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Reliability of Electroretinogram pattern in comparison with Visual Evoked Potential in Neonatal subjects

KEYWORDS: Visual impulses, Visual evoked potential, Electroretinogram, Neonate

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ABSTRACT *Recording of visual impulses is an important task in case of subjects whom ordinary recording of such techniques are impossible. Visual Evoked Potential (VEP) and Electroretinography (ERG) are among the visual impulses that are performed in neonatal subjects with naturally no cooperation. To overcome this drawback these two techniques is performed under anesthesia. In this regard it is observed that the ERG pattern obtained in these subjects under anesthesia are more reliable than VEP one, therefore the aim of present work is an attempt to look for reliability of ERG and VEP recording under anesthesia in neonatal subjects.*

Fifty neonates referred to university polyclinic for VEP and ERG examinations were selected. Conventional electrode attachment was used to connect the electrodes to the patients. The patterns obtained were analyzed by ophthalmologist to check for the reliability of the patterns obtained.

The result obtained showed ERG patterns are more reliable in comparison to VEP one.

According to result of present work it can be concluded that ERG patterns are more reliable and the possible reason is that ERG is extracted from limited layers of retina where the complexity is less in comparison to VEP patterns which is extracted from visual pathway which starts from retina & ends up to visual cortex in brain.

I. Introduction

Diagnosis of pathological conditions is very important in neonates with naturally no cooperation. Visual system & its pathological situation is important in this connection Visual evoked potential (VEP) and Electroretinography (ERG) recording in neonates lies in this category. The following survey may be useful in this connection.

Nervous system is the most complicated organ of the human body. Several aspects of this system is not known yet. Visual pathway & retina in the visual system are the visual part of the Nervous system. Visual pathway is the segment of visual system starts from retina & ends up to occipital region in brain. Retina is the light-sensitive portion of the eye that contains photoreceptor cells rods & cones. When these two photoreceptors are excited, signal are transmitted first through successive layers of neurons in the retina itself and finally into optic nerve fibers & the cerebral cortex.[1] As it is evident, visual pathway is larger & more complex than retina in the Nervous system. There are different techniques to investigate the status of these two organs. Fluorescence angiography & Magnetic Resonance Imaging (MRI) are among the techniques to check the structural changes of the retina & visual pathway respectively.[2,3] Electrophysiological techniques are the tools to look for the functional characteristics of nervous system.[4] Visual Evoked Potential (VEP) & Electroretinogram (ERG) are the two techniques which are used to search for the functional characteristics of visual pathway & retina respectively.[5]

Visual evoked potential is the potential extracted from occipital region by light stimulation of the visual system. It is consists of different peaks in which the P100 Peak of the VEP is clinically important.[6]

Electroretinogram is the electrical response of the retina which is obtained by light stimulation of retina. ERG consists of different peaks, among which a & b peaks are clinically important.[7]

Different physiological & pathological conditions may affect the functional characteristics of visual pathway & retina in different levels, some of which are listed as follow.

Pre-eclampsia is a condition in some female subjects which is accompanied by high blood pressure during pregnancy. It is observed that pre-eclampsia affect the visual pathway i.e. it increases the latency of VEP, [8,9] P100 Peak where as it does not affect the retina.[10]

Monthly cycle is a physiological condition in female subjects. Monthly cycle temporary affects the visual pathway [11] where as no effect of this condition is reported on retina.

The aim of present work is to check out the effect of certain anesthetic i.e. Thiopental sodium on these two organs & to survey the possible effect of this drug on visual pathway & retina.

II. Materials and Methods

Fifty infants referred to university polyclinic for VEP & ERG recordings were selected. Thiopental sodium was used as an anesthetic in total population. Pantops-PC_2 was the machine to record VEP & ERG in total population. In case of VEP, three electrodes i.e. active on occipital region, reference on ear lobe & ground on forehead were used to connect the patients to the machine and record VEP patterns. For ERG also three electrodes i.e. a hard contact lens as an active electrode placed on cornea, ear ring electrode placed on ear lobe & ground electrode placed on forehead were used to connect the patients to the machine & record ERG pattern.

VEP with flash stimulator was used to stimulate the eyes of the subjects; the parameters for VEP recording were selected as follow.

Amplification (Gain x 1000: 200), filtering (low cut frequency: 0.3 HZ, high cut frequency: 35 HZ).

Averaging (test duration: 500 ms, number of cycle: 75). The specifications of flash for stimulation were, delay: 0 ms, time: 10 ms, stimuli/cycle: 1/2, Filtering color: white, Intensity: maximum lux.

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Beside VEP recording, ERG was also recorded in total population. The parameters for VEP recording were selected as follow,

Amplification (Gain x 1000: 20), Filtering (low cut frequency: 0.3 Hz, high cut frequency: 500 Hz), Averaging (Test duration 250 ms, number of cycle: 25). The specifications of flash for stimulation were, delay: 0 ms, time: 10 ms. Stimuli/cycle: 1/1, Filtering color: white, Intensity: maximum lux.

Amplitude & latency of VEP, P100 in case of VEP & amplitude & latency of b wave of ERG was measured for each infant. A group of neuro- ophthalmologist and biophysicist were selected to check the reliability of patterns obtained.

III. Results

The aim of present work is to compare & check the reliability, of electroretinogram & visual evoked potential patterns obtained under anesthesia & relate it to structural basis of origin of these potentials. Figure 1 is the sample ERG & VEP patterns obtained in different cases.

