ORIGINAL ARTICLE

The Use of Nerve Conduction Studies in Determining the Short Term Outcome of Bell's Palsy

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Summary

Bell's palsy is a common neurological problem causing considerable loss of self-esteem among patients. A prospective observational study was conducted to determine the short-term outcome of Bell's palsy at 1 month and 2 months after the onset and the relationship between these outcomes with facial nerve degeneration. We also determined if gender, age, diabetes, systolic and diastolic blood pressure influence the severity of facial nerve degeneration and the clinical outcome at 2 months after the onset. After clinically grading the newly diagnosed unilateral Bell's palsy patients using the House-Brackmann facial nerve grading system, nerve conduction studies of the facial nerve were done to determine the severity of facial nerve degeneration. The recovery of the facial paralysis was clinically graded again at the end of 1 month and 2 months from the onset. A total of 37 patients were recruited. There was a strong positive correlation between facial nerve degeneration and the clinical outcome of Bell's palsy at 1 month ($r=0.794$; $p<0.0005$) and 2 months ($r=0.732$; $p<0.0005$) after the onset. There was no significant correlation between either the facial nerve degeneration or the clinical outcome at 2 months with the patients' age ($p=0.288$ and $p=0.799$ respectively), systolic blood pressure ($p=0.425$ and $p=0.933$ respectively) or diastolic blood pressure ($p=0.243$ and $p=0.579$ respectively). Neither the severity of facial nerve degeneration nor the clinical outcome at 2 months were significantly different between male and female patients ($p=0.460$ and $p=0.725$ respectively) or diabetic and non-diabetic patients ($p=0.655$ and $p=0.655$ respectively).

Key Words: Bell's palsy, Short-term outcome, Facial nerve degeneration, Nerve conduction studies

Introduction

The most common form of facial paralysis is idiopathic facial paralysis, also referred to as Bell's palsy. The annual estimated incidence ranges from 15 to 40 per 100,000[1]. It can occur in any age group but is most prevalent in the third decade[2]. There is no gender or racial predilection, and both sides of the face are affected in equal proportions. The presentation is recurrent in approximately 7% of patients[3]. Despite the fact that Bell's palsy is idiopathic by definition, there has been increasing evidence of a viral aetiology, namely the herpes simplex virus I.

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It has been known that the outcome of Bell's palsy is dependent on the severity of facial nerve degeneration that is best determined between 10-14 days after the onset using nerve conduction studies (NCS)[4]. The reduction of compound motor action potential (CMAP) amplitude of the affected facial nerve compared to the normal side reflects the extent of facial nerve degeneration [5,6].

The eventual outcome of Bell's palsy is generally good[1,7,8]. However there has been limited data especially locally on the short-term outcome. We believe this is important because facial expression contributes to self-image that is crucial in our day-to-day life.

The present study was conducted to evaluate the association between the facial nerve degeneration, determined by the facial NCS, and the short term outcome of patients with Bell's palsy (i.e. at 1 month and 2 months after the onset) who were treated with standard therapy in Hospital Universiti Kebangsaan Malaysia (HUKM). It has been the hospital's clinical practice since 1998 to perform facial NCS on all patients with Bell's palsy. However, the association of the short term clinical outcome with this practice has not been fully evaluated. We also determined if age, gender, hypertension and the co-existence of diabetes mellitus influenced the severity of facial nerve degeneration and the outcome at 2 months after the onset.

Materials and Methods

This was a prospective observational study carried out by the neurology department in Hospital Universiti Kebangsaan Malaysia (HUKM) between August 2001 and February 2002. All patients with Bell's palsy who were seen within 1 week of the onset were included in this study. Patients who had a known aetiology of facial paralysis (e.g. acute or chronic middle ear disease, tumour or trauma affecting the facial nerve, Ramsay-Hunt syndrome) were excluded. Other patients who were excluded were those with bilateral facial nerve palsy, severe hypertension (blood pressure more than 200/120 mmHg), contraindication to high dose steroids i.e. severe peptic ulcer disease or glaucoma, allergy to acyclovir and first trimester pregnancy.

