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Intraoperative Monitoring of Microvascular Decompression in Hemifacial Spasm

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The significance of intraoperative electrophysiologic monitoring during microvascular decompression was evaluated prospectively in 261 patients with the hemifacial spasm from 1985 to 1995. The patients were divided into a monitored group and a non-monitored group. Identification of the offending vessels was facilitated by the monitoring during the surgical procedure and the complication rate of the monitored group was significantly lower than that of the non-monitored group ($p<0.05$). In addition, the abnormal muscle response continued to improve during the follow-up period, thus the electrophysiological status of the hemifacial spasm after the microvascular decompression improved significantly with time ($p<0.05$). In conclusion, intraoperative monitoring is useful for identifying the exact offender among multiple vessels, and lowering the complication rate of the microvascular decompression for the hemifacial spasm.

Key Words: Hemifacial spasm, intraoperative monitoring, microvascular decompression

Intraoperative electrophysiologic monitoring during microvascular decompression (MVD) for the hemifacial spasm (HFS) is known to be useful in identifying the causative vessel or vessels, determining the adequacy of the decompression, and, in turn, preventing the postoperative complications (Matsushima *et al.* 1990; Haines and Torres, 1991; Harper, 1991; Møller, 1991; Isu *et al.* 1992). However, there have been only a few reports using this technique during the MVD, and a comparative study of the intraoperative monitoring is even rarer(Jang *et al.* 1994; Shin *et al.* 1995).

In this study, the clinical usefulness and the effectiveness of the intraoperative monitoring during the MVD were analyzed prospectively by comparing the clinical results between the monitored and non-monitored groups of patients with HFS.

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MATERIALS AND METHODS

Two hundred and sixty one patients with HFS who were treated with the MVD from 1985 to 1995 were included in this study. The subjects were divided into two groups; the monitored group (n=152) and the non-monitored group (n=109). Among the 261 patients, 226 patients were followed up for at least 6 months with a mean duration of 339 days.

The clinical results were divided into six assessment grades as shown in Table 1. Similar grading systems were used previously (Iwakuma *et al.* 1982; Jannetta, 1982; Auger *et al.* 1986; Wilkins, 1991). The excellent and good results were considered successful.

The Cadwell Excel EMG machine (Cadwell

Table 1. Grading of clinical results after microvascular decompression

Grade	Appearance of symptoms
Excellent	Complete disappearance of the hemifacial spasm
Good	One or two episodes of the minimal muscle spasms occurring per week
Fair	One or two episodes of the minimal muscle spasms occurring per day but much a improved state of the hemifacial spasm
Poor	Frequent episodes of the muscle spasms everyday with only slight improvement of the initial sytmptoms
Bad	An unchanged or an aggravated state of the hemifacial spasm
Recurrence	Reappearance of the symptoms after the initial resolution

Table 2. Characteristics of patients with hemifacial spasm

Contents	Monitored group (N=154)	Non-monitored group (N=109)
Sex(M:F)	25:127	20:89
Affected side(Rt:Lt)	80: 72	56:53
Age(yrs)*	45.6±9.36	48.1±9.38
Symptom duration(yrs)*	8.3±5.25	7.8±4.95

*:mean±SD

Table 3. Distribution of the offenders

Offenders	No. of cases(%)	
	Monitored group	Non-monitored group
AICA*	83(54.6)	50(45.8)
PICA#	25(16.5)	15(13.8)
AICA+PICA	20(13.2)	13(11.9)
AICA+VA@	9(5.9)	13
PICA+VA	9	10(9.2)
AICA+PICA+VA	4(2.6)	7(6.4)
Others	2(1.3)	1(1.0)
Total	152(100.0)	109(100.0)

*AICA: Anterior-inferior cerebellar artery
#PICA: Posterior-inferior cerebellar artery
@VA: Vertebral artery

Laboratories, Inc., Kennewick, WA, USA) was used for the intraoperative monitoring. The abnormal muscle response (AMR) was amplified with the gain of 200 to 1000 uV per division and the filter was set from 10 Hz to 10 KHz. The zygomatic branch of the facial nerve was antidromically stimulated with an intensity of 5 to 15mA and the AMR was recorded at the mentalis muscle with a monopolar needle electrode. Further detailed techniques of the intraoperative monitoring procedures have been explained in a previous study (Shin *et al.* 1995). The electrophysiological studies were done preoperatively, intraoperatively, immediate postoperatively and at least 3 months after the MVD.

For statistical analysis, the student's t-test, the chi-square test, and the Mann-Whitney test were used.

RESULTS

Clinical characteristics

The patients' mean age was 47 years and 82.8 % of them were females while 70% were in their 5th and 6th decades. There were no statistical differences in gender, affected side, age or symptom duration between the two groups (Table 2).

