Vascular Decompression in Trigeminal Neuralgia

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Abstract
Trigeminal neuralgia (TN) is a sudden, severe, brief, stabbing and recurrent pain within one or more branches of the trigeminal nerve. Although multiple mechanisms involving peripheral pathologies at root (compression or traction), dysfunctions of brain stem, basal ganglion and cortical pain modulatory mechanisms could have role, neurovascular conflict (NVC) is most accepted theory. Patients with significant medical comorbidities, without NVC and multiple sclerosis are generally recommended to undergo gamma knife radiosurgery, percutaneous balloon compression, and glycerol rhizotomy and radiofrequency thermocoagulation procedures. Microvascular decompression (MVD) is surgical treatment of choice in TN resistant to medical management. There may be multiple NVC and entire course of root from pons to ganglion should be decompressed. Nerve combing or partial sensory root sectioning can be combined with MVD when no vascular conflict is detected intraoperative. Successful outcome after MVD in typical TN is 90-95% and 75% at 1 and 5 years respectively. Immediate postoperative pain relief, shorter preoperative duration, older age, and typical features are good predictors of favorable outcome. Type 2 TN, presence of autonomic symptoms; multiple sclerosis is associated with poor prognosis. Compression or contact on the root by the prosthesis should be avoided to prevent recurrence. Endoscopic technique can be used alone for vascular decompression or as an adjuvant to microscope. It allows better visualization of vascular conflict including ventral aspect. Effectiveness and completeness of decompression can be assessed and new vascular conflicts that may be missed by microscope can be identified. It requires less brain retraction.

ABBREVIATIONS
GKRS: Gamma Knife Radiosurgery; GR: Glycerol Rhizotomy; MS: Multiple Sclerosis; MVD: Microvascular Decompression; NVC: Neurovascular Conflict; PBC: Percutaneous Balloon Compression; PSRS: Partial Sensory Root Sectioning; REZ: Root Entry Zone; RFTC: Radiofrequency Thermocoagulation; TN: Trigeminal Neuralgia; TR N: Trigeminal Nerve

INTRODUCTION
Trigeminal neuralgia (TN) is defined as sudden, severe, brief, stabbing and recurrent pain within the distribution of one or more branches of the trigeminal nerve (TR N). Microvascular decompression (MVD) may be considered over other techniques to provide the longest duration of pain freedom [1]. Vascular compression is indicated both in type 1 trigeminal neuralgia (TN) with intermittent pain [2] and in type 2 (constant pain), [3] with vascular compression. Although MVD is also effective in multiple sclerosis (MS) [4], ectatic vessel with neuralgia, [5] and after stereotactic radiosurgery, [6] cure rate is higher in type 1 TN with arterial compression compared to neuralgia with venous compression or no neurovascular conflict (NVC) [7]. Although less invasive procedure may be preferable in elderly patients, as complications do tend to increase gradually with an advanced age, MVD is recommended in younger patients and in physiologically healthy elderly population [8,9].

Surgical procedure of microvascular decompression
Presurgical virtual endoscopy [10] and 3D computer graphics models can provide excellent visualization of NVC and allows simulation [11]. The Dextroscope system can also create a stereoscopic neurovascular model to shorten the learning curve and real-time intraoperative findings were comparable [12]. Laterally placed craniotomy helps to visualize the whole nerve root along with root entry zone (REZ). Prominent suprameatal tubercle should be drilled out for better exposure of trigeminal nerve and vascular conflicts [13]. Dissection of the cerebellar horizontal fissure (transhorizontal approach) and rostral retraction of the superior semilunar lobule allows easy identification of the root entry zone. Supracerellar route permit identification and dissection of the offending supraclerellar artery. Whole surface of the trigeminal nerve can be observed...
easily by combining these two transhorizontal fissure and supracerebellar approaches [14]. Preservation of the vestibular nerve arachnoid minimizes complications especially hearing loss [15]. Dissection in MVD is not significantly difficult after gamma knife radiosurgery (GKRS) [15]. All vessels in relation to the nerve up to meckel’s cave should be decompressed [16,17]. There may be multiple vessels related to the root. Sacrifice of a small intraneural vein can be performed while partial sensory root sectioning (PSRS) is preferred over extensive mobilization of large vein [18]. Wrapping techniques should be preferred to decompress intraneural artery [18].

