Electrodiagnosis and Recovery of Facial Paralysis at King Chulalongkorn Memorial Hospital

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Objective: *To study electrodiagnostic findings and recovery patterns of patients with facial nerve paralysis.*
Material and Method: *Seventy-six medical records of patients who had a facial paralysis and had their electrodiagnosis performed in a 2-year period were reviewed. Patients were invited for re-evaluation. The patients would be evaluated according to House-Brackmann Facial Nerve Grading Scale (HBFNGS), residual impairment, disability, emotional and social consequences.*
Results: *Complete data were obtained from 50 patients whose mean age was 47.0 $\pm$ 17.9 years. Seventy-two percent were diagnosed as Bell's palsy. There was significant correlation between %CMAP amplitude and HBFNGS (grade I-VI) at r = 0.5; p < 0.01. All cases of Bell's palsy with CMAP amplitude $\geq$ 70% of normal side regained full recovery. Patients with CMAP amplitude $\geq$ 30% had good recovery. Bell's palsy with CMAP amplitude < 10% and with other causes had poor outcome. Nine patients had synkinesis. Most of them were of traumatic cause and had severe nerve degeneration. No evidence showed that electrical stimulation was a factor inducing synkinesis.*
Conclusion: *Percent CMAP amplitude could moderately predict the outcome of Bell's palsy better than other causes of facial palsy. The paralysis from traumatic cause with low %CMAP amplitude had more chance to develop synkinesis.*

Keywords: *Facial paralysis, Facial nerve palsy, Electrodiagnosis, House-Brackmann Facial Nerve Grading Scale, Synkinesis, Recovery*

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Facial nerve paralysis is the most common cranial nerve disorder[1]. Most of them are Bell's palsy. Trauma and Herpes zoster oticus (Ramsey Hunt syndrome) are the second and the third most common causes. Other causes are tumor, neurological and systemic/metabolic diseases[2]. The incidence of Bell's palsy in Thailand was 39/10,000 per year[3]. Electrodiagnosis is the most valuable investigative tool for diagnosis, determining severity, predicting prognosis, and following up the outcome of treatment[4,5]. The percentage of residual compound muscle action potential (%CMAP) amplitude at 2 weeks after the onset of Bell's palsy is widely used to determine the functional outcome. If more than 10%CMAP amplitude is found, good recovery should be seen[1]. Eighty-four percent of the cases of Bell's palsy recover to normal, most of them within 3 weeks[6]. Complications such as synkinesis are related to severity and recovery rate[7].

The treatment is usually conservative which may later switch to surgery. The conservative treatment includes pharmacotherapy and rehabilitation. Prednisolone is known to prevent further denervation, enhance recovery as well as decreases synkinesis[8,9]. Rehabilitation is also known for preventing disability. Electrical stimulation (ES) is widely used for treating facial paralysis[10,11]. In animal studies, ES produced controversial outcomes; some showed inhibition of

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reinnervation and increased synkinesis[12,13], whereas others showed increased regeneration[14-16]. However, a case series in which high voltage ES was applied showed clinical improvement[17]. Nevertheless, no good clinical trial has ever confirmed the functional outcome, impairment, and disability after ES.

As is known in Thailand, there has not been any study on the correlation of electrodiagnosis and recovery of facial paralysis. Therefore, the aims of the present study were: 1) to study the electrodiagnostic findings and recovery patterns of patients with facial nerve paralysis; and, 2) to study the treatment outcomes and degrees of satisfaction of the patients who underwent rehabilitation programs.

Material and Method

Study design: Cross-sectional study

Patients' inclusion: Medical records of patients who had a facial paralysis and had their electrodiagnosis performed during January 2003 and December 2004 were reviewed. The patients who had facial paralysis due to lower motor neuron lesion and not associated with or as part of other diseases, e.g., Guillain-Barre syndrome were recruited. All patients who met the criteria were contacted by telephone and invited for re-evaluation. An interview with physical examination was carried out for each subject at the Department of Rehabilitation Medicine, King Chulalongkorn Memorial Hospital. Each case record form of the subjects included demographic data, history of illness and treatment, House-Brackmann facial nerve grading scale (HBFNGS)[18], 12-item clinical assessment of residual impairment[19], residual disability, emotional and social consequence affect[20], and patient satisfaction after treatment.

The present study was approved by the Ethics Committee of the Faculty of Medicine, Chulalongkorn University. All patients were required to give their written informed consent.

