CLINICAL ARTICLE

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The Efficacy of Microvascular Decompression in Hemifacial Spasm over the Course of Time

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Objective : Microvascular decompression(MVD) at root exit zone(REZ) of the facial nerve has been largely popularized and it has become the standard treatment for patients with hemifacial spasm(HFS). This sturdy is performed to evaluate the efficacy of MVD over the course of time

Methods : From 1994 to 2003, 50 patients with HFS who underwent MVD were followed up for more than 6 months. We retrospectively analyzed results with medical records and telephone researches.

Results : The mean age of patients at the time operation was 57.6 years and 84% of the patients were female. The mean duration of follow-up after operation was 3.4 years (range 0.5~7.8 years). One day after MVD, 54% of patients had complete relief of spasm immediately. Continuous improvements of HFS were observed during the follow-up period and these improvements were statistically significant with time ($P<0.05$). Until 6 months after operation, complete relief of spasm was observed in 84% of patients. The delayed relief of spasm was observed in 35.7% of our patients who experienced complete relief.

Conclusion : The efficacy of MVD in HFS is improves with time. Continuous follow-up evaluations for the duration of more than at least 6 months after MVD are important for the decision of its clinical results because delayed relief of spasms occurs.

KEY WORDS : Hemifacial spasm · Microvascular decompression · Delayed relief.

Introduction

Hemifacial spasm(HFS) is a movement disorder characterized by painless unilateral paroxysmal involuntary tonic clonic spasms occurring in the muscles innervated by the facial nerve. HFS is a severe disability with social and esthetic impact on a patient's life. The spasms usually begin in the orbicularis oculi muscle and gradually spread to the other muscles of facial expression. The spasms are triggered or made worse by psychological stress, fatigue, or voluntary movement of facial muscles and can occur in sleeping.

In the surgical treatment of HFS, vascular compression of the facial nerve in patients with HFS was first described by Campbell and Keedy[4] in 1947. Gardner and Sava[8] first published the operative finding of hemifacial spasm and proposed decompression of the facial nerve for hemifacial spasm in 1962. Since Jannetta[16,17] organized this theory that HFS is caused by a vascular compression of the facial nerve at the root exit zone(REZ) and suggested that microvascular decompression (MVD) is the most effective treatment of patients with HFS in the 1970s, MVD has been largely popularized and it has become the standard treatment for patients with HFS.

The authors analyzed 50 patients of operated in our hospital to evaluate the efficacy of MVD over the course of time. We retrospectively analyzed the preoperative symptoms, operative findings, clinical results, and postoperative complications after MVD in patients with HFS.

Materials and Methods

Patients

Of patients who underwent MVD for HFS in our hospital from 1994 to 2003, 50 patients who were operated on by a surgeon were followed for more than 6 months and were entered

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Table 1. Demographic datas

Sex (Male/Female)	8 / 42 (1:5.25)
Age at operation (years)	28-77 (mean 57.6)
Duration of symptom (years)	1-40 (mean 7.7)
Laterality (Right/Left/Bilateral)	21 / 27 / 2
Clinical sign & symptoms (Number)	-
Facial spasm, only	23
Facial weakness	16
Facial impairment	7

into our study. Patients with symptomatic HFS due to tumor, aneurysm, or arteriovascular malformation were excluded.

Preoperative evaluations

Diagnosis of HFS was performed through preoperative evaluations such as specific symptoms, neurological examinations, electromyography, and radiological findings. All patients underwent preoperative magnetic resonance imaging(MRI) and angiography(MRA) to rule out other disease and demonstrate the relationship between the REZ of the facial nerve and vascular structure. We could confirm the vascular compression of facial nerve in 54% (27cases) out of 50 patients. Forty three patients underwent preoperative electromyography and the abnormal muscle response(AMR) was confirmed in 38 patients (62.7%). The AMR was recorded at the mentalis muscle during stimulation of zygomatic branch of the facial nerve. On preoperative audiometry, hearing impairment was showed in 7 patients (17.1%).

