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ORIGINAL ARTICLE

Microsurgical anatomy of the vein of Labbé

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Abstract
Objective Venous drainage of the temporal lobe is of great importance in various neurosurgical and combined skull base approaches. The most significant draining vein of the temporal lobe is the inferior anastomotic vein (vein of Labbé). The purpose of this study was to examine the detailed anatomy and variations of the vein of Labbé (VL) from microsurgical perspective.
Methods Fourteen fixed human cadaver heads (28 sides) with perfused vessels were included to define microsurgical anatomy and variations of the VL.
Results The main findings of the present study were as follows: (1) drainage pattern of the VL was found to be very variable in cadaveric dissections; (2) VL drained around the sinus confluence at the tentorium in one specimen (3.5%), into the large meningeal vein in the occipital dura mater in another specimen (3.5%). The VL rarely (7%) drains into the superior petrosal sinus (SPS) which may make combined skull base approaches very difficult or impossible.
Conclusion Results of this study suggest that careful and thorough evaluation of the VL is of great importance, especially in surgeries combining a subtemporal route with petrosal approaches by sectioning the SPS and the tentorium.

Keywords Bridging veins · Cadaveric study · Tentorium · Temporal lobe · Vein of Labbé

Introduction

The vein of Labbé (VL) is the largest vein connecting the veins along the sylvian fissure with the transverse sinus (TS). Several investigations into the microanatomy of the VL including cadaveric and radiological studies (digital subtraction angiography, MR venography) have been published [1–6, 8–12]. In this study, detailed microsurgical anatomy and variations of the VL were studied in cadaveric dissections. Pictorial demonstration of the variations has also been provided for a better understanding of the difficulties involved at various surgical approaches in this region.

Materials and methods

Cadaveric dissections were performed in the Department of Neurological Surgery, University of Wisconsin. Fourteen fixed human cadaver heads (age range 55–74 years) were injected with colored silicone; bilateral large hemispheric craniotomies were made on cadaveric heads. Microsurgical anatomical dissections were performed using a Leica, Wild M 695 surgical microscope under 3× to 40× magnifications, and measurements were made with a digital caliper. The following data were examined: (1) distance between

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the VL entry point to the tentorium and the junction of the superior petrosal-transverse-sigmoid-sinuses (SPTS); (2) distance between the VL entry zone to the TS and the junction of the SPTS; (3) number of bridging veins; and (4) drainage pattern of the VL.

Results

The VL was clearly defined in 80% of the specimens (Fig. 1a), and there were two veins which had almost equal diameters as VL in 20% of the cadavers (Fig. 1b). The average number of temporal bridging veins were four (ranging from 1 to 7). The termination area and drainage pattern of the VL were quite variable. In the present cadaveric study, the VL drained directly into the TS in 46.5% of the specimens. The VL drained indirectly into the TS through one of the tentorial sinuses (venous lake, lateral tentorial sinus) or meningeal vein in the occipital dura mater in 46.5% of the specimens (Fig. 2a). Of these, the VL drained around the sinus confluence at the tentorium (posterior one-third of the tentorium) in one specimen (3.5%) (Fig. 2b) and into the large meningeal vein in the occipital dura mater in another specimen (3.5%). The VL drained directly into the superior petrosal sinus (SPS) in two specimens (7%) (Fig. 2c).

The average distance of the VL from tentorial entry zone to the SPTS was 13.1 mm (range 3.5–37 mm) and in these cases, the VL was running within the tentorium from its tentorial entry point to its final drainage point to the TS over a varying length (2.8–24.5 mm). The average distance of the VL's TS entry point either directly or via a tentorial venous lake to the SPTS was 24.6 mm (ranging from 11.7 to 56.7 mm).

The VL and temporal bridge vein drainage patterns were classified into three main groups: (1) drainage only into tentorium; these were subclassified as: (1a) entering the tentorium separately from different points (Fig. 3a), (1b)

