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Blink Reflex in Facial-Hypoglossal Anastomosis

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Summary. The blink reflex was investigated in two patients after a facial-hypoglossal anastomosis had been performed. In each case the first component of the blink reflex could be demonstrated with normal latency on the operated side after ipsilateral supraorbital stimulation. These findings give further evidence that the first component of the blink reflex is not monosynaptic in nature. The second component of the blink reflex was distinctly retarded in the first case and was not seen at all in the second case. The second component of the blink reflex is influenced strongly by alteration of the intrabulbar and efferent part of the reflex circuits; it shows some correlation with voluntary motor activity.

Key words: Facial-hypoglossal anastomosis – Blink reflex – Electromyography.

Zusammenfassung. Der Orbicularis-oculi-Reflex (Blinzelreflex oder Glabella-Reflex) wurde bei 2 Patienten mit Facialis-Hypoglossus-Anastomose untersucht. Beide Fälle hatten die erste Komponente des Blinzelreflexes mit normaler Latenz auf der operierten Seite nach ipsilateralem supraorbitalem Reiz. Diese Befunde zeigen, daß die erste Komponente des Blinzelreflexes nicht monosynaptisch sein kann. Die zweite Komponente des Blinzelreflexes war im Fall 1 wesentlich verzögert und fehlte in Fall 2. Die zweite Komponente wird erheblich beeinflußt durch Veränderung im intrabulbären und efferenten Teil des Reflexbogens und entspricht etwa der Willküraktivität.

Schlüsselwörter: Facialis-Hypoglossus-Anastomose – Blinzelreflex – Elektromyographie.

Introduction

Kugelberg (1952) was the first to analyze the blink reflex by electromyography. He discovered that after electrical stimulation of the supraorbital nerve, two

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components of the reflex could be distinguished. The first component (R_1) occurs ipsilaterally and has a course synchronous with the potential and a latency of about 12 ms. The second component (R_2) is bilateral with a course asynchronous with the potential and a latency of 21 to 40 ms. The second component is correlated to the clinically observable blink reflex. According to Kugelberg (1952) the first component is a monosynaptic reflex of myotatic origin, whereas the second component is a polysynaptic skin reflex of nociceptive nature. Many authors confirm these findings (Oka et al., 1958; Rushworth, 1962; Struppler and Dobbelstein, 1963; Gandiglio and Fra, 1967; Bender et al., 1969; Moldaver, 1973). Bratzlavsky (1972a) was able to demonstrate the myotatic origin of the blink reflex by stretching extraocular muscles.

Many authors nowadays are of the opinion that the first component is not of myotatic origin (Shahani, 1968, 1970; Shahani and Young, 1968, 1972; Penders and Delwaide, 1969; Bratzlavsky, 1972b; Trontelj and Trontelj, 1973). Messina (1975) notices that R_1 is dependent on the exteroceptive fibres, but is proprioceptive in nature. Kimura and Lyon (1972) and Kimura (1974) think that an alteration of R_1 in intact trigeminal and facial nerves points to a lesion on the pons, whereas the delay or the extinction of R_2 when R_1 is intact indicates a lesion of the ipsilateral tractus and the nucleus spinalis n. trigemini or of the contralateral hemispheres.

We set out to elucidate which electromyographically analyzable components the blink reflex shows when the efferent part is changed, as in the case of substitution of the facial nerve by the hypoglossal nerve (facial-hypoglossal anastomosis, which is done for therapeutic reasons). Struppler and Dobbelstein (1963) analyzed two patients with facial-hypoglossal anastomosis and found in one case no restitution of the blink reflex and in the other case a restitution in which R_1 showed a latency of 14 ms. They interpreted their findings as indicating a double reinnervation of the facial nerve. They considered it impossible that the first component of the blink reflex, which is generally thought to be monosynaptic, could spring to another brain nerve.

Methods

The electromyographic investigations were performed by a 4-channel Tönnies oscilloscope and stimulator. Voluntary activity and reflectory responses of mimic muscles were recorded by surface electrodes (silver plates of 5—6 mm diameter). The supraorbital nerves were stimulated supramaximally above the eyebrows (silver plates of 10 mm diameter).

