

DEVELOPMENT OF THE MAIN ELECTRORETINOGRAPHIC COMPONENTS IN PREMATURE INFANTS DURING THE FIRST WEEKS OF LIFE

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Horsten and Winkelman (1960) first showed that the electrical activity of the retina is present in premature babies at birth. In a further study Rouher and co-workers (1967) pointed out the existence of the photopic retinal function in newborns born prematurely. The Samson-Dollfus (1967) and Nagata (1977) experiences showed, in order to demonstrate the electroretinographic maturation process in prematures, an increasing a-and b-wave amplitude in relation to gestational age.

These previous results indicate that the ERG registration in premature infants may be considered an usefull index of maturity at birth, especially if this study is performed with an averaging computerized technique and supported by other available investigations such as VEP, Forced choice preferential looking, EEG, etc.

However at present time it isn't still clearly recognized the evolution of the main ERG's components in prematures of different gestational ages during the first weeks of life.

The aim of our study is to investigate the development of the photopic and scotopic electroretinographic components in the first weeks of extrauterine life in infants born prematurely.

SUBJECT AND METHODS

We have examined 8 premature babies (gestational age: 29-36 weeks; birth weight: 1020-2400 g). The arterial PO₂ ranged from 60 to 100 mmHg during the

period of our examination. The other metabolic parameters were within the normal limits.

The ERG's registration were performed at birth and repeated weekly from 4 times at least to 6 times after birth at different post-natal ages. After the ERG registration we performed an indirect ophthalmoscopy to exclude any vitreo-retinal abnormality clinically evident.

In no case was general anesthesia used nor pharmacological sedation, but the ERG was recorded after the feeding in condition of wake and after instillation of 0.4% Novesine. The pupils were dilated with repeated instillations of 1% cyclopentylate and 5% phenylephrine. The eyelids were maintained opened by a sharp speculum that we have shaped.

The newborns were always maintained into their incubators during the examination.

The active electrode was a small spiral of AgCl_2 which contained inside a sharp cotton flake imbued with physiological salt solution and maintained on the corneal surface. The reference electrode was placed in the auricular lobe and a mass electrode was applied in the centre of the forehead.

The ERG was recorded with the electroretinograph PANTOPS M₂ (Biophysic Medical Co.). The electroretinographic responses were averaged (N = 256) by a computer of average transients with a memory of 12 bits (4096 levels). The flash stimuli were provided by a continuous luminous source consisting of an halogen lamp and transmitted by optic fibers. We have used flashes of white light of 2.000 lux intensity and orange monochromatic light of 517 A wavelenght, 5 msec. duration and 4 Hz frequency. The extremity of the optic fibers was placed 5 cm above the infant's eye. The pre-amplifiers used have a differential entrance, a gain of 2.000 x 20, a band-pass from 0.2 to 1.000 Hz and an impedance of 2 x 1 MOhm.

The premature infant was dark adapted for a period of 30 minutes, both eyes being covered with opaque eye pads. After the registration of a static ERG with white light, the infants were submitted to a continuous white stimulus (2.000 lux intensity) for a period of 3 minutes. Immediately after we registered an ERG response every 2 minutes for a period of 16 minutes utilizing the orange stimulus.

Cases

Age (weeks)	1	2	3	4	5	6	7	8
29	28 msec / 20 uV	-	-	-	-	-	-	-
30	20 "/ 20"	28 msec / 30uV	-	-	-	-	-	-
31	n. r. / n. r.	28 "/ 20 "	-	-	-	-	-	-
32	n. r. / n. r.	24 "/ 30 "	28 msec / 40uV	-	-	-	-	-
33	26 "/ 50"	26 "/ 30 "	30 "/ 40 "	-	-	30 msec / 20uV	-	-
34	n. r. / n. r.	26 "/ 30 "	26 "/ 50 "	26 msec / 30uV	-	30 msec / uV	n. r. / n. r.	-
35	-	24 "/ 30 "	24 "/ 50"	24 "/ 40 "	28 "/ 40 "	28 "/ 30 "	26 "/ 30 "	-
36	-	28 "/ 30 "	28 "/ 30 "	24 "/ 40 "	26 "/ 40 "	n. r. / n. r.	26 "/ 40 "	26 msec / 30uV
37	-	-	-	-	28 "/ 40 "	26 "/ 40 "	-	24 "/ 40 "
38	-	-	-	-	28 "/ 30 "	-	-	26 "/ 50 "
39	-	-	-	-	28 "/ 40 "	-	-	26 "/ 50 "
40	-	-	-	-	-	-	-	24 "/ 40 "
41	-	-	-	-	-	-	-	24 "/ 50 "

Table No. 1

A-WAVE AMPLITUDE (MICROVOLTS) AND LATENCY (MSEC.) CHANGES IN SUBSEQUENT POST-NATAL WEEKS IN PREMATURE BABIES. (n. r. = not registered)

