tomeningeal artery through the superior orbital fissure.

According to Streeter [58], the superior petrosal sinus appears in the 18-mm embryo. Padget identified the superior petrosal sinus at 14–16 mm as early as Stage 4 (Fig. 2C). However, the definitive superior petrosal sinus is the last of the major adult sinuses to be formed. Of note, the superior petrosal sinus has no well-defined communication with the cavernous sinus and any communication that occurs is late in development.

Special attention should be given to the development of the orbital veins. Before Stage 4, the primitive maxillary vein, caudal and ventral to the eye, is the only drainage pathway of the optic region. At Stage 4, a smaller vein, the primitive supraorbital vein, arises from the superficial tissues cranial and dorsal to the eye. This vein will become the superior ophthalmic vein. The primitive supraorbital vein initially drains directly into the stem of the anterior dural plexus between CNs V and IV. Because of the approximation of the two nerves, the stem of the veins is wedged between CNs IV and VI. A new anastomosis appears lateral to the ophthalmic (V1) nerve and CN IV that reroutes the primitive supraorbital vein to the stem of the maxillary vein. This explains the adult trajectory of the superior ophthalmic vein, which laterally crosses the annular tendon and the cranial nerves that course through the superior orbital fissure to drain into the anterior cavernous sinus.

A discussion of the venous system of the cavernous sinus is incomplete without the inclusion of the emissary veins, including its connections to the face and pterygoid plexus. According to Padget, definitive emissary veins are seen at Stage 7 (Fig. 2E), as has been the case for most of the veins associated with the cavernous sinus. A frontal tributary of the primitive supraorbital vein anastomoses with the anterior facial vein at the inner angle of the eye, forming the angular vein. Superficial tributaries of the primitive supraorbital vein also form the definitive supraorbital and frontal veins. Formation of the cavernous sinus at Stage 7, according to Padget, clarifies the origin of the remaining emissary connection commonly found at the base of the adult skull, the sphenoid emissary vein (of the foramen ovale). This vein communicates with the pterygoid plexus, which is derived from the medial components of the primitive maxillary vein present already at an earlier stage. There is also an inconstant accessory sphenoid emissary (foramen of Vesalius).

Both the sphenoid and Vesalian emissary veins drain what Padget termed the "lateral wing of the cavernous sinus," a remnant of the pro-otic sinus. Browder and Kaplan refer to the sphenoid emissary vein as the trigeminal plexus [6, 24].

Venous anatomy of the lateral sellar compartment

The lateral sellar compartment can be succinctly defined as the dural envelope that encloses the parasellar internal carotid artery (ICA). However, its exact borders are still the subject of controversy. Anteriorly, the cavernous sinus proper extends to the superior orbital fissure. Posteriorly, the sinus extends to the dorsum sellae medially and the ostium of Meckel's cave laterally. Superiorly, the sinus roof is defined by clinoidal dural folds. Inferiorly, the lateral sellar compartment is limited by the periosteum of the sphenoid bone and sella turcica. The medial limit is still controversial. Some authors do not recognize a medial dural wall of the cavernous sinus and believe that the medial wall is made of the pituitary capsule [9, 30, 66]. Controversy also exists regarding the lateral boundaries of the lateral sellar compartment; specifically, should the periosteal dural compartment containing V2, V3, and associated venous channels be included in the lateral sellar compartment? If we consider Parkinson's concept that the extradural neural axis compartment is a continuum from the sacrum to the orbit along the inner skull base, then V2, V3, and accompanying venous channels should be included in the lateral sellar compartment.

Variably sized venous spaces exist in this region, lying extradurally beneath the inner dural layer (Fig. 5). These spaces communicate with an extensive variety of venous tributaries and pericavernous venous structures (described below). The cavernous sinus essentially forms a venous crossroads in the central skull base; according to the embryology, the primary pathway is from the orbit through the venous channels of the lateral sellar compartment to the inferior petrosal sinus and internal jugular vein.