Electrodiagnostic technique

Electrodiagnostic technique was conducted according to the standard method of King Chulalongkorn Memorial Hospital[21], using electrodiagnostic instrument model Medelec Sapphire Premiere, UK. Active surface electrode was placed at a motor point of the nasalis muscle. Reference electrode was placed at the nose tip, and ground electrode at the glabella, 8 centimeters from the active electrode. Orthodromic stimulation was done. Latency was recorded at the initial positive deflection and CMAP amplitude was recorded from baseline to negative peak. The percentage of fiber remaining was calculated by dividing the CMAP amplitude of the affected side by the amplitude of the sound side, multiplied by 100.

Statistical analysis

Data were analyzed using SPSS statistic program (version 12.0, SPSS Inc., Chicago, IL, USA). Qualitative data are shown in frequency and percentage. Quantitative data are shown as mean $\pm$ standard deviation (SD). Spearman rank correlation was used for analyzing correlation between variables and recovery of facial paralysis. The p-value < 0.05 was considered significant.

Results

Percentage of fiber remaining and recovery

Seventy-six records were reviewed. Fifty patients could come for re-evaluation. They were 18 males (36%), and 32 females (64%). Their mean age was 47.0 $\pm$ 17.9 years. Thirty-six patients (72%) were diagnosed as Bell's palsy. Other causes of facial paralysis are shown in Table 1. Electrodiagnosis was done averagely on 46.3 $\pm$ 58.5 days after onset. Thirteen patients (26%) had it within 2 weeks. Twenty-seven (54%) had complete recovery (HBFNGS grade 1). Their recovery time was 93.6 $\pm$ 83.3 days. No one was HBFNGS grade 6. Of the Bell's palsy group, 25 (69%) had complete recovery with recovery time of 9 6.2 $\pm$ 86.1 days.

There were significant correlations between percentage of axonal fiber remaining (%CMAP amplitude) of the affected side and HBFNGS of all patients with r = 0.41, and of the Bell's palsy group with r = 0.50

Table 1. Causes of facial paralysis

Cause	Number of patient (%)
Bell's palsy	36 (72)
Trauma	6 (12)
Temporal bone fracture	3
Head injury	1
Parotidectomy	1
Resection of acoustic neuroma	1
Infection	7 (14)
Parotid abscess	1
Ramsay Hunt syndrome	6
Others	1 (2)
Total	50 (100)

Table 2. Frequency of the patients with different percentage of compound muscle action potentials (%CMAP) amplitude and HBFNGS in Bell's palsy and non-Bell's group

% CMAP amplitude	HBFNGS									
	Bell's palsy (n = 36)					Other causes (n = 14)				
	1	2	3	4	5	1	2	3	4	5
91-100	2	-	-	-	-	-	-	-	-	-
81-90	3	-	-	-	-	-	-	-	-	-
71-80	2	-	-	-	-	1	-	1	-	-
61-70	1	1	-	-	-	-	-	-	-	-
51-60	1	1	-	-	-	-	-	1	-	-
41-50	4	2	-	-	-	1	-	-	-	-
31-40	5	-	-	-	-	-	-	-	-	-
21-30	4	1	1	-	-	-	-	1	3	-
11-20	2	-	1	1	-	-	-	2	1	1
0-10	1	1	-	1	1	-	1	-	1	-

at $p < 0.01$. Frequency of %CMAP amplitude and HBFNGS in Bell's palsy and other causes are shown in Table 2.

Treatment and rehabilitation

Thirty-eight patients (76%) underwent a rehabilitation program. Electrical stimulation, facial muscle exercise, massage, and heat therapy were done in 26 (68%), 16 (42%), 17 (44%), and 11 (29%) patients, respectively. Four patients (10.5%) were treated with acupuncture. Twenty-nine patients (76%) marked their levels of satisfaction from "good" to "very good".

Regarding pharmacotherapy, 28 from 50 patients (56%) were treated with prednisolone; four (8%) with acyclovir; two (4%) with prednisolone and acyclovir; 32 (64%) with vitamin $B_{1\text{-}6\text{-}12}$, four (8%) with mecobalamin; and, three (6%) with herb. Nine of 12 who did not join the physical therapy were Bell's palsy and all had complete recovery in 23.1 ± 11.8 days.

