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J. B. B. BROOKS,[1, 2] M. R. JARDIM,[2] R. M. PAPAIS-ALVARENGA,[2]
and Y. D. FRAGOSO[1, 2]

TIME PARAMETERS OF THE BLINK REFLEX IN NORMAL SUBJECTS

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Our study was aimed at estimating normal time values for the EMG waves recorded in the blink reflex test. The group examined included 400 healthy subjects (226 women and 174 men, with mean age about 50 years). There was no significant difference between the ages of the male and female subjects. The mean latency of the R1 wave in the response was 10.3 msec, while R2 was obtained after 32.5 msec, on average. The contralateral response component R2c was observed after 34.4 msec, on average. Gender did not influence the results, while age had a significant effect on R1 ($P = 0.029$) and R2c ($P = 0.0003$). The older the subject, the longer the latencies of the above waves. The data obtained on a rather large sampling of the tested subjects can be useful as normography for medical and neurophysiological purposes.

Keywords: blink reflex, EMG, brainstem, pons, *medulla oblongata***.**

INTRODUCTION

Initially described by W. Overend in 1896 [1], peculiarities of the blink reflex (*orbicularis oculi* reflex) may be indicative of lesions or dysfunctions of the brainstem, particularly of those in the trigeminal-facial arcs. Kugelberg [2] complemented initial observations in 1952, and the blink reflex test became a part of standard studies of "face neurophysiology." This reflex is elicited by stimulation of the supraorbital nerve on one side of the face, leading to initiation of two ipsilateral EMG response components (R1 and R2) and one contralateral component (R2c). The R1 represents the activity of an oligosynaptic pathway involving the main sensory nucleus of the trigeminal nerve and the intermediate subnucleus of the facial nerve. The R2 is a second response that includes a descent to the spinal trigeminal tract, while R2c is provided by a reflex pathway that crosses the brainstem in the medulla and progresses through the reticular formation to elicit the response at the contralateral facial nucleus.

The blink reflex has been shown to be altered in a variety of neurological conditions. Multiple sclerosis [3-5], Parkinson's disease [6], and dementia with Lewy bodies [7] are among the diseases that may modify responses in the blink reflex test. Patients with chronic headaches have also been shown to demonstrate altered responses in the above test [8, 9], although not all authors agree with this [10].

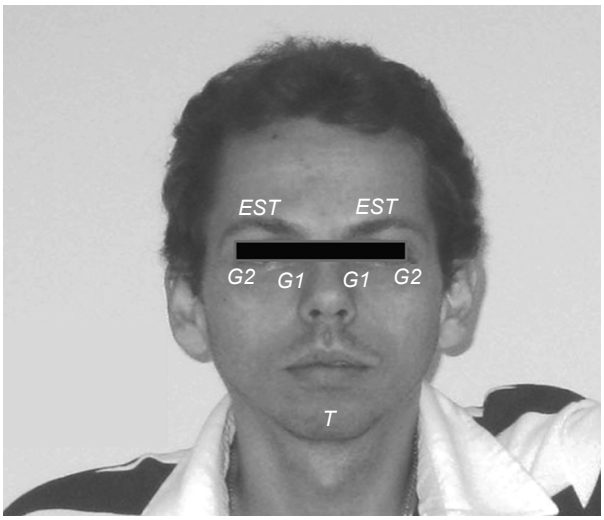
When studies of neurological diseases and the blink reflex were carried out, the control groups used by the authors were typically rather limited, and maximally a few dozen control subjects were usually mentioned in each report. The aim of our study was to assess the blink reflex test in a relatively large sampling of individuals claiming to be in good general health, thus establishing "normal" values of the respective time parameters that can be used as controls in further blink reflex studies.

METHODS

The group examined consisted of 400 subjects who were attending the EMG laboratory for nonspecific complaints, as well as volunteers who were enrolled in the project. All subjects previously diagnosed with central or peripheral nerve diseases, earlier cranial nerve lesions, autonomic disturbances, or *diabetes mellitus*, as well as those using drugs with anticholinergic properties, were excluded.