Another long-standing controversy concerns the exact structure and organization of the venous channels that compose the cavernous sinus. The cavernous sinus has been referred to as a sinus or a plexus. In fact, the venous channels of the lateral sellar compartment vary greatly from one specimen to
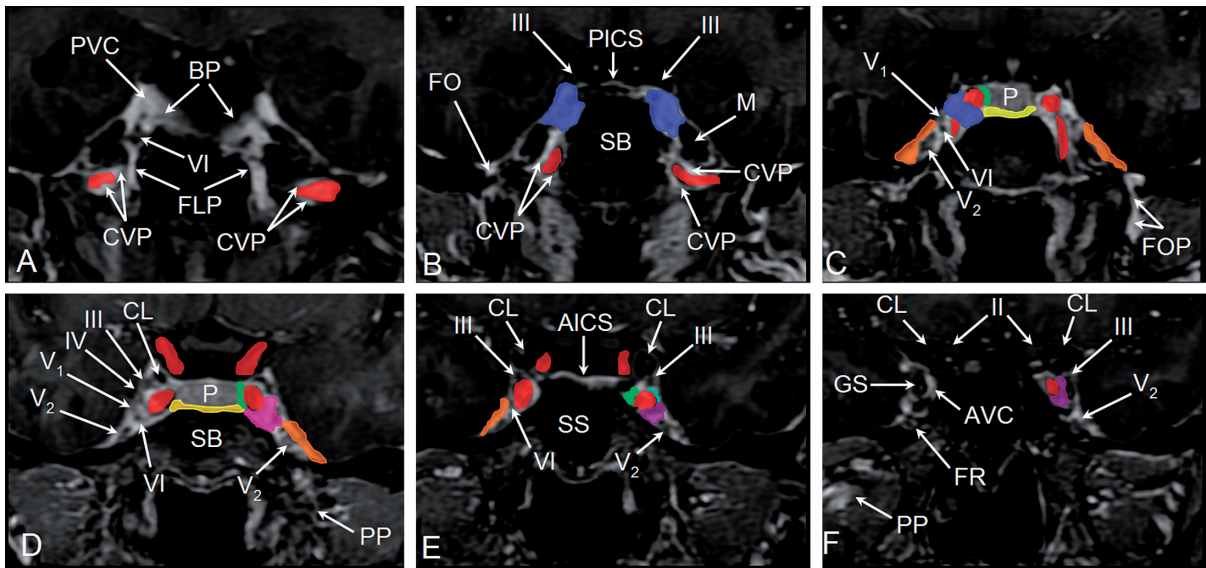
Fig. 5A–F. Lateral sellar venous compartments. (3 Tesla, coronal 3D FSPGR sequence, TR 9.1 msec , TE 3.9 msec, 1.25-mm slice thickness, after 20 cc intravenous gadolinium.) Some slices are same as in Fig. 15. Internal carotid artery (*ICA*) is overlaid in red. *II–VI* cranial nerves, *AICS* anterior intercavernous sinus, *AVC* anterior venous confluence, *BS* basilar sinus, *CL* clinoid, *CVP* carotid venous plexus, *FLP* venous plexus of the foramen lacerum, *FOP* venous plexus of the foramen ovale, *GS* greater wing of sphenoid bone, *M* Meckel's cave, *P* pituitary gland, *PICS* posterior intercavernous sinus, *PP* pterygoid plexus, *PVC* posterior venous confluence, *SS* sphenoid sinus. Spaces of the cavernous sinus are denoted in color overlays. Dark blue: posterior superior space; Green: medial space; Purple: anterior inferior space; Light blue: lateral space; Yellow: inferior intercavernous connections; Orange: lateral pericavernous sinus plexus or laterocavernous sinus. Note how the carotid venous plexus is well seen surrounding the ICA below the skull base and within the petrous bone below the cavernous sinus (**A,B**). Venous spaces merge with the spaces of the cavernous sinus as the ICA becomes intracavernous (with permission from the Mayfield Clinic)

another. In the fetal period, the venous channels of the lateral sellar compartment are clearly individual vessels separated by connective tissue and without a muscular layer [32]. Therefore, the macroscopic appearance of the venous channels of the lateral sellar compartment evolves from a network of venous channels of various size veins to a large venous cavity resulting from the coalescence of those veins. In this coalescence of veins, the remnants of the venous walls and surrounding fibrous tissue appear as trabeculae that have historically led to numerous misconceptions [27, 32, 33]. More relevant than the question of the term sinus versus plexus to define the cavernous sinus is the issue of the ultrastructure of the venous wall. The venous channel walls of the cavernous sinus differ from a classic venous wall composed of a basal membrane, smooth muscular media, and adventitia [32, 33]. The junction between the orbital veins and the anterior aspect of the cavernous sinus illustrates this difference. At the level of the orbital apex, the layer of smooth muscle

cells disappears and the superior ophthalmic vein progressively takes on a structure identical to a sinus with a basal membrane surrounded by fibrous connective tissue (but without smooth muscle). Therefore, the venous channels of the lateral sellar compartment may have a structure of a plexus or a sinus depending on their macroscopic appearance. However, the ultrastructure of the venous wall is more of a sinus structure.
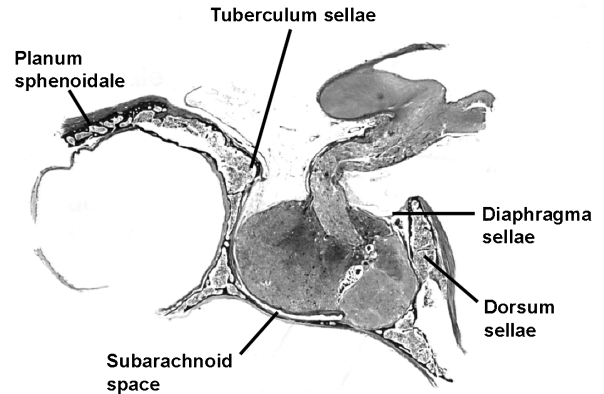
The presence of arachnoid and arachnoidal granulations that are associated with the venous elements of the lateral sellar compartment is also of import; this was first emphasized by Kricovic [33] and Kehrli et al. [27–30] who proposed a classification of cavernous sinus meningiomas according to the localization of the arachnoidal granulations from which meningiomas arise. They emphasized that such classification, while not clinically applicable, helps to understand some of the features including invasiveness of cavernous sinus meningiomas. Arachnoid tissue is present in several locations within the lateral
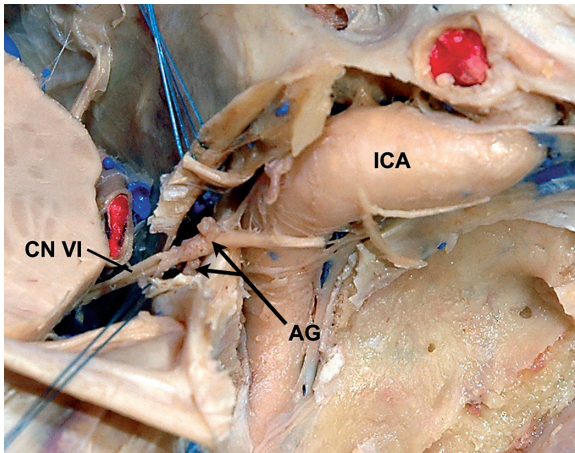
Fig. 6. Anatomical dissection of the lateral sellar compartment of a cadaveric specimen. Lateral wall of the cavernous sinus (right side) has been removed exposing the intracavernous (C4) segment of internal carotid artery (*ICA*) and CN VI. Arrows show arachnoid granulations (*AG*) (with permission from the Mayfield Clinic)

