The Laterocavernous Sinus System: Venous Inflows, Venous Outflows, and Clinical Significance

Xianli Lv, Chuhan Jiang, Youxiang Li, Lian Liu, Jie Liu, Zhongxue Wu

BACKGROUND: **The laterocavernous sinus system is best defined as the entire territory served by the laterocavernous and the superior petrosal sinuses (SPS).**

METHODS: **The laterocavernous sinus is a small but important venous structure located between the two dural layers forming the lateral wall of the cavernous sinus and has been described as one of the principal drainage pathways of the deep and superficial middle cerebral veins.**

RESULTS: **Several disease processes in the head involve the laterocavernous sinus. To evaluate and treat these diseases it is necessary for neuroradiologists not only to know selective angiography and embolization techniques, but also the territory of the laterocavernous sinus and venous watershed between the deep and superficial venous systems.**

CONCLUSIONS: **In the present report the normal angiographic anatomy of the laterocavernous sinus system, its relationship with the deep and superficial venous systems, and its importance in clinical situations are outlined.**

Key words
- Cerebral
- Laterocavernous sinus
- Veins

Abbreviations and Acronyms
BVR: Basal vein of Rothensal
CS: Cavernous sinus
DAVF: Dural arteriovenous fistula
IPS: Inferior petrosal sinus
LCS: Laterocavernous sinus
LMV: Lateral mesencephalic vein
PP: Pterygoid plexus
SMCV: Superior middle cerebral vein
SOV: Superior ophthalmic vein
SPS: Superior petrosal sinus
TS: Transverse sinus
UV: Uncal vein

From the Beijing Neurosurgical Institute and Beijing Tiantan Hospital, Capital Medical University, Beijing, People's Republic of China

To whom correspondence should be addressed: Zhongxue Wu, M.D. [E-mail: ttyyzjb@sina.com]

Citation: World Neurosurg. (2011) 75, 1:90-93.
DOI: 10.1016/j.wneu.2010.09.016

Journal homepage: www.WORLDNEUROSURGERY.org

Available online: www.sciencedirect.com

INTRODUCTION

Laterocavernous sinus (LCS) is the outermost venous structure of the laterosellar region, separated from the lateral compartment of cavernous sinus (CS) by the inner dural layer of the lateral wall of the CS (13, 18). LCS as an accessible compartment has been selectively used for embolization of cavernous dural arteriovenous fistulas (13, 19); however, neuroradiologists generally do not fully appreciate the clinical importance of its territory. LCS, although small, includes several important deep-tissue extracranial and intracranial structures involved in a variety of disease processes (17). The normal angiographic anatomy of the LCS is reviewed. LCS has importance in many clinical situations in which interventional neuroradiology management plays a central role. Among these are pial arteriovenous fistulas and dural arteriovenous fistulas.

MATERIALS AND METHODS

Anatomy and Embryology

LCS derives from the primitive tentorial sinus, which drains cortical blood coming from the superficial middle cerebral vein (SMCV), migrates medially toward the CS region at the time of formation of the lateral wall of the CS, during the eighth week of gestation (18). In the previous study, the LCS was found in 22% of 65 consecutive angiograms (13, 18).

