Contribution of Intracranial Vertebral Artery Asymmetry to Vestibular Neuropathy

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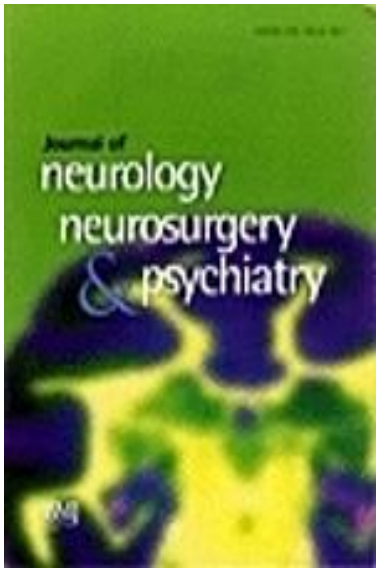
衛生福利部樂生療養院副院長
國立陽明大學神經學科助理教授



J Neurol Neurosurg Psychiatry
. 2011 Jul;82(7):823-5.

- The pathophysiology of vestibular neuronitis or neuropathy (VN) from viral inflammation of the vestibular nerve or labyrinthine ischemia has been debated.

Acta Otolaryngol Suppl 1993;503:18-22.

Something New?

Clinical Radiology Extra (2003) **56**: 57–59
doi: 10.1016/S1477-6804(03)00013-X, available online at www.sciencedirect.com

Case Report

Infarction in Anterior Inferior Cerebellar Artery Territory Caused by Occlusion of Vertebral Artery

Y. HAYASHI, H. NAKAU, H. SHIMA, Y. TOHMA, S. KIDA, J. YAMASHITA

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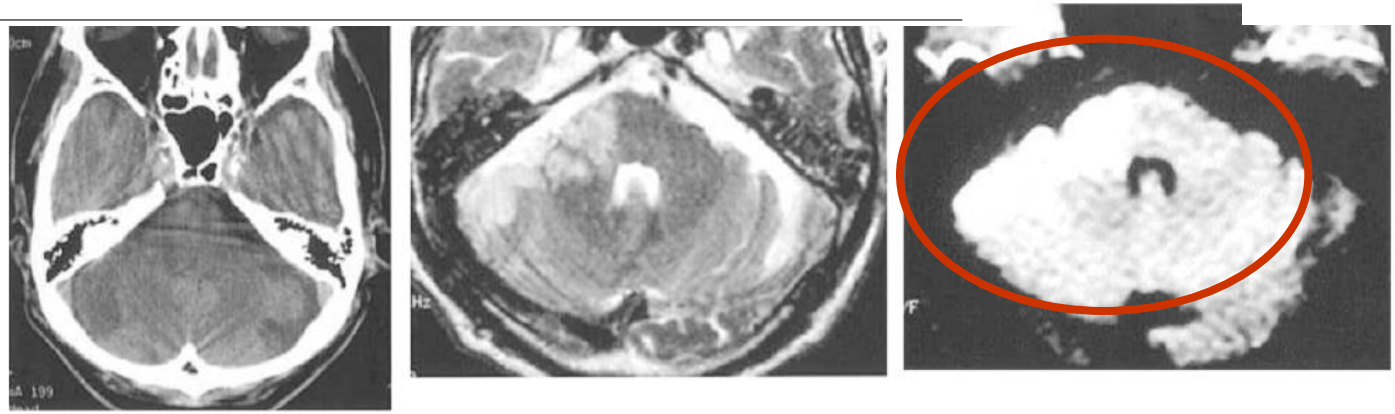

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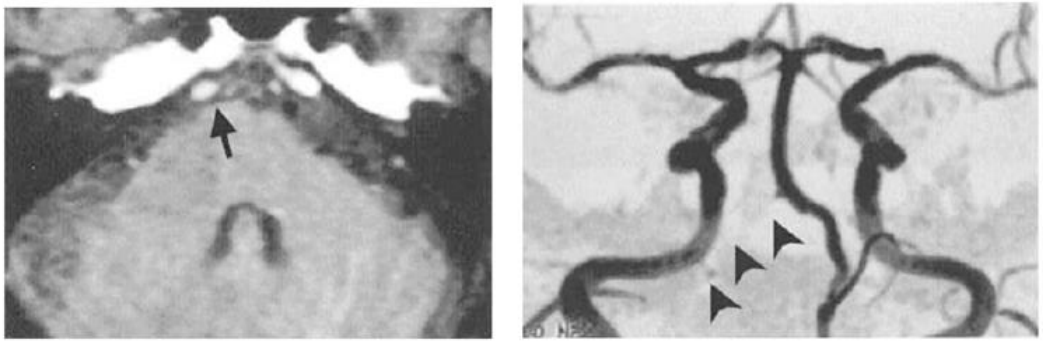


d e

Table 2. *Mean latencies of p13 and n23*

Group	No.		p13	n23 (ms)
Subjects with a VAH	26	Rt ear	18.3±2.5*	33.8±2.9*
		Lt. ear	12.0±1.3(p:0.02)	25.1±2.6(p:0.018)
Subjects without a VAH	26	Rt ear	11.9±2.7(p:0.019)	24.8±2.9(p:0.02)
		Lt. ear	12.2±1.5(p:0.02)	24.7±2.8(p:0.017)

VAH denotes vertebral artery hypoplasia. The 26 VAH were all located on right side.

Vertebral Artery Hypoplasia May Contribute to Abnormal Vestibular Evoked Myogenic Potentials

Yu-Ming Chuang[1,3,4,6], Chien-Chih Chen[2], and Ching-Po Lin[4-5]

Acta Neurol Taiwan 2009;18(2):133-136

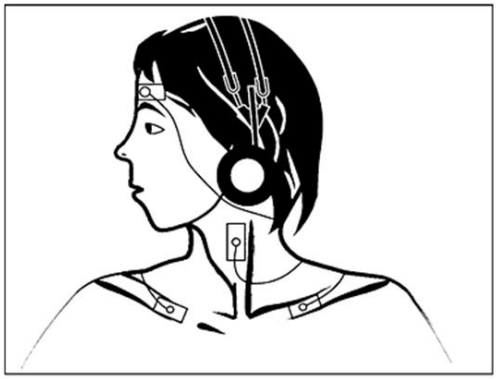


Figura 2. Posicionamento do indivíduo durante os registros das respostas do músculo esternocleidomastóideo.