Fig. 7. Illustration of a histologic midline sagittal section (using Masson's trichrome stain, magnification $1\times$) of a human revealing the sella turcica and adjacent anterior and posterior bony structures, tuberculum sellae, and dorsum sellae as well as the planum sphenoidale. Note the subarachnoid space adjacent to the sella turcica (with permission from the Mayfield Clinic)

sellar compartment. First, arachnoid extends along the cranial nerves as illustrated by Kerli et al. [27]. According to these authors, an arachnoid sleeve with corresponding arachnoidal granulations extends into the lateral sellar compartment along CNs III, IV, and V. Rhoton also recently described an oculomotor sleeve and subarachnoid space that follows CN III into the lateral sellar compartment [50, 51]. Such a sleeve also exists for CN VI. We identified an arachnoidal sleeve and arachnoid granulations of CN VI in the posterior venous cavity of the lateral sellar compartment (Fig. 6). According to Kehrli et al. [27] the arachnoid associated with CN V stops at the level of the trigeminal ganglion within Meckel's cave and does not follow the trigeminal branches (V1–V3) into the lateral sellar compartment. Although we agree with this finding, we have identified a sleeve of arachnoid that followed the trigeminal motor root. Kricovic [33] also described arachnoidal granulations that arose from the arachnoid covering the thin inner wall of Meckel's cave. The arachnoid also extends in front of the pituitary gland, as we identified in several histological sections [52] (Fig. 7).

Several descriptions of the venous spaces of the lateral sellar compartment have been proposed [25, 34, 50, 51, 54, 57]. Rhoton [50, 51] described four venous spaces within the cavernous sinus based on their relationship to the ICA (Fig. 5). The posterior superior space located superior and posterior to the ICA is the largest. This space is connected with the inferior petrosal sinus, which is the main drainage route of the cavernous sinus, basilar sinus, and dorsal intercavernous sinus. The anterior inferior space is located in front of the anterior loop of the ICA; it extends anteriorly to the venous confluence of the superior and inferior ophthalmic veins. The anterior confluence was previously described by Sadasivan et al. [54] as the fifth venous space of the lateral sellar compartment termed the anterior cavernous sinus space. The medial compartment, which lies between the pituitary gland and ICA, varies in size, primarily depending on the artery's tortuosity. A lateral compartment can be identified between the ICA and lateral wall.