Residual impairment, disability, and emotional and social consequences

According residual impairment scale, zygomatic drop and synkinesis were found in 11 (22%) and nine (18%) patients, respectively. All patients who had blepharoclonus also had synkinesis. Two-thirds of the patients had crocodile tearing and one-half of those who had tearing also had synkinesis. Difficult in rising teeth was the most common residual disability, which was found in seven (14%) patients. Eleven patients had emotional and social consequences. Residual

Table 3. Residual impairment, residual disability, emotional and social consequence (50 cases)

Residual impairment	n
Impairment	
Zygomatic drop	11
Synkinesis	9
Drooling	4
Loss of taste	4
Bell's phenomenon	3
Crocodile tear	3
Buccinator paralysis	3
Frozen nasalis	3
Tearing	2
Blepharoclonus	2
Hyperacusis	0
Abnormal blink	0
Residual disability	
Difficulties in	
Rinsing teeth	7
Drinking	6
Eating	5
Communication	3
Brushing	1
Emotional & social consequence	
Consequence affect	
No	39
Irritable	6
Isolation	5
Less productive	0
Depression	0

Table 4. Factors associated with synkinesis after facial paralysis

Factors	Synkinesis (n = 9)	No synkinesis (n = 41)
Age	46.9 ± 23.3	47.1 ± 16.9
Bell's palsy	3 (8.3%)	33 (80.5%)
Other causes of paralysis	6 (42.9%)	8 (57.1%)
%CMAP amplitude	13.8 ± 9.7 (0-28)	43.0 ± 26.8 (0-100)
HBFNGS 1	-	27
2	-	7
3	-	7
4	7	-
5	2	-
6	-	-
%CMAP amplitude < 30 & ES Rx	6/9 (66.7%)	10/15 (66.7%)

impairment, residual disability, emotional and social consequence are shown in Table 3.

Factor associated with synkinesis

Regarding synkinesis, five from nine patients (56%) were from traumatic causes. Mean%CMAP amplitude was 13.8 ± 9.7 (range 0-28) and all of them had HBFNGS grade 4-5. Among the patients who did not develop synkinesis, 33 patients (81%) were Bell's palsy; their mean%CMAP amplitude was 43.0 ± 26.8 (range 0-100) and none of them had HBFNGS > grade 3. Percentage of the patients whose%CMAP amplitude < 30 and received ES therapy were equal in both groups. Factors associated with synkinesis are shown in Table 4.

Discussion

Percentage of fiber remaining (%CMAP amplitude) of the paralyzed facial nerve

Facial paralysis is a common disease referred to the electrodiagnostic laboratory at King Chulalongkorn Memorial Hospital. Five percent of all patients in the laboratory had facial paralysis. The most common cause was Bell's palsy, which is similar to reports of recent studies[3,22]. The electrodiagnosis comparative study of %CMAP amplitude between the affected and the sound side has an important role in determining the prognosis. If the amplitude was found higher than 10%CMAP in the affected side, the patient had a good chance for functional recovery[1,23]. In the present study, as shown in Table 2, 24 of 32 (75%) patients with Bell's palsy who had more than 10%CMAP amplitude gained complete recovery (HBFNGS grade 1). All cases of Bell's palsy with more than 70%CMAP amplitude had complete recovery and with more than 30%CMAP amplitude recovered to HBFNGS grade 1-2. Fifty percent, 37%, and 25% of complete recovery were found in those who had less than 30%CMAP, 20%CMAP and 10%CMAP amplitude, respectively. This result was the same as that reported by Kim DJ[24].

As for facial paralysis from other causes, patients with less than 30%CMAP amplitude had incomplete recovery. This was different from Bell's palsy, in which one patient who had less than 5%CMAP amplitude still had full recovery. Therefore, the pathogenesis of facial palsy is an important prognostic factor as well as the amount of remaining axons.

The mean of%CMAP amplitude in the present study seemed high because of the long duration between the onset and the time of electrodiagnostic test. Some patients recovered from neurapraxia after 2 weeks. Seventy-six percent of the patients underwent rehabilitation program. More than half of the subjects had good recovery. Eight patients who had poor recovery were of traumatic causes. The mean %CMAP amplitude of this group was low (14.4 ± 10.3%).

Synkinesis

Synkinesis was associated with low %CMAP amplitude and traumatic causes. Severe degree of nerve pathology led to nerve regeneration in the wrong directions and hence progressed to synkinesis. In the present study, 56% synkinesis were found in the traumatic group and 33% of the cases were Bell's palsy. However, all of them had low %CMAP amplitude. These results were the same as the report of Maeyama H et al[25]. No evidence from the present study showed any correlation between ES and synkinesis.

