A Novel Technical Refinement of Microvascular Decompression: Pain Relief and Complication Rate in a Consecutive Series of Patients With Trigeminal Neuralgia

Francesco Tomasello, MD*
Antonino Germanò, MD*
Angelo Lavano, MD‡
Alberto Romano, MD§
Daniele Cafarella, MD§
Nicola Gorgoglione, MD*
Domenico La Torre, PhD, MD‡

*AOU Policlinico "G. Martino," Università degli Studi di Messina, Messina, Italy; ‡AOU "Mater Domini," Università degli Studi "Magna Greacia" di Catanzaro, Catanzaro, Italy; §Casa di Cura "Villa Salus" di Siracusa, Melilli, Italy

Correspondence:
Domenico La Torre, PhD, MD,
AOU "Mater Domini,"
Università degli Studi "Magna Greacia" di Catanzaro,
Viale Europa, 1,
88100 Catanzaro, Italy.
Email: dlatorre@unicz.it

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BACKGROUND: Microvascular decompression (MVD) represents a milestone for the treatment of trigeminal neuralgia (TN). Nevertheless, several complications still occur and may negatively affect the outcome. We recently proposed some technical nuances for complication avoidance related to MVD.

OBJECTIVE: To verify the efficacy of the proposed refinement of the standard MVD technique in terms of resolution of the pain and reduction of complication rates.

METHODS: We analyzed surgical and outcome data of patients with TN using a novel surgical refinement to MVD, over the last 4 yr. Outcome variables included pain relief, facial numbness, muscular atrophy, local cutaneous occipital and temporal pain or numbness, cerebellar injury, hearing loss, cranial nerve deficits, wound infection, and cerebrospinal fluid (CSF) leak. Overall complication rate was defined as the occurrence of any of the aforementioned items.

RESULTS: A total of 72 consecutive patients were enrolled in the study. Pain relief was achieved in 91.6% and 88.8% of patients at 1- and 4-yr follow-up, respectively. No patient reported postoperative facial numbness during the entire follow-up period. The incidence of CSF leak was 1.4%. One patient developed a complete hearing loss and another a minor cerebellar ischemia. There was no mortality. The overall complication rate was 5.6%, but only 1.4% of patients experienced permanent *sequelae*.

CONCLUSION: The proposed refinement of the standard MVD technique has proved effective in maintaining excellent results in terms of pain relief while minimizing the overall complication rate associated with this surgical approach.

KEY WORDS: Complications, Functional outcome, Hockey stick-shaped incision, Microvascular decompression, Minimally invasive surgery, Retrosigmoid approach, Trigeminal neuralgia

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Since the microvascular decompression (MVD) was popularized by Jannetta in 1967,[1,2] the surgical technique has evolved and some "technical nuances" have been proposed with the aim both to improve the functional results and to reduce postoperative complications.[3-5] However, despite the improvement in functional short- and long-term outcome, the procedure is to some extent burdened by a series of morbidities ranging from 5% to 23% according to different series reported in literature.[6-11] Moreover, little is still known about the so-called minor complications of MVD, such as skin dysesthesia, suboccipital local pain, and muscular atrophy.[5,12-14] Since MVD for trigeminal neuralgia (TN) is a functional neurosurgical procedure, it is mandatory to strive for the achievement not only of good results in terms of functional outcome, but also in terms of the lowest complication rate. With this purpose, we recently proposed a refinement of the MVD

ABBREVIATIONS: BNI, Barrow Neurological Institute; **CPA,** cerebellopontine angle; **CSF,** cerebrospinal fluid; **GAN,** greater auricular nerve; **GON,** great occipital nerve; **LON,** lower occipital nerve; **MRI,** magnetic resonance imaging; **MVD,** microvascular decompression; **PH,** postoperative headache; **SPV,** superior petrosal vein; **TN,** trigeminal neuralgia

TABLE 1. Demographics and Clinical Characteristics		
Mean age (yr)	**58.25 (range 26-81)**	
Sex	Male	30 (41.7%)
	Female	42 (58.3%)
Side	Right	37 (51.4%)
	Left	35 (48.6%)
V-branches	V1	/
	V2	17 (23.6%)
	V3	13 (18.1%)
	V1-V2	9 (12.5%)
	V2-V3	26 (36.1%)
	V1-V2-V3	7 (9.7%)
Follow-up (mo)		31.21 (range 10-48)

technique providing, *inter alia*, a retromastoid skin incision with a hockey stick shape, designed to preserve the main nerves that cross that region, a small craniectomy (17-20 mm in diameter), a microsurgical phase performed without the use of retractors, and a multilayer dural reconstruction.[5]