Autologous muscle graft, [19] oxidized regenerrated cellulose, [20] and fibrin glue alone [21] can be used to transpose vessel away from the nerve. Transposition of the offending vessel with Teflon wool or slings, especially in tortuous NVC, is useful [22,23]. Aneurysm clip with or without unabsorbable dural sling can be used [24,25]. Combing [26] or PSRS can be combined with MVD when no vascular conflict is detected [27]. Adhesion between the trigeminal root and surrounding structures, secondary to fibrin glue or prosthesis, can stretch nerve, which can cause recurrence [28]. Prosthesis if used should be lying in subarachnoid space or cistern avoiding contact to root [29]. Arachnoid membrane of CPA can be used as a sling to transpose the superior cerebellar artery [30]. Muscle pieces interposition between the dura mater, use of artificial dura mater, cranioplasty, sealing of mastoid sinus by bone wax and muscle can be effective technique for the prevention of CSF leak [31,32]. Re surgery is also equally effective and safe after failed MVD [33]. The preservation of the petrosal vein and its tributaries, lateral inversion vein of fourth ventricle is important in preventing the postoperative vestibular and cerebellar disorders [34].

RESULTS OF MVD

Successful outcome after MVD in typical TN is about 90-95% and 75% at 1 and 5 years respectively [35,36,37,38]. MVD is significantly superior to GKRS [39]. Trigeminal nerve combing improves pain relief in patients without vascular compression [26]. 3D models by fusing CTA and FIESTA can be used to evaluate the translational and rotational shift of the compressive artery, and decompressed distance from the root after failed MVD [40]. Immediate postoperative pain relief is a good predictor of better long-term outcome [41]. Type 2 TN, [42] presence of autonomic symptoms, [43] MS [44] are associated with poor prognosis. Shorter preoperative duration before surgery, older age, and typical features are good predictors of favorable outcome [45]. Subset of patients progressed from Type 1 to Type 2 TN over time also have good outcome resembling Type 1 TN [46]. Low FA values can be reversed after successful MVD [47].

Complications of MVD

The trigemino-cardiac reflex due to stimulation of the trigeminal nerve during MVD may result in about 50% fall in heart rate and mean arterial blood pressure. Cessation of manipulation leads to normalization of these parameters [46]. Facial nerve dysfunction, hearing abnormality and trigeminal nerve dysfunction may be observed especially after more dissection and mobilization of respective nerve.

Recurrents, ranging from 18% to 34%, may be seen at long-term follow up [48,49]. It is more common within two years of surgery and thereafter at a rate of 2-3.5% per year [48]. Significant predictors of recurrence are younger age, and symptoms lasting longer than 10 years [49]. Recompression due to regrowth of new vein and artery [50] can cause TN. Hardened Teflon can pierce nerve and produce recurrence, [51] therefore the contact of prosthesis, if used, with nerve should be avoided. Outcome can be improved by establishing center dealing TN [52].

Endoscopic vascular decompression

Endoscopic techniques are increasingly being used in spine, [53-55] and cranial pathologies [56-62]. Endoscopic technique can be used alone [63,64] or as an adjuvant to microscope [65-67]. It is a minimally invasive technique [67,68], allows better visualization of entire root from pons to ganglion [63,68,69] including ventral aspect [69]. Effectiveness and completeness of decompression can be better assessed [63,69]. New nerve-vessel conflicts can be identified which may be missed by microscope in 7.5% to 33% patients [70-73]. It is safe, [64,74,75] requires less brain retraction [63,70,76-78] and associated with improved pain relief with lower complications as compared to MVD [79].

CONCLUSION

Medical treatment with drugs should be tried in trigeminal neuralgia. With an availability of increasing number of drugs it is likely that surgical option may not be offered for many years. Microscopic or endoscopic vascular decompression is recommended because of non-destructive nature especially when NVC is present in young adults or healthy elderly. Gamma Knife Radiosurgery, Radiofrequency thermoablation, Glycerol Rhizotomy, and Percutaneous balloon compression can be used in elderly patients with medical co morbidity and without NVC.

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