All patients recruited for this study had a total of 4 visits. The first visit was within 1 week of the onset of Bell's palsy where the facial paralysis was clinically graded using the House-Brackmann grading system. (Table I) They were subsequently given the standard treatment practiced in HUKM namely prednisolone 1mg/kg/day for 10 days (except diabetics), acyclovir 200mg five times a day for 5 days, facial physiotherapy and ipsilateral eye protection with an eye-pad. The second visit was between 10-14 days after the onset when facial nerve NCS were done to determine the extent of facial nerve degeneration. The third and last visits were at 1 month and 2 months after the onset respectively when the outcome of facial paralysis was clinically evaluated using the same grading system used at the first visit.

The severity of facial nerve degeneration was calculated using the following formula:

$$\text{Facial nerve degeneration} = [1-n] \times 100\% ;$$

$$n = \frac{\text{affected facial nerve CMAP amplitude}}{\text{normal facial nerve CMAP amplitude}}$$

The statistical analysis used were the Fisher exact test for nominal non-parametric variables, Spearman rho correlation for ordinal non-parametric variables and Pearson correlation for parametric variables. A p value of less than 0.05 was deemed significant.

Definitions

1. Complete clinical recovery of Bell's palsy is defined as House-Brackmann (H-B) facial nerve grading I.
2. Total facial paralysis is defined as H-B facial nerve grading VI.
3. Incomplete facial paralysis or incomplete clinical recovery is defined as H-B facial nerve grading II, III, IV and V.

Table I: House-Brackmann (H-B) Facial Nerve Grading System [9]

Grade	Characteristics
I. Normal	Normal facial function in all areas
II. Mild dysfunction	**Gross** Slight weakness noticeable on close inspection. May have very slight synkinesis. At rest, normal symmetry and tone. **Motion** Forehead: moderate-to-good function Eye: complete closure with minimal effort Mouth: slight asymmetry
III. Moderate dysfunction	**Gross** Obvious, but not disfiguring differences between the two sides. Noticeable but not severe synkinesis, contracture, or hemifacial spasm. At rest, normal symmetry and tone. **Motion** Forehead: slight-to-moderate movement Eye: complete closure with effort Mouth: slightly weak with maximum effort
IV. Moderately severe dysfunction	**Gross** Obvious weakness and/or disfiguring asymmetry. At rest, normal symmetry and tone. **Motion** Forehead: none Eye: incomplete closure Mouth: asymmetric with maximum effort
V. Severe dysfunction	**Gross** Only barely perceptible motion. At rest, asymmetry **Motion** Forehead: none Eye: incomplete closure Mouth: slight movement
VI. Total paralysis	No movement

Results

A total of 37 patients were included in this study. They consisted of 20 females (54.1%) and 17 males (45.9%). There were 20 (54.1%) Malay, 13 (35.1%) Chinese, 3 (8.1%) Indian patients and one (2.7%) Indonesian patient. The mean age was 39.2±16.7 years (with a range of 13 to 67 years). 64.9% (n=24) of them had the left facial nerve affected while 35.1% (n=13) had the right. Only one (2.7%) patient had a recurrence of Bell's palsy and only one (2.7%) patient had a positive family history of Bell's palsy. Two (5.4%) of the patients were pregnant at presentation (in the second and third trimester).

Among the 37 patients, 21.6% (n=8) had hypertension, 21.6% (n=8) had type 2 diabetes mellitus, 2.7% (n=1) had ischaemic heart disease, 2.7% (n=1) had a previous stroke and 5.4% (n=2) had chronic renal disease. The mean SBP and DBP at the first visit were 127.9 ± 19.5 mmHg and 79.4 ± 10.8 mmHg, respectively. Among patients who had hypertension, the mean SBP and DBP at the first visit were 156.0 ± 15.1 mmHg and 95 ± 5.9 mmHg, respectively.