Vestibular evoked myogenic potential

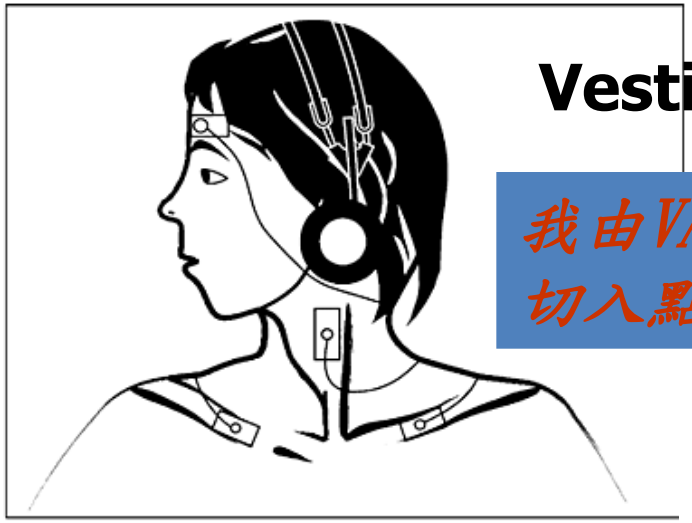
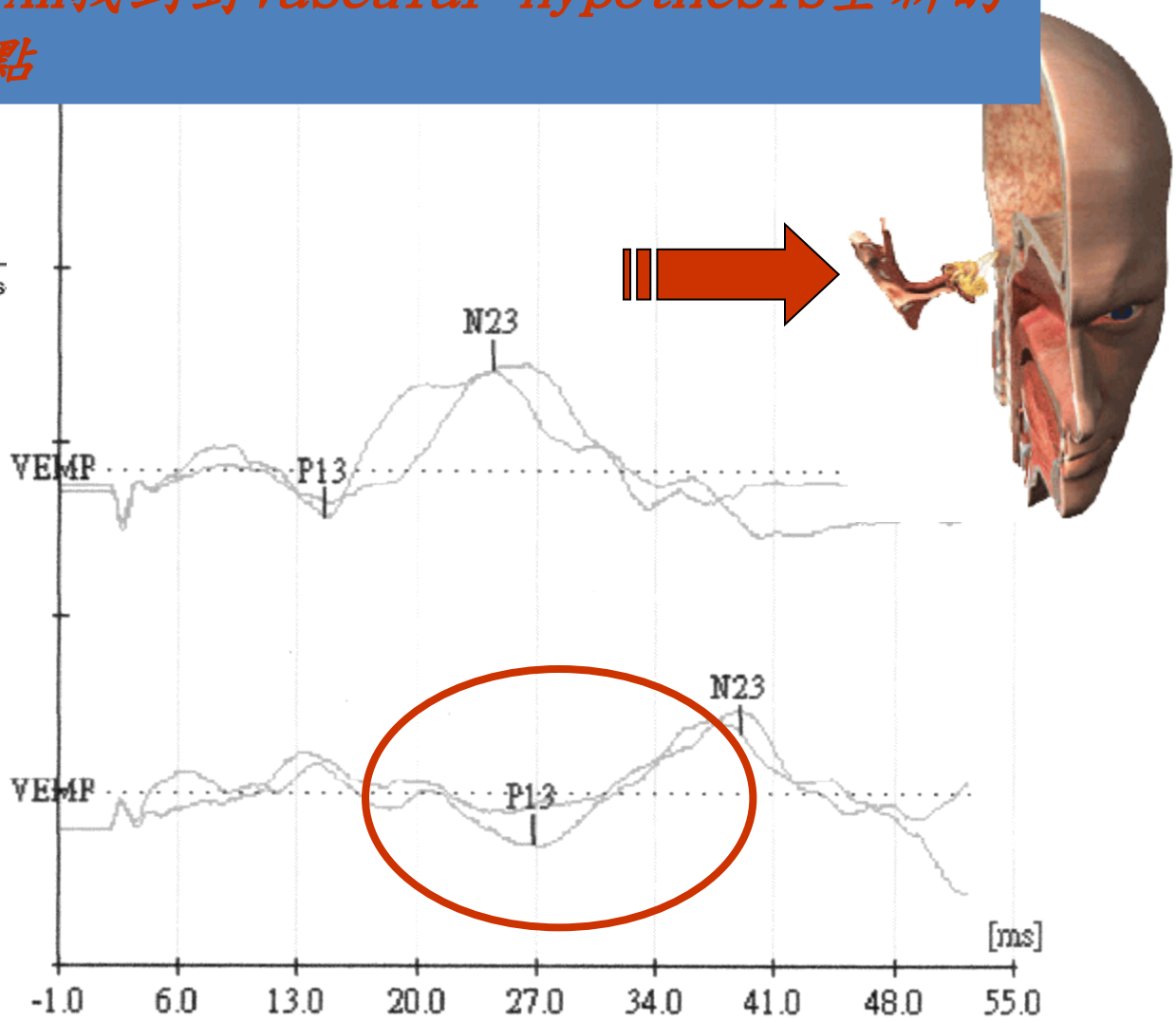
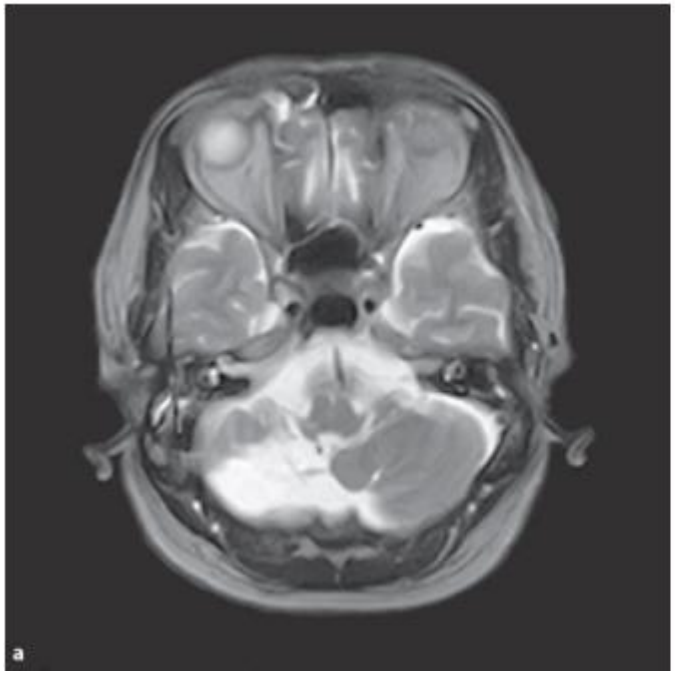


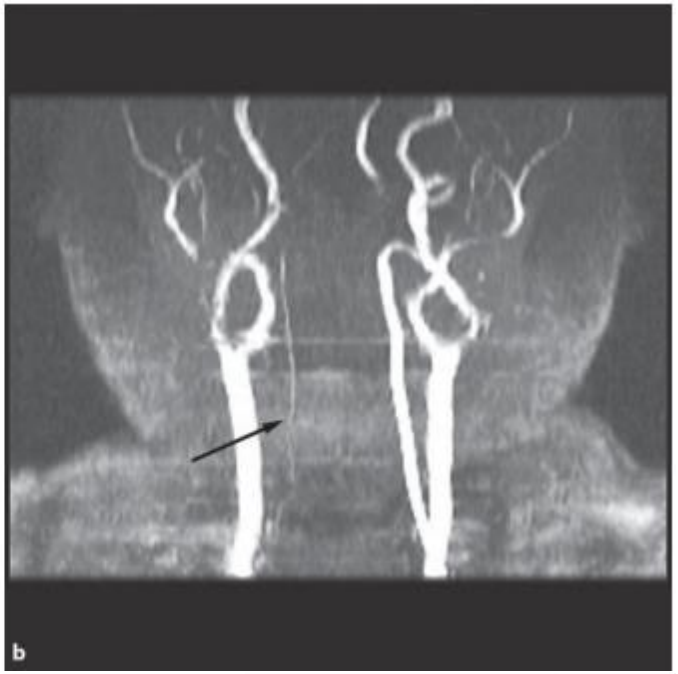
Figura 2. Posicionamento do indivíduo durante os registros das res
postas do músculo esternocleidomastóideo.