The venous spaces of the lateral sellar compartment receive connections from multiple venous structures (Figs. 8–11). Anteriorly, the lateral sellar compartment connects with and receives blood from the superior and inferior ophthalmic veins, either separately or as a common anterior venous confluence within the superior orbital fissure [12, 50, 51, 57]. Using phlebography, Brismar [5] identified a medial ophthalmic vein that drains into the anterior cavernous sinus below the superior ophthalmic vein in 39% and an inferior ophthalmic vein in 65% of cases. Spektor et al. [57] explicitly focused on an inferior ophthalmic vein in 91.7% of cases (24 sides). The superior ophthalmic vein
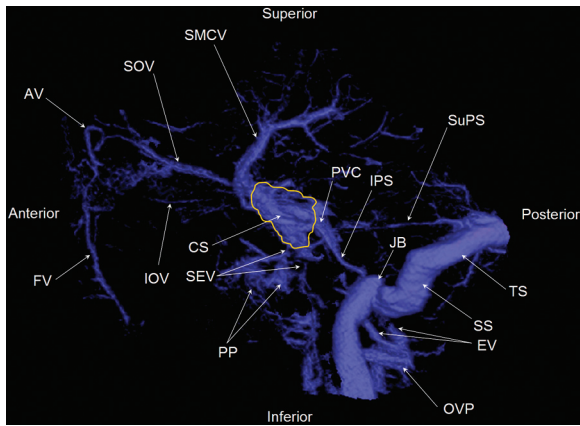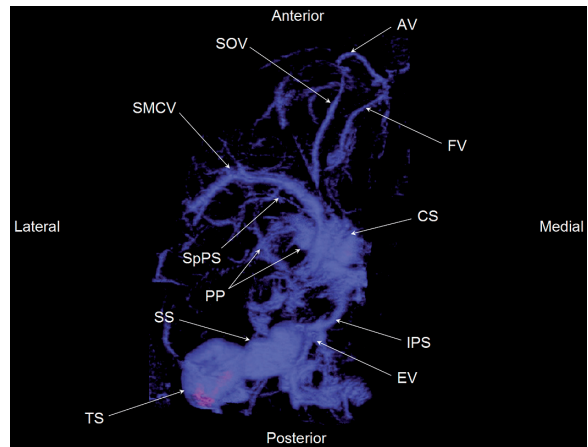
Fig. 8. Venous connections of the lateral sellar venous compartment. Lateral projection, volume rendered image, 3D gadolinium-enhanced elliptic-centric-encoded magnetic resonance venography. Arterial structures and overlapping venous sinuses and veins removed for clarity. *AV* angular vein, *CS* cavernous sinus region (lateral sellar extradural venous compartment), *EV* emissary veins, *FV* facial vein, *IOV* inferior ophthalmic vein, *IPS* inferior petrosal sinus, *JB* jugular bulb, *OVP* occipital venous plexus, *PP* pterygoid plexus, *PVC* posterior venous confluence, *SEV* skull base emissary veins, *SMCV* superficial middle cerebral vein, *SuPS* superior petrosal sinus, *SOV* superior ophthalmic vein, *SS* sigmoid sinus, *TS* transverse sinus. Location of the lateral sellar extradural venous compartment (*CS*) is marked in yellow. Venous flow into the cavernous sinus is from the SOV and IOV anteriorly, and the SMCV and sphenoparietal sinus anterior laterally. Note the multiple skull base emissary veins connecting the CS with the pterygoid plexus. Note the facial vein directly connecting with the superior ophthalmic vein serving as a direct venous route from the face to the cavernous sinus. SMCV in this case enters directly into the cavernous sinus complex. The IPS is usually larger than the SuPS (with permission from the Mayfield Clinic)

Fig. 9. Venous connections of the cavernous sinus (lateral sellar venous compartment). Direct cranial caudal projection. Volume-rendered image, 3D gadolinium-enhanced elliptic-centric-encoded magnetic resonance venography. Arterial structures and overlapping venous sinuses and veins removed for clarity. Left cavernous sinus and venous structures have been removed. *AV* angular vein, *CS* lateral sellar venous compartment, *EV* emissary veins, *FV* facial vein, *IPS* inferior petrosal sinus, *JB* jugular bulb, *PP* pterygoid plexus, *SMCV* superficial middle cerebral vein, *SS* sphenoid sinus, *SOV* superior ophthalmic vein, *SS* sigmoid sinus, *TS* transverse sinus. Note small size of the sphenoparietal sinus in this case where the superficial middle cerebral vein directly enters the cavernous sinus (with permission from the Mayfield Clinic)

receives an important tributary, the angular vein, which directly connects the veins of the face with the lateral sellar compartment. Inferiorly, the lateral sellar compartment connects with the pterygoid plexus via multiple skull base foramina. The most prominent connection is the plexus within the foramen ovale extending along the mandibular nerve as it exits Meckel's cave. Other skull base foraminal connections to the pterygoid plexus include venous structures that extend through the foramen rotundum, foramen lacerum, and foramen of Vesalius.

The superficial middle cerebral vein is a vital cortical venous structure that drains the majority of the perisylvian region including portions of the temporal, parietal, and frontal lobes [50, 51]. Embryologically, the superficial middle cerebral vein drains into the tentorial sinus, which ultimately drains into the transverse sinus. Preservation of the superficial middle cerebral veins is often difficult when opening the Sylvian fissure because of their variability [16, 26, 50, 51, 55, 60, 61]. Using fat-suppressed contrast-enhanced 3D fast gradient-echo MR, Tanoue et al. classified the drainage patterns of the superficial middle cerebral vein into four types (Fig. 12) [61]. The superficial middle cerebral vein usually drains into the proximal part of the sphenoparietal sinus or directly into the lateral part of the cavernous sinus. The authors also described three variations of the sphenoparietal sinus of Breschet (Fig. 13).

