
Contents

1	General Introduction	1
1.1	<i>Vascular Anatomy and Biological Processes</i>	1
1.1.1	Vasculogenesis	2
1.1.2	Metameric Origin of Cranial Endothelial Cells	4
1.1.3	Fusion and Dysangiogenesis	5
1.1.4	Angiogenesis	6
1.1.5	Vascular Remodeling	7
1.1.6	Triggers (Causative and Revealing)	8
1.1.7	Segmental Vulnerability in Cerebral Arteries	10
1.1.8	Arteries and Veins	25
1.1.9	Variations and Variability of Cerebrofacial Arteries	25
1.2	<i>Collateral Circulation</i>	27
1.2.1	Normally Enlarged and Hypertrophied Vessels	27
1.2.2	Collateral Circulation and Skeletal Changes	30
1.2.3	Collateral Circulation and Muscular Arteries	32
1.2.4	Congenital or Acquired Variation? Normal or Pathological Variation?	32
1.2.5	Congenital Hypoplasia and Acquired Hypotrophy	37
1.2.6	Hemodynamic Equilibrium	43
1.2.7	Effects of High Flow on a Preexisting Arterial Arrangement	44
1.2.8	Collateral Circulation and Angiogenesis	54
1.2.9	Multiple Constraints and Chronology of the Collateral Response	61
1.3	<i>Principles</i>	69
2	Spinal and Spinal Cord Arteries and Veins	73
2.1	<i>Introduction</i>	73
2.1.1	Embryology	74
2.1.2	Metameric Supply and Axial Organization	74
2.1.3	Fusion, Desegmentation, and Failed Fusion	77
2.2	<i>Spinal Arteries</i>	81
2.2.1	General Aspects	81
2.2.2	Vertebral Supply	85
2.2.3	Anastomoses	89
2.2.4	The Cervical and Vertebral Arteries	93
2.2.5	The Thoracic Arteries	104
2.2.6	The Lumbar and Sacral Arteries	109

2.3	<i>Dural Arteries</i>	110
2.4	<i>Spinal Cord Arteries</i>	116
2.4.1	Spinal Radicular Arteries	116
2.4.2	Radicular Arteries	116
2.4.2.1	The Radiculopial Arteries	119
2.4.2.2	The Radiculomedullary Arteries	123
2.4.3	Extrinsic Arterial Supply to the Spinal Cord	130
2.4.3.1	General Aspects	130
2.4.3.2	The Ventral (Anterior) Spinal Artery	130
2.4.3.3	Pial Network, Axial Arteries, Vasa Corona, Centripetal System	135
2.4.4	Intrinsic Blood Supply to the Spinal Cord	139
2.4.4.1	Sulcal Arteries	139
2.4.4.2	The Radial Perforating Arteries	141
2.4.4.3	Intrinsic Anastomoses	144
2.5	<i>Spinal Cord Veins</i>	146
2.5.1	General Aspects	146
2.5.2	The Intrinsic Venous System	146
2.5.3	The Extrinsic Venous System	148
2.5.4	Radicular Veins	154
2.6	<i>Spinal and Extraspinal Venous System</i>	159
2.6.1	General Aspects	159
2.6.2	Extradural Venous Spaces	160
3	<i>Craniocervical Junction</i>	165
3.1	<i>The Pharyngo-occipital System</i>	165
3.1.1	Phylogenesis	167
3.1.2	Embryology	168
3.1.2.1	The Caroticovertebral Anastomoses	168
3.1.2.2	The Type II Proatlantal Artery	169
3.1.2.3	The Type I Proatlantal or Atlantal Artery	171
3.1.2.4	The Hypoglossal Artery	175
3.1.2.5	The Otic Artery	179
3.1.3	The Occipital Artery	180
3.1.3.1	Origins of the Occipital Artery	180
3.1.3.2	The Branches of the Occipital System	187
3.1.4	The Ascending Pharyngeal Artery	200
3.1.4.1	Origin of the Ascending Pharyngeal Artery	201
3.1.4.2	The Branches of the Ascending Pharyngeal System	203
3.1.5	The Pharyngo-occipital Collateral Network	211
3.2	<i>Arterial Supply to the Posterior Fossa Central Nervous System</i>	224
3.2.1	Principles and Comparative Anatomy	224
3.2.2	The Vertebrobasilar System	228
3.2.3	Fenestration and Duplications	229
3.2.4	Supply to the Upper Cervical Cord	238
3.2.4.1	The Ventral (Anterior) Spinal Artery	238