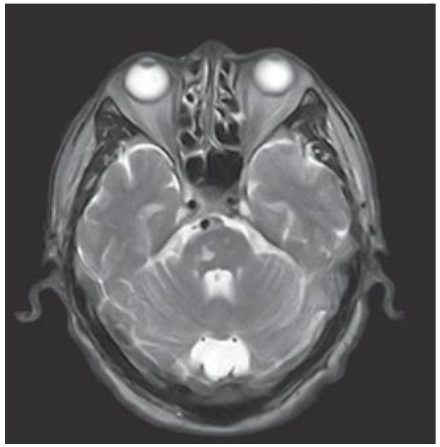
我由VAH找到對Vascular hypothesis全新的切入點



Acta Neurol Taiwan 2009;18(2):133-136







European Neurology

Original Paper

Eur Neurol 2006;55:193–197
DOI: 10.1159/000093868

Received: November 7, 2005
Accepted: March 29, 2006
Published online: June 13, 2006

Toward a Further Elucidation: Role of Vertebral Artery Hypoplasia in Acute Ischemic Stroke

Yu-Ming Chuang[a, c, d] Yuarn-Chung Huang[b] Han-Haw Hu[c, d] Ching-Yih Yang[e]

[a]Department of Neurology, Tao-Yuan General Hospital, [b]Keelung General Hospital, [c]Taipei Veterans General Hospital, [d]National Yang-Ming University, and [e]Department of Radiology, Keelung General Hospital, Tao-Yuan City, Taiwan, ROC

Table 2. Spectral parameters measured during migraine attacks and headache-free periods

	Tested group (n = 26)		Control (n = 26)	
	headache-free	attack	headache-free	attack
Net VA flow volume, ml/min	128.7 ± 11.6	130.6 ± 12.1 (power: 0.51)	137.2 ± 11.8	135.2 ± 12.5 (power: 0.53)
Resistance index				
Left VA	0.65 ± 0.11	0.68 ± 0.13 (power: 0.49)	0.66 ± 0.12	0.65 ± 0.13 (power: 0.55)
Right VA	0.89 ± 0.12	0.79 ± 0.05[1] (p = 0.03)	0.65 ± 0.11	0.66 ± 0.14 (power: 0.53)
Diameter, mm				
Left VA	0.31 ± 0.09	0.30 ± 0.10 (power: 0.51)	0.29 ± 0.08	0.30 ± 0.06 (power: 0.50)
Right VA	0.19 ± 0.04	0.18 ± 0.06 (power: 0.53)	0.28 ± 0.07	0.29 ± 0.05 (power: 0.52)
Left VA				
PSV	59.8 ± 12.6	58.9 ± 13.9 (power: 0.53)	60.8 ± 15.6	61.2 ± 15. 4 (power: 0.55)
EDV	30.5 ± 8.7	32.7 ± 9.1 (power: 0.61)	31.7 ± 8.5	32.7 ± 8.9 (power: 0.51)
TAMV	43.6 ± 9.6	43.6 ± 9.6 (power: 0.52)	43.6 ± 9.6	42.9 ± 6.8 (power: 0.57)
Right VA				
PSV	27.8 ± 8.9	28.9 ± 9.1 (power: 0.51)	58.7 ± 12.8	57.9 ± 14.5 (power: 0.52)
EDV	9.6 ± 3.7	14.6 ± 5.7[1] (p: 0.032)	29.6 ± 8.8	28.6 ± 8.5 (power: 0.55)
TAMV	14.9 ± 5.8	18.7 ± 6.4[1] (p: 0.04)	46.5 ± 9.8	457 ± 85 (power: 0.55)

Values are means ± SD. PSV = Peak systolic velocity; EDV = end-diastolic velocity; TAMV = time-average mean velocity.
[1] Test group: migraine without a hypoplastic VA; control: migraine with a hypoplastic VA.

Original Paper

European Neurology

Eur Neurol 2008;59:148–151
DOI: 10.1159/000111878

Received: May 16, 2007
Accepted: June 23, 2007
Published online: November 30, 2007

Toward a Further Elucidation: Role of Vertebral Artery Hypoplasia in Migraine with Aura

Yu-Ming Chuang[a–d, f] Yuan-Chung Hwang[b] Ching-Po Lin[d, e] Chih-Yang Liu[d, e]

[a]Department of Neurology, Tao-Yuan General Hospital, [b]Keelung General Hospital, [c]School of Medicine, [d]Institute of Biomedical Imaging and Radiological Sciences, [e]Institute of Neuroscience, National Yang-Ming University, and [f]Taipei Veterans General Hospital, Taipei, Taiwan, ROC

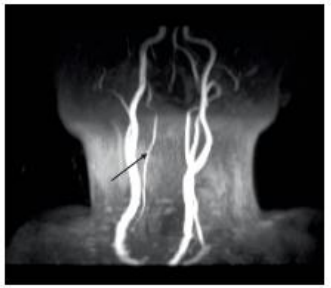
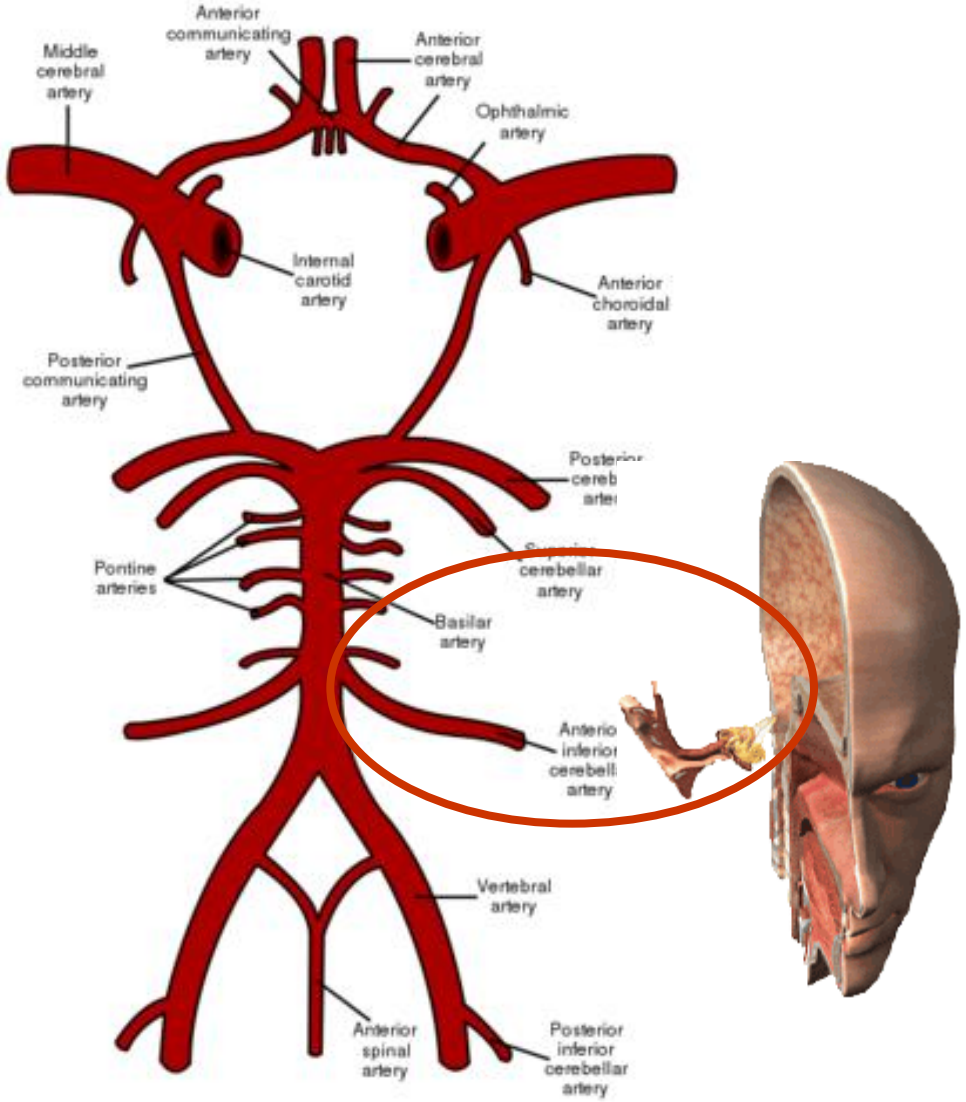
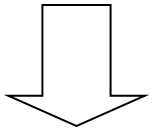


Fig. 1. The net VA flow volume measured in a woman who had migraine with prolonged aura was 128.8 ml/min. The corresponding cervical MR angiogram confirmed the diagnosis of right-sided VA hypoplasia (arrow).