Controversies also exist regarding the sphenoparietal sinus of Brechet. As stated by Padget [41, 42], the sphenoparietal sinus should not be confused with the tentorial sinus because they have distinct origins. Ruiz et al. [55] noted that the superficial middle
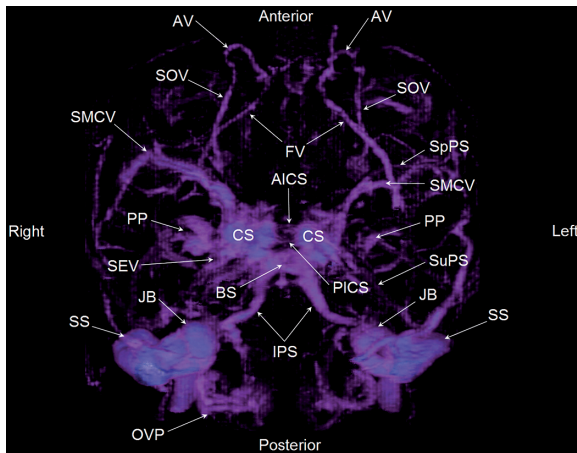
Fig. 10. Venous connections of the cavernous sinus (*CS*) (lateral sellar venous compartment). Frontal oblique caudal projection. Volume-rendered image, 3D gadolinium-enhanced elliptic-centric-encoded magnetic resonance venography. Arterial structures and overlapping venous sinuses and veins removed for clarity. Frontal oblique projection nicely demonstrates the intercavernous connections, anterior intercavernous sinus (*AICS*) and basilar sinus (*BS*). Small dot of enhancement between the AICS and posterior intercavernous sinus (*PICS*) is the infundibular stalk. On the left a moderate-sized superficial middle cerebral vein (*SMCV*) joins a small sphenoparietal sinus (*SpPS*) to become a common trunk joining the CS. Large right-sided SMCV overlaps the very small SpPS on this side. *AV* angular vein, *FV* facial vein, *IPS* inferior petrosal sinus, *JB* jugular bulb, *OVP* occipital venous plexus, *PP* pterygoid plexus, *PVC* posterior venous confluence, *SEV* skull base emissary veins, *SS* sigmoid sinus, *SuPS* superior petrosal sinus, *SOV* superior ophthalmic vein, *TS* transverse sinus (with permission from the Mayfield Clinic)

cerebral vein never drains into the sphenoparietal sinus. The sphenoparietal sinus drains branches of the middle meningeal veins, diploic veins of the lesser sphenoid wing, and orbital veins that follow the orbitomeningeal artery through the lateral part of the superior orbital fissure [41, 42, 55]. The sphenoparietal sinus courses along the inferior aspect of the lesser sphenoid wing, crosses over the superior ophthalmic vein, and drains into the most anterior aspects of the venous channel of the lateral sellar compartment.

Ruiz et al. [55] also commented on a laterocavernous sinus located between the two layers of the lateral wall of the cavernous sinus and a paracavernous sinus located laterally along the temporal fossa floor. Gailloud et al. [16], using cerebral angiograms

(Fig. 14), then described three types of drainage patterns of the superficial middle cerebral vein. In 20% of cases, it drains into a laterocavernous sinus, which in turn either drains into the superior petrosal sinus (18%), pterygoid plexus (27%), cavernous sinus (32%), or a combination of those (23%). In 39% of cases, the superficial middle cerebral vein drains into the paracavernous sinus, which in turn either drains into the superior petrosal sinus (33%), pterygoid plexus (44%), cavernous sinus (5%), or a combination of those (18%). Embryologically, connections between the cavernous sinus and the derivatives of the tentorial sinus (superficial middle cerebral vein, laterocavernous sinus, paracavernous sinus) are established late in the fetal period [16, 32].

Posteriorly, the cavernous sinus connects broadly with a venous confluence that we dealt with earlier, the posterior venous confluence. This confluence connects the large basilar plexus along the dorsum sellae, inferior petrosal sinus along the clival margin, and superior petrosal sinus along the petrous ridge, with the posterior cavernous sinus. Destrieux [8] termed this connection the petroclival venous confluence while Iaconetta [22] called it the sphenopetroclival venous gulf. Importantly, CN VI courses through this region as it enters the cavernous sinus. The inferior petrosal sinus is the main venous drainage route of the lateral sellar compartment. It extends inferiorly along the clivus and connects the cavernous sinus to the jugular bulb or lower sigmoid sinus. The inferior petrosal sinus is usually much larger than the superior petrosal sinus, which connects the cavernous sinus to the transverse sinus along the petrous ridge. The superior petrosal sinus also receives bridging veins from the cerebellum and brainstem [51]. According to Padget [41, 42], no connection exists between the superior petrosal sinus and the cavernous sinus until late in development. Knosp et al. [32] opined that the superior petrosal sinus was always superior to the porous trigeminus; a connection was also identified between the superior petrosal sinus and cavernous sinus in 60% of cases. They emphasized that the diameter of the superior petrosal sinus increases distal to the entry of the superior petrosal vein; the superior petrosal sinus represents drainage for this vein rather than the cavernous sinus.