At the first visit, 89.2% (n=33) of patients had incomplete facial paralysis and 10.8% (n=4) of the patients had total facial paralysis (two of these patients were male and above 50 years old, two of them had diabetes mellitus as well as SBP and DBP of more than 140mmHg and 90mmHg, respectively). The majority of those with incomplete facial paralysis at the first visit had H-B facial nerve grading V. The H-B facial nerve grading of patients during each visit is shown in Figure 1.

At 1 month after the onset of Bell's palsy, 32.4% (n=12) of patients had complete clinical recovery and at 2 months, 73.0% (n=27) had complete clinical recovery. All patients (n=4) with total facial paralysis at first presentation had incomplete clinical recovery at 2 months after the onset of Bell's palsy compared to 18.2% (n=6) of those with incomplete facial paralysis (p=0.003).

The percentage of patients with complete clinical recovery at 1 month and 2 months after the onset of Bell's palsy according to the H-B facial nerve grading at the first visit and facial nerve degeneration is shown in Figures 2 and 3.

Facial NCS showed that 18 patients (48.6%) had less than 50% and 27 patients (73%) had less than 75% facial nerve degeneration, respectively. Among those who had complete clinical recovery within 1 month after the onset of Bell's palsy, 91.7% (n=11) had less than 50% degeneration of the facial nerve. Among those who had complete clinical recovery within 2 months, 92.6% had less than 75% degeneration of the facial nerve.

Among patients with less than 50% degeneration of the facial nerve, 64.7% (n=11) had complete clinical recovery at 1 month after the onset of Bell's palsy compared to 5.0% (n=1) of those with 50% or more degeneration ($p<0.0005$). In addition, among patients with less than 75% degeneration of the facial nerve, 92.6% (n=25) had complete clinical recovery at 2 months after the onset of Bell's palsy compared to 20.0% (n=2) of those with 75% or more degeneration ($p<0.0005$).

There was a strong positive correlation between the severity of facial nerve degeneration and the clinical outcome of Bell's palsy at 1 month and 2 months after its onset. The correlation coefficients were 0.794 ($p<0.0005$) and 0.732 ($p<0.0005$), respectively. However there was no statistically significant correlation between the facial paralysis grading at the first visit and the severity of facial nerve degeneration $r=0.303$; $p=0.068$).

There was no statistically significant difference in terms of severity of facial nerve degeneration between males and females ($p=0.460$), diabetics and non diabetics ($p=0.655$), or left and right Bell's palsy ($p=0.716$). There was also no statistically significant correlation between the severity of facial nerve degeneration and the patients' age ($p=0.288$), SBP ($p=0.425$) or DBP ($p=0.243$).

There was no statistically significant difference in the clinical outcome at 2 months after the onset of Bell's palsy between male and female (p=0.725) or diabetic and non diabetic patients (p=0.655). There was also no statistically significant correlation between the clinical outcome at 2 months after the onset of Bell's palsy and the patients' age (p=0.779), SBP (p=0.933) or DBP (p=0.579).

