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EVOKED ELECTROMYOGRAM AS A FUNCTION OF FACIAL NERVE

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Abstract : Compound muscle action potentials were recorded bilaterally from alae nasi muscles following stimulation of facial nerve in 45 normal subjects in the age group of 20–30 years. Latency, amplitude and total duration of the compound muscle action potential were compared on both sides. A significant positive correlation between the three parameters with the highest for the amplitude was observed. Therefore it is suggested that amplitude is a better parameter for comparison while testing for side to side facial nerve integrity.

Key words : CAP amplitude facial nerve facial nerve integrity

INTRODUCTION

Evoked electromyogram (EEMG) is the evoked compound muscle action potential (CAP) recorded in response to stimulation of the corresponding nerve. Facial electromyogram or facial electroneurography is now regarded as a valuable tool for assessing facial nerve function. Although stimulation electromyography was introduced by Gilliat and Taylor (1) as early as in 1959, it was Esslen (2) who pioneered this as a test for facial nerve function. The technique offered the distinct advantage over previous methods of providing an objective quantitative assessment of facial nerve function. The latency, amplitude and total duration of the CAP are the important parameters of evoked EMG. The technique relays on comparing these values obtained from the affected side with that from the normal side in unilateral facial palsy. Though reports are available on clinical trials, there is no systematic information regarding side-to-side variations of the above parameters in normal subjects. The main criticism of EEMG of facial nerve is whether latency, CAP amplitude or total duration is direct representative of facial nerve integrity. With this in view, the present study was undertaken in normal subjects to see whether equivocal responses could be obtained on the two sides of the face and also which of the parameters of evoked EMG is most reliable measure in comparison of right and left differences in the assessment of functional integrity of the facial nerve.

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METHODS

The study was carried out on healthy human volunteers. 45 subjects consisting of 23 males and 22 females in the age group of 20–30 years were selected for the study. Individuals with a history of facial paralysis, neuromuscular disorders or with a metallic prosthesis were excluded from the study. Subjects informed consent was taken and they had the freedom to withdraw from the study at any time.

Evoked electromyogram was recorded using the NEUROCARE EMG SYSTEM (Biotech India Ltd).

The subject was made to lie in supine position. The skin on the alae nasi was cleaned and the recording electrodes were firmly placed bilaterally and secured with conductive paste and tape. Standardized recording lead placement technique (SRLP) as described by May et al (3) was followed. Periauricular skin was cleaned and bipolar stimulating electrode was placed on the facial nerve where it emerges at the stylomastoid foramen behind the ramus of the mandible. Optimized placement of stimulation electrodes was used throughout the study. The stimulating position was manually adjusted during trial stimuli to determine the optimal position to generate the compound muscle action potential. The stimulus applied was 0.3 msec. long pulse. The current intensity was increased from zero to a level sufficient to evoke maximal CAP. An additional 10% to 20% of current was added to produce supramaximal stimulation (4, 5, 6). A single supramaximal stimulus was given to the facial nerve and an individual response (CAP) was recorded from alae nasi muscles. The response was recorded first on the right side and then on the left side. Shifting of the electrodes was not necessary as one electrode serves as reference for the other. From the CAP displayed on the monitor, latency, amplitude and total duration of the CAP were measured (Fig. 1). Latency was measured in milliseconds from the start of the stimulus artefact to the onset of muscle response. Total duration of the response from the beginning to the end of CAP was also measured in milliseconds. Peak-to-Peak amplitude was measured in microvolts. Three trials were done for reproducibility on each side of the face and the best was considered. Data were compiled and computed by using ANOVA analysis. Correlation coefficient for all the three parameters between right and left side was calculated.

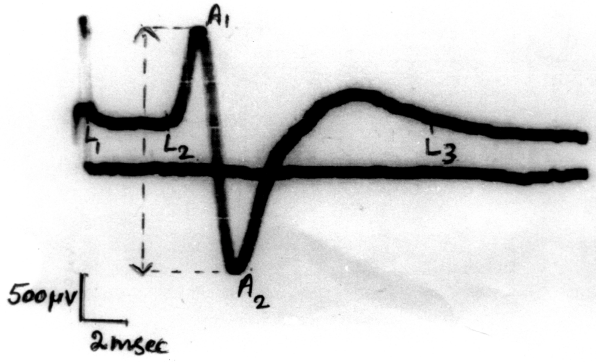

Fig. 1: Compound action potential (CAP) of alae nasi obtained from single supramaximal stimulation of facial nerve.
L1 to L2 = Latency
L2 to L3 = Total duration
A1 to A2 = Peak to Peak amplitude
Scale: 1 cm on vertical scale is 500 μV
1 cm on horizontal scale is 2 msec

RESULTS

Mean, SD, t value and significance level for latency, amplitude and duration of the response is shown in Table I. Mean value of latency on the right side was found to be 3.51 ± 0.38 msec and on left side 3.45 ± 0.49 msec. Mean value of amplitude was found

TABLE I: Mean, standard deviation, t-value and significance level for latency, amplitude and duration of the response.