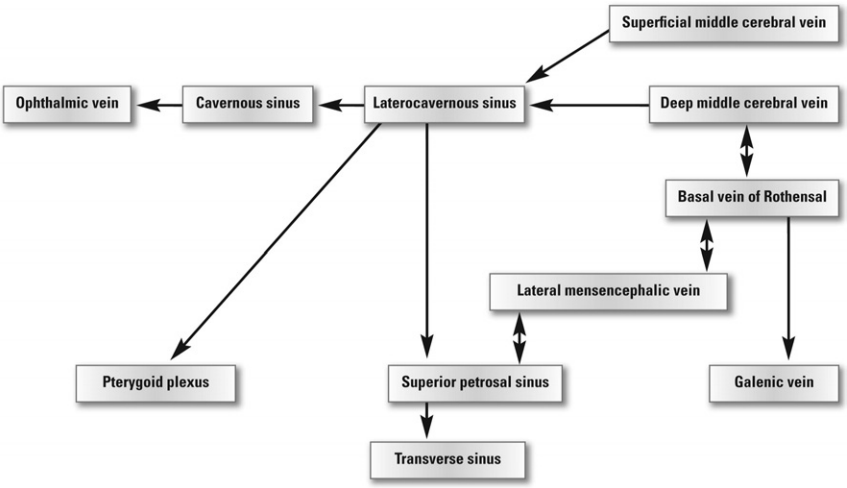

Figure 1. Diagram depicting the laterocavernous sinus system and its anastomosis.

Laterocavernous Sinus System

LCS is inside the lateral wall (i.e., as a part of the various venous pouches that go on to form the CS) and it has been described as one of the principal drainage pathways of the SMCV (18). LCS is the outermost venous structure of the laterosellar region, separated from the lateral compartment of CS by the inner dural layer of the lateral wall of the CS (5). This inner layer may be seen as a thin vertical opacification defect between the LCS and the lateral compartment of the CS when these venous spaces are visible together. The two structures, CS and LCS, are separate anatomic entities with distinct functional and clinical implications (5, 13, 18). A medial system is made up of the superior ophthalmic vein (SOV), the CS, and the inferior petrosal sinus (IPS) (the CS system), and a lateral system draining the cortical blood of the cerebral convexity through the SMCV toward pterygoid plexus (PP) and/or transverse sinus (TS) through the LCS (the LCS system). The latter pathway may take the form of a paracavernous sinus (46.5%), an LCS (34%), or a classic termination of SMCV into the anterosuperior aspect of the CS (19.5%) (17, 18). Four basic drainage pathways have been described for LCS (17): 1) toward the TS through the SPS; 2) toward the PP through openings in the floor of the middle cranial fossa; 3) toward the posterior aspect of CS; and 4) toward the basal vein of Rothensal (BVR) by the uncal vein (UV).