The anterior-inferior cerebellar artery was the most common offender, followed by the posterior-inferior cerebellar artery. There was no statistical difference of the distribution of the offenders between two groups (Table 3). However, when the offenders were divided into a single offender and multiple offenders, 71.1% were found to have a single offender in the monitored group as compared to 59.6% in the non-monitored group, which was statistically signifi-

Table 4. Distribution of the postoperative complications

Complications	No. of cases(%)	
	Monitored group	Non-monitored group
Headache or dizziness	4	13
Dysphagia or hoarseness	5	3
Infection or CSF* leakage	3	2
Facial palsy	1	3
Hearing loss or tinnitus	2	1
Multiple complications	6	4
Others	2	3
Total	23/152(15.1)	29/109(26.6)

CSF*: cerebrospinal fluid
$Z = -2.2843$, $p < 0.05$

Table 5. Follow-up clinical results

Results	No. of cases(%)	
	Monitored group	Non-monitored group
Excellent	109(82.6)	78(83.0)
Good	10(7.6)	10(10.6)
Fair	7(5.3)	3(3.2)
Poor	1(0.7)	2(2.1)
Bad	3(2.3)	0
Recur	2(1.5)	1(1.1)
Total	132(100.0)	94(100.0)

cant ($z = -1.89$, $p < 0.05$).

The complication rate in the monitored group was 15.1%, which was significantly less than that (26.6%) of the non-monitored group ($z = -2.2843$, $p < 0.05$), and most (95%) of the complications were only transient except 4 cases (Table 4).

Follow-up results

After more than 6 months of follow-up of 226 MVD cases, the success rate was 90.2% in the monitored group and 93.6% in the non-monitored group, respectively, revealing a similar long-term outcome (Table 5). Among the 68 monitored group who received follow-up electrophysiological study after more than 3 months, AMR status improved significantly with time ($p < 0.05$) (Table 6).

Table 6. Abnormal muscle response during follow-up

AMR* status	No. of cases(%)	
	Immediately after MVD#	3 months after MVD
Complete disappearance	35(51.5)	44(64.7)
Reduced to 50% or less	28(41.2)	17(25.0)
Remained above 50%	3(4.4)	4(5.9)
No change or increase	2(2.9)	3(4.4)

AMR*: abnormal muscle response
MVD#: microvascular decompression
chi-square = 14.03, $p < 0.05$

DISCUSSION

Intraoperative electrophysiological monitoring has been reported to be helpful in accurately identifying the causative vessel and lowering the complication rate during MVD (Haines and Torres, 1991; Møller, 1991) as it was proved in our study. However, other studies have also credited its usefulness in improving the cure rate and evaluating the adequacy of decompression during the procedure as well as shortening the operation time (Møller and Jannetta, 1987; Møller and Sen, 1990; Isu *et al.* 1992).

Multiple arterial involvement was significantly less in the monitored group than in the non-monitored group. During the MVD procedure it is not easy to localize the causative vessel or vessels accurately and an innocent vessel may be mistakenly considered as one of the multiple offenders. This error can be avoided by the use of intraoperative monitoring. In our studies, we believe that intraoperative monitoring made it possible to determine the exact causative vessel among the multiple vessels which grossly compressed the facial nerve (Auger *et al.* 1981; Matsushima *et al.* 1990; Haines and Torres, 1991).

The complication rate in the monitored group was significantly lower than that of the non-monitored group allowing us to conclude that intraoperative monitoring during the MVD is effective in reducing the occurrence of complicaitons after the procedure.

However, facial weakness, which was not included as one of the complications, was the most common symptom that the patients complained after MVD, and in about two thirds of them, this subjective weakness developed one week after the procedure. The delayed occurrence of the symptoms may be due to the delayed recent perception of the old symptoms which had been present even before the MVD (Frueh *et al.* 1990). In the presence of the spasm, the facial weakness might have gone unnoticed.

The rate of successful results in the two groups were similar with 90.2% and 93.6%. Although the intraoperative monitoring allows more accurate identification of the causative vessel or vessels, often, anatomical position makes it difficult, if not impossible, to completely decompress the identified offender. Moreover, the experience and the technique of the operator may be the key factor to the success of MVD.

The electrophysiological status after MVD continued to improve during the follow-up period, and this phenomenon was consistent with the other reports (Auger *et al.* 1981; Kim and Fukushima, 1984; Nielsen, 1984; MØller and Jannetta, 1987). Sood *et al.* (1993) explained that this phenomenon could be due to the demyelination and the time-consuming process of remyelination in case of HFS. The immediate disappearance of the AMR could be the result of the disappearance of the spontaneous or ectopic excitation by the pulsatile compressive force of the offending vessels (Kim and Fukushima, 1984; MØller and Jannetta, 1985; Nielsen, 1985; MØller and Jannetta, 1986; Sanders, 1989). On the other hand, the delayed disappearance could be due to the complete regeneration of the micro-injury of the facial nerve (Auger, 1979; Hopf and Lowitzsch, 1982; Kim and Fukushima, 1984; Nielsen, 1984), or to the gradual stabilization of the facial motor nucleus (Valls-Sole and Tolosa, 1989; MØller and Sen, 1990; Roth *et al.* 1990; Saito and MØller, 1993).

In conclusion, intraoperative electrophysio-logical monitoring was useful in identifying the causative vessel or vessels, and reducing the complication rate of MVD in HFS. However, the monitoirng itself did not improve the cure rate. Further study is needed to understand the electrophysiological characteristics of HFS and the electrophysiological mechanism of the continuous improvement of the AMR after MVD.

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