Parameter		*Mean*	*SD*	*t-value*	*P-value*
Latency (m.sec.)	Rt.	3.51	0.38	0.804	>0.05
	Lt.	3.45	0.49		
Amplitude (μV)	Rt.	2828.26	918.07	1.725	>0.05
	Lt.	2989.13	1073.62		
Total duration (m.sec.)	Rt.	5.03	1.48	1.098	>0.05
	Lt.	5.22	1.54		

to be 2829.26 ± 918.07 μv on the right side and 2989.13 ± 1073.62 μv on the left side. The total duration of CAP on the right side was 5.03 ± 1.48 msec and on left side 5.22 ± 1.54 msec. P value for all the parameters was >0.05. All the three parameters were comparable bilaterally on both sides as no significant difference was found in the mean value of any of the three parameters studied. The correlation coefficient between right and left for all the parameters is shown in Table II. The correlation coefficient for latency is 0.381, for amplitude 0.809 and for total duration 0.679. It is found that the correlation coefficient between right and left for all the parameters was highly significant. It implies that the direction of variable is the same. Therefore any parameter can be made use of for comparison in unilateral facial nerve lesions. Among the three parameters highest correlation was for the amplitude (0.81).

TABLE II: Correlation between right and left with respect to latency, amplitude and duration of the response.

Parameter		*Correlation coefficient*	*P-value*
Latency	(Rt. and Lt.)	0.381	<0.009
Amplitude	(Rt. and Lt.)	0.809	<0.001
Total duration	(Rt. and Lt.)	0.679	<0.001

From the observations it appears that peak-to-peak amplitude is the best parameter for comparative purposes while testing for side-to-side facial nerve integrity.

DISCUSSION

Electrical stimulation has been used by neurologists for over years to test motor nerve function. In recent years the precision of such tests has been greatly increased by the recording of compound muscle action potentials as a measure in a number of neuromuscular disorders. Almost every aspect of this type of response might be useful in diagnosis (7).

In the present study individual CAP from alae nasi muscles were recorded on both sides of the face for comparison. Averaging of responses was not required since the signal-to-noise ratio was relatively high. The authors of the present study found no significant side to side difference in the mean values of latency, amplitude and total duration of the CAP. This finding was not surprising. Theoretically if a subject is normal, CAP obtained with supramaximal strength of a facial nerve stimulation will show no side-to-side difference. Clinically the lack of side-to-side difference in normal subjects implies that any consistent and repeatable difference measured in a patient with unilateral facial palsy is potentially significant.

Response latency is largely a measure of the time required to conduct a nerve action potential to travel down the nerve plus neuromuscular transmission time and muscle fibre depolarization time. Since the latter two are relatively constant, changes in latency reflect changes in nerve conduction time. Skevas et al., (8) reported that facial nerve latency time measurement

is a simple, valuable and accurate early test in the prognosis of Bells palsy. But Esslen (9) stated that although CAP latency statistically increased with higher degrees of degeneration, in the individual case this measurement was not a useful parameter. In the distal ramifications of a predominantly motor nerve, latency values have limited clinical value, so the interpretation of the electrophysiological event focuses on the amplitude of the CAP (10). The total duration of action potential measured from the beginning to the end of CAP is related to the difference in conduction time in the various axons and muscle fibres. Peak to peak amplitude of the CAP is roughly proportional to the number of muscle fibres that respond to the nerve impulse which in turn correlate with the number of intact motor neurons. It is found that measurement of amplitude is probably the most sensitive prognositic feature in facial nerve conduction studies (11). The present study has shown that amplitude is a better parameter to compare the functional integrity of the nerve. The present observation is in conformity with that of Hughes et al who also reported no significant change in side-to-side comparison in amplitude (12). This has been further confirmed by Gavilan et al (13).

In conclusion evoked electromyogram of facial nerve is of great value in assessing facial nerve's functional integrity. In the present study bilateral stimulation of facial nerve produced equivocal responses. The positive correlation coefficient between right and left for the parameters is highly significant. Therefore any parameter can be made use of for comparison in pathological conditions of facial nerve. Among these three, amplitude is a better parameter for comparison since its correlation coefficient is highest. Amplitude of the CAP directly correlates to the facial nerve integrity.

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