The present study compares recovery and percentage of fiber remaining (%CMAP amplitude) of

the paralyzed facial nerve from Bell's palsy vs. other causes. Factors associated with synkinesis are also shown. Limitations of this study were: 1) small sample size; 2) not every patient had electrodiagnostic test within 2 weeks after the onset (but the recovery and prognosis was the same as a recent study in the West). A prospective study in a larger population should be conducted in the future.

A clinical applicability of the study is: 1) percentage of CMAP amplitude could be used for predicting recovery of facial paralysis from Bell's palsy and other causes; 2) ES is safe and could be applied for retarding muscle atrophy, prevention of fibrosis, and for facial muscle re-education especially in patients with severe paralysis.

Conclusion

Seventy percent of facial paralysis patients at King Chulalongkorn Memorial Hospital were diagnosed as Bell's palsy. The percentage of CMAP amplitude had a moderate correlation with the functional outcome as evaluated by HBFNGS. The correlation was higher in Bell's palsy cases than in other groups. Synkinesis was associated with traumatic causes and low %CMAP amplitude. ES was safe for treatment and most of the cases were satisfied with the rehabilitation program.

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ไฟฟ้าวินิจฉัยและการฟื้นตัวของผู้ป่วยโรคอัมพาตใบหน้าในโรงพยาบาลจุฬาลงกรณ์

วสุวัฒน์ กิติสมประยูรกุล, พวงเพชร ศิริเลิศธนานนท์, ดุจใจ ชัยวานิชศิริ

***วัตถุประสงค์**: ศึกษาลักษณะการตรวจพบทางไฟฟ้าวินิจฉัยของเส้นประสาท facial และการฟื้นตัวของผู้ป่วยโรคอัมพาตใบหน้า*

***วัสดุและวิธีการ**: สืบค้นผลการตรวจของผู้ป่วยอัมพาตใบหน้าที่ถูกส่งมาตรวจ ณ ห้องปฏิบัติการไฟฟ้าวินิจฉัย ฝ่ายเวชศาสตร์ฟื้นฟู โรงพยาบาลจุฬาลงกรณ์ จำนวน 76 ราย ติดตามผู้ป่วยมาตรวจประเมินซ้ำโดยตรวจ House-Brackmann Facial Nerve Grading Scale (HBFNGS), residual impairment, disability, emotional และ social consequences scale ร่วมกับหาความสัมพันธ์ระหว่างร้อยละของขนาด compounded muscle action potential (%CMAP amplitude) ที่เหลือกับการฟื้นตัว*

***ผลการศึกษา**: ผู้ป่วยที่ได้รับการตรวจประเมินซ้ำทั้งสิ้น 50 ราย อายุเฉลี่ย 47.0 $\pm$ 17.9 ปี เป็น Bell's palsy ร้อยละ 72 พบว่าร้อยละของขนาด CMAP ที่เหลือของเส้นประสาท facial มีความสัมพันธ์กับการฟื้นตัวของกล้ามเนื้อใบหน้า ค่า $r = 0.5$ ($p < 0.01$) เมื่อประเมินด้วย House-Brackmann Facial Nerve Grading Scale ผู้ป่วย Bell's palsy ที่มี CMAP amplitude $\geq$ 70% ของข้างปกติจะมีการฟื้นตัวสมบูรณ์ทุกราย ถ้าขนาด > 30% มีโอกาสฟื้นตัวดี ผู้ป่วย Bell's palsy ที่มี CMAP amplitude < 10 % ของข้างปกติและที่เกิดจากสาเหตุอื่นมีการฟื้นตัวไม่ดี ผู้ป่วย 9 ราย มี synkinesis ส่วนใหญ่เกิดจากการบาดเจ็บอย่างรุนแรง และไม่พบการกระตุ้นกล้ามเนื้อใบหน้าด้วยไฟฟ้าส่งเสริมการเกิด synkinesis*

***สรุป**: ร้อยละของขนาด CMAP ที่เหลือของผู้ป่วยอัมพาตใบหน้าจาก Bell's palsy ช่วยพยากรณ์การฟื้นตัวของกล้ามเนื้อใบหน้าได้ในระดับปานกลาง และใช้พยากรณ์ได้ดีกว่าที่เกิดจากสาเหตุอื่น ผู้ป่วยที่มีสาเหตุจากการบาดเจ็บที่มีร้อยละของขนาด CMAP น้อยมีโอกาสเกิด synkinesis ได้มาก*