Veins of the Cerebellopontine Angle and Specific Complications of Sacrifice, with Special Emphasis on Microvascular Decompression Surgery. A Review

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Key words
- Cerebellopontine angle veins
- Cranial nerve microvascular decompression
- Hemifacial spasm
- Trigeminal neuralgia
- Vagoglossopharyngeal neuralgia
- Venous complications

Abbreviations and Acronyms
AICA: Anterior inferior cerebellar artery
CPA: Cerebellopontine angle
CN: Cranial nerve
dSPVS: Deep superior petrosal venous system
HFS: Hemifacial spasm
MVD: Microvascular decompression
NVC: Neurovascular conflict
PICA: Posterior inferior cerebellar artery
SPS: Superior petrosal sinus
SPV: Superior petrosal vein
SPVS: Superior petrosal venous system
sSPVS: Superficial superior petrosal venous system
TN: Trigeminal neuralgia
VBA: Vertebrobasilar artery
VGPN: Vagoglossopharyngeal neuralgia

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Good knowledge of the anatomy of veins is of crucial importance for the functional surgery of cranial nerve (CN) disorders, especially microvascular decompression for trigeminal neuralgia (TN), hemifacial spasm (HFS), and vagoglossopharyngeal neuralgia (VGPN). Although controversial, veins may be involved in neurovascular conflicts and may constitute dangerous obstacles to access to the CNs.

With the aim of estimating the implications of veins in those diseases and evaluating the linked surgical difficulties, we carried out a review of the literature from 2000 to the end of February 2018. For this review, articles found on PubMed that gave enough precision about veins were retained (39 articles on TN, 38 on HFS, 8 on VGPN, and 26 on complications related to venous sacrifices).

Before this review, we described a simplified anatomic classification of veins, amenable to easing the surgical approach to CNs. Access to the trigeminal nerve, via the infratentorial-supracerebellar route, is almost always affected by the superficial superior petrosal venous system, whereas access to the facial and cochleovestibular complex as well as to the lower CNs, through the infrafloccular trajectory, is almost always exempt of important venous obstacles.

Respective incidences of venous compression at the origin of hyperactive CN syndromes are given. The percentages of a venous conflict alone were calculated at 10.8% for TN, 0.1% for HFS, and 2.9% for VGPN. We review the complications considered in relation with venous sacrifices. Precautions to minimize these complications are given.

INTRODUCTION

Veins are of major importance for surgery of cranial nerve (CN) disorders in the cerebellopontine angle (CPA). Veins can play a role in the mechanisms of hyperactive syndromes as a result of neurovascular conflicts (NVCs) and/or be an obstacle to reach the nerves in the decompression procedures. As classically recommended for tumor surgery in the CPA, venous drainage must be respected as much as possible to avoid swelling and infarction.

The anatomy of the venous system in the posterior fossa with its many variants

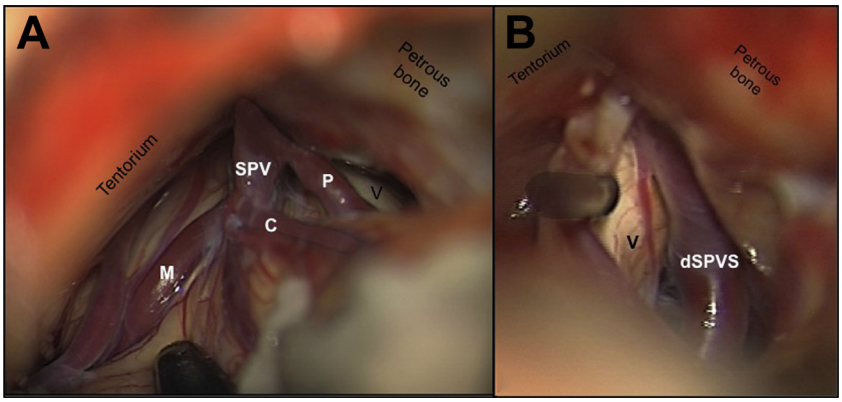

Figure 1. Representation of the venous system in relation to the trigeminal nerve. (**A**) The superficial superior petrosal venous system posterior to the right trigeminal nerve (V) seen through an infratentorial-supracerebellar route. The superior petrosal vein (SPV) drains into the superior petrosal sinus. The 3 principal affluents of the SPV are the mesencephalic vein (M), the cerebellar vein (C), and the pontine vein (P). (**B**) A transverse vein from the deep superior petrosal venous system (dSPVS) on the right side. The transverse vein is posterior and inferior to the trigeminal root (V) at the exit from the porus of the Meckel cave.

