

Microvascular decompression as a treatment for cranial nerve hyperactive dysfunction – a critical view

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Neurovascular compression has been postulated as a probable mechanism for a large number of cranial nerve syndromes, with trigeminal neuralgia (TGN) as the prime example. Microvascular decompression (MVD) is often cited as the procedure of choice for treatment of medically refractory TGN. Arguments against these assumptions are: MRA studies indicate that vascular contact with the trigeminal nerve is present in most healthy individuals. Treatment results of MVD in multiple sclerosis patients with TGN are almost as good (at least in the short term) as in idiopathic cases. MVD is reported to provide pain relief even in TGN patients without visible neurovascular contact. In other syndromes of cranial nerve ‘hyperactive dysfunction’ – vertigo, tinnitus and neurogenic hypertension – the documentation is even weaker.

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Introduction

The theory behind microvascular decompression (MVD) surgery for medically refractory trigeminal neuralgia (TGN) is seductive and intuitively plausible:

As we grow older, our arteries elongate, and might form contact with the trigeminal nerve. The pulsating mechanical irritation induces focal demyelinating lesions close to the root entry zone (REZ), causing ephaptic transmission with cross-talk between individual nerve fibres, explaining how minor sensory stimulation causes shooting pain, the ‘tic doloreaux’. Surgical removal of the neurovascular compression, by transposition of soft tissue between the vessel and the nerve, can thus bring the nerve function back to normal, and cure the patient. Neurovascular contact (NVC) between the nerve and some vessel can be found in a large majority of TGN patients, and their pain improves or disappears after surgery in over 90% of cases. So, what is the problem?

Neurovascular compression

As a start, let us examine the concept of neurovascular compression. NVC is a slightly broader term, and can be visualized by diagnostic imaging (MR). Such contact to the trigeminal nerve can be demonstrated in the great majority of healthy persons (1). NVC can be found in most patients with atypical facial pain (2). In a blinded study NVC was almost as frequently found on the asymptomatic side in TG patients (3). Even a study claiming excellent sensitivity and specificity of MR angiography (MRA) in the diagnosis of NVC showed NVC on the asymptomatic side in 17/92 patients (4). No blinded trial has demonstrated any convincing discriminatory value of MRA, 3D-MRA or CISS sequences in the selection of patients for MVD in TGN. The initial series of Janetta and coworkers, performed prior to modern MRI technology, describe treatment results which are equivalent or even superior to later series (5). NVC or even ‘compression’ can be observed during surgery, of course. As this kind of

surgery is never performed on asymptomatic individuals, we do not know whether this is a part of the normal anatomy in ageing subjects. Biopsy studies have shown focal demyelination in cases of TGN treated by MVD, but not as a consistent finding in all cases, an observation which rightly or wrongly is ascribed to sampling error (6).

Some data can be found in the plethora of neurosurgical literature regarding other and even more speculative MVDs, of the IX, Xth and VIII cranial nerve: NVC, which can be demonstrated by MRA or inspection during surgery, is common in these nerves and is not correlated with any specific clinical syndrome. Neurovascular compression of the eighth nerve is described to cause tinnitus, hearing loss, very brief 'vestibular paroxysmia' or more long-lasting 'disabling positional vertigo', in all possible combinations (7–9). NVC is thus neither a necessary nor a sufficient condition for any of these cranial nerve symptoms, and the same, dubious factor (neurovascular compression) is stated as a cause for a plethora of unspecific symptoms.

The strongest candidate for a disease that is caused by NVC is hemifacial spasm. Even for this condition MRI/MRA fails to demonstrate NVC in some patients, and demonstrates NVC in healthy subjects and at the asymptomatic side of patients in almost half of the cases (10).

In the small minority of TGN patients where no NVC can be demonstrated, the clinical features, age, concomitant medical problems, etc. are indistinguishable from patient with presumed neurovascular compression as etiology (11, 12). In many patients, the observed (and treated) neurovascular conflict consists of venous 'compression' only. These patients do not differ from artery NVC regarding clinical features, and treatment results are only marginally inferior (13). Evidently, pulsating forces are not necessary for causing painful compression of the nerve.

Neurovascular compression as the etiology for TGN (in the majority of patients) is an unproven and (in my opinion) even unlikely concept.

Trigeminal neuralgia in multiple sclerosis

The second objection to MVD as the treatment of choice in TGN comes from observations in multiple sclerosis (MS) patients. The lifetime prevalence of TGN in MS patients is 1%–2%, or ten times the risk of non-MS patients. The pathogenesis is almost certainly demyelinating plaques in the CNS part of the trigeminal root or its central connections. Still, MVD has been performed frequently in these patients. Visual identification of

NVC is made in most cases, as can be expected based on the MRA studies (1–3). The results of this surgery in MS patients are inferior to idiopathic TGN, but rather the disturbing fact here is that it works at all! The frequency of immediate pain relief after MVD in MS patients is close to idiopathic TGN (14, 15), although a greater recurrence rate is seen. The single autopsy report on an MS patient treated with MVD for TGN (16) describes no clear signs of compression neuropathy in the nerve.