3.2.4.2	The Lateral Spinal Artery	240
3.2.5	The Basilar Artery	243
3.2.6	Cerebellar Arteries	246
3.2.6.1	The Posterior Inferior Cerebellar Artery	246
3.2.6.2	The Anterior Inferior Cerebellar Artery	253
3.2.6.3	Brain Stem Arteries	259
4	Skull Base and Maxillofacial Region	261
4.1	<i>Embryology of the Carotid System</i>	262
4.1.1	The Internal Carotid Arterial Trunk	262
4.1.2	The Carotid Branches to the Face	268
4.2	<i>The Arteries of the Middle Ear and Branches of the Petrous Internal Carotid Artery</i>	271
4.2.1	The Arteries of the Middle Ear	271
4.2.2	Arterial Variants in the Middle Ear	281
4.2.2.1	Hyostapedial Artery Variants	283
4.2.2.2	Aberrant Flow of the Internal Carotid Artery in the Tympanic Cavity	285
4.2.2.3	The Pharyngotympanostapedial Artery	290
4.3	<i>Anatomy and Variations of the Extracranial Carotid Artery Branches</i>	292
4.3.1	The Maxillary Artery Branches Outside the Cranial Cavity	292
4.3.1.1	Hemodynamic Balances	292
4.3.1.2	The Extracranial Base of the Skull and the Nasal Cavity	295
4.3.1.3	The Maxillomandibular Region	304
4.3.1.4	The Maxillary Collateral Pattern	315
4.3.2	The Musculocutaneous Arteries of the Head and Mouth	325
4.3.2.1	The Arteries of the Scalp	325
4.3.2.2	Arteries to the Face	342
4.3.2.3	The Arteries of the Floor of the Mouth	356
4.3.2.4	The Linguofacial Collateral Pattern	362
4.3.3	Thyrolaryngeal Arteries	370
4.3.3.1	The Laryngeal System and Its Branches	371
4.3.3.2	Connections with the Glandular Thyroid System	376
4.3.3.3	Thyroid Gland Arteries	377
4.3.3.4	Parathyroid Supply	379
4.3.4	Common Carotid Bifurcation	384
5	The Skull Base and Extradural Arteries	387
5.1	<i>The Cavernous Sinus Region</i>	389
5.1.1	Phylogenesis of the Cavernous Branches of the Internal Carotid Artery Siphon	391
5.1.1.1	The Rete Mirabile	393
5.1.1.2	Balanced Supply	395
5.1.1.3	Dominant Internal Carotid Artery Supply	395
5.1.2	The Internal Carotid Artery Siphon and Its Branches	395

5.1.2.1	The Trigeminal Artery	396
5.1.2.2	The Lateral Artery of the Clivus	398
5.1.2.3	The Lateral Artery of the Trigeminal Ganglion	401
5.1.2.4	The Recurrent Artery of the Foramen Lacerum	401
5.1.2.5	The Primitive Maxillary Artery	411
5.1.2.6	The Posteroinferior Hypophyseal Artery	412
5.1.2.7	The Embryonic Ophthalmic Arteries and the Inferolateral Trunk	414
5.1.2.8	The Capsular Arteries	425
5.2	<i>Embryology and Anatomy of the Branches Supplying the Orbit</i>	426
5.2.1	The Orbital Artery of the Stapedial System	426
5.2.2	The Origins of the Middle Meningeal Artery	427
5.2.3	The Ophthalmic Artery and Its Branches	435
5.2.3.1	The Central Retinal Artery	440
5.2.3.2	The Posterior Ciliary Arteries	443
5.2.3.3	The Lacrimal Artery	445
5.2.3.4	The Muscular Branches	447
5.2.3.5	The Anterior and Posterior Ethmoidal Arteries	447
5.2.3.6	The Supraorbital Artery	449
5.2.3.7	The Palpebral Arteries	449
5.2.3.8	The Supratrochlear or Frontal Artery	450
5.2.3.9	The Dorsal Nasal Artery	450
5.2.4	Variants of the Orbital Supply	450
5.2.5	The Extracranial Maxillary Artery Branches to the Orbit . .	453
5.2.5.1	The Anterior Deep Temporal Artery	453
5.2.5.2	The Infraorbital Artery	453
5.2.5.3	The Orbital Branches of the Sphenopalatine Artery	454
5.2.5.4	Other Branches	455
5.3	<i>Supply of the Adjacent Meninges</i>	455
5.3.1	The Artery of the Free Margin of the Tentorium Cerebelli .	455
5.3.2	The Basal Tentorium Arterial Arcade	458
5.3.3	Meningeal Branches of the Ethmoidal Arteries	461
5.3.4	The Supply to the Convexity	461
5.3.5	The Middle Cranial Fossa	467
5.4	<i>The Transosseous Peripheral Nervous System Arterial Supply</i>	467
5.4.1	Phylogeny	468
5.4.2	Supply of the Extraocular Nerves and the Ophthalmic Root of the Trigeminal Nerve	469
5.4.3	Supply of the Trigeminal Nerve and Trigeminal Ganglion	471
5.4.4	Supply of the Facial Nerve	473
5.4.5	Supply of the Ninth and Tenth Cranial Nerves	475
5.4.6	Supply of the 11th Cranial Nerve	475
5.4.7	Supply of the 12th Cranial Nerve	475
5.4.8	Supply of the First and Second Cervical Roots	475
5.4.9	Supply of the Third and Fourth Cervical Roots	475

