A new electrophysiological non-invasive method to assess retinocortical conduction time in the rat through the simultaneous recording of electroretinogram and visual evoked potential

Background – Visual evoked potential (VEP) is the bioelectrical signal generated by visual cortex in response to visual stimulation. VEP is defined by 3 main components: P1, N1 and P2. On the other hand, electroretinogram (ERG) records responses of retinal cells to visual stimuli. A first component, a-wave, represents responses from photoreceptors, whereas a second component, b-wave, reflects activity of the inner retina, mainly bipolar cells. VEP is generally recorded in rodents invasively through epidural electrodes, while ERG can be recorded both invasively (with subscleral electrodes) and non-invasively (with epicorneal electrodes). Simultaneous recording of VEP and ERG allows evaluation of conduction time from retina to visual cortex, enabling to distinguish pathologies affecting retino-cortical projections from others damaging retinal tissues.

Aim of the Study – To develop a non-invasive method exploiting simultaneous recording of epidermal VEP and epicorneal ERG to study retinocortical function and to evaluate its reliability and repeatability over time.

Materials & Methods – Female wild-type DA rats were anaesthetized with ketamine/xylazine (40/5 mg/kg). Epidermal VEP (Ag/AgCl cup electrode on scalp) and epicorneal ERG (gold ring electrode on eye surface) were recorded simultaneously in response to flash stimulation (3 trains of 20 stimuli of 10 µs duration and 1 Hz frequency).

Results – ANOVA for repeated measures showed that ERG b-wave latency was stable across 6 weekly time-points ($p = 0.172$), as well as VEP N1 ($p = 0.457$) and P2 ($p = 0.062$) latencies. Mean retinocortical time from b-wave to N1 (RCT1) was 7.6 msec and remained comparable across the 6 time-points ($p = 0.426$). Mean retinocortical time from b-wave to P2 (RCT2) was 28.7 msec and did not show significant variations over time ($p = 0.086$). Coefficient of variation (Cov%) over time, adjusted for sample size, was calculated as an index of repeatability. For RCT1, Cov% was <20%, while for RCT2 and the latencies of b-wave, N1 and P2 it was always <7%.

Conclusions – Our new non-invasive method allowed to obtain latencies and retinocortical times that were constant across a long period (6 weekly time-points) and had a good CoV% over time. Through the employment of removable electrodes, this method allows to assess retinocortical function in long follow-up studies. Moreover, its non-invasiveness reduces animal distress and avoids brain and eye lesions that could interfere with physiological responses of the visual system.