The paired lateral sellar compartments connect with each other primarily via a large basilar sinus or plexus posterior to the upper clivus and dorsum
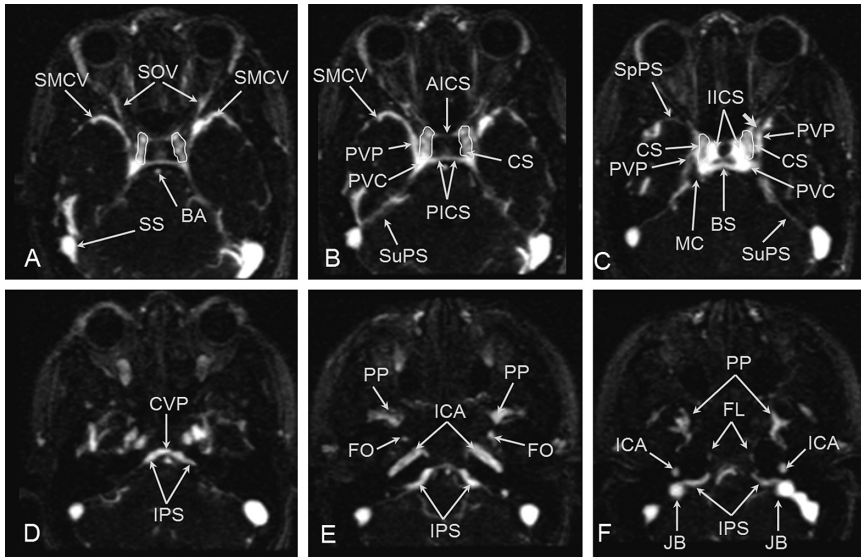
Fig. 11. Axial reformatted source images from 3D gadolinium-enhanced elliptic-centric-encoded magnetic resonance venography (**A–F**, superior to inferior). Classically described location of the lateral sellar extradural venous compartment (yellow) lying near the ICA location. Note the prominent venous opacification along the lateral margin of the lateral sellar venous compartment (*CS*), appearing separate from the sinus in part on the left by a linear cleft (arrow, **C**); this likely represents in part the so-called paracavernous venous plexus or laterocavernous sinus, receiving blood from skull base foraminal plexus, sphenoparietal sinus (*SPS*), or superficial middle cerebral vein (*SMCV*). Small venous channels extend through the skull base within the foramen lacerum (*FL*). Paired inferior petrosal sinuses (*IPS*) in this patient are large extending along the clivus to the jugular bulb (*JB*). *AICS* anterior intercavernous sinus, *BS* basilar sinus, *EV* emissary veins, *FLP* venous plexus of the foramen lacerum, *FOP* venous plexus of the foramen ovale, *FV* facial vein, *IICS* inferior intercavernous sinus, *IOV* inferior ophthalmic vein, *M* Meckel's cave, *OVP* occipital venous plexus, *PICS* posterior intercavernous sinus, *PP* pterygoid plexus, *PVC* posterior venous confluence, *PVP* paracavernous venous plexus, *SuPS* superior petrosal sinus, *SOV* superior ophthalmic vein, *SS* sigmoid sinus (with permission from the Mayfield Clinic)
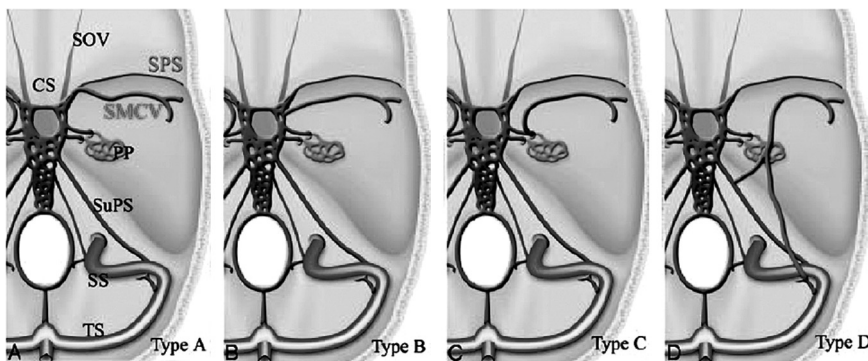

