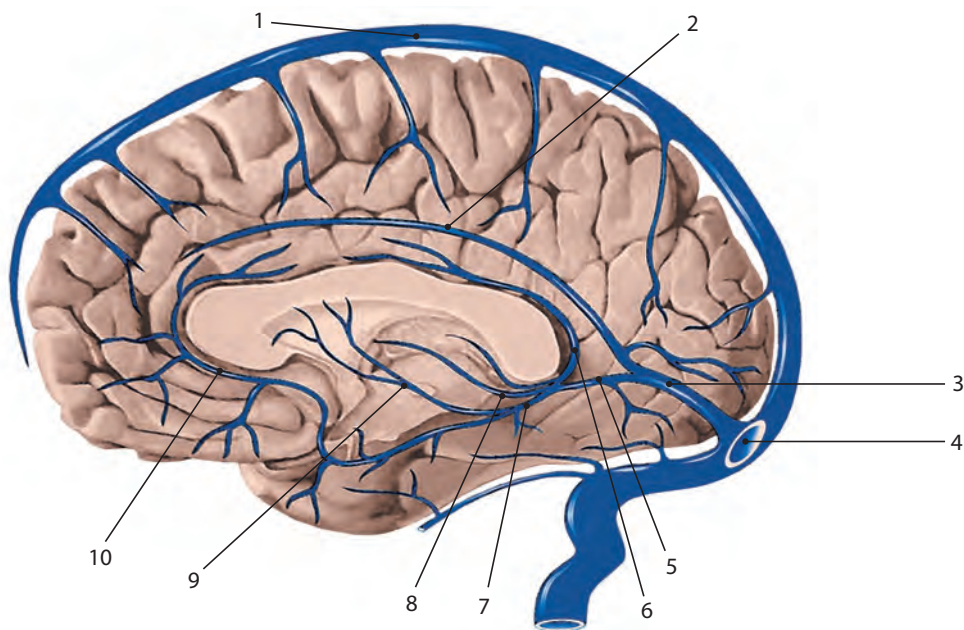


Fig. 204. Deep cerebral veins: 1 — superior sagittal sinus; 2 — inferior sagittal sinus; 3 — straight sinus; 4 — confluence of sinuses; 5 — great cerebral vein; 6 — posterior vein of corpus callosum; 7 — basal vein; 8 — internal cerebral vein; 9 — superior thalamostriate vein; 10 — anterior cerebral vein