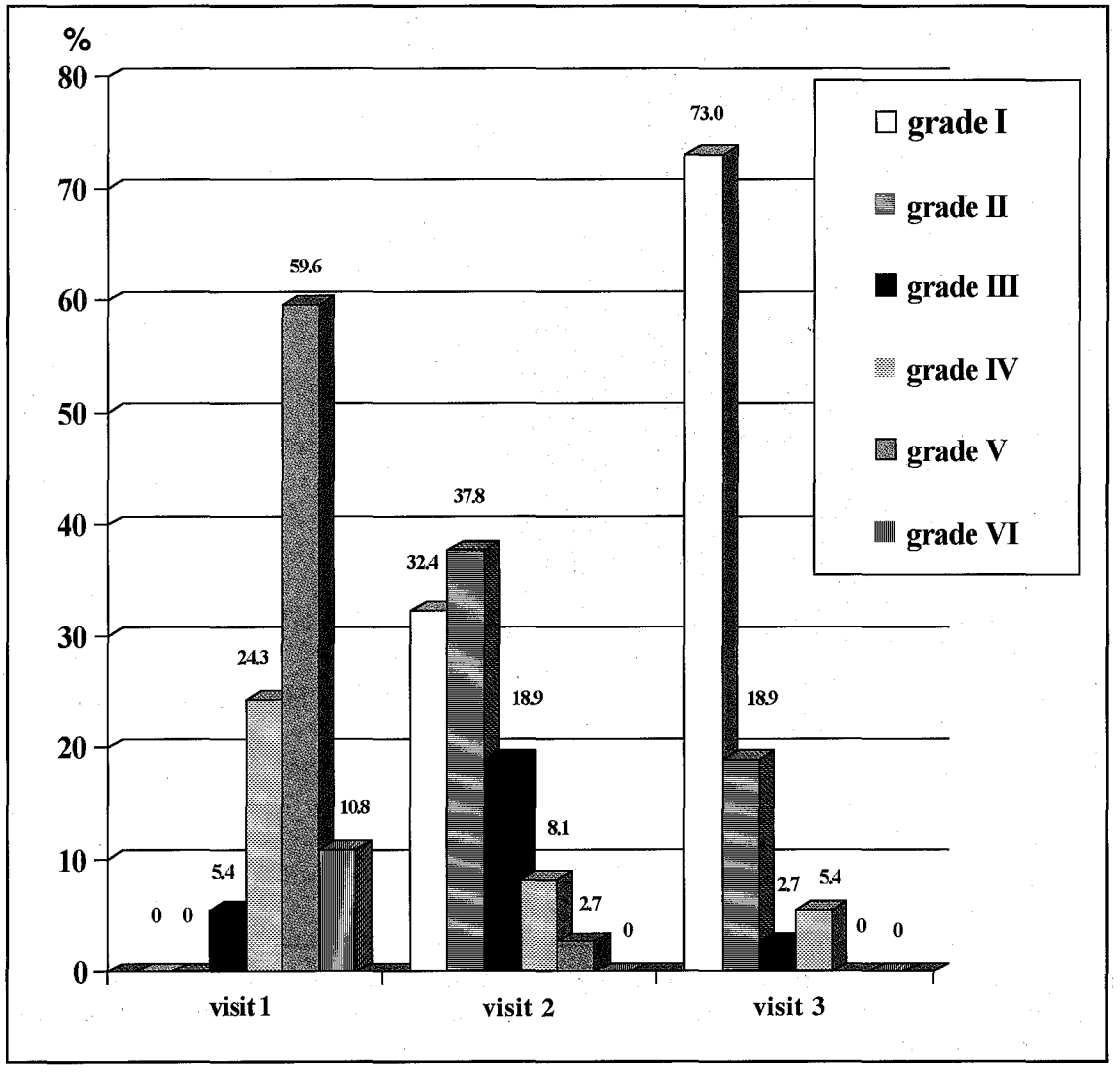
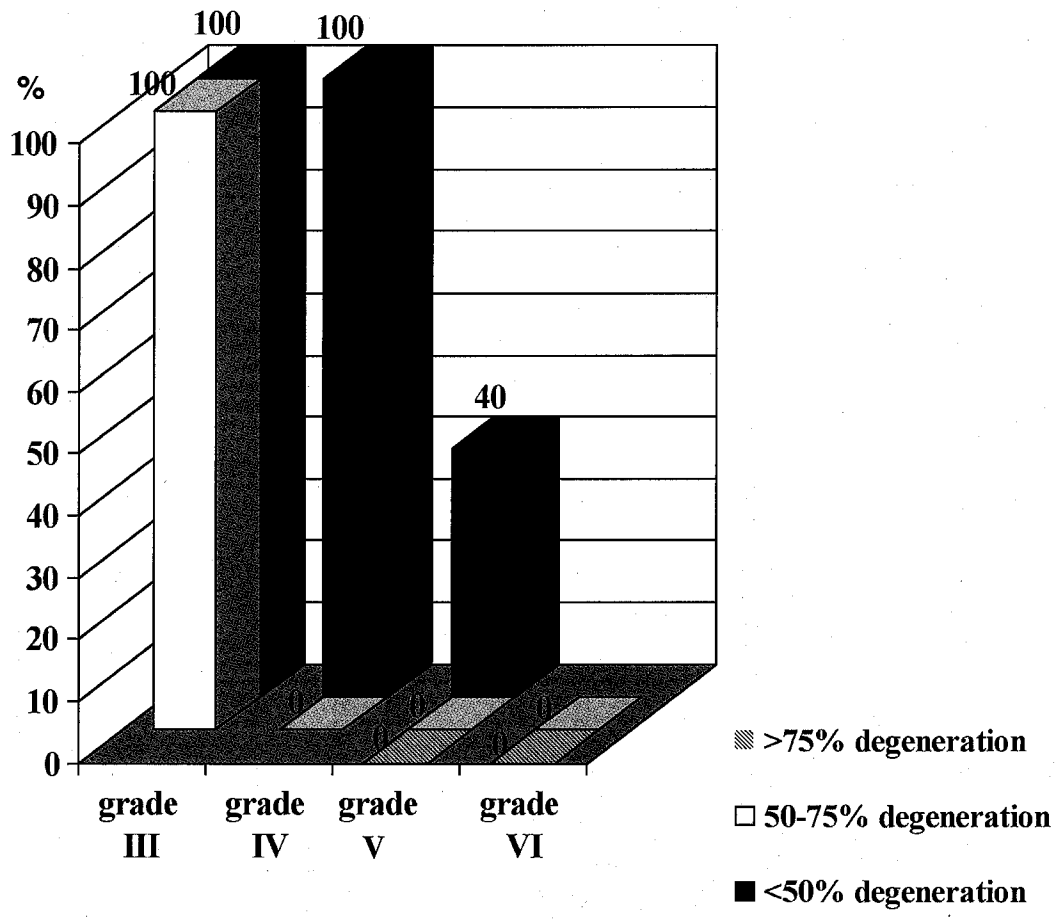