Operative techniques

All operations were performed by the senior author (D.G.K.). The patient's head were placed in the lateral decubitus position and was fixed with a three-pin head holder. The patient's neck was slightly flexed and the head was slightly rotated away from the lesion side, and declined toward floor about 15 degrees. After a skin incision on the retroauricle and retromastoid, retromastoidal craniectomy of a triangular shape was performed. The dura was then opened and cerebrospinal fluid(CSF) was drained sufficiently until the brain became slack. The REZ of the facial nerve was approached by careful retraction of cerebellum under the microscopy. After confirmation of the offending vessel and REZ of the facial nerve, decompression of the facial nerve was obtained by dissection and transposition of offending vessel from the facial nerve using shredded Teflon felts.

Analysis of results

We retrospectively analyzed results with medical records and telephone researches. An assessment of operative results was divided into three grades[3,20]. Complete relief of HFS after MVD was graded as "excellent", improvement more than 75% in intensity and frequency of spasm was graded as "partial", and others was graded as "failure". The results with "excellent" and "partial" grades were considered a successful operation.

The relief of HFS over the course of time after MVD was assessed by Kaplan-Meier curve and it was statistically analyzed by the Mann-Whitney test. $P<0.05$ was considered statistically significant.

Table 2. Distribution of offending vessels at the root exit zone

Offending vessel	No.(%)
PICA*	31(62%)
AICA**	14(28%)
VA***	1(2%)
PICA + VA	1(2%)
AICA +VA	1(2%)
Vein	2(4%)
Total	50(100%)

PICA* : Posterior inferior cerebellar artery, AICA** : Anterior inferior cerebellar artery, VA*** : Vertebral artery

Results

Clinical characteristics

Patient's ages at the time of operation varied from 22 to 77 years. Their mean age at the time operation was 57.6 years and 84% (42 cases) of the patients were female. The mean age of onset of symptom was 50 years and 62% (31 cases) of the patients were between the ages of 40 and 59 years when HFS occurred. The mean duration of symptoms before operation was 7.7 years (range 1~40 years). The affected side of symptom was left in 27 patients, right in 21 patients, and both in 2 patients. In the case of the two patients with bilateral HFS, the more severe side of symptoms was operated on. Preoperative ipsilateral facial weakness and hearing impairment were observed in 32% and 14% of patients respectively (Table 1).

Operative findings

The common offending vessels were the posterior inferior cerebellar artery(PICA) (62%) and anterior inferior cerebellar artery(AICA) (28%). Other vessels were the vertebral artery in one patient, multiple arteries in 2 patients, and unnominated vein in 2 patients (Table 2).

Follow-up results

All patients were followed for more than 6 months after operation and the mean follow-up duration was 3.4 years (range 0.5~7.8 years). One day after operation, 54% of patients had excellent results, 26% had results of partial relief, and 20% of had results of failure. At 1 weak after operation, 64% of patients had excellent results, 18% had results of partial relief, and 18% had results of failure. At 6 months after operation, excellent results were observed in 84% of patients, partial in

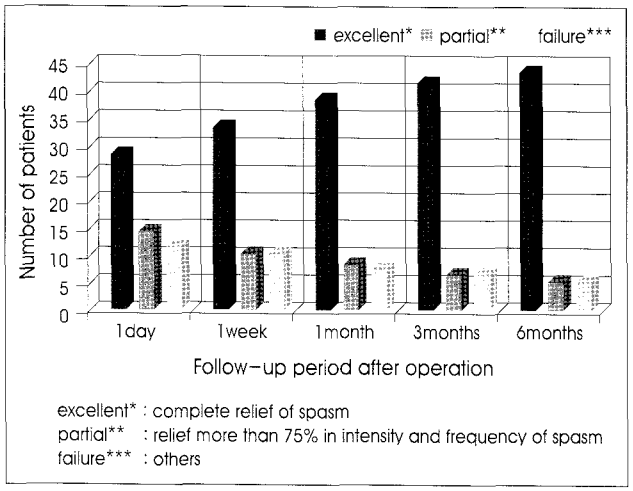

Fig. 1. Clinical results during the follow-up period.