AICA rather than VA: VN supplier?



Does VAH contribute to Vestibular Neuronitus.



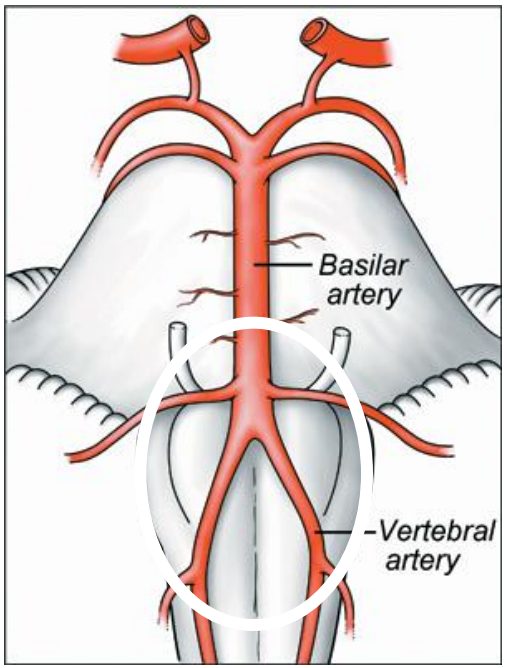
Define VA/AICA hemodynamic association

Other Cerebral vessels

Basilar artery: 唯一由兩條上游血管(VA)匯聚而成,

垂直整合

水平整合



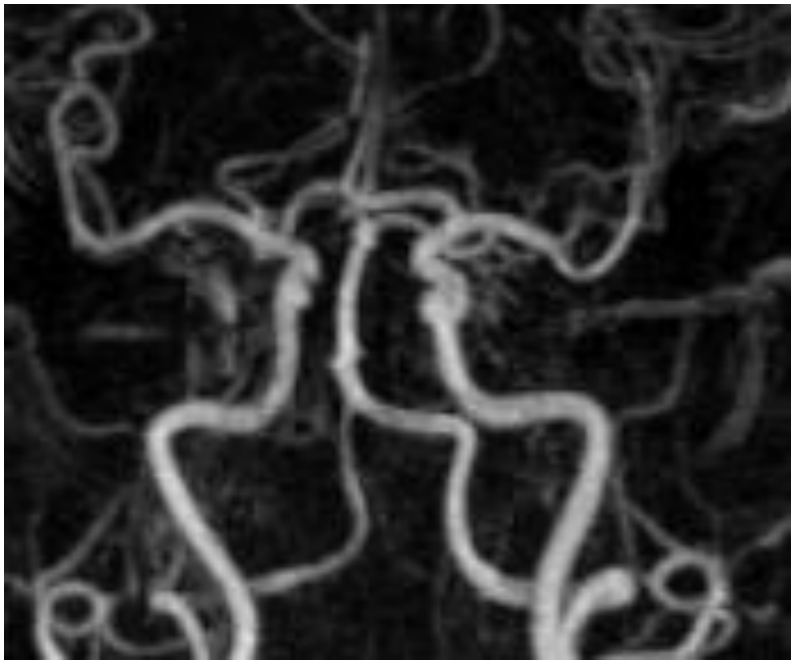
We need larger sample size to test this hypothesis

Clinical effect of valacyclovir drug for vestibular neuronitis

Protocol No.:	DOH94-TD-I-111-012
Development phase:	Local Research Study
Principal Investigator:	Chiang-Feng Lien, M.D. Otolaryngology Department Taipei Veterans General Hospital
Co-Investigators:	Wen-Huei Liao, M.D. Otolaryngology Department Taipei Veterans General Hospital
First subject first visit:	December 16, 2005
Last subject last visit:	June 23, 2008
Sponsor:	National Science and Technology Program for Biotechnology and Pharmaceuticals
Biostatistician:	Ms. Ashley Li Virginia Contract Research Organization Co., Ltd. Taipei, Taiwan

感謝陳昌明主任提供70名VN完整MRA及Caloric test

How to define V4 hypoplasia ?



AI= left minus right VA diameter/left plus right VA diameter

AI >40% (specificity for VAH: 90.9%)

if < 0.22 cm in diameter

Ultrasound Med Biol 2004; 30: 605-9.
J Neurol Sci. 2007;260:183-7.

From January 2006 to October 2007, consecutively recruited 70 unilateral VN patients who participated in a double-blind randomized placebo controlled trial on the therapeutic effect of valacyclovir on VN in a tertiary referral medical cente

All patients underwent complete neurologic examination, caloric irrigation, cranial MRI with contrast medium(3T), and laboratory testing

The inclusion criteria:

1. Within 72 hours of acute or subacute onset of severe,prolor rotatory vertigo, nausea and postural imbalance unilateral functional deficit of the horizontal semicircular canal and caloric irrigation showed >25% canal paresis of the affected ear
2. A horizontal spontaneous nystagmus with a rotational component toward the unaffected ear (fast phase) and the head-thrust test showed an ipsilateral deficit of the horizontal canal,
3. No tinnitus or acute hearing loss, and
4. Exclusion of central, bilateral or other peripheral vestibular dysfunction.

The NEW ENGLAND JOURNAL of MEDICINE

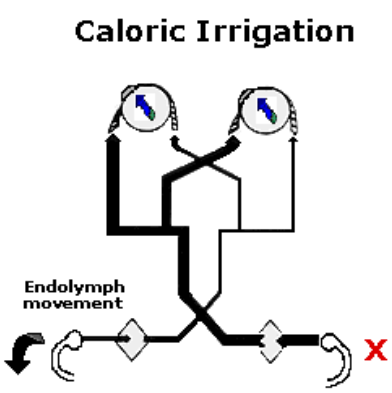
ORIGINAL ARTICLE

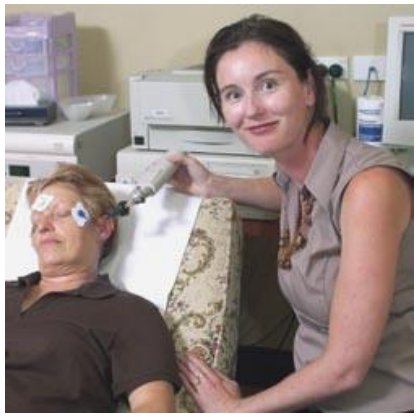
N ENGL J MED 351;4 WWW.NEJM.ORG JULY 22,

Methylprednisolone, Valacyclovir, or the Combination for Vestibular Neuritis

Michael Strupp, M.D., Vera Carina Zingler, M.D., Viktor Arbusow, M.D., Daniel Niklas, Klaus Peter Maag, M.D., Ph.D., Marianne Dieterich, M.D., Sandra Bense, M.D., Diethilde Theil, D.V.M., Klaus Jahn, M.D., and Thomas Brandt, M.D.

