Commentary on:
Analysis of Venous Drainage from Sylvian Veins in Clinoidal Meningiomas
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Cerebral Veins: To Sacrifice or Not to Sacrifice, That Is the Question

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In the January 2013 issue of **WORLD NEUROSURGERY**, Nagata et al. presented an interesting retrospective analysis of 22 consecutive patients with clinoidal meningiomas that were surgically treated at the Osaka City University Hospital over a 13-year period. All patients underwent preoperative digital subtraction angiography to assess the pattern of drainage of the Sylvian venous system and were accordingly classified into 3 categories: cavernous type, in which the Sylvian veins drained in the usual antegrade fashion into the cavernous sinus via the sphenoparietal sinus; sphenobasal type, in which the Sylvian veins drain inferiorly into the pterygoid plexus; and cortical type, in which the Sylvian veins drained in a retrograde fashion into cortical veins. In their series, the authors found that 63.6% (n = 14) of the patients had retrograde flow into cortical veins, 27.3% (n = 6) had inferior drainage into the pterygoid plexus, and only 9.1% (n = 2) had the normal anterior drainage into the cavernous sinus. It is presumed that this reversal of flow, which was only seen with large clinoidal meningiomas, was a consequence of tumor growth and subsequent gradual occlusion of the normal antegrade Sylvian venous drainage.

The authors then tailored their surgical approach, which was particularly relevant in patients with cavernous and sphenobasal drainage patterns, so as to preserve Sylvian venous drainage at all costs. The authors claimed that they had no major complications related to venous injury. However, the only major complication in their series occurred in a patient with a cavernous pattern of venous drainage who suffered a frontal hematoma secondary to excessive frontal lobe retraction because the authors were unwilling to sacrifice the anterior temporal Sylvian vein draining into the sphenoparietal sinus that would have allowed posterolateral retraction of the temporal lobe, which is usually well tolerated (7). The authors presumed that this complication was the cumulative consequence of frontal lobe retraction and a disturbance in venous return, despite the fact that the anterior Sylvian vein was not sacrificed at surgery, and in their conclusion they strongly recommended that tumor removal should be performed with venous preservation. Although it is true that brain retraction when combined with venous sacrifice is associated with a higher risk of brain injury than retraction alone (10, 11), we suggest that such retraction may not have been necessary had the authors electively sacrificed the Sylvian vein prior to tumor resection, which would have allowed an anterior temporal corridor for the approach. Furthermore, to our knowledge, and as the authors themselves state, there is no clear documentation in the literature that sacrifice of the anterior Sylvian veins once they leave the fissure and drain into the sphenoparietal sinus leads to any serious damage.

This article brings up the important topic of venous sacrifice in cranial neurosurgery. Frequently a neurosurgeon encounters a vein that limits exposure, and he or she must make a decision regarding whether the vein can be safely sacrificed. Unfortunately there is insufficient literature to help guide the surgeon, and the neurosurgical community has paid little attention to this issue. Because the consequences of venous sacrifice can be devastating, the prevailing trend is to never electively sacrifice an important vein. This, of course, is generally a healthy surgical attitude, but the important issue of surgical judgment comes into play not infrequently when preserving such a vein may lead to excessive retraction of eloquent brain, increase the danger of tumor or arteriovenous malformation resection or clipping of an

Key words
- Clinoidal meningioma
- Skull base surgery
- Sylvian veins
- Venous drainage

Abbreviations and Acronyms
ICG: Indocyanine green
SPV: Superior petrosal veins

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aneurysm by compromising the exposure, or limit the extent of resection of a tumor because of the limited exposure allowed by preservation of the vein. In the subsequent section, we discuss the most common important veins encountered during various cranial neurosurgical approaches and the possible consequences of their sacrifice. However, before we begin, we would like to emphasize that the following are general guidelines based on the scanty literature available and on the senior author's (R.C.H.) personal experience, and are not meant to diminish the importance of careful surgical judgment on a case-by-case basis.

SUPERFICIAL CEREBRAL VEINS

The superficial cortical veins belong to 4 systems: 1) the superior sagittal group, which drains into the superior sagittal sinus; 2) the sphenoidal group, which drains into the sphenoparietal and cavernous sinuses; 3) the tentorial group, which drains into sinuses in the tentorium; and 4) the falcine group, which drains into the inferior sagittal or straight sinuses or their tributaries (18). These systems are strongly interconnected and thus capable in many instances of maintaining venous drainage after sacrifice of a single vein. Furthermore, there appears to be a reciprocal relationship between these systems so that enlargement of the territory drained by one system is generally associated with a decrease in the territory drained by another. Finally, it should be noted that there is considerable variability in these systems, not only from one individual to another, but also in different hemispheres in the same individual.