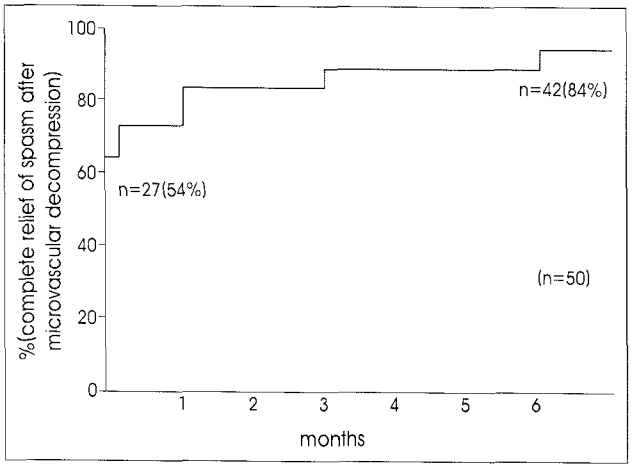

Fig. 2. The Kaplan-Meier curve of complete relief cases of hemifacial spasm after microvascular decompression in 50 cases. In these 50 cases, complete relief of spasm is observed 42 cases and delayed complete relief of spasm is observed in 15 cases.

Table 3. Postoperative complications

Transient complications	No.(%)	Permanent complications	No.(%)
Facial weakness	8(16%)	Facial weakness	1(2%)
Dizziness	6(12%)	Hearing impairment	1(2%)
Lower cranial nerve palsy	3(6%)	-	-
Hearing impairment	2(4%)	-	-
CSF* leakage	2(4%)	-	-
Total	21(42%)	-	2(4%)

CSF* : Cerebrospinal fluid

8%, and failure in 8% (Fig. 1). Continuous improvements of results were observed during follow-up period and these gradual clinical improvements were statistically significant with time ($P<0.05$). The cases with excellent and partial result were considered the successful case of operation. The rate of success of operation was 92%. Among 42 patients with excellent result at time of the last evaluation, 15 (35.7%) patients had delayed complete relief of spasms during follow-up period (Fig. 2). In these patients, the duration of complete resolution was 2~7 days in 5 patients, 8~30 days in 5 patients, 31~90 days in 3 patients, and 91~180 days in 2 patients. The mean duration of resolution was 32.7 days (range 4~150 days). In 30 patients who were followed up to 2 years, there were no change of results compared with the results at 6 months after operation.

Complications

There was no operative mortality in this study. Postoperative complications occurred in 23 patients, but most of the cases were transient complications and they completely recovered during the follow-up period. There were two patients with permanent complications, facial weakness and hearing impairment respectively (Table 3).

The most common postoperative complication was transient facial weakness. Transient facial weakness occurred in 8 patients. Among 8 patients, delayed facial weakness occurred in 6 patients. The delayed facial weakness occurred 1~2 weeks after the operation and was completely recovered 2~4 weeks after the onset of symptoms. There were two patients with postoperative CSF leakage. The CSF leakage of one patient was spontaneously resolved, but the other continued after lumbar drainage. 3 weeks after MVD, continuous CSF leakage was controlled via revision and repair of the dura. Permanent complications occurred in two patients, facial weakness was observed in one patient and hearing impairment in one patient.

Discussion

HFS is an uncommon disorder characterized by unilateral involuntary paroxysmal tonic clonic spasms occurring in the muscles innervated by the facial nerve. Although painless, HFS may cause social or psychological dysfunction and difficulty of normal activity. HFS is a relatively rare disorder, the prevalence rate is approximately 0.8 cases per 100,000 per year and it occurs predominantly in women[2]. It frequently occurs in patients between the ages of fifth and sixth decades, and it is predominantly involved on the left side[6,14,39]. In our study, women aged 40 to 59 years were predominantly involved and the lesion of symptoms occurred more often on the left side corresponding with other previous reports. The rate of preoperative facial weakness in our patients (32%) was somewhat higher than the previously reported values of 10% to 26%[6,14].