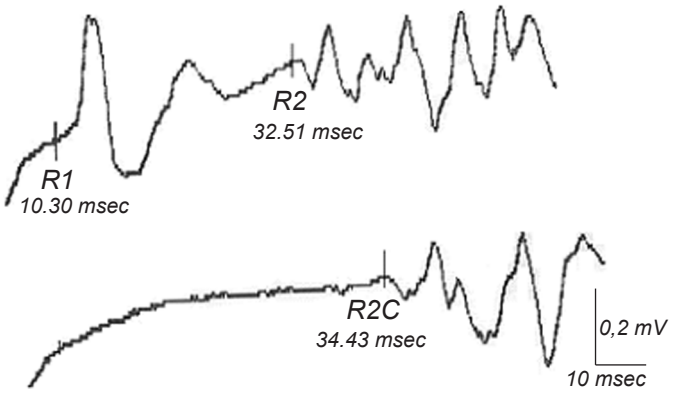
The blink reflex was assessed using two-channel Nicolet Viking Quest EMG equipment (Nicolet Biomedical Inc., USA). All tests were performed by the same medical doctor. The subjects were in the supine position, lying down in a relaxed state with their eyes

[1] Department of Neurology, Universidade Metropolitana de Santos, São Paulo, Brazil.
[2] Department of Neurology, College of Post-Graduation Studies, Universidade Federal do Estado do Rio de Janeiro, Rio de Janeiro, Brazil.
Correspondence should be addressed to Y. D. Fragoso
(e-mail: yara@bsnet.com.br).



F i g. 1. Blink reflex test. Allocation of the electrodes for stimulation and recording of the reflex.

Р и с. 1. Розташування електродів для стимуляції та відведення ЕМГ при тестуванні рефлексу кліпання.



F i g. 2. Blink reflex-related waves. R1 is the first ipsilateral wave, R2 is the second ipsilateral wave, and R2c is contralateral to the stimulus.

Р и с. 2. Компонентний склад ЕМГ, що реєструється при рефлексі кліпання.

open. Figure 1 shows positions of the electrodes on the face of the subject. A ground electrode was placed on the chin; an active recording electrode was fixed on the inferior orbital part of the *orbicularis oculi*, just laterally to the vertical line that can be drawn with the pupils in midposition. The reference recording electrode was placed laterally to the lateral canthus of each eye. Recording electrodes were placed on both sides. The frequency filter settings were 10 Hz and 10 kHz. Facial nerve studies were initially performed on each subject to ensure that normal motor latency and amplitude could be obtained on each side and that there was no damage to the peripheral part of the efferent loop of the reflex. The supraorbital branches of the trigeminal nerve were stimulated on each side with 20-45 mA rectangular current pulses (0.1-0.3 msec long). The stimulus intensity was increased in 5-mA steps until a reliable and reproducible response was obtained. Bilateral recordings were made simultaneously.

In order to measure the R1, R2, and R2c latencies and to obtain an unambiguous response, individual threshold stimulus intensities were used. Ten responses were superimposed from each side, and the median of these responses was chosen. Typical registration of the waves is shown in Fig. 2.

The results of this study are essentially descriptive in their nature. Means ± s.d. are shown below. Whenever statistical analyses were required for the variables, the Fisher's exact test and Student's *t*-test were used.

RESULTS

The group of 400 healthy subjects included 226 women (mean age 50.7 ± 18.7 years) and 174 men (50.9 ± ± 17.8 years). There was no statistically significant difference between the ages of the male and female subjects. The R1, R2, and R2c time parameters were established for these groups and correlated with gender and age. These results are summarized in Table 1. The average time taken to elicit the R1 response was 10.30 msec, while R2 was obtained after 32.51 msec, on average. The contralateral response R2c was observed after an average of 34.43 msec after stimulation. Gender did not influence the above values, while age had a significant effect on the R1 ($P = 0.029$) and R2c ($P = 0.0003$) latencies. The older the subject, the longer the latency to elicit the above waves of the reflex. These results are summarized in Table 1. Minimum and maximum values recorded for each subgroup of controls are presented in Table 2.

DISCUSSION

Abnormal values for the blink reflex parameters may indicate brainstem lesions or dysfunction [11-13]. Although the blink reflex has been studied for many years, data from a large group of controls have never been available to the researchers. Small control groups for each study have been described and should continue to exist, but it seems expedient to form a large historical database to use as reference values. When small groups of patients and controls are studied, discrepant results may

Table 1. Latencies of the Components of Blink Reflex-Related EMG

Т а б л и ц я 1. Латентні періоди компонентів ЕМГ, що реєструються при рефлексі кліпання