Experience from MVD in MS is a strong argument against the vascular compression theory for TGN. Presumably, some other, non-specific mechanism might explain the moderate but a significant effect of treatment.

Mechanism of effect for MVD: not radically different from partial rhizotomy?

Nobody can deny that MVD works, although we might disagree on why it works. Minimal surgical manipulation of the trigeminal root, with application of the teflon sponge, has been reported to provide pain relief even in cases with no NVC (12, 17). Revuelta-Guiterrez et al. (12) reported MVD ('the sponge') to be equally effective in 21 TGN patients without NVC as in patients with such contact.

The third objection against this procedure is the lack of solid evidence for a superior effect compared with other less invasive procedures. No randomized, controlled trials (RCTs) of MVD vs glycerol or radiofrequency rhizotomy, stereotactic radiosurgery or other treatments have been published. The almost universal acceptance of open brain surgery as the treatment of choice in a condition with other, less risky options available, without such RCTs is remarkable. The general impression has been created, with no solid evidence RCTs, that MVD leaves less local sensory side effects in the form of bothersome dysethesias, and also less relapses of pain in the long run.

Although this might be correct, at least for the dysesthesia part, the magnitude of difference is unknown. MVD is clearly not a harmless procedure. While a reported surgical mortality of 0.3% and a risk of disabling brainstem infarction/hemorrhage of 1%–2% (18) appears good compared with other open brain surgery the complication rate is unacceptable if other less risky treatments provide equal pain relief.

Neither will treatment with percutaneous techniques preclude later MVD: as Slettebø and Eide have demonstrated (11), MVD provides equally good pain relief in patients with prior glycerol or

RF treatment as in patients with no previous surgical treatment. It is not necessary to choose MVD as the first choice surgical treatment in order to avoid refractoriness.

Alternative mechanisms for trigeminal neuralgia – the HSV hypothesis

I wonder whether the embracement of the neurovascular compression concept in TGN in part can be explained by the paucity of alternative theories for idiopathic TGN. Improved understanding of HSV infections has given birth to an attractive hypothesis. Dormant HSV genomes reside in Gasseris ganglion indefinitely, and have a strong tendency to be reactivated by practically all kinds of manipulation of the trigeminal nerve (19). *In vitro* studies indicate that non-translated RNA transcripts from HSV accumulate in senescent neurons (20), and might influence ion channel expressions, creating ephaptic transmission or other hypersensitivity of the nerve. Reactivation of HSV might ‘flush out’ this accumulated waste and explain the persistence of freedom from pain even after the short lived neuropraxia has subsided (20, 21). The advantage of this hypothesis is partly that it can explain why TGN is a disease primarily of the lower divisions of the nerve; the lower divisions of the trigeminal nerve are more heavily infected by HSV-1 as they innervate the oropharynx.

No matter what the mechanism effect will turn out to be, the vast literature on MVD in TGN indicates that permanent or long-lasting pain relief can be obtained without major loss of facial sensibility.

MVD in other cranial nerve hyperactive dysfunctions

In clinical neurology, the growing popularity of MVD in other cranial nerve syndromes is more disturbing. After all, MVD is undoubtedly an effective treatment for TGN, and when performed by surgeons of high competence, the complication rate is low. Treatment of vertigo and tinnitus by MVD is still performed despite the absence of specific, or even suggestive clinical or physiological findings indicating a neurovascular compression as the cause of the patients’ symptoms. No significant difference between rates of NVC in patients and asymptomatic controls has been found. In published MVD series, vestibular migraine, the most common cause of episodic vertigo next to BPPV, is not even mentioned as a possible differential diagnosis (7, 8). The selection of patients for MVD as a treatment for tinnitus is reported depend on ‘the probability that their tinnitus was

a result of vascular compression of the auditory nerve’ (9). This probability can evidently be calculated as all the 72 patients reported showed ‘significant vascular compression of the auditory portion of the eighth nerve’.

The implementation into clinical routine of an expensive and potentially lethal therapy based on uncontrolled studies is not warranted. A high rate of patient satisfaction after such experimental therapy is clearly not sufficient: Most dinner guests will praise the food, especially if it is the hostess who is asking .

MVD for hypertension is an even more dubious concept; as in the other ‘neurovascular syndromes’ no difference in NCV between patients and controls has been demonstrated (22). The published treatment results are not suggestive of a specific disorder of ‘neurogenic hypertension’ (23).

MVD for the many syndromes of ‘cranial nerve hyperactive dysfunction’ should still be regarded as a treatment with unknown mechanism of action, for clinical syndromes of unknown etiology.

