www.jkns.or.kr 10.3340/jkns.2009.45.6.336
J Korean Neurosurg Soc 45 : 336-340, 2009

Print ISSN 2005-3711 On-line ISSN 1598-7876

Clinical Article

Prognostic Factors of Hemifacial Spasm after Microvascular Decompression

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Objective : The factors that influence the prognosis of patients with hemifacial spasm (HFS) treated by microvascular decompression (MVD) have not been definitely established. We report a prospective study evaluating the prognostic factors in patients undergoing MVD for HFS.
Methods : From January 2004 to September 2006, the authors prospectively studied a series of 293 patients who underwent MVD for HFS. We prospectively analyzed a number of variables in order to evaluate the predictive value of independent variables for the prognosis of patients undergoing MVD. The patients were followed-up at regular intervals and divided into as cured and unsatisfactory groups based on symptom relief. Uni- and multivariate analyses were performed using logistic regression models.
Results : A total 273 of 293 (94.2%) patients achieved symptom relief within one year after the operation. Intraoperatively, the indentation of the root exit zone was observed in 259 (88.5%) patients. Uni- and multivariate analyses revealed that the symptoms at postoperative 3 months (p<0.001) and indentation of the root exit zone (p=0.036) were associated with good outcomes.
Conclusion : The intraoperative finding of root exit zone indentation will help physicians determine the prognosis in patients with HFS. To predict the prognosis of HFS, a regular follow-up period of at least 3 months following MVD should be required.

KEY WORDS : Hemifacial spasm · Microvascular decompression · Prognosis · Chronology.

INTRODUCTION

Hemifacial spasm (HFS) is an induced movement disorder characterized by intermittent, involuntary, irregular, unilateral, tonic or clonic contractions of muscles innervated by the ipsilateral facial nerve. In the typical syndrome, the spasm starts from the orbicularis oculi muscle and progresses downward to involve the orbicularis oris, buccinators, and/or platysma muscles[7,8]. The pioneering work of Jannetta et al.[7] provided a great contribution to our understanding of the pathophysiological mechanism of this rhizopathy and the concept of neurovascular decompression for the treatment of hemifacial spasm is now widely accepted[3,5,9,11,13,14,22].

Neurovascular compression, as a leading cause of HFS, has been reported on by many authors with considerably satisfactory postoperative results[2,12,15,20]. Although the concept of neurovascular compression and the rationale for microvascular decompression (MVD) have been sufficiently clarified, one cannot assume that patients will become spasm-free immediately after the MVD since the postoperative course can be variable. Some patients become spasm-free within several months or even years after the operation. But, some wax and wane, some go through recurrence following temporary relief and some fail to become spasm-free[4]. Therefore, it is difficult to know when surgeons should judge the post-surgical results and how long they should "wait and see" before reoperating on patients with unsatisfactory results. The comprehension of several peri-operative findings would be helpful for physicians not only to choose the optimum post-surgical treatment, but also to give patients sufficient information about the potential post-operative courses they might experience.

We report a prospective study evaluating the prognostic factors following MVD for HFS.

MATERIALS AND METHODS

A total of 293 consecutive patients who underwent MVD for HFS between January 2004 and September 2006 were

• Received : April 4, 2009 • Accepted : May 31, 2009
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included in the study. Patients who underwent re-operation were excluded. The patient population consisted of 209 women and 84 men (female/male ratio; 2.48 : 1); their ages ranged from 25 to 72 years (mean, 48.6 years) (Table 1). Postoperative follow-up review was available for 12 to 43.5 months with a median period of 26.9 months.

All of the patients underwent preoperative evaluation via computed tomography (CT), magnetic resonance imaging (MRI), and 3-dimensional time-of-flight MR angiography[21]. Both pure tone audiometry and speech audiometry were performed preoperatively by an otolaryngologist in all patients. Facial electromyograms and brainstem auditory evoked potentials[6,16,23] were recorded with surface electrodes from the orbicularis oculi muscles using Viking IV EMG equipment (Nicolet Biomedical. Instrument, Madison, WI, USA).