Fig. 12. Schematic drawings of variations of connections of the superficial middle cerebral vein (*SMCV*). Type A, vein connects with the proximal sphenoparietal sinus (*SPS*) and flows into the frontal aspect of the cavernous sinus (*CS*). Type B, vein connects with the lateral aspect of the cavernous sinus independently. Type C, vein turns downward and connects with the pterygoid plexus through the middle cranial fossa. Type D, vein runs across the pyramidal ridge and connects with the superior petrosal sinus or transverse sinus via the tentorial sinus. *SOV* indicates the superior orbital vein, *PP* pterygoid plexus, *SuPS* superior petrosal sinus, *SS* sigmoid sinus, *TS* transverse sinus (with permission from Tanoue S et al. (2006) AJNR 27: 1083–1089, Fig. 1)
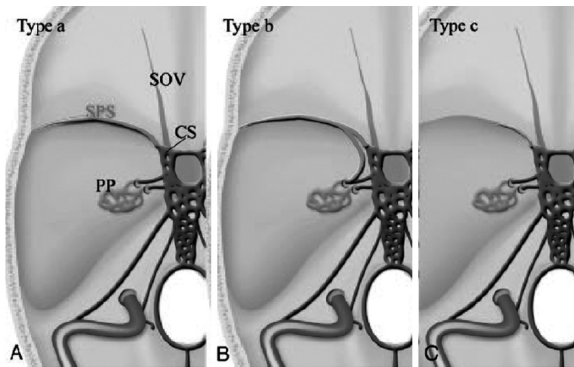
Fig. 13. Schematic drawings of variations (Types a–c) of the sphenoparietal sinus (*SPS*). Type a, SPS runs along the lesser sphenoid wing and connects to the anterior aspect of the cavernous sinus (*CS*). Type b, SPS runs along the lesser sphenoid wing and connects with the foramen ovale plexus or pterygoid plexus (*PP*). Type c, hypoplastic SPS connects with the CS. *SOV* superior orbital vein (with permission from Tanoue S et. al. (2006) AJNR 27: 1083–1089, Fig. 3)
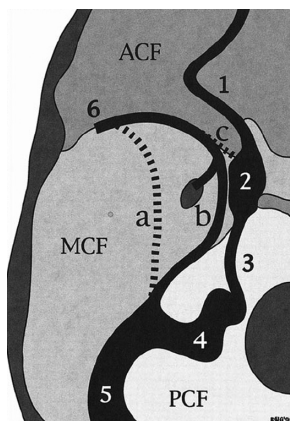
Fig. 14. Schematic representation of the three basic drainage pathways of the superficial middle cerebral vein (*SMCV*) according to San Millan Ruiz et al. [55]. Superior view of the anterior (*ACF*), middle (*MCF*), and posterior cranial fossae (*PCF*). The SMCV may continue as a paracavernous sinus coursing laterally over the MCF (*a*), may run as a laterocavernous sinus enclosed within the lateral wall of the cavernous sinus (*b*), or may terminate into the anterosuperior aspect of the cavernous sinus (*c*). Venous outflow toward the pterygoid plexus via a skull base foramen is shown for the LCS. *1* Superior ophthalmic vein, *2* cavernous sinus, *3* inferior petrosal sinus, *4* sigmoid sinus, *5* transverse sinus, *6* SMCV (with permission from Gailloud P et al. (2000) AJNR 21: 1923–1929, Fig. 1)

sellae. Additional connections are rendered with multiple intercavernous sinuses, which can occur along any surface of the pituitary gland. These are

usually visible as a larger posterior intercavernous sinus, a smaller anterior intercavernous sinus, and a variable inferior intercavernous sinus connection [32] (Figs. 10 and 11). The entire complex of intercavernous connections is termed the "circular sinus" [50].

Imaging of the venous part of the cavernous sinus

With improvement of MR imaging techniques, the venous and soft tissue components of the lateral sellar compartment can be demonstrated in vivo with unprecedented detail [13, 36, 37, 48, 64, 65]. Our demonstration of the complex venous anatomy of the lateral sellar compartment was feasible at 3 Tesla as well as 3D MRV [15] by high-resolution MR imaging. This imaging shows the soft tissue components and venous relationships of the lateral sellar compartment by using noninvasive imaging techniques most commonly used for evaluating skull base and sellar lesions.

On contrast-enhanced T1-weighted MR images, parasellar venous structures enhance intensely, outlining the cranial nerves as filling defects or impressions on the enhancing sinus components (Figs. 5, 15). The dura also variably enhances, defining the outer wall of the sinus. Other filling defects, such as intracavernous arterial vessels and dural reflections, are variably seen [13, 65]. CNs III, VI, V2, and V1 are well visualized and their anatomic relationships can be outlined routinely. Because of the small size of CN IV and its position adjacent to CN III, it is less well delineated [65]. The complex internal venous structure of the lateral sellar extradural venous compartment is difficult to detect on MR imaging. Early dynamic CT studies have, however, successfully increased our understanding of different compartments that enhance in different sequence after contrast administration [4]. Although compartmentalized dural fistula drainage has been described [7], descriptions of lateral sellar compartments have been more important in determining potential conduits for surgical therapy of lesions in this region [51].