Table 1. Studies Reporting Venous Neurovascular Conflicts with Compressing Vein Alone or in Association with an Artery During Microvascular Decompression for Trigeminal Neuralgia

Reference	Number of Cases	Vein with Arteries (%)	Vein Alone (%)
Matsushima et al., 2004[9]	121	14.9	5.8
Li et al., 2005[10]	62	20.9	0
Kabil et al., 2005[11]	255	15.7	9.8
Kuncz et al., 2006[12]	160	11.9	5.6
Sindou et al., 2006[13]	362	23.2	3.3
Pamir et al., 2006[14]	90	7.8	7.8
Sandell et al., 2008[15]	135	37.8	18.5
Linskey et al., 2008[16]	36	88.8	2.8
Zhong et al., 2008[17]	407	11.8	
Günther et al., 2009[18]	107	28	14
Ni et al., 2009[19]	33	17	10.0
Salama et al., 2009[20]	21	NA	19.1
Kabatas et al., 2009[21]	62	33.9	17.7
Miller et al., 2009[22]	157	NA	23.6
Leal et al., 2010[23]	100	17	NA
Ferroli et al., 2010[24]	476	35.0	NA
Bond et al., 2010[25]	119	NA	13.0
Oesman et al., 2011[26]	156	14	9
Oishi et al., 2011[27]	35	8	8.5
Tucer et al., 2012[28]	37	NA	10.8
Zhong et al., 2012[29]	1274	35	
Zhang et al., 2013[30]	154	18	6
Jo et al., 2013[31]	141	11.3	13.5
Li et al., 2014[32]	231	NA	12.4
Chen et al., 2014[33]	99	35.4	
Setty et al., 2014[34]	57	7	14
Yang et al., 2014[35]	59	5.2	8.5
Khan et al., 2015[36]	53	0	1.8
Hitchon et al., 2015[37]	51	0	17.6
Dumot et al., 2015[6]	326	29.1	8.9
Martinez-Anda et al., 2015[38]	271	NA	4.8
Han et al., 2016[39]	40	2.5	12.5
Zhao et al., 2016[40]	440	20.2	12.9
Wang et al., 2017[41]	420	NA	6.0
Inoue et al., 2017[42]	179	NA	8.9
Cheng et al., 2017[43]	60	NA	8.3

Of the 2669 articles listed from PubMed using the criteria described in the Methods section, 2319 were excluded by title reading, 185 by abstract reading, and 126 by article reading.
NA, not available.

Continues

has been extensively described in several reports.[1-4] Matsushima et al.[5] gave a particularly detailed description of the veins of the posterior fossa with their course on the surface of the brainstem and cerebellum in panoramic views.

During surgical procedures in the CPA, the CNs are most often approached through minimal openings. Therefore, we found it useful to revisit their surgical anatomy the way they are seen through keyhole retromastoid approaches. In addition, we carried out a review of the implications of veins in the NVCs responsible for trigeminal neuralgia (TN), hemifacial spasm (HFS) and vagoglossopharyngeal neuralgia (VGPN), and of complications linked to their sacrifices during microvascular decompression (MVD).

METHODS

For this review, data were extracted from the authors' populations of patients referred for TN, HFS, or VGPN and operated on for a first MVD between 2005 and 2014 by the senior author (M.S.) and from the publications in English listed through the PubMed system from 2000 to the end of February 2018. A literature search for the respective diseases was conducted by the first author (C.D.) using the following terms: (hemifacial spasm) [Title/Abstract], (trigeminal neuralgia) [Title/Abstract], (vago-glossopharyngeal neuralgia) OR (glossopharyngeal neuralgia) [Title/Abstract]. Only articles reporting >20 cases and with sufficient description of the vessels encountered were included. When the same team published several articles, attention was paid to include only the articles with different series. The reviewing process is given with the number of articles excluded in the legend of the corresponding table. For the complications linked to the veins, research was performed using the terms: (microvascular decompression) AND complications. Articles were considered only if venous complications were precisely reported. For those reporting cerebellar hematomas or strokes, articles were retained even if their venous origin was not fully ascertained.

Surgical Anatomy

Veins in Relation to the Trigeminal Nerve. A simplified anatomic description was made