The postoperative outcomes were evaluated by a specialized nurse practitioner (Lee JA), who did not know the patient's intraoperative findings. Telephone interview was additionally used when patients could not make a follow-up visit. Because there is no universally approved scale system to measure the symptoms of HFS, we evaluated the patients' symptoms by using the scale of zero to ten; if zero means spasm-free state and ten stood for the worst spasm they had ever had before the surgery in terms of both frequency and intensity.

Surgical techniques and operative findings

All surgeries were performed by a single surgeon at the same institute. All of the surgical procedures were performed via a lateral retrosigmoid suboccipital approach, which has been well described in the literatures[10,17,22]. After opening the dura mater, the cerebellum was gently retracted, exposing the facial nerve that was compressed by the arteries and/or veins. Teflon felt and thread (DuPont, Wilmington, DE, USA) were inserted between the facial nerve and the offending vessels. As a result of the operative procedure, the facial nerve was freed from the offending vessel. Lumbar drainage was not required during the intra- and postoperative periods. During surgery, brain stem auditory evoked potential and facial EMG monitoring were performed from the time of administration of general anesthesia until the time of dural closure.

The vessel that compressed the facial nerve was recorded as the compressing vessel, which was identified in all cases. Various types of vascular compression were found in most of the 293 patients. The compressive vascular structures involved were the antero-inferior cerebellar artery (AICA) in 158 (53.9%) patients, the postero-inferior cerebellar artery (PICA) in 73 (24.9%) patients, the vertebral artery (VA) in 2 (0.7%) patients, the anteroposterior common cerebellar trunk in 14 (4.8%) patients, a single vein in 1 (0.3%) patient, and two or more vessels in 45 (15.3%) patients (Table 1).

Indentation of the root exit zone (REZ) of the facial nerve caused by an offending vessel was identified in order to determine the severity of vascular compression. The indentation of the REZ by compressing vessels was observed in 259 (88.4%) patients and categorized into three grades (Table 2). Because there is no universally approved grade to assess the degree of the indentation, we classified into three grades; grade 1 means no or mild indentation on the REZ and grade 3, severe indentation with discoloration. The degree of indentation reflects the severity of neurovascular compression intraoperatively. The degree of indentation was severe in 64 (21.6%) patients, moderate in 114 (39.2%) patients and mild in 115 (39.2%) patients.

Statistical analyses

First, we investigated the following clinical characteristics for

Table 1. Characteristics and operative findings of patients

Caracteristic	Cured group	Unsatisfactory group	Total	*p*-value
No. of patients (%)	276 (94.2)	17 (5.8)	293 (100)	
Age (year)	48.6 (25-72)	48.2 (25-62)	48.6 (25-72)	$p>0.05$
Sex				
Male	79 (28.6%)	5 (29.4%)	84 (28.7%)	
Female	197 (71.4%)	12 (70.6%)	209 (71.3%)	
Symptom duration (mo)	62.3 (5-300)	68.8 (11-240)	62.7 (5-300)	$p>0.05$
Side				$p>0.05$
Left	125 (45.3%)	10 (58.8%)	135 (46.1%)	
Right	151 (54.7%)	7 (41.2%)	158 (53.9%)	
Offending vessel				$p>0.05$
AICA	150 (54.3%)	8 (47.1%)	158 (53.9%)	
PICA	68 (24.6%)	5 (29.4%)	73 (24.9%)	
VA	2 (0.7%)	0	2 (0.7%)	
Vein	1 (0.4%)	0	1 (0.3%)	
AICA+PICA	13 (4.7%)	1 (5.9%)	14 (4.8%)	
AICA+VA	27 (9.8%)	3 (17.6%)	30 (10.2%)	
Other complex	15 (5.4%)	0	15 (5.1%)	

AICA : antero-inferior cerebellar artery, PICA : postero-inferior cerebellar artery, VA : vertebral artery

Table 2. Grades of indentation on the root exit zone of the facial nerve

Indentataion	Definition	Total (%)
Grade 1	No or mild indentation	64 (21.6)
Grade 2	Moderate indentation	114 (39.2)
Grade 3	Severe indentation with discoloration	115 (39.2)

all patients : age, gender, spasm side, preoperative symptomatic period, compressive pattern by offending vessel, and clinical outcome at each time of follow-up. We prospectively analyzed these variables in order to assess the predictive value of independent variables for prognosis after MVD. Uni- and multivariate analyses were performed by using logistic regression models. All data were analyzed using the SPSS program (ver. 15). The patients were divided into two groups on the basis of their clinical outcomes (cured group and unsatisfactory group), and the clinical courses of the two groups were retrospectively compared. The cured group indicated that residual spasm or only minimal twitching remained with symptom relief over 80% and unsatisfactory group that below 80%[22]. Chi-square test was used to compare the clinical courses between the cured group and unsatisfactory group.