Superior Sagittal Group

Bridging veins to the superior sagittal sinus include the frontopolar, anterior frontal, middle frontal, posterior frontal, precentral, central, postcentral, anterior parietal, posterior parietal, and occipital veins as well as the superior anastomotic vein of Trolard (18). These veins are often encountered during interhemispheric approaches. There is a greater concentration of bridging veins, known as the central group of veins, in the middle third of the superior sagittal sinus. Sacrifice of any of the central group of veins is dangerous and may result in contralateral hemiplegia worse in the lower extremities. On the other hand, there is an area relatively devoid of bridging veins anterior to the coronal suture and posterior to lambdoid suture that generally permits frontal and occipital lobe retraction without sacrificing any large veins during the anterior interhemispheric transcallosal and paraoccipital transtentorial approaches, respectively. Occasionally, however, a bridging vein is encountered during these approaches; sacrifice is generally well tolerated provided that the vein is small in size and there are sufficient adjacent collateral vessels.

Falcine Group

In addition to the bridging veins that join the superior sagittal sinus, there are bridging veins of various sizes that arise from the anterior pericallosal vein and enter the inferior sagittal sinus (18). They are occasionally seen during the anterior interhemispheric transcallosal approach and may be safely sacrificed if necessary.

The internal occipital (anterior calcarine) vein drains into the internal cerebral vein or the vein of Galen. It is frequently encountered and must be sacrificed during exposure of the pineal region through a paraoccipital transtentorial approach. Although we believe that occlusion of the internal occipital vein may be performed with minimal morbidity, Rhoton has stated that its sacrifice may cause a homonymous hemianopsia (18). This complication, however, may be a consequence of the occipital lobe retraction required during the approach rather than of venous disturbance related to sacrifice of the internal occipital vein.

Sphenoidal Group

This group is formed by the terminal ends of the superficial and occasionally the deep Sylvian veins, which drain into the sphenoparietal and cavernous sinuses, or less commonly into the sphenobasal sinus. Sacrifice of any of the superficial or deep Sylvian veins while they are still within the fissure should be performed with great trepidation and only if they are of small caliber and demonstrate adequate anastomoses. However, as previously mentioned, interruption of the anterior terminal ends of the Sylvian veins once they leave the fissure and enter the sphenoparietal, sphenobasal, or cavernous sinus can be performed safely. In fact we routinely sacrifice these veins without consequence, as is frequently necessary during the "half and half" or "tempropolar approach" to lesions of the tentorial incisura, upper clivus, and interpeduncular cistern (7). The reason this is possible is that normally there are sufficient cortical collateral vessels to allow a rapid reversal of flow without adverse sequelae.

Tentorial Group

Several bridging veins may be encountered during the subtemporal approach as they run from the temporal lobe to enter the transverse and tentorial sinuses. The vein of Labbe, also known as the inferior anastomotic vein, creates an anastomosis between the superficial Sylvian veins and the transverse sinus distally. It must be preserved at all costs to avoid venous infarction of the temporal lobe. Although it is well known that dominant temporal lobe damage can cause serious neurological morbidity, injury to the nondominant temporal lobe from damage to the vein of Labbe can be just as devastating, resulting in major disturbances in personality and memory. The presence of a more anteriorly situated vein of Labbe can present a major obstacle during the subtemporal approach. The senior author has described a technique to circumvent this problem by resecting a small amount of the inferior temporal gyrus either in front or behind the vein of Labbe to avoid stretching the vessel and injuring it (6).

Veins along the inferior surface of the temporal lobe may be also encountered during subtemporal exposures. Rhoton divided these veins into a medial group (uncal, anterior hippocampal, and medial temporal veins), which drains into the basal vein of Rosenthal, and a lateral group (anterior, middle, and posterior temporobasal veins), which drains into the tentorium and eventually the transverse sinus (18). Occasionally the lateral inferior temporal veins can be of considerable caliber and pose a limitation during the subtemporal approach. They also can drain into a large tentorial sinus that may make division of the tentorium dangerous. There appears to be a reciprocal relationship between the size of the inferior temporal veins and the vein of Labbe, so that enlargement of one system is associated with a decrease in size of the other. The decision regarding the safety of sacrificing one or more of the inferior temporal veins is not straightforward and requires careful intraoperative surgical judgment. On several