Most cases of HFS patients have no abnormality on the standard imaging studies. In previous reports, the incidence of pathologic lesions on standard imaging studies is 0.8% to 1%[3,34]. The pathologic lesion of symptomatic HFS includes

arteriovascular malformation, aneurysm, brain tumor, arachnoid cyst, infartion of brain stem, and multiple sclerosis[13,25,36,38,39].

MRI and MRA are commonly used for the initial screening procedure in patients with HFS and special MRI techniques are reported that demonstrate compression of the facial nerve by vascular structures at the REZ[10,21,26,37]. In their reports, the sensitivity of MRI or MRA using special techniques of detecting the neurovascular decompression was 100% in HFS[10,21,26]. In our study, preoperative MRI and MRA were used to exclude lesions of symptomatic HFS and demonstrate the relationship between the REZ of the facial nerve and vascular structure in all patients. We could confirm the vascular compression of facial nerve in 54% (27 cases) and this result was lower than results of previous reports. We assume that the result was caused by deficiency of special magnetic resonance techniques in our hospital, such as three-dimensional short-range MRA or three-dimensional Fourier Transformation-Constructive Interference in Steady State image. Our experience tells us that these MRI techniques were very useful for the preoperative evaluation of patients with HFS but not mandatory for surgical planning. In cases with the absence of visible vascular compression of the facial nerve on MRI, we planned a surgery if these patients had typical symptoms of HFS and abnormality of preoperative EMG.

Generally, the most common offending vessel is PICA and the secondary vessel is AICA[3,16,23]. Other vessels, such as the vertebral artery, small artery or arteriole, and vein also can compress the facial nerve[3]. In our study, the PICA (62%) was identified most frequently, followed by the AICA (28%).

In medical treatment of hemifacial spasm, carbamazepine is the most popular medication, followed by clonazepam, baclofen, other benzodiazepines, anticonvulsants, and anticholinergic drugs, but none provide satisfactory or sustained improvement of the facial spasms[1,3,12,30]. We also experienced that these medications were disappointing in our patients. Treatment with botulinum A toxin for facial dyskinesiae including HFS is well known[7,40]. This technique required multiple injections in muscles and is effective for only three to four months, when it must be repeated. The procedure can give rise to complications including ptosis, exposure keratitis, diplopia, epiphora, drooling, and strabismus[18]. Excess dosage at the time of injection can result in temporary facial paralysis. The reported complication rate with this technique is 2% to 14% per treatment[18,35]. Because of these disadvantages, we believe that this procedure must be used only in the selected cases of some patients. In our study, 4 patients out of 50 patients experienced injection of the botulinum toxin before the operation, but HFS recurred in all patients.

Surgical treatment for HFS, MVD at the REZ was introduced in late 1960s and was largely popularized by Jannetta[16,17]. MVD has reported that it is the most excellent method of treatment for HFS[16,17,39], and this procedure has become the standard treatment for HFS at present.

Reported rates of complete relief from HFS following MVD vary between 60% to 93%[3,5,15,31,34] with different follow-up period. In our study, the rates of excellent results and partial results at 1 week after operation were 64% and 18%. The rate of total successful results including excellent and partial results, was 82%. However, after the 6 months of follow-up, the rates were changed in that excellent results were 84% and partial results were 8% (successful results : 92%). Among 42 patients with excellent results at time of the last evaluation, 15 (35.7%) patients had delayed complete relief of spasms during the follow-up period. In our study, continuous improvements of results after MVD in HFS were observed for at least 6 months and these gradual clinical improvements were statistically significant with time. Our results were compared with previous reports. Shin et al.[31] reported the results, in which 6 months of follow-up examinations of patients who had undergone MVD. In their study, the percentages of those with excellent clinical results improved from 61.1% after 1 weak to 74.8% after 3 months and to 82.7% by the final evaluation after 6 months of follow-up. Delayed resolution of HFS was observed in 37.4% of the patients who experienced complete resolution in their report. Goto Y et al.[9] showed that the rate of immediate complete relief after MVD was 69.6% and the rate of complete relief at 1.5 year follow-up was 91.1%. They reported the results that the delayed complete relief of spasms was observed in patients until one year after MVD. In our results, delayed complete relief of spasms was observed for at least 6 months after operation. Because delayed complete relief of spasms occurs, continuous follow-up for more than at least 6 months is important for the decision of clinical results of MVD in patients with HFS.