RESULTS

A total of 276 (94.2%) patients achieved symptoms relief following MVD. The detailed distributions of the various parameters evaluated for association with prognosis are in given in Tables 2 and 3. The major postoperative complications included permanent hearing loss in 6 (1.8%), immediate facial weakness in 4 (1.4%), delayed facial weakness in 6 (2.0%), and cerebrospinal fluid leakage in 1 (0.3%). One patient with delayed facial palsy had spontaneous symptom improvement[19]. There was neither death nor ischemic insults in our series.

Prognostic factors

In the univariate analyses, the intraoperative finding of indentation and clinical good outcome at 3 months postoperative were significantly associated with better outcomes (p=0.022 and p<0.001). Contrary to our expectation, severe indentation of the REZ of the facial nerve was closely associated with better outcomes, rather than no or minimal indentation. With regular interval follow-up examination, clinical outcome at 3 months postoperative was a strong predictor of prognosis, which implied that at least 3 months of follow up evaluations are needed in order to predict the outcome following MVD for HFS. In contrast, other variables such as age, gender, spasm side, preoperative symptomatic period, compressive pattern and type of offending vessel were not associated with the prognosis (Table 3). Furthermore, multivariate analysis revealed that both factors significantly affected the clinical outcome (p<0.001 and p=0.036) (Table 4).

Clinical course based on the outcome

Of the 293 patients in our series, 276 (94.6%) were included in the cured group based on their clinical outcomes at one-year postoperative, and 17 (5.4%) were included in the unsatisfactory group. The differences in clinical improvement between the two groups were not definite during the early follow-up period (post. 3 days and post. 1 month, p= 0.826 and p=1.00). However, at 2 months postoperative, the cured group showed distinct clinical improvement in comparison

Table 3. Univariate analysis of prognostic variables (p*)

Parameter	B	S.E.	Wald	Sig.	Exp (B)
Age	-0.004	0.025	0.026	0.871	0.996
Sex	-0.038	0.549	0.005	0.944	0.962
Lesion	-0.546	0.507	1.156	0.282	0.579
Duration of symptom	0.554	0.502	1.215	0.27	1.740
Symptom at 3 months	4.082	0.677	36.327	0.000	59.267
Offending vessels	0.027	0.117	0.053	0.818	1.027
Indentation	-1.758	0.767	5.255	0.022	0.172

*Binary logistic regression. B : parameter estimate, SE : standard error, Sig. : significance, Exp(B) : odds ratio

Table 4. Multivariate analysis of prognostic variables (p*)

Parameter	B	Wald	Sig.	Exp (B)	Exp (B) 95% CI	
					Lower Bound	Upper Bound
Age	-0.202	0.088	0.767	0.817	0.215	3.101
Symptom at 3 mo	4.458	29.672	0.000	86.317	17.357	429.264
Indentation	-1.872	4.405	0.036	0.154	0.027	0.884

*Multinomial logistic regression. B : parameter estimate, Sig. : significance, Exp(B) : odds ratio

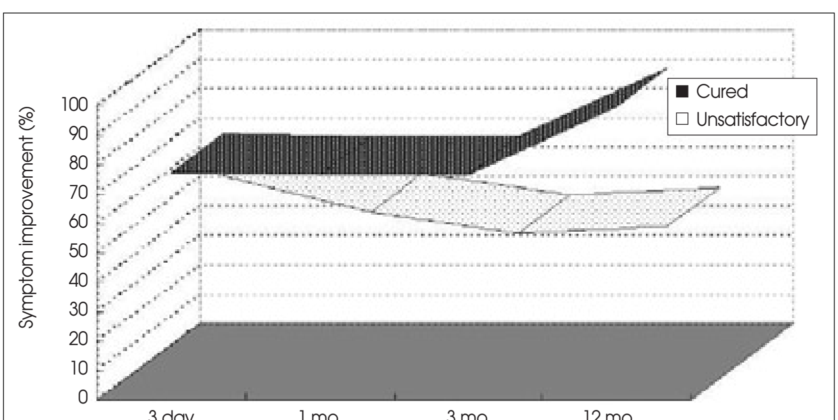

Fig. 1. The graph showing the pattern of clinical improvement in each group. Cured group, steady improvement that leads to cure after postoperative 3 months. Unsatisfactory group, symptomatic improvements are decreased (p<0.014).