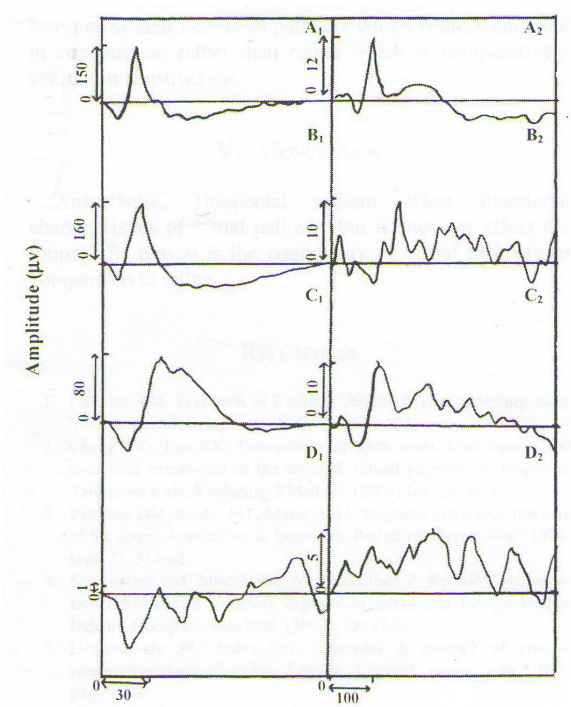

Fig. 1 Comparison of sample ERG & its counterpart VEP pattern in infant subjects in following cases.

A_1: Normal ERG pattern without anesthetic

A_2: Normal VEP pattern without anesthetic

B_1: Normal well shaped ERG pattern under anesthesia

B_2: Delayed & distorted VEP pattern under anesthesia

C_1: Broad b wave ERG pattern under anesthesia

C_2: Approximately Normal VEP pattern with two consecutive peaks under anesthesia

D_1: ERG pattern with severe fall in b wave of ERG pattern under anesthesia

D_2: VEP pattern with multi peaks under anesthesia

Figure 1- A_1 is the ERG pattern with 156 μv & 40 m sec as a voltage & latency of b wave respectively & its counterpart VEP (Figure 1-A_2) with 92 m sec as latency of VEP, P100 Peak in a healthy infant without using anesthetic. The two ERG & VEP patterns are well defined.

Figure I- B1 is the ERG pattern with 152 μv & 44 m sec as a voltage & latency of b wave respectively & its counterpart VEP (Figure 1- B_2) with 152 m sec as a latency of VEP, P100 peak in a healthy infant using anesthetic Thiopental sodium. As it is obvious from the Figure the ERG is fully normal where as it counterpart VEP is delayed & distorted in shape.

Figure 1- C_1 is the ERG pattern with 86 μv & 65 m sec as a voltage & latency of b wave respectively & it's counterpart VEP, P100 Peak (Figure 1- C_2) with 104 m sec as a latency of VEP, P 100 Peak in a subject with retinal problem & approximately normal VEP. In this case the VEP pattern seems normal as far as the latency is concerned but the two consecutive peaks are observed which makes doubtful decision where as the ERG pattern is well defined despite the dystrophy available in the retina.

Finally Figure 1- D_1 is the ERG pattern with 1 μv & 64 m sec as a voltage & latency of b wave respectively & it's counterpart VEP (Figure 1- D_2) with 226 m sec as latency of VEP, P100 Peak in case of a blind infant under anesthesia, In this case despite the severity of the case, the ERG pattern is once again well defined where as the VEP is with multi peaks which make inaccurate diagnosis.

IV. Discussion

According to figure 1 which is the sample VEP & ERG patterns obtained under anesthesia in case of the infants referred to university polyclinic, it is evident that the ERG patterns are more reliable than the corresponding VEP patterns. ERG pattern are accurate in shape & the a & b peaks of ERG are distinct & resolved completely even in severe pathological conditions, where as in case of VEP pattern this characteristics is not observed despite the care was taken to have accurate VEP patterns. The possible reason for this difference may be the adverse effect of anesthetic, Thiopental sodium on visual pathway & there by distorted VEP patterns. The adverse effect of Thiopental sodium is not observed in case of retinal layers & there by well shaped & reliable ERG patterns was obtained.

The possible reason for this discrepancy may lies in complexity of visual pathway in comparison to retinal layers. This assumption may be supported by following statements. [12]

In case of pre-eclampsia which is a pathological condition in some pregnant subjects, the adverse effect is observed on visual pathway rather than retina i.e. the VEP, P100 Peak is delayed [8,9] where as normal ERG patterns with distinct a & b peaks are obtained in these subjects. [10]

Second statement which may support the above assumption is the Monthly Cycle which is a physiological condition in female subjects. In this case the VEP, P100 Peak is delayed & the VEP patterns are not fully resolved [11] where as on other hand there is not any report of ERG changes during monthly cycle in female subjects.

The above reason supports the above assumption that the anesthetic, Thiopental sodium may affect the part of Nervous system i.e. visual pathway which is more complex in construction rather than retina which is comparatively simpler in construction.

V. Conclusion

Anesthetic, Thiopental sodium affect functional characteristics of visual pathway but it does not affect the retina. The reason is the complexity of visual pathway in comparison to retina.

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