Cranial MRI with contrast medium(3T)





Jongkee's formula

CP: {(RW+RC) – (LW+LC)/RW+RC+LW+LC} x100%
DP: {(RW+LC) – (RC+LW)/RW+RC+LW+LC} x 100%

RW and LW: warm air irrigation response in right (RW) or left (LW) ear
RC and LC: cold air irrigation response in right (RC) or left (LC) ear

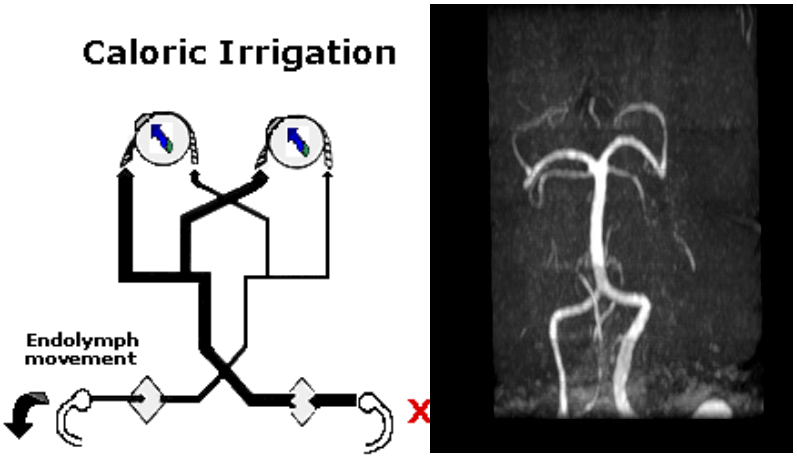
Pract Otorhinolaryngol (Basel) 1962;24:65-93.

The control group:

50 age/sex matched healthy subjects
(22 males) aged 48.4±14.5 years
(range 30 to 86 years)
Physical check-up and MRI/MRA study
Imaging Center of Taipei Veterans General Hospital
January to August 2006.

J.S.C Ko, M.D

Matching intracranial VAH side and VN side by caloric test



Results

None of our patients exhibited contrast enhancement of the inner ear,

Distinct scenario from Bell's palsy

Results

Relative risk (RR) of VAH in VN RR = 2.21

VN subjects :29 VAH (right/left: 23/6) (42.0%)
Controls : 6 VAH (right/left: 5/1) (12%)

Results

	VN with VAH	VN without VAH	p
No. of cases	29	40	
Age, year	50.29±8.5	48.55±6.5	0.073
Radiological findings			
Asymmetry index of VA	0.49±0.06	0.28±0.11	0.018*
No. of right VAH	23		
No. of left VAH	6		0.019*
No. of ipsilateral VAH according to VN lesion side			
Global	19/29 (65.52%)		
Right VAH with ipsilateral. VN	14/23 (60.87%)		
Left VAH with ipsilateral. VN	5/6 (83.33%)		0.037*

	Vascular risk group	Non-vascular risk group	p
No. of cases	51	18	
Age, year	63.29±8.5	48.55±6.5	0.019
Risk factors (%)			
Hypertension	31	0	
Diabetes mellitus	18	0	
Smoking	20	0	
Coronary artery disease	10	0	
Hyperlipidemia	32	0	
Radiological findings			
VAH	21 (41.17%)	8 (44.44%)	0.230
	R/L: 17/4	R/L: 6/2	
No. of ipsilateral VAH according to VN lesion site			
Global	17/21 (80.95%)	2/8 (25%)	0.009
Right VAH with ipsilateral VN	13/17 (76.47%)	1/6 (16.6%)	0.009
Left VAH with ipsilateral VN	4/4 (100%)	1/2 (50%)	0.068

* left VAH versus right VAH

Summary

- Accordance of VAH and ipsilateral VN
- Left VAH/VN higher association?
- Medical vascular risk summation effect

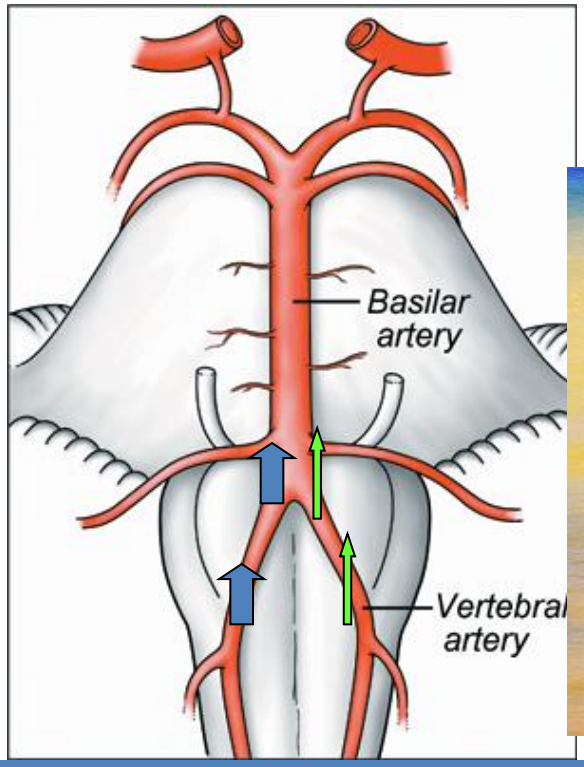
Hemodynamic association of VA and ipsilateral AICA?

Double hump profile
Fahraeus-Lindqvist effect

Double hump profile

Merging flows in an arterial confluence:
the vertebro-basilar junction.

J Fluid Mechanics Digital Archive 1995; 304 : 119-141.



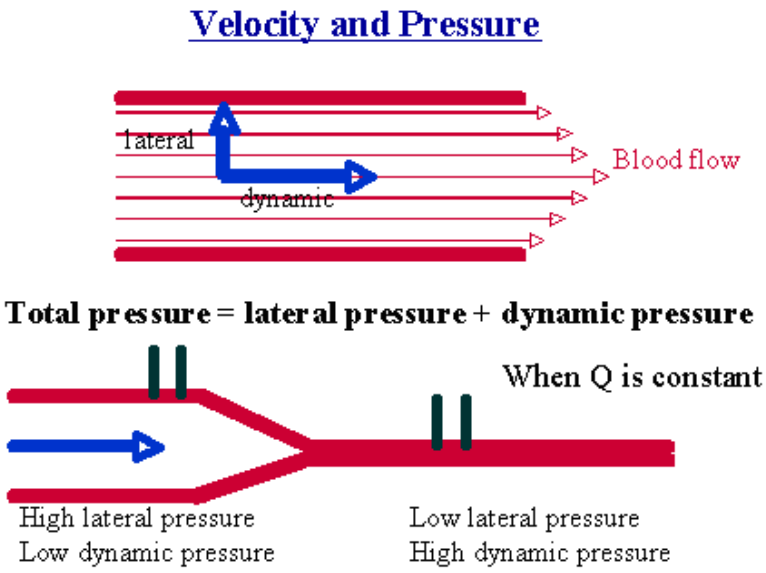
BA ‘double hump’ axial velocity profile just downstream of the VA confluence