Cases and Results

Case 1. K. J., agriculturist, born 1912. Sudden left facial paresis in November 1965. Slight restitution after antirheumatic therapy. In April 1966 severe recidative left facial paresis, resistant to antirheumatic and electrophysical therapy. Neurologically an almost complete paresis of the left facial nerve was found. In May 1967 a facial-hypoglossal anastomosis was performed on the left side. The facial nerve was cut where it left the base of the skull. The hypoglossal nerve was cut as peripherally as possible, leaving the ansa hypoglossi intact. Then

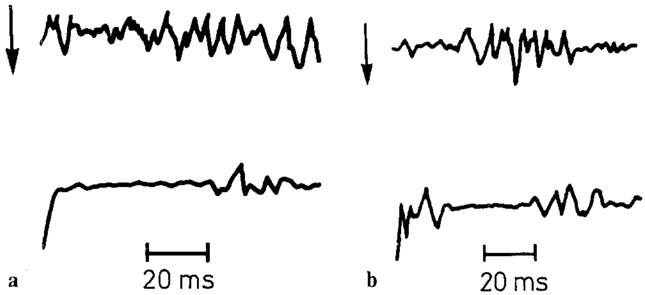

Fig. 1 a and b. Case 1. *Top line*—right m. orbic. oculi; *bottom line*—left m. orbic. oculi. **a** Stimulation of right supraorbital nerve. **b** Stimulation of left supraorbital nerve

Table 1

	Stimulus responses in			
	M. orbic. oculi d.		M. orbic. oculi s.	
	R_1	R_2	R_1	R_2
	Latency in ms			
Case 1. Left facial-hypoglossal-anastomosis				
Stimulation of right supraorbital nerve (Fig. 1 a)	11.2	40	—	60
Stimulation of left supraorbital nerve (Fig. 1 b)	12	35	12.5	56
Case 2. Left facial-hypoglossal anastomosis				
Stimulation of right supraorbital nerve	10	30	—	—
Stimulation of left supraorbital nerve (Fig. 3)	9	33	11	—

an exact anastomosis of the central hypoglossal and the peripheral facial nerve was performed.

Neurological findings in October 1975: When raising the eyebrows, the wrinkles of the forehead were less pronounced on the left side. The eyelids could be closed on both sides. The left plica nasolabialis and the left part of the mouth moved well. The protruded tongue was drawn to the left. The left half of the tongue shows a marked hypotrophy.

Electromyographic findings in October 1975: Left m. orbicularis oculi shows a mixed pattern with amplitudes up to 400 µV. In the left part of the m. orbic. oris an interference pattern with amplitudes of up to 600 µV could be ascertained. The findings of the electromyographic examination of the blink reflex are presented in Table 1.

The reaction time for voluntary eyelid contraction is lengthened for the left eye by 40 ms (right eye 120 ms, left eye 160 ms).

Case 2. M. S., housewife, born 1922. Since summer 1971 increasing hypaesthesia of the left side of the face, vertigo, and vomiting. For some months hypacusis and difficulty with gait. Operation for a tumor in the left cerebellopontine angle in April 1972. It was an acusticus neurinoma as big as a walnut and histologically of fibrillar type A. The facial nerve, partially split up in the tumor, was resected. No damage could be found in the trigeminal nerve. After the operation a complete peripheral paresis of the left facial nerve was found, showing no restitution. In November 1972 a facial-hypoglossal anastomosis was performed.

Neurological findings in October 1975: The left eyebrow remained motionless when patient tried to raise it. The left eye remained open for 2—3 mm, when she tried to close it (Fig. 2a). The blink reflex could not be observed in the left eye. The left plica nasolabialis and the left angle of the mouth moved well. The protruded tongue was drawn to the left (Fig. 2b) and showed

Fig. 2. Case 2

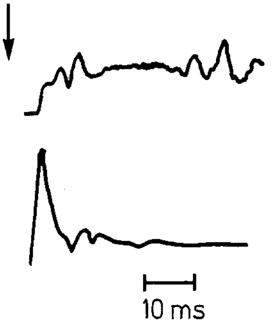

Fig. 3. Case 2. Stimulation of left supraorbital nerve. *Top line*—right m. orbic. oculi; *bottom line*—left m. orbic. oculi

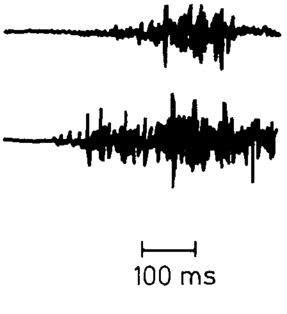

Fig. 4. Case 2. Latency time of voluntary contraction of m. orbic. oculi. *Top line*—left orbic. oculi m.; *bottom line*—right orbic. oculi m.

extensive hypotrophy of the left side. Anacusis on the left, and no reaction of labyrinth to stimulation.