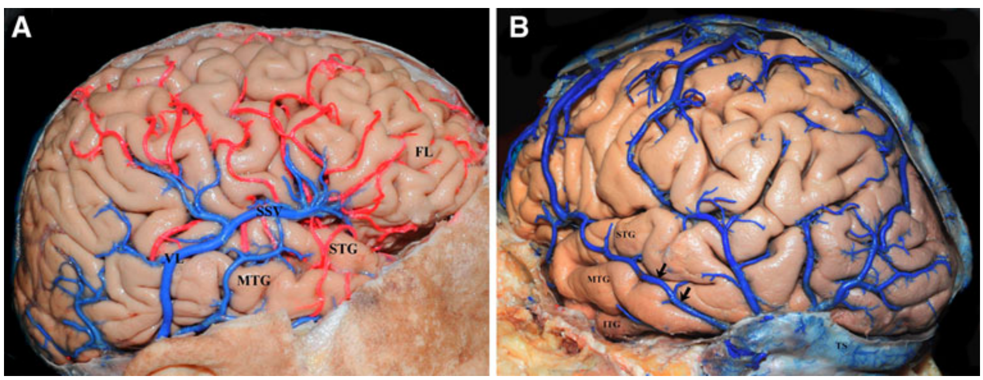

Fig. 1 **a** Cadaveric dissection showing the right hemisphere. Note that the vein of Labbé is the largest vein of the temporal lobe in this specimen. *SSV* superficial sylvian vein, *VL* vein of Labbé, *FL* frontal lobe, *MTG* middle temporal gyrus, *STG* superior temporal gyrus. **b** Left side of the hemisphere. Cadaveric dissection demonstrating multiple veins with equal diameters entering the transverse sinus in the left hemisphere. *Black arrows* indicate the vein of Labbé. *TS* transverse sinus, *MTG* middle temporal gyrus, *STG* superior temporal gyrus, *ITG* inferior temporal gyrus

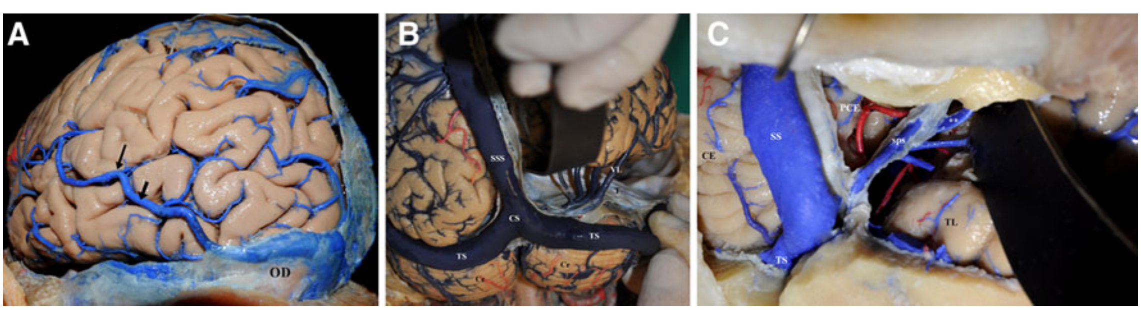

Fig. 2 Variations of the temporal lobe venous drainage patterns. **a** Left side of the hemisphere**.** The vein of Labbé drains into the transverse sinus through the large meningeal vein in the occipital dura mater in the left hemisphere. *Black arrows* point the vein of Labbé. *OD* occipital dura mater. **b** The vein of Labbé, temporal and occipital bridging veins terminate at the posterior tentorial area near the confluence sinuses in the right hemisphere. *VL* vein of Labbé, *TS* transverse sinus, *SSS* superior sagittal sinus, *CS* confluence sinuses, *T* tentorium, *Ce* cerebellum. **c** Left side of the cadaveric specimen. Rare variation of the vein of Labbé. The vein of Labbé drains directly into the superior petrosal sinus. In this variation, sectioning of the superior petrosal sinus would not be possible to complete combined subtemporal with transpetrosal approach. *SS* sigmoid sinus, *double asterisk* the vein of Labbé, *TS* transverse sinus, *CE* post-sigmoid cerebellum, *TL* temporal lobe, *sps* superior petrosal sinus, *PCE* presigmoid cerebellum