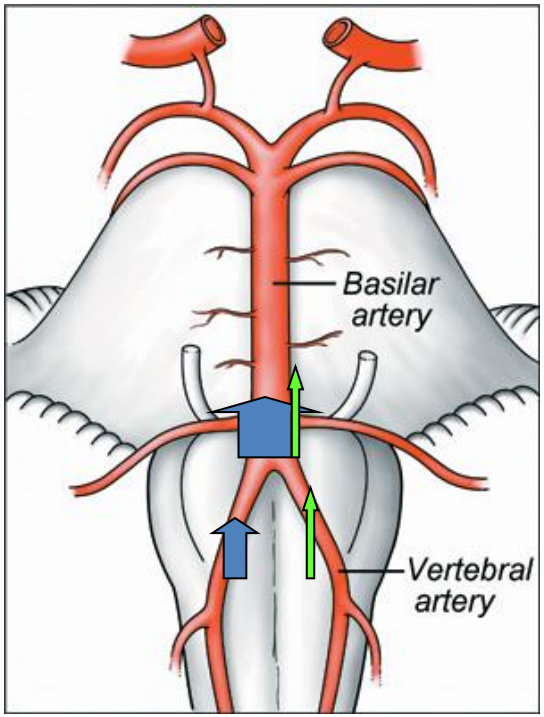
Fahraeus-Lindqvist effect

Fahraeus-Lindqvist effect

only plasma along wall more plasma than red bloc
small vessels - thus reduced hematocrit

Caplan LR. *J Neurol Neurosurg Psychiatry* 2009;

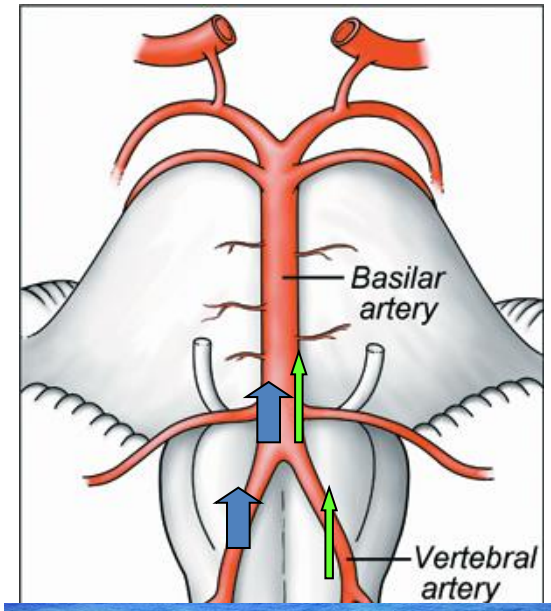


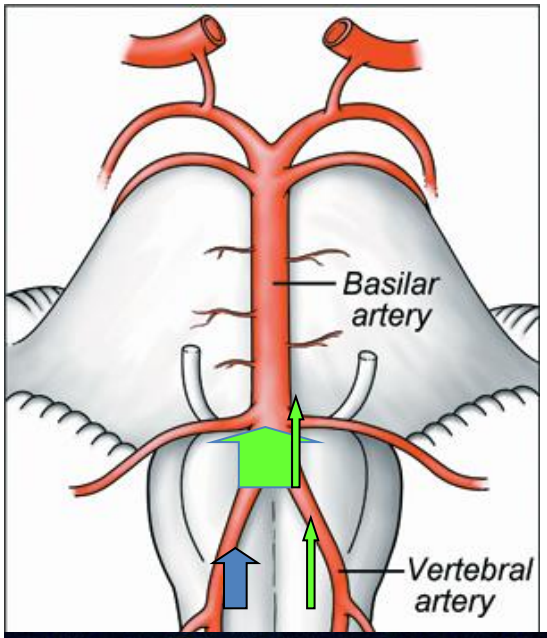


Merging flows in an arterial confluence:
the vertebro-basilar junction.

+

Fahraeus-Lindqvist effect





Higher accordance VAH and VN at left side?

Compensation compromise of left VBA
Asymmetrical Neurovascular modulation

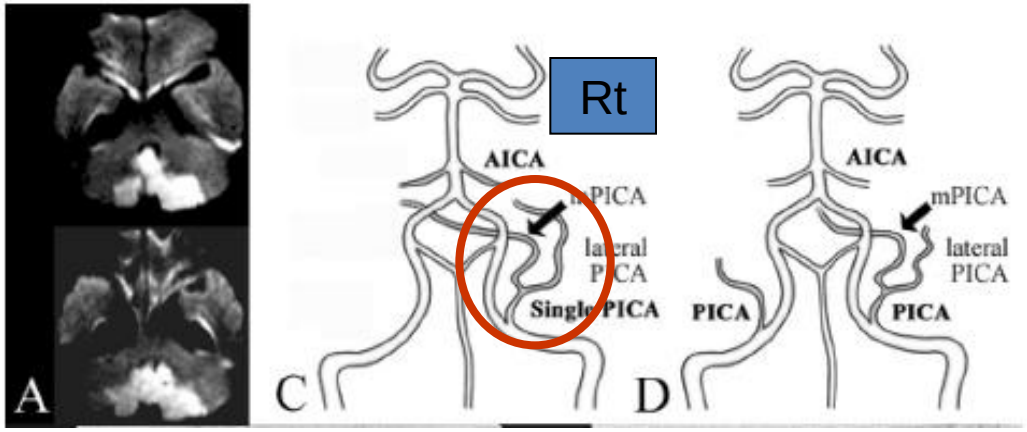
Compensation compromise of left VBA

Compensatory widening of downstream branches

In our cases, 35% of them showed normal distribution, 64% dominant Rt AICA, and 65% dominant Rt PICA.

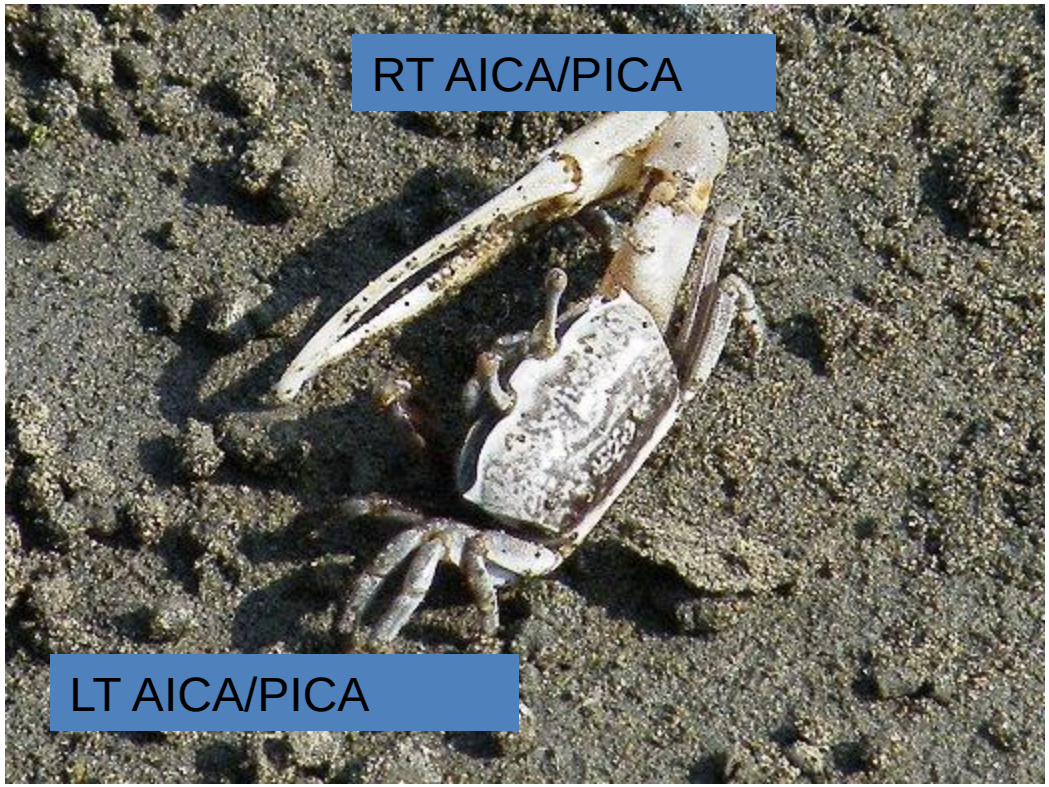
J Neurol Neurosurg Psychiatry 2007;78;954-958