Electromyographic findings in October 1975: Derivation from left m. frontalis shows bioelectric silence. In left m. orbic. oculi a mixed pattern with amplitudes up to 200 μV is found. From the left angle of m. orbic. oris an interference pattern with amplitudes up to 500 μV is derived. The findings of the electromyographic examination of the blink reflex are presented in Table 1.

We also performed a retroauricular stimulation on the left side to exclude reinnervation through the proximal part of the facial nerve. No reaction in the mimic muscles was found after this procedure. Furthermore, we anesthetized the proximal stump of the facial nerve near the proc. stylomastoideus. The electromyographic pattern of the blink reflex was not influenced by this procedure.

The reaction time for voluntary eyelid contraction is lengthened on the left side (right eye 100 ms, left eye 140 ms—Fig. 4).

Discussion

In case 1 a nearly complete reinnervation of the mimic face muscles was attained after grafting of the hypoglossal nerve onto the distal facial trunk. The blink reflex was found with both components, R_1 with normal latency and R_2 with lengthened latency.

A normal latency of the first component could also be seen in case 2, who showed only slight reinnervation especially in the orbicularis oculi muscle. The second component was missing, although there was a slight contraction when patient attempted to close the eyelid. A blink reflex was, however, not observed.

It is generally supposed that the afferents responsible for the first component of the blink reflex terminate in the sensory nucleus of the trigeminal nerve in the pontine area. The afferents of the second component terminate in the nucleus tractus spinalis trigemini. In case of facial-hypoglossal anastomosis, the original efferent part of the blink reflex is eliminated, the innervation of the muscles of the face occurs by the nucleus of the hypoglossal nerve. As far as the blink reflex is concerned, the efferent part is not only exchanged, but also altered in its intrabulbar part. Nevertheless, we found a normal latency of the first component of the blink reflex. A reinnervation of the mimic muscles by the proximal facial nerve trunk could be excluded, because we found no response in the orbicularis oculi muscle after retroauricular stimulation. Furthermore, anesthesia of the facial trunk did not alter the blink reflex elicited by stimulation of the supraorbital nerve.

In case 1 the first component of the blink reflex showed a latency of 12.5 ms on the operated side and of 11.2 ms on the intact side. In case 2, a latency of 11 ms on the operated side was found compared with 10 ms on the intact side. It should be stressed that in both cases the latency found on the operated side appeared normal when compared with the normal data of Kugelberg (1952), Gandiglio and Fra (1967), Bender et al. (1968), Kimura and Lyon (1973), Eisen and Danon (1974), and Ongerboer de Visser and Goor (1974). We have no explanation for the finding that the first component was seen bilaterally after stimulation of the left side.

Of particular interest is the finding that after implantation of the hypoglossal onto the facial nerve, a normal first component of the blink reflex was found in both cases and that in one case a clinically and electromyographically well-established blink reflex could be found. In normal subjects we could not see electromyographic activity in the innervatory area of the hypoglossal nerve after stimulation of the supraorbital nerve. It must therefore be presumed that a reflex can 'learn' to use a completely new motoneuron as its efference. Our findings substantiate the poly- or oligo-synaptic genesis of the first component of the blink reflex and rule out a monosynaptic origin.

The second component of the blink reflex was distinctly retarded in case 1 and was not seen at all in case 2. The second component shows, in contrast to the first component, a marked dependence on the altered efferent part of the reflex circuit. The polysynaptic second component of the reflex, with its complicated neuronal substrate, seems to be more irritable then the oligosynaptic first component.

Case 1 showed an elongated reaction time in the m. orbicularis oculi, in which a retarded second component was also observed. In case 2, which did not possess a second component, an elongated reaction time was also seen. Only slight voluntary innervation was noted in the same muscle. Such a parallelism between the behavior of the polysynaptic reflex activity and voluntary motor activity would seem to indicate an integration of polysynaptic reflex into a hierarchical system of voluntary motor activity, especially in view of our inability to demonstrate a discrepancy between the oligosynaptic elementary reflex and voluntary motor activity.

The elementary oligosynaptic reflex does not provide sufficient conditions for voluntary innervation. The elementary reflex is necessary, but not sifficient in itself, for a highly differentiated motor activity.

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