with the unsatisfactory group (p=0.014). The patients in the cured group showed gradual symptom improvement over the 3-month (91.3%) after the operation, but the patients in the unsatisfactory group showed no more symptom improvement at 3 months (17.6%) postoperative (Fig. 1).

DISCUSSION

MVD is an efficacious method for treating HFS, with good outcomes in 92 to 97% of patients[2,20]. Such a high success rate of treatment makes a statistical analysis difficult because the subset of recurrences or treatment failures is very small, ranging from only 1 to 10.3%[18,20]. Despite the small number of surgical failures, the exact reasons for surgical failure remain unclear.

In our study, the severity of indentation predicted the clinical outcome. In fact, we hypothesized that severe indentation would be associated with poor outcomes after MVD. However, our results demonstrated that patients with no or mild indentation of the REZ of the facial nerve had rather poor outcomes, which suggests that the surgeon could find the optimal site for decompression on the REZ more easily. Another possibility is that patients with no or mild indentation on the REZ of the facial nerve might have secondary HFS rather than primary HFS by neurovascular compression. In particular, facial synkinesis or post-herpetic facial spasm can induce symptoms similar to those of primary HFS, and these disease entities are generally associated with disappointing surgical results. On the other hand, vascular compression may not be the only cause of spasm in all cases. Aoki and Nagao[1] reported a case of HFS in which no vascular abnormality was observed during surgery and mere manipulation and surrounding dissection of the nerve resulted in symptom resolution.

Wilkinson et al.[24] showed that facial muscle motor evoked potentials during MVD represent a novel tool for routine intraopertive monitoring of the facial nerve and can proceed uninterruptedly during surgery. In our previous study[10], we asserted surgical exploration to completely and directly identify the abnormalities, such as facial nerve indentation and nerve displacement, was more important than intraopertive monitoring during MVD.

Another important finding of this study is that some patients with residual symptoms on the third postoperative day or at the 1-month follow-up tended to show gradual improvement in their spasm throughout the follow-up period. This may be attributable to gradual resolution of the lateral spread response, as previously reported[22]. The results of the present study suggest that residual hyper-excitability might be a contributing factor to the remaining symptoms, which can be proved by long-term follow-up examination using facial EMG. However, chronologic analysis of symptomatic changes revealed that the symptom of follow-up interval 3 months postoper-ative differentiated the cured group from the unsatisfactory group (Fig. 1); this finding implied that it might be possible to predict the surgical outcome as early as 3 months after the surgery (the overall cure rate in this study was 94.2% at postoperative 12 months which is close to the cure rate at 3 months postoperative (87.2%)). This knowledge would provide patients with more reliable information concerning their residual symptoms before and after surgery. In addition, unnecessary attempts to perform a re-operation could be prevented in patients who have residual symptoms. Although the postoperative result can be predicted as early as 3 months after the surgery, the results should be analyzed after 12 or more months postoperative period. Patients who have significant residual symptoms lasting for 12 months or longer should be informed of the need for a re-operation or consider other treatment options because the possibility of cure after 12 months is very low.

CONCLUSION

Due to the diversity of the postoperative course following MVD for HFS, surgeons have had difficulty in evaluating the postoperative results of the procedure. Our results demonstrate that a postoperative follow-up interval of 3 months is the minimum duration of follow-up required in order to predict the outcome of MVD for HFS. Our results also indicate that the intraoperative finding of indentation of the REZ would help surgeons determine the optical decompression site in HFS. Although we have limited experience in MVD, this knowledge can be useful for informing patients about the postoperative course in a time-specific manner and in making decisions on the optimal post-surgical management, if needed. Additionally, the postoperative serial long-term follow up needs to verity the relationship between the grade of indentation on the REZ and the speed of symptom relief.

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