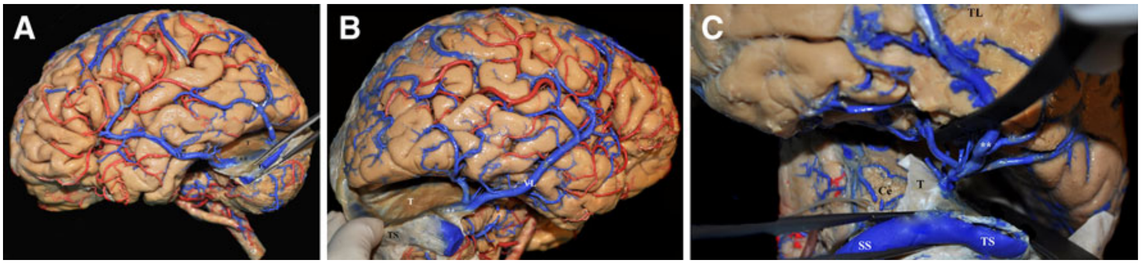

Fig. 3 Panoramic views of the temporal lobe venous drainage pattern only into tentorium. **a**The temporal veins enter the tentorium separately from different points in the left hemisphere. The vein of Labbé terminates at the anterior part of the tentorium via a venous lake. Other veins (*white arrows*) form venous candelabra before entering the middle part of the tentorium. *VL* vein of Labbé, *single asterisk* venous candelabra, *TS* transverse sinus, *T* tentorium, *double asterisk* venous lake. **b** The temporal veins enter the tentorium all together at a single point without merging beforehand in the right hemisphere. The vein of Labbé and other temporal veins terminate at the anterior part of the tentorium. The venous lake receiving one or more venous drainage complexes runs within the leaves of the tentorium before terminating into the transverse sinus. Note that this variation may also pose a challenge in sectioning the tentorium when combined skull base approach is undertaken. *VL* vein of Labbé, *TS* transverse sinus, *T* tentorium, *double asterisk* venous lake. **c** Left side of the hemisphere. Veins merge together into a single vein (candelabra) before entering the tentorium in the left hemisphere. *TL* temporal lobe, *Ce* cerebellum, *T* tentorium, *double asterisk* vein of Labbé, *TS* transverse sinus, *SS* sigmoid sinus

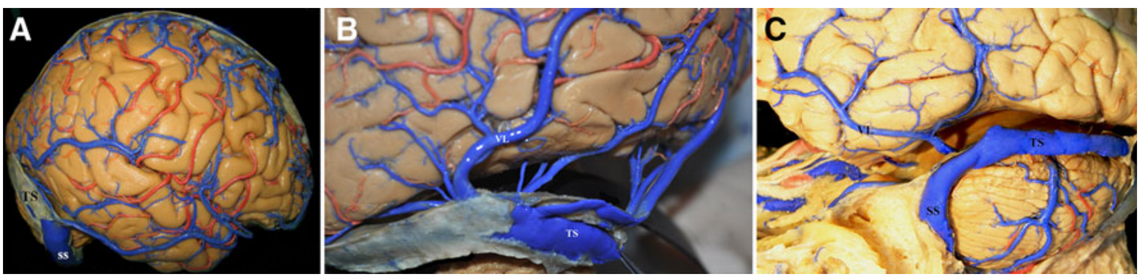

Fig. 4 Panoramic views of the temporal lobe venous drainage pattern only into transverse sinus. **a** The vein of Labbé drains into the transverse sinus separately from different points in the right hemisphere. *TS* transverse sinus, *SS* sigmoid sinus. **b** Left side of the cadaveric specimen. The vein of Labbé drains into the transverse sinus separately or merging together as venous complexes in the left hemisphere. *VL* vein of Labbé, *TS* transverse sinus. **c** Left side of the cadaveric specimen. The vein of Labbé drains into a single channel before merging into the transverse sinus (candelabra). *TS* transverse sinus, *VL* vein of Labbé, *SS* sigmoid sinus

entering the tentorium all together at a single point without merging beforehand (Fig. 3b) and (1c) merging together into a single vein (candelabra) before entering the tentorium (Fig. 3c); (2) drainage only into the TS; these were subclassified as: (2a) draining into the TS one by one at different points without merging together (Fig. 4a), (2b) draining into the TS separately or merging together as venous complexes (Fig. 4b), (2c) merging into a single channel before draining into the TS (candelabra) (Fig. 4c); (3) drainage into both the TS and the tentorium (Fig. 5a–b).

Discussion

Mapping the temporal venous anatomy is crucial for access to deep seated lesions during transtentorial, combined transpetrosal and transtemporal approaches [1, 7]. The VL is at risk, especially, in lateral skull base approaches and in medial tentorial lesions requiring incision through the tentorium and elevation of the temporal lobe. According to Koperna et al. [5], VL could be identified in 82% of the specimens, and in the remaining 18% there were two veins from the temporal lobe which were almost equal in caliber. On the other hand, other authors found the VL in all of their specimens [2, 12]. In the present study, the VL could be clearly defined in 80% of the specimens, and there were two veins which were almost equal in diameter in 20% of the cadavers.