The present paper is designed to verify if, using the refinement of the technique proposed in our previous study, it is possible to achieve a further reduction of complication rates, maintaining similar results in terms of resolution of the pain. For this purpose, we here report the functional outcome and complication rate of 72 consecutive patients who underwent MVD using the refinement of the technique proposed in our previous paper.[5]

METHODS

Study Design and Setting

In this study, we collected data from patients presenting medically refractory TN over the past 4 yr, operated consecutively with a refinement of the standard MVD technique. All patients included in the present study signed an informed consent for the scientific use of their data according to the requirements of the local Institutional Review Board.

Participants and Study Size

Table 1 summarizes the demographic and clinical characteristics of the patients. The eligibility criteria included age of $\geq$18 yr, and patients affected by TN with neurovascular compression documented preoperatively with high-resolution brain magnetic resonance imaging (MRI) and intraoperatively confirmed. Patients who had atypical TN and/or who underwent previous interventions or procedures for the same disease were excluded from the analysis. A total of 72 patients with TN were included in this study. The process of patients' selection and management is reported in the diagram chart (Figure 1).

Data Sources and Variables

Clinical, radiological, treatment, and follow-up data were obtained by outpatient clinical evaluation at defined time intervals and collected in a dedicated digital archive. An initial clinical evaluation was obtained at time of discharge, and patients were then reviewed in our outpatient clinic at 1, 6, 12, and 48 mo after surgery. All patients performed a preoperative high-resolution brain MRI, including constructive interference in steady-state and time-of-flight sequence to confirm the clinical diagnosis before undergoing the refined MVD, as previously reported.[5] Data from the first 15 patients included in the study and operated on by the same technique have been extrapolated from our previous series, and, therefore, data related to these patients are retrospective. Differently, data from the other consecutive 57 patients have been prospectively included in the digital archive.

Surgical Technique

Details of the surgical technique are reported in our previous paper.[5] Briefly, the patient is placed in lateral position with the hips and knees placed in flexion, and the head turned 45° contralaterally with slight extension preserving venous drainage. A novel hockey stick-shaped retromastoid skin incision is designed, considering specific anatomic landmarks, to preserve the main nerves that cross that region (Figure 2). In detail, the superior and inferior aspects of the incision were performed, respectively, slightly above to the superior nuchal line and 2 cm superiorly to the mastoid tip, with the aim to preserve the greater auricular nerve (GAN). Moreover, to avoid injuries of lower occipital nerve (LON) the most medial aspect of the incision was made approximately 7 cm lateral to the external occipital protuberance. Finally, the great occipital nerve (GON) is quite far from the incision. A musculocutaneous miniflap was performed through a smooth muscle dissection. In this step, we recommend never to use monopolar cautery, in order to avoid muscular atrophy, and to use a self-retaining retractor with blunt tips, to reduce the risk of nerve injuries. Next, a small craniectomy (average 18 mm in diameter) with a single burr hole and rongeurs was performed. The superior aspect of the craniectomy faces the transverse sigmoid junction. Opening the mastoid cells should be avoided to minimize the risk of cerebrospinal fluid (CSF) fistula or infection. If, unintentionally, the mastoid air cells are opened, they must be meticulously closed with bone wax. Then, the dura mater is opened in a curvilinear fashion and reflected toward the sigmoid sinus. This is the best opening to maximize the cerebellopontine angle (CPA) exposure and facilitate a watertight closure. The microsurgical steps of the operation were similar, with other surgical descriptions already reported. A lumbar drain is never necessary. Indeed, by means of a microincision of the arachnoid, a progressive and optimal CSF release is achieved, allowing the cerebellum to fall away inferiorly and posteriorly from the petrotentorial corridor. In such a way, it is possible to obtain inferolateral cerebellar retraction and maximal visualization of the rostral portion of the CPA cistern. Cerebellar retractors are not used avoiding any traction of the seventh to eighth cranial nerve complex and, if possible, any opening of the arachnoid covering of these nerves. During the procedure, the cerebellum is gently retracted only using the suction cannula. Next, regularly, we do not divide the superior petrosal vein (SPV) unless in the case of unexpected bleeding. At this point, the trigeminal nerve is exposed, and a complete arachnoidal dissection is done. Moreover, we generally use a rigid endoscope with a 0- or 30-degree lens (Karl Storz, Tuttlingen, Germany) to visualize possible distal compression, and preoperative MRI volumetric measurement of the CPA showed that the average volume of the CPA cistern on the affected side was significantly smaller than the unaffected side. Finally, we interpose autologous muscle to resolve neurovascular conflicts. At the end of the microsurgical step, CPA is gently irrigated with Ringer solution to restore the CSF, and the seventh to eighth cranial nerve complex with papaverine. Concerning the closure step, we believe that the dural curvilinear opening reduces the rate of postoperative CSF leak. Moreover, we routinely use 2 or 3 layers of collagen sponges (DuraGen;