Cases

Age (Weeks)	1	2	3	4	5	6	7	8
29	140msec / 50uV	-	-	-	-	-	-	-
30	78 "/ 40 "	120msec / 50uV	-	-	-	-	-	-
31	86 "/ 50 "	82 "/ 50 "	-	-	-	-	-	-
32	62 "/ 70 "	68 "/ 60 "	112msec / 50uV	115msec / 60uV	-	90msec / 40uV	-	-
33	70 "/ 80 "	72 "/ 80 "	82 "/ 40 "	86 "/ 50 "	-	70msec / 70uV	68 "/ 60 "	-
34	70 "/ 90 "	66 "/ 90 "	60 "/ 50 "	60 "/ 70 "	80msec / 60uV	68 "/ 70 "	70 "/ 65 "	-
35	-	-	58 "/ 65 "	60 "/ 80 "	68 "/ 80 "	70 "/ 80 "	65 "/ 70 "	70msec / 60uV
36	-	-	52 "/ 65 "	56 "/ 75 "	75 "/ 70 "	60 "/ 80 "	-	72 "/ 70 "
37	-	-	-	-	62 "/ 70 "	-	-	60 "/ 85 "
38	-	-	-	-	65 "/ 65 "	-	-	54 "/ 95 "
39	-	-	-	-	60 "/ 75 "	-	-	52 "/ 100 "
40	-	-	-	-	-	-	-	50 "/ 100 "
41	-	-	-	-	-	-	-	-

Table No. 2

B₂-WAVE AMPLITUDE (MICROVOLTS) AND LATENCY (MSEC) CHANGES IN SUBSEQUENT POST-NATAL WEEKS IN PREMATURE BABIES

RESULTS

We have analysed the photopic and scotopic components of the ERG represented by a- and b_2 - waves which resulted quite always well elicited. Their changes in the early weeks after birth are reported in tables n. 1 and n. 2.

1. The a-wave amplitude and latency seem to present almost constant values in subsequent post-natal ages after birth.
2. The b_2 -wave presents an increase in the amplitude and a reduction of its latency in subsequent post-natal ages after birth.
3. These changes of the b_2 -wave seem to be more remarkable and precocious in prematures of lower gestational age than in prematures of higher gestational age.

DISCUSSION

In present study we recorded an adapto-electroretinogram with a standard averaging technique in premature infants starting from 29th gestational age week. In these newborns we also registered the ERG weekly from 4 times at least to 6 times after birth. We obtained a remarkable increase of the b_2 -wave amplitude and a precocious reduction of its latency in prematures of the lower gestational ages. On the other hand in prematures of higher gestational age these changes seem to be less evident.

Amplitude and latency of the a-wave present moderate changes in subsequent registrations during the early weeks after birth.

Results obtained suggest some speculations. The peculiar evolution of the two main electroretinographic components should be explained considering their origin in different retinal layers. According with Auerbach and Burian (1955) the a-wave represents the activity of the receptors elements, the rods and cones, while Miller and Dowling (1970) and Babel and co-workers (1977) found the b-wave origin in the inner retinal layers where it is probably produced by Müller cells.

As all the layers of the choroid, which provides to the nutritional apport to retinal receptors, are well differentiated by 7th month of foetal life, we think that may explain the almost constant electrical response of the photoreceptors in subsequent post-natal ages. Instead the evolution of retinal circulation, which supplies the inner retinal layers and is developing during the last weeks of intrauterine life, could explain the increase of b-wave amplitude and the

reduction of its latency registered in premature babies after birth. The most remarkable increase of b₂-wave recorded in prematures of lower gestational age during the early weeks of extrauterine life may be also explained by their precocious visual experience. This hypothesis is in part supported by results obtained by Sokol and Jones (1979). These A.A. in fact obtained a shorter latency of P100 VEPs components in 7 premature babies in comparison with full-term newborns, and suggested this phenomenon could be produced by a precocious visual stimulation.

Our results seem to indicate that the particular changes of b-wave in post-natal periods may be utilized to recognize the moments of greatest evolutive risk in premature infants. For that reason we think that regular study of this component of the ERG may be considered an additional and useful method for the surveillance of the anatomic maturation process of retinal tissue in the lower gestational ages.

SUMMARY

We have studied the development of the main electroretinographic components in premature infants during the first weeks of life. The method utilized was the adapted electroretinogram in condition of wake. The ERG was repeated weekly from 4 times at least to 6 times after birth in 8 prematures.

The amplitude and latency of the a-wave resulted poorly influenced by increased post-natal age. On the contrary we have registered a progressive increase of the amplitude and a similar reduction of the latency of the b-wave in subsequent post-natal weeks in premature babies of lower gestational age. Results obtained indicate that the ERG study may be considered a useful method for the surveillance of the anatomic and functional maturation of the retinal tissue in premature infants.

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