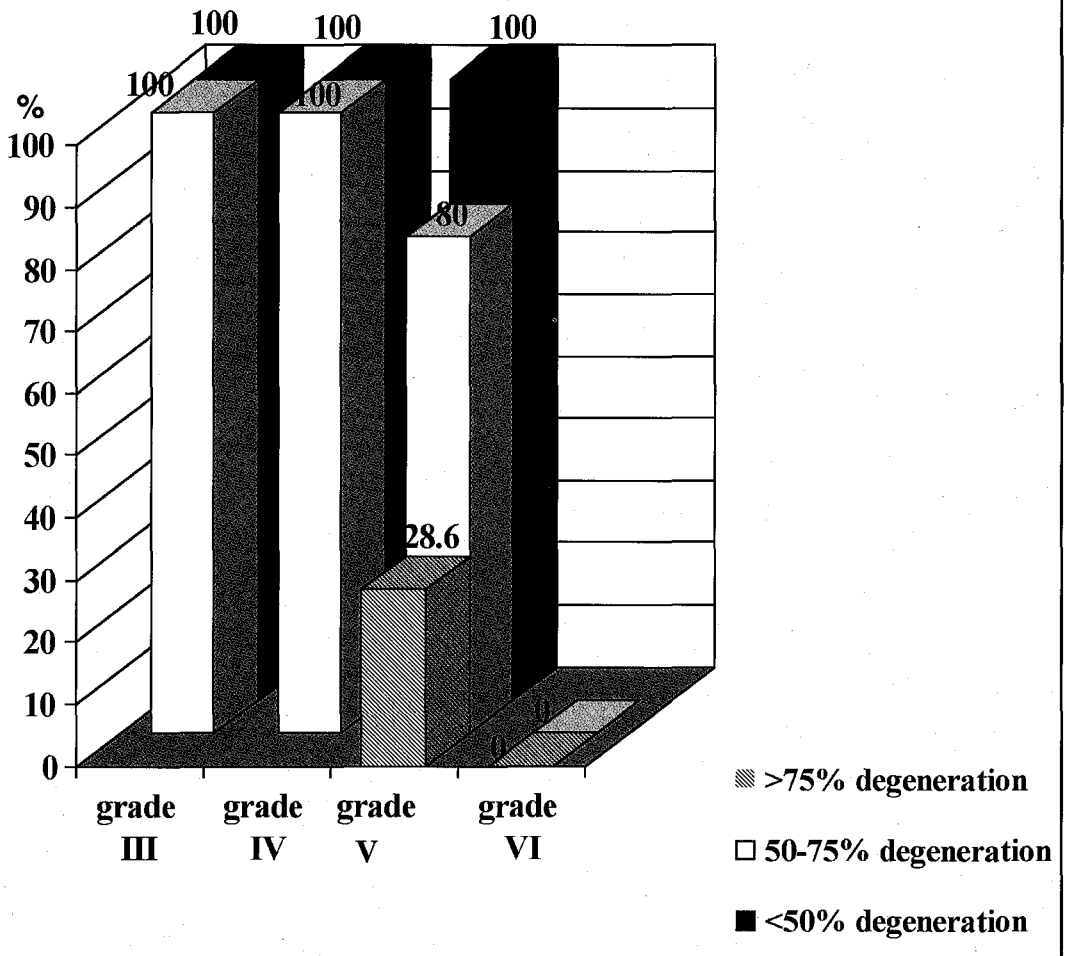