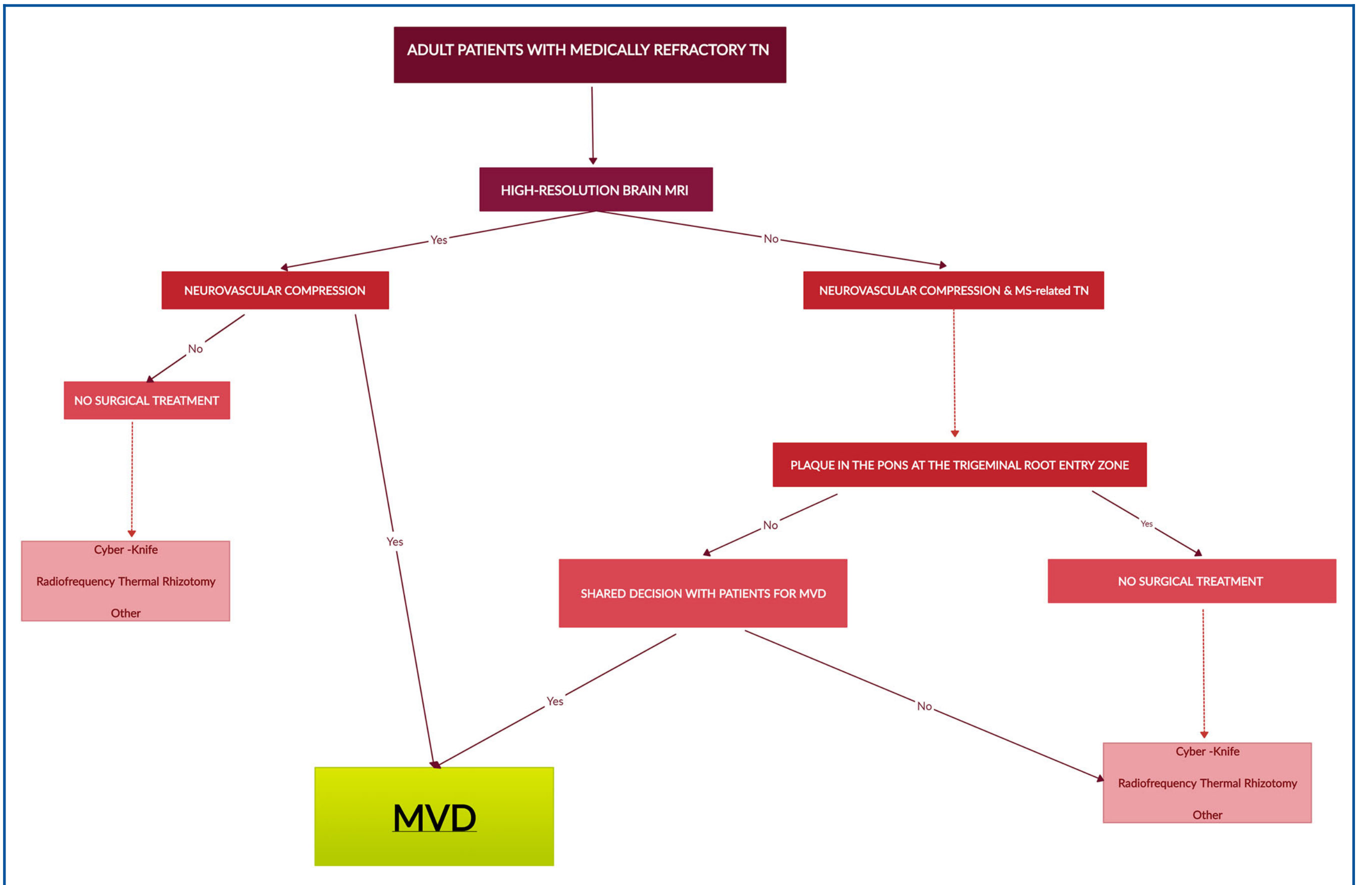


FIGURE 1. *Patients' selection and management flowchart.*

Integra LifeSciences, Plainsboro, New Jersey) covered with fibrin glue. In this manner, the small fascial-muscle-cutaneous flap had no contact with dura, preventing any kind of pain. Muscles and skin are closed with interrupted resorbable stitches, avoiding entrapment of the cutaneous nerve.

Outcome Analysis and Quantitative Variables

We analyzed functional, clinical, radiological, treatment, and follow-up data of 72 patients included in the study. The variables considered to verify the efficacy of the proposed refinement on functional outcome and complication rate in TN patients included the following: pain relief and facial numbness in the short and long periods, muscular atrophy, local cutaneous occipital and temporal pain or numbness or any discomfort related to sensory disturbances in these