References

1. KRESS B, SCHINDLER M, RASCHE D, HAHNEL S, TRONNIER V, SORTOR K. Trigeminal neuralgia: Wie häufig gibt es gefallenenervnenkontakt bei schmerzfreien probanden? Fortschr Röntgenstr 2006;**178**:313–5 .
2. LANG E, NARAGHI R, TANRIKULU L, et al. Neurovascular relationship at the trigeminal root entry zone in persistent idiopathic facial pain: findings from MRI 3D visualization. J Neurol Neurosurg Psychiatry 2005;**76**:1506–9.
3. ANDERSON VC, BERRYHILL PC, SANDQUIST MA, CIAVERELLA DP, NESBIT GM, BURCHIEL KJ. High resolution three-dimensional magnetic resonance angiography and three-dimensional spoiled gradient-recalled imaging in the evaluation of neurovascular compression in patients with trigeminal neuralgia: a double blind pilot study. Neurosurgery 2006;**58**:666–73.
4. PATEL NK, AQUILINA K, CLARKE Y, RENOWNDEN SA, COAKHAM B. How accurate is magnetic resonance angiography in predicting neurovascular compression in patients with trigeminal neuralgia? A prospective, single-blinded comparative study. Br J Neurosurg 2003;**17**:60–4.
5. BARKER FG II, JANNETTA PJ, BISSONETTE DJ, LARKINS MV, JHO HD. The long-term outcome of microvascular decompression for trigeminal neuralgia. N Engl J Med 1996;**334**:1077–83.
6. LOVE S, COAKHAM HB. Trigeminal neuralgia: pathology and pathogenesis. Brain 2001;**123**:2347–60.
7. JANNETTA PJ, MØLLER MB, MØLLER AR. Disabling positional vertigo. N Engl J Med 1984;**310**:1700–5.
8. BRACKMANN DE, KESSER BW, DAY JD. Microvascular decompression of the vestibulocochlear nerve for disabling positional vertigo: the House Ear Clinic experience. Otol Neurotol 2001;**22**:882–7.
9. MØLLER MB, MØLLER AR, JANNETTA PJ, DONG JHO H. Vascular decompression surgery for severe tinnitus: selection criteria and results. Laryngoscope 1993;**103**:421–7.

10. HO SL, CHENG PW, WONG WC, et al. A case-controlled MRI/MRA study of neurovascular contact in hemifacial spasm. *Neurology* 1999;**53**:2132–9.
11. SLETTEBØ H, EIDE PK. A prospective study of microvascular decompression for trigeminal neuralgia. *Acta Neurochir* 1997;**139**:421–5.
12. REVUELTA-GUTIERREZ R, LOPEZ-GONZALES MA, SOTO-HERNANDEZ JL. Surgical treatment of trigeminal neuralgia without vascular compression: 20 years of experience. *Surg Neurol* 2006;**66**:32–6.
13. LI ST, PAN Q, LIU N, SHEN F, LIU Z, GUAN Y. Trigeminal neuralgia: what are the important factors for good operative outcomes with microvascular decompression. *Surg Neurol* 2004;**62**:400–4.
14. BROGGI G, FERROLI P, FRANZINI A, SERVELLO D, DONES I. Microvascular decompression for trigeminal neuralgia. *J Neurol Neurosurg Psychiatry* 2000;**68**:59–64.
15. BROGGI G, FERROLI P, FRANZINI A, et al. Operative findings and outcomes of microvascular decompression for trigeminal neuralgia in 35 patients affected by multiple sclerosis. *Neurosurgery* 2004;**55**:830–8.
16. CROOKS DA, MILES JB. Trigeminal neuralgia due to vascular compression in multiple sclerosis – post mortem findings. *Br J Neurosurg* 1996;**10**:85–8.
17. BAECHLI H, GRATZL O. Microvascular decompression in trigeminal neuralgia with no vascular compression. *Eur Surg Res* 2007;**39**:51–7.
18. KALKANIS SN, ESKANDAR EN, CARTER FG. Microvascular decompression surgery in the United States, 1996 to 2000: mortality rates, morbidity rates, and the effects of hospital and surgeon volumes. *Neurosurgery* 2003;**52**:1251–61.
19. PAZIN GJ, HO M, JANNETTA PJ. Reactivation of herpes simplex virus after decompression of the trigeminal nerve root. *J Infect Dis* 1978;**138**:405–9.
20. DECKER AD, SMITH JE. Are latent, immediate-early genes of herpes simplex virus-1 essential in causing trigeminal neuralgia? *Med Hypotheses* 2002;**59**:603–6.
21. TENSER RB. Trigeminal neuralgia. Mechanisms of treatment. *Neurology* 1998;**51**:17–9.
22. THUERL C, RUMP LC, OTTO M., et al. Neurovascular contact of the brain stem in hypertensive and normotensive subjects: MR findings and clinical significance. *Am J Neuroradiol* 2001;**22**:476–80.
23. FRANK H, SCHOBEL HP, HEUSSER K, GEIGER H, FAHLBUSCH R, NARAGHI R. Long term results after microvascular decompression in essential hypertension. *Stroke* 2001;**32**:2950–5.