Fig. 1: Percentage of patients according to H-B grading during each visit



Note: There were no patients with grade III and IV who had > 75% facial nerve degeneration. Also there are no patients with grade VI who had < 50% facial nerve degeneration.

Fig. 2: The percentage of patients with complete recovery at 1 month after the onset of Bell's palsy according to H-B facial nerve grading at first visit and severity of facial nerve degeneration



Note: There were no patients with grade III and IV who had > 75% facial nerve degeneration. Also there are no patients with grade VI who had < 50% facial nerve degeneration.

Fig. 3: The percentage of patients with complete recovery at 2 months after the onset of Bell's palsy according to H-B facial nerve grading at first visit and severity of facial nerve degeneration

Discussion

Nerve conduction studies, by providing an objective quantitative assessment of facial nerve function, are potentially the most accurate method of assessing facial nerve degeneration. The amplitude of the CMAP represents the synchronous discharge of a group of facial muscle motor units resulting from supramaximal stimulation of the facial nerve. The reduction in amplitude of the CMAP on the affected side, when compared with the normal side is thought to reflect the number of fibres that have undergone Wallerian degeneration.

Bell's palsy probably represents a spectrum of nerve injury; some fibres have simple conduction block whilst others suffer complete degeneration. The probability of recovery for an individual is inversely proportional to the number of fibres which have undergone degeneration, particularly if this is associated with injury to the endoneurium; the latter sometimes lead to inappropriate regeneration resulting in incomplete recovery and other sequelae.

There have been many studies that have shown the strong relationship between the NCS findings and the long term or eventual outcomes of Bell's palsy patients. Yasukawa et al [10] studied 47 patients with Bell's palsy and found that 80% of them had < 90% degeneration of the affected facial nerve, all of whom recovered satisfactorily within 4 months. Wang et al [11] who studied 22 patients with complete facial palsy, found that of those with < 90% loss of electroneurographic response, 83.3% had complete recovery while of those with ≥ 90% loss, 70% had incomplete recovery at 6 months after the onset of Bell's palsy. In addition, May et al [5] found that when the response to NCS was ≥ 30%, about 84% eventually had complete recovery and when the response was < 25%, about 88% had incomplete recovery.

Although it has been proven that the eventual outcome of Bell's palsy is good, there is limited information about the short term outcome in these patients. There is also little knowledge about the use of NCS in predicting the short term outcome of Bell's palsy patients. We believe that it is important to know the short term outcome of Bell's palsy simply because it affects facial expression which is a crucial part of self image.