areas, cerebellar injury, hearing loss, cranial nerve deficits, wound infection, and CSF leak. Functional outcomes and complications rate were assessed immediately after surgery and by outpatient clinic evaluations at defined time intervals. To avoid inconsistent interpretation, we evaluated functional results according to Barrow Neurological Institute (BNI) pain intensity score and BNI facial numbness scale (Figure 3A and 3B).

As is obvious, the ideal outcome in patients with debilitating TN pain should be a postoperative BNI pain score of I (no pain, off medications), but a good outcome is also generally considered with a postoperative BNI pain scores of I to III, because patients experience a return to normal

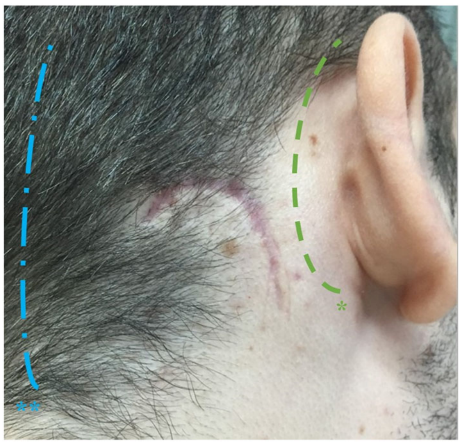
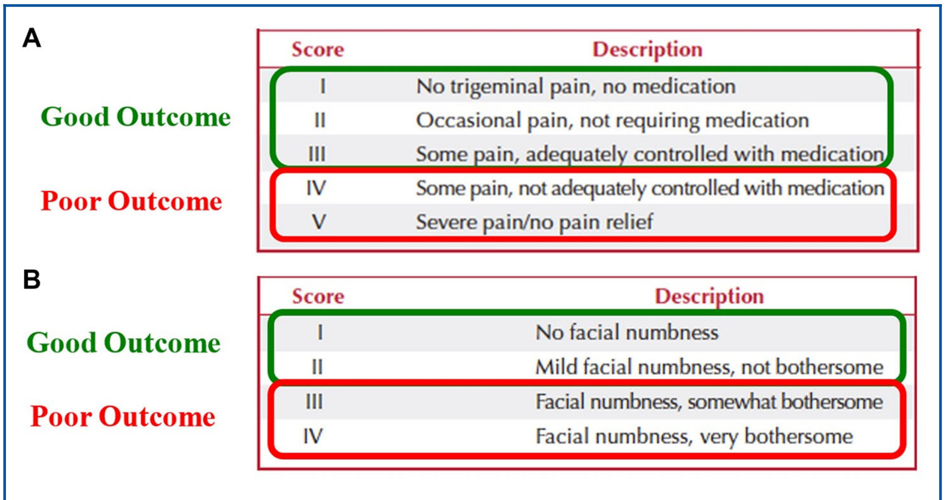


FIGURE 2. *The hockey stick-shaped skin incision. *greater auricular nerve (GAN). **Lesser occipital nerve (LON).*