Han et al. [3] have reported that in 74% of the specimens in their study, the VL drained into the TS directly and the remainder drained either through the tentorial sinus (8%), the meningeal vein in the occipital dura mater (9%) or the SPS (8%). In our cadaveric study, the percentages of VL's draining into the TS either directly or indirectly (via tentorial sinus or a vein inside the occipital dura mater, etc.) were found to be equal (46.5%) and the VL terminated into the SPS in 7% of specimens. Recognition of a drainage pattern of the VL into the SPS is extremely important in surgeries combining a subtemporal approach with various transpetrosal approaches where the SPS is divided along with tentorium. In these cases, although rare, the SPS cannot be divided to perform a combined approach. In petrosal

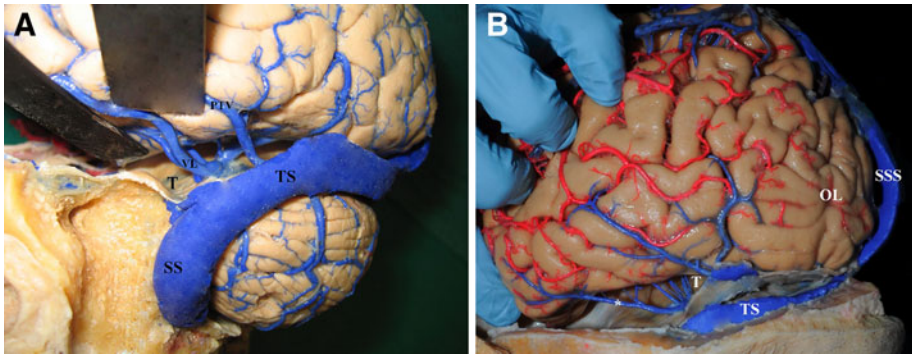

Fig. 5 Combined drainage pattern into both the transverse sinus and tentorium. **a** Left side of the cadaveric dissection. Multiple temporal veins and the vein of Labbé terminate at the same point in the tentorium and the posterior temporal vein drains directly into the transverse sinus. Note that in this drainage pattern, if desired, tentorial incision should be anterior to the vein of Labbé. *VL* vein of Labbé, *TS* transverse sinus, *T* tentorium, *PTV* posterior temporal vein, *SS* sigmoid sinus. **b** Left side of the cadaveric dissection. Multiple veins and the vein of Labbé entering into the same point of the tentorium and the other veins draining directly into transverse sinus in the left hemisphere. *TS* transverse sinus, *single asterisk* vein of Labbé, *T* tentorium, *OL* occipital lobe, *SSS* superior sagittal sinus

approach, burr holes are paced straddling the transverse sinus, extending laterally to its junction with the sigmoid sinus. Then, care must be taken to avoid injury and sacrifice of the vein of Labbé with a safe and gentle placement of self-retaining retractors on the posterior temporal lobe, especially in dominant hemisphere.

Sakata et al. [12] have divided venous drainage patterns of the temporal lobe into five types depending on the distribution of the venous entry complex. The venous entry complex located only at the TS area (Type IA); only at the tentorial area (Type IB); the petrosal and TS area (Type IIA); the tentorial and transverse sinus area (Type IIB) and all three areas (Type III). Guppy et al. [2] classified the geometry of the venous complexes as: (1) multiple venous drainage complexes forming a single vein before termination; (2) multiple venous drainage complexes/vein entering independently; and (3) the venous lake. Two major criteria are very important in the drainage pattern of the temporal lobe during surgery. The first is the anatomical location of the drainage point and the second is the configuration and pattern of the draining veins. In the present study, classification was according to the aforementioned criterion as shown in Figs. 3, 4 and 5. From these configurations, recognition of the ones in which the VL along with other bridging veins drain altogether at the same point (Figs. 2c, 3b, c, 4c) is crucial during surgery to prevent injury to these veins and possibly result in the venous infarct of the temporal lobe.

Koperna et al. [5] had divided the distance between the confluence of the sinuses and the junction of the transverse, superior petrosal and sigmoid sinuses into three parts and classified them as anterior, middle and posterior. In their study, the tentorial entry of VL was found to be in the anterior third in 75% of the cases and in the middle in 25% of the cases. In the present cadaveric study, the drainage point of the VL (either directly into TS or through the tentorial sinus) was around the junction of SPTS (anterior third of the tentorium) in 82% of the specimens.

According to our cadaveric investigation, the VL should not be perceived as a classical venous bridge between the lateral sulcus and the TS. Meanwhile, the rich configuration variability and diversity of the drainage points of the bridging veins of the temporal lobe should be acknowledged as well.

Conclusion

The VL should not be perceived as a classical venous bridge between the lateral sulcus and the TS according to our investigations. The variations should be kept in mind in operations requiring incisions to the superior petrosal sinus, tentorium and the dura mater over occipital lobe in order to prevent devastating complications.

Conflict of interest There is no conflict of interest regarding the manuscript and it is not financially supported by any person or institute.

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