VAH: compensatory by ipsilateral bigger AICA PICA

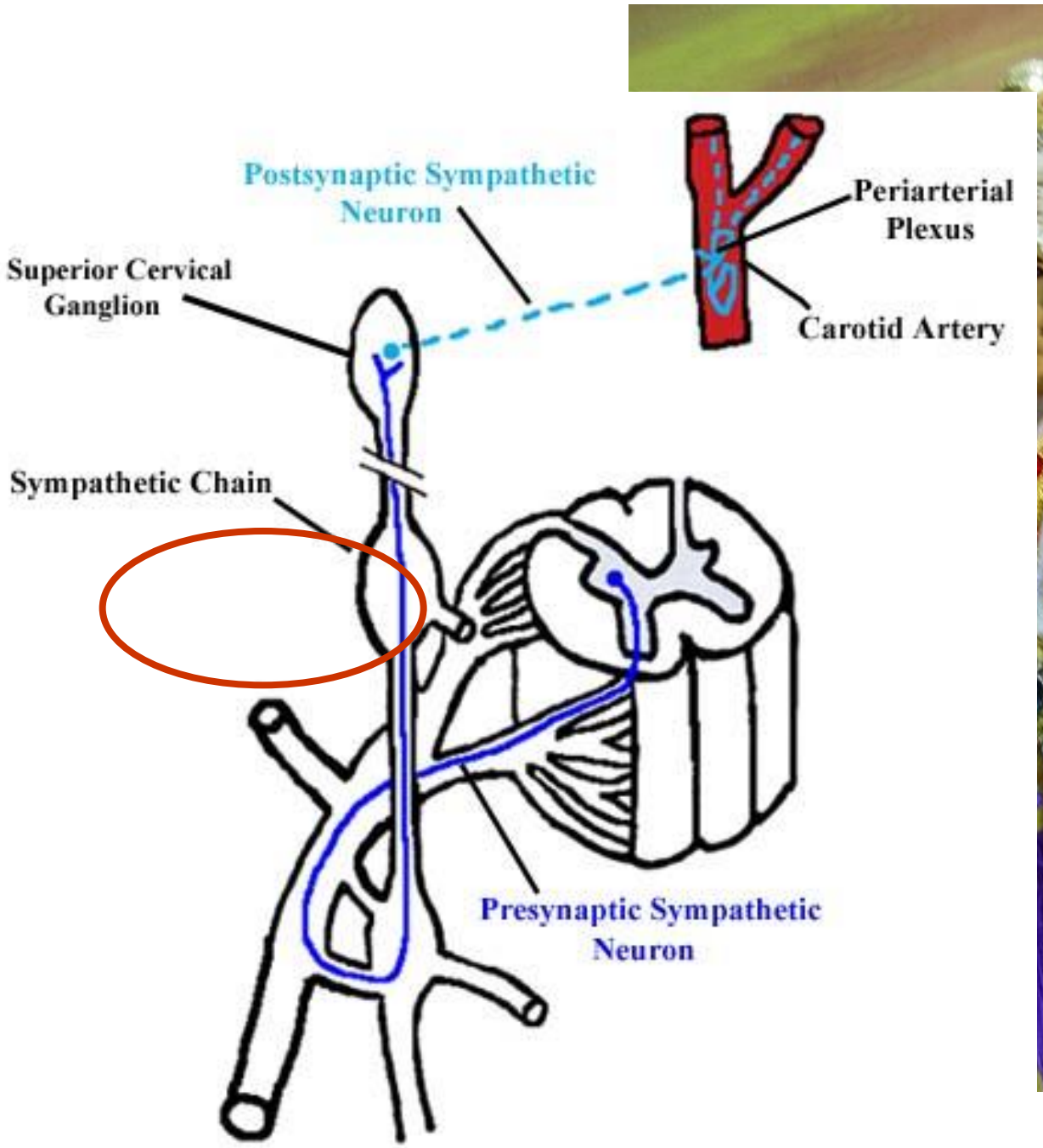


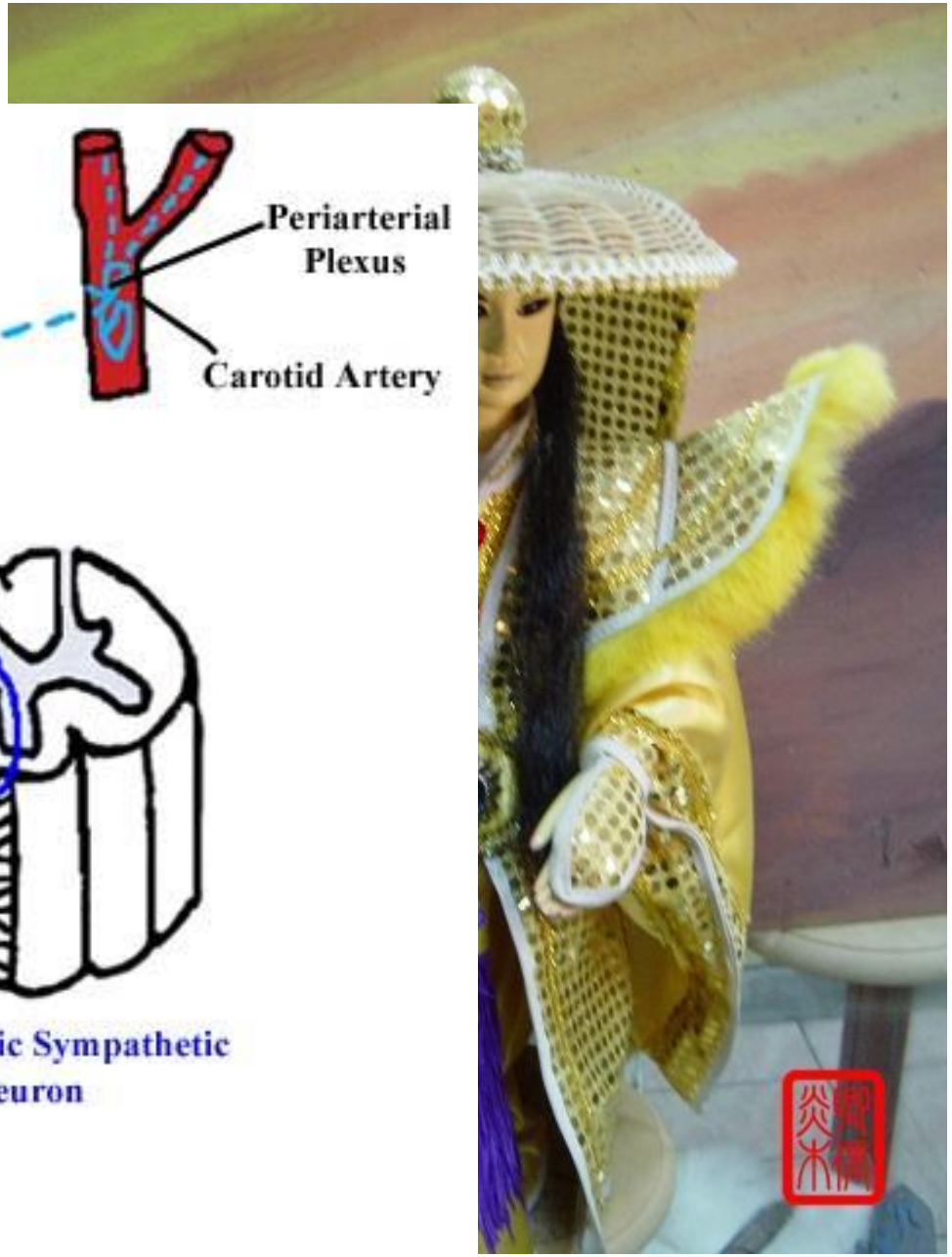
J Neurol Neurosurg Psychiatry 2007;78;954-958