A

	Score	Description
Good Outcome	I	No trigeminal pain, no medication
	II	Occasional pain, not requiring medication
	III	Some pain, adequately controlled with medication
Poor Outcome	IV	Some pain, not adequately controlled with medication
	V	Severe pain/no pain relief

B

	Score	Description
Good Outcome	I	No facial numbness
	II	Mild facial numbness, not bothersome
Poor Outcome	III	Facial numbness, somewhat bothersome
	IV	Facial numbness, very bothersome

FIGURE 3. **A**, *Barrow Neurological Institute pain intensity score.* **B**, *Barrow Neurological Institute facial numbness scale.*

function. Therefore, the categories of pain relief evaluated included good outcome (BNI pain score I-III) and poor outcome (BNI pain score IV-V). Pre- and postoperative pain measurements were obtained. All patients undergoing MVD for the treatment of TN have an initial pain score of V. Pain intensity was based on qualitative patient self-assessment and on the patient's drug consumption.

Facial numbness is categorized as good outcome (BNI facial numbness scale I-II) and poor outcome (BNI facial numbness scale III-IV). Facial numbness was assessed according to the patient's subjective discomfort.

The overall complication rate was defined as the occurrence of any of the aforementioned items.

TABLE 2. Intensity of Postoperative Pain

	No. of pts	
BNI score	Immediately postop	At last follow-up
1	69 (95.8%)	64 (88.8%)
2	/	/
3	3 (4.2%)	
4	/	8 (11.2%)
5	/	/

RESULTS

Participants and Descriptive Data

A total of 72 consecutive patients with TN were included in the present study. There were 42 females and 30 males, with a mean age of 58.25 yr (range 26-81 yr). A total of 35 patients (48.6%) had a left TN and 37 patients (51.4%) had right side symptoms. Regarding the branches of fifth cranial nerve, V2 was involved in 17 cases (23.6%) and V3 in 13 cases (18.1%). Nine patients (12.5%) presented symptoms in both V1 and V2, 26 patients (36.1%) manifested symptoms in V2 and V3, while in 7 cases (9.7%), all three branches were involved. The mean follow-up was 31.21 mo (range 10-48 mo). Demographic and clinical characteristics, including age, sex, side, fifth cranial nerve branches involved, and mean follow-up are reported in Table 1.

No patients were lost to follow-up.

Main Results

In terms of pain relief, a good outcome (BNI pain score I-III) was achieved in all patients, in 66 patients (91.6%), and 64 (88.8%) patients, in immediately postop, at 1-yr follow-up, and at last follow-up, respectively. At the last follow-up, 8 patients (11.2%) presented a BNI pain score of 4, resulting in a poor outcome. Among these, 4 patients were affected by multiple sclerosis and referred a recurrence of pain at 7 d, 10 d, 12 mo, and 15 mo, respectively. No one referred a BNI pain score of V. Concerning BNI facial numbness scale, 3 out of 72 patients (4.2%) referred persistency of "facial numbness without bothersome" (grade II on BNI facial numbness scale), and 69 out of 72 (95.8%) were grade I. This means a good outcome for all patients, and this rate remained stable during the entire follow-up period.

Results of the functional outcome are reported in Tables 2 and 3.

Only 1 patient (1.4%) presented a postoperative CSF leak, solved with surgical revision of dural closure. One patient developed complete hearing loss, while another patient suffered of a temporary mild VIII cranial nerve dysfunction. A minor cerebellar ischemia, resulting in postoperative ataxia completely recovered at 1 mo, was recorded in one patient. However, this patient was an 81-yr-old patient with several preoperative risk factors including diabetes, hypertension, and dyslipidemia and a diffuse cerebrovascular disease documented with preoperative

TABLE 3. Facial Numbness

	No. of pts	
BNI score	Immediately postop	At last follow-up
1	69 (95.8%)	69 (95.8%)
2	3 (4.2%)	3 (4.2%)
3	/	/
4	/	/

TABLE 4. Overall Complications Rate

Complications	No. of pts (%)
Complications with neurological sequelae	1 (1.4%)
Hearing loss	1 (1.4%)
Death	/
Cerebellar injury	/
CSF leakage	/
Facial paresis	/
Complications without neurological sequelae	3 (4.2%)
Minor cerebellar ischemia	1 (1.4%)
Mild temporary VIII cranial nerve dysfunction	1 (1.4%)
CSF leakage	1 (1.4%)
Facial numbness (BNI score III-IV)	/[a]
Hydrocephalus	/
Muscular atrophy	/
Local cutaneous occipital and temporal pain and/or sensory disturbances	/
Wound infection	/
Overall rate	4 (5.6%)

[a]Three patients had facial numbness BNI grade score II.

cerebral MRI. No patient complained of dysesthesia in the GON, LON, and GAN territories. No muscular atrophy and wound infection were observed.