Groups	Latency of the component, msec			Significance of differences, *P*
	R1	R2	R2c	
Total group (*n* = 400)	10.30 ± 0.94 (8.88…11.71)	32.51 ± 3.32 (27.53…37.49)	34.43 ± 3.20 (29.64…39.23)	
Men (*n*=174)	10.32 ± 0.96 (8.88…11.75)	32.51 ± 3.33 (27.51…37.50)	34.44 ± 3.20 (29.65…39.21)	*P* for R1 = 0.790 *P* for R2 = 0.994 *P* for R2c = 0.984
Women (*n*=226)	10.29 ± 0.93 (8.89..11.69)	32.51 ± 3.31 (27.54…37.48)	34.43 ± 3.19 (29.65…39.21)	
50 years or younger (*n*=205)	10.19 ± 0.94 (8.78…11.60)	32.45 ± 3.32 (27.47…37.43)	34.36 ± 3.19 (29.58…39.14)	*P* for R1 = 0.029 *P* for R2 = 0.766 *P* for R2c = 0.0003
51 years or older (*n*=195)	10.39 ± 0.95* (8.97…11.82)	32.55 ± 3.33 (27.55…37.54)	35.51 ± 3.20* (30.71…40.31)	

Footnotes: Means ± s.d. are shown; minimum and maximum values in the groups are shown in parantheses. Cases of significant intergroup differences are shown by asterisks.

sometimes be obtained. This may have been the case with headache studies that systematically used fewer than 50 control subjects to assess differences between patients and controls [8-10]. In the case of diseases, the only reference that exists for the values obtained at a given time point is sometimes a value from another patient, which may in any case be outside of the normal range [5].

Another advantage of having a large database of control subjects for further studies of the human blink reflex relates to the ethical aspects of the test. The blink reflex test is neither painful nor invasive, but ethics committees may not necessarily approve the test in controls due to possible discomfort caused by stimulation. With a large historical published database, the normal values can be used for comparison with patients presenting different diseases.

Significant differences in the R1 and R2c latencies relating to subjects' ages have previously been described [10]. Although differences in the values between men and women in the same age group have been reported by others [10], our study did not confirm this finding.

In conclusion, the blink reflex test is a simple, inexpensive, non-invasive, and painless procedure that could be used often in daily medical or experimental practice. It has been reported that several neurological diseases induced abnormalities in the blink reflex values [3-7, 9, 14], and our database of 400 subjects is of potential interest to certain groups of professionals. This large group of subjects providing normal time values for the responses R1, R2, and R2c may be of help to clinicians caring for patients, to electrophysiologists assessing facial reflex responses, and to researchers studying a variety of neurological diseases.

All procedures were approved by the Ethics Committee of the Universidade Metropolitana de Santos under the number 020/2011, CAAE 0017.0.161.000-11 and carried out in accordance with the Helsinki Declaration of 1975, as revised in 2000.

Written informed consent was obtained from all individuals participating in this study. Figure 1 shows the photograph of a neurologist who authorized the inclusion of his photograph in this paper.

The authors, J. B. B. Brooks, M. R. Jardim, R. M. Papais-Alvarenga, and Y. D. Fragoso, confirm that they have no conflict of interest.

Ж. Б. Б. Брукс[1,2], М. Р. Джардім[2], Р. М. Папіас-Альваренга,[2] Я. Д. Фрагозо[1,2]

ЧАСОВІ ПАРАМЕТРИ РЕФЛЕКСУ КЛІПАННЯ В НОРМІ

[1] Університет Метрополітана де Сантос, Сан-Паулу (Бразилія).

[2] Коледж післядипломних досліджень Федерального Університету штату Ріо-де-Жанейро (Бразилія).

Р е з ю м е

У своєму дослідженні ми оцінювали нормальні часові параметри хвиль ЕМГ, що реєструвалися при тестуванні рефлек-

су кліпання. До обстеженої групи ввійшли 400 здорових осіб (226 жінок та 174 чоловіки, середній вік близько 50 років) без істотної різниці віку в групах чоловіків і жінок. Середній латентний період (ЛП) хвилі R1 у складі досліджуваної рефлекторної відповіді складав 10.30, а хвилі R2 – 32.51 мс. Контралатеральний компонент відповіді R2c виникав із середнім ЛП 34.43 мс. Стать обстежених не впливала істотно на ці значення; в той же час останні демонстрували значну залежність від віку (R1, $P = 0.029$; R2c, $P = 0.0003$; чим старші були обстежені, тим довші були вказані ЛП). Результати, отримані на досить великій дослідженій групі здорових осіб, можуть бути корисними як нормографічні дані для медичних та нейрофізіологічних цілей.

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