The immediate resolution of HFS could be the result of the disappearance of the spontaneous or ectopic excitation of the offending vessel[29]. The delayed resolution could be the result of the complete regeneration of the micro-injury of the facial nerve or the gradual stabilization of the facial motor nucleus[28].

Reported rates of recurrence of HFS after MVD vary from 1.1% to 10.3%[14,27,39]. The cause of recurrent HFS after successful MVD remained unclear. Kondo[19] reported that improperly inserted or wrong-sized prostheses were the probable causes of recurrent symptoms, because improperly positioned or sized prostheses lead to an adhesion of the nerve with the affected artery. Also, he found evidence from subsequent exploratory surgeries and discovered that more frequent adhesions occurred in prostheses made of Teflon than did in prostheses made of silicone sponges. In our study, recurrence of

spasm after MVD was not observed during the follow-up period. But our results require a longer-term follow-up to be compared with other results.

Complications of MVD, including hearing impairment, facial weakness, CSF leakage, cerebellar hematoma, cerebellar or brainstem infarction, dysfunction of low cranial nerve, wound infection, meningitis, and et al. were reported[3,14,15,23]. The common complication was damage to the seven and eight cranial nerves. In our study, the total rate of postoperative complication was 46%, but most of complications were transient and improved during the follow-up period. The rate of permanent complications was 4%, including facial weakness (2%) and hearing impairment (2%).

The use of intraoperative electromyographic monitoring for confirming complete decompression of the facial nerve and reducing the occurrence of postoperative complications has been reported[11,22,24,32,33]. During the MVD procedure it is not easy to localize the causative vessel or vessels accurately; moreover, an innocent vessel may be mistakenly considered as one of the multiple offenders. This mistake can be avoided by using intraoperative monitoring. Shin et al.[33] and Heo et al.[11] reported that immediate complete disappearance of AMR after MVD or reducing more than 50% compared with preoperative AMR were observed in 92.7% and 95.5% of their patients respectively. Moller and Jannetta[24] reported that failure to relieve the neurophysiological abnormality during surgery was associated with a relatively poor prognosis for relief of HFS. However, other reports suggest that the monitoring itself did not improve the cure rate[32,33]. We cannot suggest relief of spasm and intraoperative EMG monitoring are related because we did not use intraoperative monitoring with the cases of this study.

Conclusion

The rate of success results after MVD for patients with HFS was 92% and the rate of postoperative permanent complications was 4% in our series. Continuous improvements of results after MVD in HFS were observed for at least 6 months and these gradual clinical improvements were statistically significant with time. The delayed complete relief of spasms was observed in 35.7% of our patients.

MVD is a reliable and satisfactory method of treatment for HFS and it has a high success rate and low complication rate. But continuous follow up for more than at least 6 months after MVD is important for the decision of its clinical results because delayed complete relief occurs during this period.

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Commentary

Authors documented that MVD was an effective means to relieve HFS with 92% successful results, and surgical complications are acceptable, showing that improvement pattern was variable and continuous during 6 month follow-up. In regards to follow-up period, I think 6 month follow-up is not enough to evaluate the surgical results because review of literatures disclose that nearly all recurrances occurred within 24 months of operation[1].

Authors described simply delayed complete relief as gradual clinical improvement of spasm in 15 patients(35.7 There was complete recovery in 3 days after operation, and spasm was recurred partially, which was subsided gradually in 2 weeks in 4 cases (9.8%). There was partial recovery after operation and spasm was disappeared gradually and completely in 6 months in 7 cases (17.1%). Finally, there was partial recovery after operation and symptom was somewhat remained after 6 months later (14.5%).

Like the cause of HFS, the cause of different resolving pattern of spasm after MVD remained unclear. Therefore, further study for defining the causes will be necessary.

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