The overall complication rate was 5.6%. However, as reported in Table 4, only 1.4% of patients experienced permanent neurological complication (ie, hearing loss). All the other complications were nondisabling and resolved over time.

DISCUSSION

Key Results

In the present paper, we report surgical complications and functional outcome in a series of 72 consecutive patients affected by TN operated on using a refinement of the standard MVD technique already proposed.[5] By means of this minimally invasive approach to MVD, we demonstrated that it is possible to reduce the rate of main complications, including cranial nerves impairment, cerebella damage, CSF leakage, and cerebellar injury, but also the "so-called" minor ones such as postoperative pain, sensory disturbance at the lateral occipital, temporal area and the auricular region, cervicogenic headache, and muscular atrophy.

TABLE 5. MVD: Short-Term Success Rate and Long-Term Outcome

Authors	No of cases	Good outcome
Bederson and Wilson[6]	252 pts followed up at 5 yr	75% 5 yr
Barker et al[8]	1155 pts 1005 pts followed up at 10 yr	82% postop 75% 1 yr 64% 10 yr
Broggi et al[7]	148 pts 141 pts followed up at 5 yr	85% postop 74% 5 yr
Tronnier et al[10]	225 pts	76.4% 2 yr 65% 10 yr 63% 20 yr
Sindou et al[11]	362 pts	91% 1 yr 73.38% 15 yr
Bond et al[9]	119 pts	91% postop 81% 1 yr
Present study	72 consecutive pts	100% postop 92% 1 yr 89% 4 yr

Interpretation

Although several modalities for the treatment of TN have evolved, including medical therapy, stereotactic radiosurgery, glycerol rhizotomy, radiofrequency thermal rhizotomy, and balloon microcompression, MVD still remains the gold standard of treatment for this painful condition.[3,5,8] We recently proposed a refinement of the MVD technique for complication avoidance.[5]

The present study aimed to verify the efficacy of the proposed refinement of the standard MVD technique in terms of resolution of the pain and reduction of complication rates.

Functional Outcome: Short- and Long-Term Pain Relief

In the literature, there are several series reporting data on the short-term success rate and long-term outcome of MVD.[6-11,15] These findings are summarized in Table 5. In the present series, good outcome (BNI pain score I-III) was obtained in all patients in the immediate postoperative, and in 91.6% and 88.8% at 1-yr and last follow-up, respectively. Although it is not easy to compare the results, because of the different assessment of surgical outcomes and the different periods of follow-up, our findings are quite consistent with those of other series, both in the short and long term. Analyzing the most relevant published series, we found that immediate pain relief following MVD for TN is obtained in a percentage ranging between 82% and 90%.[6-11,15] Moreover, although with lower percentages, good results are also reported over a longer period of follow-up, with pain resolution rates ranging from 64% to 76%.[6-11,15] In the largest published series, Baker and Jannetta[8] reported excellent outcome in 69.6% of 1204 patients, 10 yr after MVD. Sindou et al[11] in their paper reported a successful outcome after MVD (defined as complete pain relief, and no medications) in 91% of 362 patients at 1 yr and, according to Kaplan-Meier analyses, the probability of total cure at 15 yr was estimated in 73.38%. In other series that used

Kaplan-Meier analyses, estimated pain-free patients were 63% at 10.9 yr, 84% at 5 yr, 84.7% at 3.2 yr, and 75% at 5.1 yr.[6,7,10,16]

Mortality and Major Complications With Neurological Sequelae

On the basis of the literature review, some of the criticisms about MVD are based on presumed high mortality and morbidity.[7] However, in the literature, mortality rate after MVD is very rare, ranging from 0% to 0.8%. In our series there was no mortality. Nevertheless, MVD is still burdened by a complications rate that should be further reduced in a functional procedure. The incidence of postoperative complications varies significantly among the major published series.[6-11,15,17] Table 6 summarizes these results. In our study, we recorded one postoperative hearing loss (1.4%). A mild VIII cranial nerve dysfunction occurred in another patient, but completely recovered at the early follow-up. Concerning facial numbness, we noted a mild not bothersome facial numbness (grade II on BNI facial numbness scale) in 3 out of 72 patients (4.2%). One patient developed a postoperative CSF leak, solved with a simple surgical revision of dural closure.