In this study we found that there was a strongly positive correlation between the clinical outcome at 1 month and 2 months after the onset of Bell's palsy and the severity of facial nerve degeneration derived from the NCS done at 10-14 days after onset. And we believe that this correlation will become weaker several months after the onset of Bell's palsy.

Almost one third of the total number of patients recovered completely within 1 month and about 70% within 2 months after the onset of Bell's palsy. About 65% of those with < 50% facial nerve degeneration had complete clinical recovery within a month and more than 90% of those with < 75% degeneration had complete recovery within 2 months. These figures are relatively higher than the earlier mentioned studies especially in relation to a shorter period of recovery[11]. This could be due to the fact that at first presentation 89.2% of patients in this study had incomplete facial paralysis and they generally recover faster than patients with total paralysis do. Perhaps the combination of acyclovir and steroid treatment could have hastened the recovery as proven in a randomised controlled trial by Adour et al.[12].

Katusic et al[1] have shown that total facial weakness is one of the risk factors for incomplete recovery[1]. In our study we found that all patients with total facial paralysis at first presentation had incomplete recovery at 2 months after the onset. However, all of those with a lower facial paralysis grade (i.e. grade III and IV) at first presentation had complete recovery within 2 months after the onset. We believe this could be attributable to the degree of facial nerve degeneration, as most patients with total facial paralysis have more than

75% facial nerve degeneration compared to those with grade IV or below who have less than 75% facial nerve degeneration. Thus in this group of patients a clinical facial paralysis grading would suffice in predicting the short-term outcome. However, for patients who have grade V facial nerve palsy at first presentation (as the majority did), facial NCS is important to forecast more accurately the likely short-term outcome. NCS would also be helpful to predict the eventual outcome of patients who present with total facial paralysis[5, 10, 11].

Several studies have found that increasing age was associated with poorer outcome[13-17]. However in our study we did not find any significant correlation between age and the severity of facial nerve degeneration or the clinical outcome at 2 months. We postulate that age alone may be a weak risk factor but when combined with other risk factors it can influence the outcome substantially. Thus we conclude that age per se is probably not a major risk factor for poorer outcome.

Several clinical papers have mentioned that there is a higher incidence of Bell's palsy among diabetics and vice versa[18-20]. Thus it is difficult to distinguish a true Bell's palsy that is idiopathic from facial palsy as a result of diabetic mononeuropathy. We assumed that all the 8 patients, who were diabetic, had Bell's palsy and we included them in this study. Again we did not find any difference in the outcome at 2 months after the onset of Bell's palsy or in the severity of facial nerve degeneration between diabetics and non diabetics.

Likewise some studies had shown that uncontrolled hypertension was a risk factor for poor outcome but we did not find any correlation with the 2-month outcome or the severity of facial nerve degeneration[21, 22]. The reason for this discrepancy is not clear but we believe that hypertension alone may not have a significant influence on the outcome of Bell's palsy or the severity of facial nerve degeneration. We believe that when found in combination with other risk factors such as age, diabetes, and perhaps gender too, hypertension may have a significant influence on the clinical outcome. In addition, as almost 90% of the patients in this study had incomplete facial paralysis at first presentation, blood pressure, diabetes or age may have little influence on the outcome, compared to those with total facial paralysis.

The most important limitation of this study was the small number of patients recruited. Since the incidence of Bell's palsy is not high, a large sample size would require a longer duration of study. Nevertheless a larger sample size may make this study more reliable and yield more accurate results.

Conclusion

The outcome of unilateral Bell's palsy at 1 month and 2 months after its onset has a statistically significant and strong positive correlation with the extent of facial nerve degeneration calculated from the nerve conduction studies done between day 10 and 14 after its onset. Age, gender, diabetes, systolic or diastolic blood pressure do not influence the severity of facial nerve degeneration or the clinical outcome of Bell's palsy at 2 months after its onset, especially among patients with incomplete facial paralysis at first presentation.

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