6	Intradural Arteries	479
6.1	General Aspects	480
6.1.1	Neural Tube Vascular Homogeneity and Arterial Homologies	480
6.1.1.1	The Distributing System	480
6.1.1.2	The Sources of Supply	481
6.1.2	Development of the Arterial Supply to the Brain Tissue (In Collaboration with C. Raybaud)	481
6.1.2.1	Introduction	481
6.1.2.2	The Embryonic Period	484
6.1.2.3	The Fetal Period	489
6.1.2.4	Functional Organization and Development of the Pial Network	495
6.1.2.5	Arterial and Venous Capillaries	496
6.1.2.6	Capillary–Neural–Meningeal Relationships	497
6.2	The Internal Carotid Artery Divisions	501
6.2.1	Phylogenetic Aspects	501
6.2.1.1	Introduction	501
6.2.1.2	Phylogenetic Steps	502
6.2.1.3	Conclusions	509
6.2.2	Embryological Aspects	510
6.2.2.1	The Internal Carotid Artery Termination	510
6.2.2.2	The Limbic Arterial Arch	519
6.3	The Caudal Internal Carotid Artery Division	521
6.3.1	The PCoA-P1-Distal BA System	523
6.3.1.1	Distal Basilar Artery Fusion	526
6.3.1.2	The Anterosuperior Cerebellar Artery	538
6.3.1.3	The PCoA-P1-BA Perforators	540
6.3.2	The Posterior Cerebral Artery	548
6.3.2.1	Choroid Plexus Territory	549
6.3.2.2	Cortical Territories	557
6.3.2.3	Dural Branches	562
6.4	The Anterior Choroidal Artery	563
6.5	The Cranial Internal Carotid Artery Division	575
6.5.1	The Anterior Cerebral Artery	578
6.5.1.1	Perforators and Central Arteries	580
6.5.1.2	Truncal Variations (Proximal)	584
6.5.1.3	The Recurrent Artery of Heubner	590
6.5.1.4	Cortical Branches	596
6.5.1.5	Branches to the Corpus Callosum	611
6.5.1.6	Choroidal Branches	611
6.5.1.7	Dural Branches	611
6.5.2	The Middle Cerebral Artery	613
6.5.2.1	Central Arteries	614
6.5.2.2	Proximal Branches	617
6.5.2.3	Duplication and Fenestration	618
6.5.2.4	Cortical Branches	619
6.5.2.5	Hemispheric Arterial Balances	623

7	Intracranial Venous System (In Collaboration with C. Raybaud)	631
7.1	Introduction	631
7.2	Deep Venous System	632
7.2.1	General Aspects	632
7.2.2	Ventricular Veins and Deep Cisternal Collectors	638
7.2.2.1	The System of the Basal Vein of Rosenthal	643
7.2.2.2	The Tentorial Sinus	647
7.2.3	The Transcerebral Veins	650
7.2.4	The Developmental Venous Anomalies	656
7.2.4.1	General Aspects	656
7.2.4.2	Imaging Features	656
7.2.4.3	Associated Conditions	658
7.2.4.4	Clinical Significance	660
7.3	Superficial Veins and Sinuses	661
7.3.1	General Aspects	661
7.3.2	Nomenclature of Cortical Veins	665
7.3.3	Venodural Relationships	669
7.3.4	Dural Sinuses	669
7.3.5	Emissary Veins and Transcranial Drainage	675
7.4	Infratentorial Veins	678
7.4.1	General Aspects	678
7.4.2	Veins of the Brain Stem	680
7.4.3	The Cerebellar Veins	682
7.5	Complex Cerebrofacial Venous Drainage: From Anomaly to Abnormality	695
7.5.1	Sinus pericranii	702
7.6	CSF Circulation	710
	References	715
	Subject Index	753

<http://www.springer.com/978-3-540-41204-5>

Clinical Vascular Anatomy and Variations

Lasjaunias, P.; Berenstein, A.; Ter Brugge, K.

2001, XXII, 772 p. 677 illus., 111 illus. in color.,

Hardcover

ISBN: 978-3-540-41204-5