McLaughlin and Jannetta[4] in their large series of more than 4400 MVD reported the occurrence of cerebellar injury in 21 cases (0.87%), hearing loss in 48 (1.98%), and CSF leakage in 59 cases (2.44%). Kalkanis et al[17] analyzed results of 1326 patients who underwent MVD for TN. They reported a mortality rate of 0.3%. The overall complication rate was 5.1%, including hematomas in 0.5%, facial palsies in 0.6%, 0.7% postoperative ventilation, and trigeminal nerve section in 3.4% of patients.

A key point of our refined procedure is the absolute respect of the SPV and its tributaries, especially their 3 main afferents: mesencephalic, cerebellar, and pontine veins.[5] Recently, Dumout and Sindou[18] reported the importance to spare SPV and its tributaries during MVD to avoid potentially severe complications. They reported that the sacrifice of SPV complex or even of only one branch may lead to complications in 1.6% of patients.[18] Recently, Narayan et al[19] provided a concise review of the complications after SPV obliteration suggesting that SVP obliteration may be associated with negligible complications. However, some series showing an up to 30% complication rate from SPV sacrifice. Therefore, SPV preservation should be attempted to optimize patient outcome. In no case we sacrificed SPV and/or its branches and consequently, we had no related complications.

Minor Complication

Over the past few years, improvements of the standard technique decreased MVD mortality and morbidity rate. Nevertheless, some minor complications, including postoperative pain, sensory disturbance at the lateral occipital, temporal area and the auricular region, cervicogenic headache, and muscular atrophy, are still common postoperative MVD complications and may negatively affect the outcome of the patients.[5,12,14,20,21] In our series, no patients experienced sensory disturbance and/or cervicogenic headache, and/or muscular atrophy. The reported

TABLE 6. MVD: Mortality and Complication Rates

Authors	Patients	F. N.	F. P.	VIII c.n.d.	Cer. Inj.	CSF-L	Mortality	Other
Bederson and Wilson[6]	252 pts (166 MVD + 86 (PSR)	3%	5%	5%	0.40% (252 MVD + PSR)	2% (252 MVD + PSR)	0%	
Barker et al[8]	1336 pts MVD	2%	0.008%	1.2%	0.44%	2%	0.1%	
Broggi et al[7]	250 pts MVD	6%	1.2%	7%	0.4%	4.8%	0%	
Tronnier et al[10]	225 pts MVD	12.5%	N. R.	8%	0.8%	0.8%	0.8% (cer. inj.)	
Kalkanis et al[17]	1326 pts MVD	N. R.	0.6%	N. R.	0.5%;	N. R.	0.3%	0.4 H-V; 3.4% TNS
Sindou et al[11]	362 pts MVD	3.04%	0.83%	1.9%	0.71%	N. R.	0.44% (cer. inj.)	
Bond et al[9]	119 pts MVD	N. R.	N. R.	N. R.	0.8%	0.8%	N. R.	
Present study	72 pts MVD	4.2%	0%	2.8%[a]	1.4% (without permanent deficit)	1.4%	0%	

VIII c.n.d., VIII cranial nerve dysfunction; Cer. Inj., cerebellar injury; CSF-L, cerebrospinal fluid leakage; H-V, hydrocephalus requiring ventriculostomy; F. N., facial numbness; F. P., facial paresis; MVD, microvascular decompression; N. R., not reported; PSR, partial rhizotomy; TNS, trigeminal nerve section.