A compensatory bigger AICA/PICA developed for VAH existed exclusively on the right side



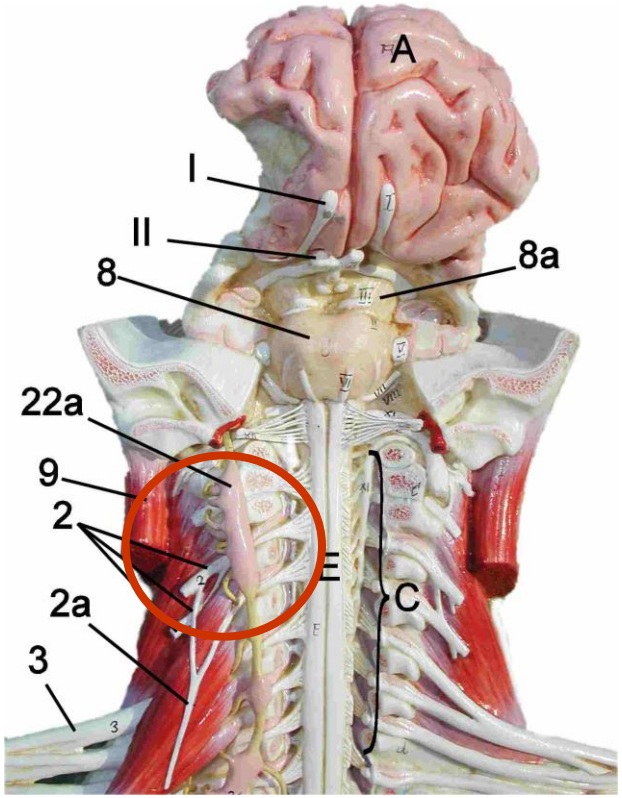
Asymmetrical Neurovascular modulation


Postsynaptic Sympathetic Neuron
Periarterial Plexus
Superior Cervical Ganglion
Carotid Artery
Sympathetic Chain
Presynaptic Sympathetic Neuron



Asymmetric post-natal development of superior cervical ganglion of paca (Agouti paca).

Int J Dev Neurosci. 2009;27:37-45.



Right SCG neurons (mono and binucleate) are bigger than the left SCG neurons

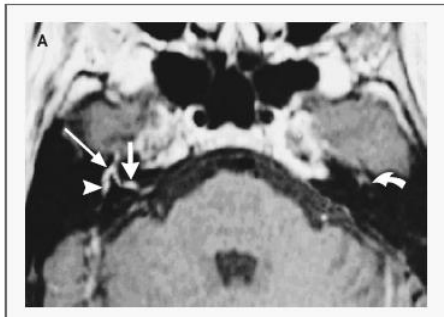
(mono and binucleate), irrespective of the animal age

Against inflammation hypothesis of VN ?

Distinct scenario from Bell's palsy

Unlike Bell's palsy
None of our patients exhibited contrast enhancement of the inner ear,
This argued against a viral etiology of VN.

J Vestib Res. 1998; 8: 427-33.



The NEW ENGLAND JOURNAL of MEDICINE

CLINICAL PRACTICE

Bell's Palsy

Donald H. Gilden, M.D.

This Journal feature begins with a case vignette highlighting a common clinical problem. Evidence supporting various strategies is then presented, followed by a review of formal guidelines, when they exist. The article ends with the author's clinical recommendations.

contrast enhancement indicate inflammation

JACC Vol. 31, No. 6
May 1998:1217–25

REVIEW ARTICLE

Interactive Role of Infection, Inflammation and Traditional Risk Factors in Atherosclerosis and Coronary Artery Disease

JAWAHAR L. MEHTA, MD, PHD, FACC, TOM G. P. SALDEEN, MD, PHD, FACC,*
KENNETH RAND, MD†
Gainesville, Florida and Uppsala, Sweden

VAH降低血量而致局部免疫障礙

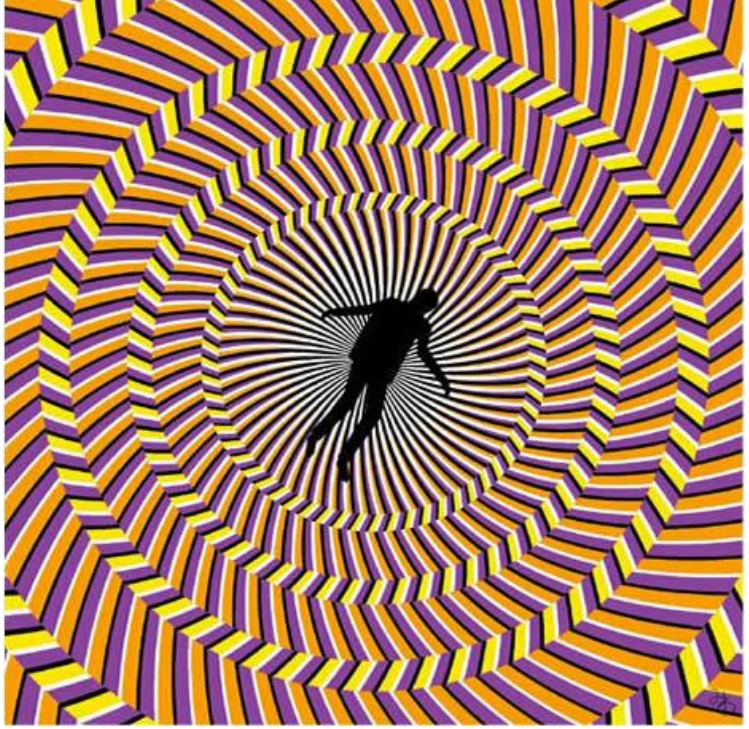
因此容易得HSV infection?

Anatomical risk factor of Vestibular Neuritis?

前庭神經炎的解剖學危險因子

Medical vascular risk summation effect to VN

Independent risk factor?



Independent risk factor: VAH ?

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Perspective

	Efficacy		Efficacy
VAH (N=29) 服 ACYCLOVIR(N=15)	9/15*(60%)	VAH (N=29) 服 Placebo (N=14)	6/14(42.8%)
Non-VAH (N=40) 服 ACYCLOVIR(N=20)	6/20 (30%)	Non-VAH (N=40) 服 Placebo (N=20)	14/20(70%)

VAH and drug response

Efficacy:
The primary measure of efficacy was the percentage of subjects with norm
(CP) result (canal paresis ≤ 25%) at week 24.