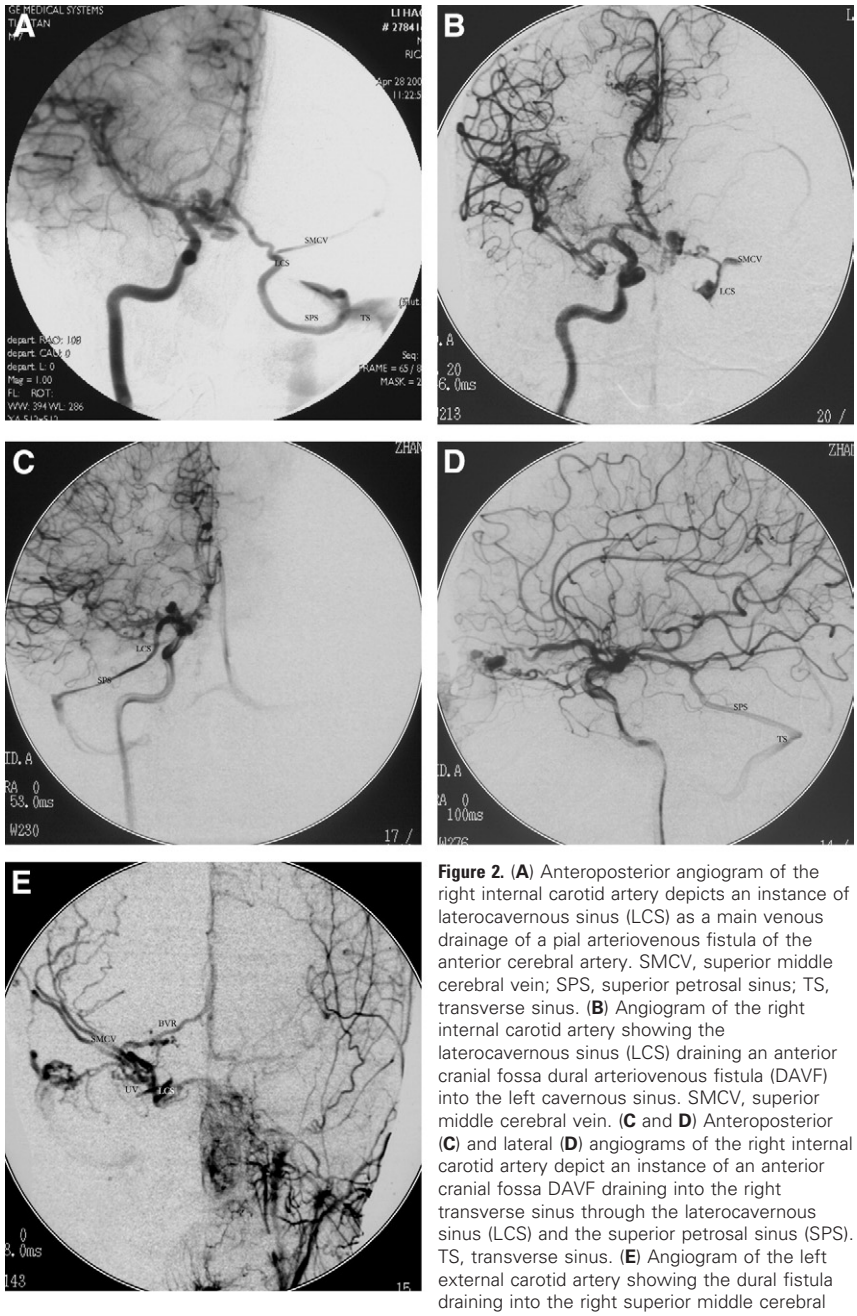

Figure 2. (**A**) Anteroposterior angiogram of the right internal carotid artery depicts an instance of laterocavernous sinus (LCS) as a main venous drainage of a pial arteriovenous fistula of the anterior cerebral artery. SMCV, superior middle cerebral vein; SPS, superior petrosal sinus; TS, transverse sinus. (**B**) Angiogram of the right internal carotid artery showing the laterocavernous sinus (LCS) draining an anterior cranial fossa dural arteriovenous fistula (DAVF) into the left cavernous sinus. SMCV, superior middle cerebral vein. (**C** and **D**) Anteroposterior (**C**) and lateral (**D**) angiograms of the right internal carotid artery depict an instance of an anterior cranial fossa DAVF draining into the right transverse sinus through the laterocavernous sinus (LCS) and the superior petrosal sinus (SPS). TS, transverse sinus. (**E**) Angiogram of the left external carotid artery showing the dural fistula draining into the right superior middle cerebral vein (SMCV), the basal vein of Rothensal (BVR), and the superior petrosal sinus through the right laterocavernous sinus (LCS). UV, uncal vein.

RESULTS

Anastomoses to the Deep Venous System

LCS system has potential anastomoses to the deep venous system through the BVR (10). The basal vein in turn is connected not only to the great vein of Galen, but also to the SPS (by the lateral mesencephalic vein), and in the adult configuration to the CS and PP (by the deep and superficial sylvian veins). This indicates that, in addition to the venous watershed existing in the white matter of the hemispheres, the LCS system is another important venous watershed between the deep and superficial venous systems (**Figure 1**).

DISCUSSION

Clinical Relevance of LCS System

LCS is readily identified angiographically on the anteroposterior projection as a slit-like structure draining SMCV toward the PP and TS through the SPS (5). LCS drained principally into the SPS or PP, as well as communicates with the CS on two occasions, either through a large opening in the posterior aspect of the lateral wall of CS or through small "en passant" connections located in the medial layer of the lateral wall of CS (5). These two anatomic situations cause two different patterns of opacification on an angiogram: 1) simultaneous opacification occurs when the LCS and CS communicate through large anastomotic channels or when the LCS terminates into