[a]One mild temporary VIII cranial nerve dysfunction.

incidence of postoperative pain and sensory disturbance in the occipital area after MVD is widely variable, ranging between 7% and 50%.[12,22] Direct injury of the nerves in the occipital area during the skin incision or during the retraction of soft tissues has been reported as the leading cause of postoperative pain and sensory disturbance.[5,12,20-26] Another potential underlying mechanisms responsible of postoperative headache (PH) after suboccipital craniectomy include adherence of suboccipital musculature to the dura with subsequent traction during neck motion and postoperative neck spasms.[22] For these reasons, several authors recommend performing a craniotomy instead of a craniectomy followed by cranioplasty with different solutions including calvarial bone grafts, methyl methacrylate, or titanium mesh-acrylic to prevent PH.[22] However, recent clinical studies that have addressed this problem have not documented any reduction in the incidence of PH in these patients.[23] Moreover, cranioplasty material seems to increase local tissue reaction, potentially resulting to a higher incidence of PH.[22,23] The proposed refinement lowered the incidence of PH compared to that reported in the literature, despite that we did not perform a replacement of a bone flap or a cranioplasty. Indeed, using a "hockey stick" retrosigmoid skin incision, we can spare the musculocutaneous nerves of the occipital region. Moreover, using several tricks and refinements of our minimally invasive approach to MVD, we demonstrated that it is possible to avoid the discomfort related to pain and sensory disturbances in the occipital area due to adhesion of the muscular flap to dura, and/or the negative effects of postoperative scarring and muscle fibrosis.[5]

In order to lower the rate of such complications, over the years, various skin incisions and scalp flaps have been proposed.[3,12,14,27] Among these, linear and its variations (such as "lazy S-shaped" and "C-shaped") incisions are the most commonly employed. The linear incision requires dissection of the sternocleidomastoid muscle and often leads to an increased postoperative discomfort and long-term suboccipital headaches due to scarring and muscle fibrosis.[3,5,12,27] Moreover, the occipital artery and occipital nerves (neurovascular bundle) can be easily injured with this incision technique, increasing the risk of postoperative painful neuroma formation.[3,5,12,27] McLaughlin et al[4] in their series of 4400 patients operated on MVD by means of a straight incision and reported that most of them experienced PH and pain at the site of incision. Also, the "C-shaped" incisions (in the lower part) may interfere with the neurovascular bundle, increasing the risk of postoperative pain and sensory disturbance.[27] In 2 different studies, in which the "C-shaped" incision was used, PH was reported in 4% and 7.5%, respectively.[22,28] In 2018 Chibbaro et al[12] proposed a modified C-shaped skin incision, reporting no retroauricular pain in a series of 40 patients who underwent to retrosigmoid approach for vestibular schwannoma. Recently, Cohen-Gadol et al[3] proposed a modified reverse "U" incision, previously described by Walter Dandy. Using this kind of incision, the authors reported, in a series of 100 patients who underwent MVD for TN and hemifacial spasm, only 1 patient experiencing PH.[3] However, this kind of incision is quite close to the LON and/or mastoid branches of the GAN,[5,12] and therefore has the potential risk of damaging the neurovascular bundle.

Finally, some attempts to protect the LON and reduce the incidence of postoperative pain were made by means of direct identification of the main trunk of the LON.[13,21,22] Findings of these studies indicate that it is not always possible to identify the LON. Moreover, this step of procedure is time consuming, and even when the LON is identified, its preservation is not guaranteed because it could be damaged during myofascial dissection or closure by the stitches.

Limitations

This is a single-center observational study and along with the relatively small patient population carries the inevitable selection biases typically associated with such study designs. These biases may limit the inferences that we can draw from the results presented herein. However, our study represents our best effort to cope with STrengthening the Reporting of OBservational studies in Epidemiology guidelines. Moreover, even if we recognize the limitations that may reduce the generalizability of our findings, we believe that the present study provides useful information concerning the possibility to minimize complication rates while maintaining similar results in terms of functional outcomes in patients with TN.

CONCLUSION

MVD is functional neurosurgery, and therefore any effort should be made to prevent postoperative morbidity. The hockey stick-shaped skin incision, based on easily recognized anatomic landmarks, allows to spare the main nerves that cross that region and to reduce the incidence of postoperative discomfort or unnecessary pain. The proposed refinement to standard MVD techniques was demonstrated to guarantee an optimal exposure of the CPA and minimize the overall rate of complications related to this surgical approach, and therefore can improve the quality of life of our patients with TN.

Disclosures

The authors have no personal, financial, or institutional interest in any of the drugs, materials, or devices described in this article.

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