The venous connections of the cavernous sinus proper have traditionally been demonstrated by catheter angiography. In spite of being requisite for rapid sequence imaging of fistulas and other vascular lesions of the lateral sellar compartment, the incom-
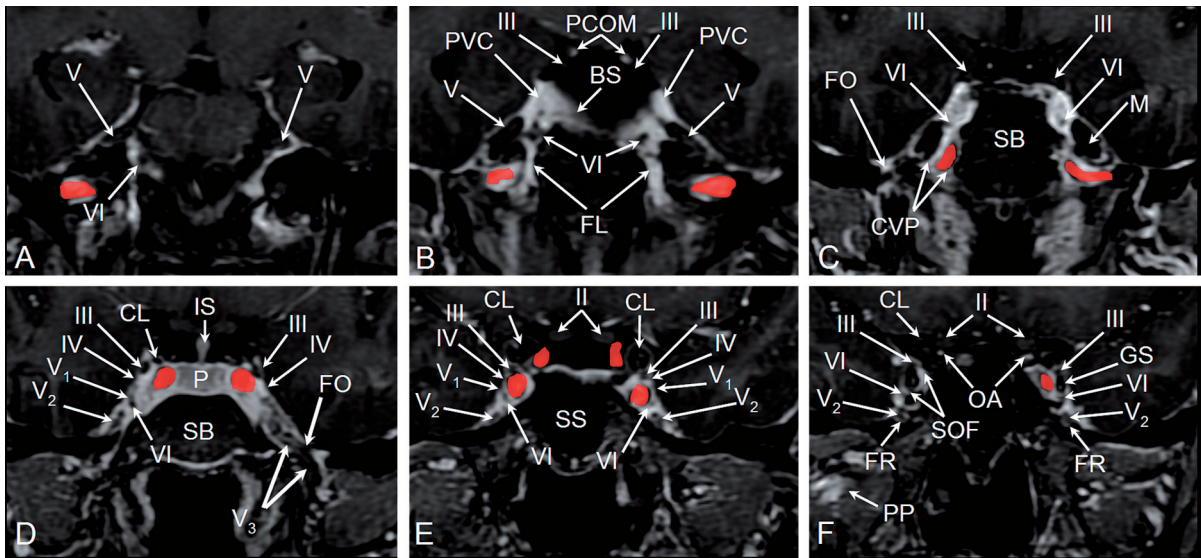
Fig. 15. Soft tissue anatomy of the lateral sellar compartment (3T, coronal 3D FSPGR sequence, TR: 9.1 msec, TE: 3.9 msec, 1.25 mm slice thickness, after 20 cc intravenous gadolinium) from posterior (**A**) to anterior (**F**). Internal carotid artery (ICA) is traced and overlaid in red to aid in identification. Venous compartments of the lateral sellar region enhance intensely, outlining the ICA, and cranial nerves (CNs). CN III can be identified entering the cavernous sinus superiorly (**C**), extending to lie beneath the clinoid process (**D**), superior to the ICA (**E**), and extending into the upper SOF anteriorly (**F**). CN IV is very small in the lateral wall of the sinus producing a subtle impression and filling defect, variably seen just below CN III (**D, E**). CN V_1 can be identified exiting the superior margin of Meckel's cave lying along the lateral wall of the sinus. Initially at the level of CN VI, V_1 ascends anteriorly entering the SOF along with CNs III and IV. Meckel's cave is visualized lying posterior and inferior to the cavernous sinus (**C**), accepting the CN V root as it extends through the cistern (**A,B**). Posterior venous confluence, connecting the inferior petrosal sinus, superior petrosal sinus, and basilar sinus with the posterior cavernous sinus, lies just above and medial to Meckel's cave (**B**). CN V_2 keeps an inferior position outside of the cavernous sinus, bordered laterally by enhancing dura and lateral paracavernous venous plexus (**D, E**), entering the foramen rotundum anteriorly along with a small enhancing venous plexus (**F**). CN V_2 lies outside the dural envelop of the cavernous sinus. CN V_3 exits Meckel's cave inferiorly, seen as a filling defect among the rich venous plexus in the foramen ovale (**D**). CN VI enters the cavernous sinus from the cistern through the basilar venous plexus/posterior venous confluence (**A**), through Dorello's canal deep to the petrosphenoid ligament (**B**), entering the cavernous sinus deep to the outer dural layer (**C, D**) (investing CNs III–V_1), eventually lying directly lateral to the ICA (**E**). Venous plexus of the foramen lacerum (**B**) and foramen ovale (**D**) appear as lobular areas of intense enhancement extending into the foramina. Pituitary gland is visible as a zone of slightly diminished enhancement within the sella. Dura of the medial cavernous sinus wall is not well seen on this sequence. *II–IV* Cranial nerves *II–IV*, V_1–V_3 first through third divisions of CN V (ophthalmic, maxillary, and mandibular nerves, respectively), *V* retrogasserian trigeminal root at the level of the porous trigeminus, *CL* clinoid process, *CVP* pericarotid venous plexus (carotid venous plexus), *FL* foramen lacerum plexus, *FO* foramen ovale, *FR* foramen rotundum, *GS* greater wing of the sphenoid bone marginating the superior orbital fissure, *IS* infundibular stalk, *M* Meckel's cave, *P* pituitary gland, *PCOM* posterior communicating artery, *PP* pterygoid plexus, *PVC* posterior venous confluence, *SOF* superior orbital fissure, *SS* sphenoid sinus, *SB* sphenoid bone, *OC* optic chiasm, *OS* optic strut, *OT* optic tract (with permission from the Mayfield Clinic)

plete filling of the cavernous sinus secondary to inflow effects limits its ability to completely opacify and define the sinus three-dimensionally. Three-dimensional gadolinium-enhanced elliptic-centric-encoded MRV is a newer technique [15] that we have used extensively to evaluate patients with suspected venous occlusion. It provides high-resolution evaluation, with the acquisition timed to coincide with maximal venous contrast opacification. The pro-

duction of selected multiplanar reformations and volume rendered images in any plane or rotation is a significant benefit of this technique.

Conclusions

The value of this discussion is to enhance the understanding of the complex anatomy of the lateral

sellar compartment to better serve patients by the effective and safe treatment of pathologies within this region. Knowledge of the embryology, particularly of the venous anatomy, which is considerably more complex and variable than the arterial, is requisite. Furthermore, the technological advancements currently afforded the medical community, 3D MRV enables visualization and/or identification of soft tissue and vascular anatomy in the greatest detail. Thus, a keen appreciation of the myriad embryological variants will be invaluable in the interpretation of the vascular imagery.

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