The Suboccipital Cavernous Sinus
Microsurgical anatomic study

- Ten formalin fixed cadaver heads
- Blood vessels perfused with colored silicone rubber
- Dissection under magnification
- Measurements obtained under magnification
Anatomic elements presented topographically (bilateral or right side):

(a) Muscular layers
(b) Posterior atlanto-occipital membrane
(c) Venous structures
(d) Spinal nerves
(e) VA with adjacent structures
V3 is covered by three layers of muscles

- Superficial
- Intermediate
- Deep
V3 is covered by three layers of muscles

- Superficial
- Intermediate
- Deep
Suboccipital venous plexus

- Drains blood from surrounding structures
- Multiple anastomoses with surrounding venous structures
- Continues inferiorly into deep cervical vein
Deep muscular layer

- Rectus capitis posterior minor muscle
- Rectus capitis posterior major muscle
- Obliques capitis superior muscle
- Obliques capitis inferior muscle
- Semispinalis cervicis muscle
- Splenius cervicis muscle
Posterior atlantooccipital membrane

Stretched between occipital bone and posterior arch of atlas
Suboccipital Cavernous Sinus: Compartment Borders

- Proximally, lateral (periosteal) ring
- Distally, distal (dural) ring
- Inferiorly, posterior arch of atlas
- Ventrally, dura and capsule of atlantooccipital condylar articulation
- Dorsally, posterior atlantooccipital membrane
Suboccipital Cavernous Sinus (SCS)

- Surrounded by fibrous membrane
- Contains and cushions
  - V3h
  - Muscular artery of V3h
  - Posterior meningeal artery of V3h
  - Periarterial autonomic neural plexus
  - C1 nerve branching into anterior and posterior rami
SCS Anastomosis with Surrounding Venous Structures

- Contralateral scs via internal vertebral plexus
- The jugular bulb and jugular vein
  - Anterior condylar vein (hypoglossal canal)
  - Posterior condylar vein (posterior condylar canal)
  - Lateral condylar vein (lateral to condyle)
- Suboccipital venous plexus via anastomotic vein that courses through foramen of A-O membrane
Vertebral Artery Venous Plexus (VAVP)

- Encircles V3v
- Inferior continuation of SCS
- Anastomosing with surrounding venous structures (e.g., vertebral venous plexus, suboccipital venous plexus)
Vertebral venous plexus (VVP)

- Internal (within vertebral canal)
- External (around vertebral column)

Vertebral Artery (VA) segments

- Pretransverse (V1)
- Transverse (V2)
- Suboccipital (V3)
- Intracranial (V4)
Suboccipital (V3) segment

From transverse foramen of axis to VA penetration of dura
Suboccipital (V3) segment of VA

- Vertical part (V3v)
- Horizontal part (V3h)
Lateral (periosteal) ring

- In the transverse foramen of atlas
- Encircles
  - SCS
  - V3
  - Periarterial autonomic neural plexus
Distal (dural) ring

- At dural penetration of V3
- Encircles
  - V3
  - Periarterial autonomic neural plexus
  - (possibly) origin of posterior spinal artery
Arterial branches of V3

- 4 constant branches
  - V3v
    - Muscular artery
    - Radiculomuscular artery
  - V3h
    - Muscular artery
    - Posterior meningeal artery
Muscular artery of V3v

- Smallest branch of V3
- Arises ventral to the anterior ramus of C2 nerve
- Mean diameter 0.4 mm
- Anastomoses with ascending pharyngeal artery
- Vascularizes glomus jugulare and other tumors
- Same on both sides (90%) or larger on the left side (10%)
Radiculomuscular artery of V3v

- Largest branch of v3
- Arises below transverse foramen of atlas
- Gives rise to
  - Radiculomedullary branch (C2 nerve and ganglion, spinal cord)
  - Muscular branch (suboccipital muscles)
- Some on both sides in all specimens
- Mean diameter 1 mm
Muscular artery of V3h ("Salmon’s suboccipital artery")

- Courses posteriorly through foramen of atlantooccipital membrane.
- Vascularizes suboccipital muscles
- Anastomoses with branches of occipital artery (role in occlusive cerebrovascular disease)
- Same in both sides (70%) or larger on right side (30%)
- Mean diameter 0.5mm
Posterior meningeal artery of V3h

- Arises at superior medial loop
- Vascularizes neighboring posterior fossa dura
- Vascularizes meningiomas, glomus jugulare tumors, dural AVMs, etc.
- Diameters same on both sides (70), larger on right side (20%) or larger on left side (10%)
- Mean diameter 0.8 mm
Vascular loops of V3

- Inferior medial loop (iml)
- Inferior lateral loop (ill)
- Superior lateral loop (sll)
- Superior medical loop (sml)
Spinal nerves

- C1 nerve
- C2 nerve
C2 nerve

- Anterior ramus
  - Attached to V3v by fibrous adhesions
  - Contributes to cervical neural plexus
- Posterior ramus
  - Medial branches (major occipital nerve)
  - Lateral branches (suboccipital muscles)
C1 nerve

- Anterior ramus (cervical neural plexus)
- Posterior ramus (suboccipital muscles)
Hypotheses

- Loops of V3 and of petrous cavernous ICA (which also increase contact surface of arteries cushioned by veins), their intraluminal pressures and their pulsations are interrelated with pressures of their venous compartments (CS and SCS).
- In turn, they all affect ICP and play role in its regulation
- CS and SCS provide alternative *extracranial to intracranial route* for metastatic disease spread (tumor, infection)


Anderson R. Diodrast studies of the vertebral and cranial venous system to show their probable roles in cerebral metastases. *Journal of Neurosurgery* 8: 411-422, 1951.

“Ampulloglomerullar organ”
(Parke and Valsamis, 1967)

- Groups of venous sacculations within SCS
- Associated with system of glomerular arteriovenous formations and numerous nerves
- Capable of responding to changes in venous pressures
- Structurally resembling carotid and aortic bodies

SCS is Strickingly Similar to CS

- Anatomic properties of their contents
  - Venous cushioning
  - Contain and cushion V3 and petrous-cavernous ICA
    - Four arterial loops
    - Supporting fibrous vascular rings delineating compartments (plexus – sinus)
    - Transitional patterns of V3 and petrous-cavernous ICA arterial walls
  - Contain and cushion nerves (cranial or spinal)
Kawase T, van Loveren H, Keller JT, et al.
Meningeal architecture of the cavernous sinus: clinical and surgical implications.
Neurosurgery 39: 527-536, 1996
SCS is Strikingly Similar to CS (cont.)

- Related embryological development
- Location at skull base
- Neurosurgical importance
Die zwischen der Arteria vertebralis und den vertebraLEN uN
d cerebralen Venen bestehende Verbindung
am atlantookzipitalen Abschnitt beim Menschen
Von B. Zolnai
Mit 5 Abbildungen im Text.
(Eingegangen am 26. August 1963)
Similar or identical function roles

- Mutually anastomose
- Alternative venous drainage pathways from intracranium
- Take part in ICP regulation
- Role in equalizing pressures within venous systems and transmitting influence of respiratory and cardiac pressures to intracranial compartments ("valveless systems")
- Role in metastatic spread of diseases (tumor, infections) to intracranium