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Neuroscience Discovery Services

Poster number: ADM-0609-001

VEP and ERG Monitoring in STZ-Induced Peripheral Neuropathy in Rats

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Introduction

Visual evoked potentials (VEP) and electroretinography (ERG) are crucial electrophysiological techniques for detecting signs of diabetic peripheral neuropathy. VEP measures electrical activity in the visual cortex, revealing prolonged latency and reduced amplitude in diabetic patients. These changes correlate with diabetes duration and the presence of peripheral neuropathy. ERG assesses retinal function and can detect alterations before visible retinopathy develops. Together, VEP and ERG provide a comprehensive evaluation of the visual system in diabetic patients, from the retina to the visual cortex, enabling detection and monitoring of disease progression, and assessment of intervention effectiveness. These tools offer valuable insights for managing diabetic complications and potentially improving patient outcomes. In this study we show for the first time changes in VEP and ERG in STZ induced diabetes in mice. We also correlated those changes with the traditional measurements of tactile allodynia and blood flow.

Methods

Diabetes was induced by a 0.5ml injection of Streptozotocin (STZ) at 60mg/kg dissolved in citrate buffer (pH=6) into the tail vein of each SD male and female rats. The development of diabetes was confirmed by measuring the blood glucose levels (BGL). Laser Doppler (LDF) was used to assess changes in peripheral blood flow on the foot of the animals. Tactile allodynia was assessed using von Frey methodology. Responses to cold plate (0±2ºC) and hot plate (50±2ºC) were also recorded. Visual evoked potential (VEP) and electroretinography (ERG) were assessed at the end of the study using NIM4 eclipse intra operative monitoring system. One hundred sweeps of ERG and VEPs via flash googles were averaged and the latencies and amplitudes were measured.

Conclusions

It is well established that STZ results in peripheral neuropathy, as demonstrated by changes in withdrawal responses to mechanical and/or thermal stimuli. The current study aligns with previous findings. In this study, sex differences in temperature response were observed. Female STZ-treated animals experienced a reduction in body weight, while male STZ animals failed to gain weight compared to controls.

For the first time, this study monitors ERG and VEP in STZ rats. At 2 months post-STZ administration, a significant reduction in both ERG (B-wave) and VEP amplitudes was observed.

Next Steps

- Monitoring ERG and VEP in female animals.
- Monitoring NCV in female and male animals.
- Understanding morphology changes in males and females following STZ.

Results

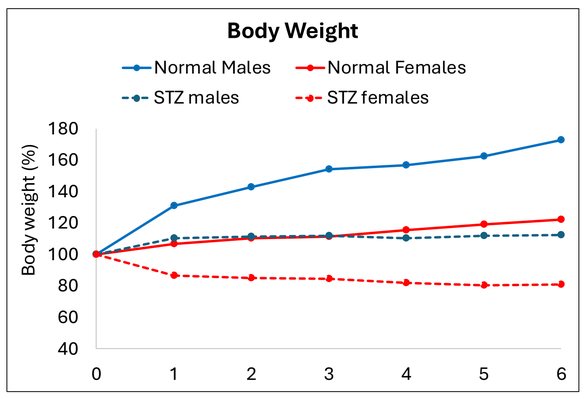


Figure 1: **Body weight.** STZ-treated animals gained less weight than normal animals. Females treated with STZ showed reduced body weight

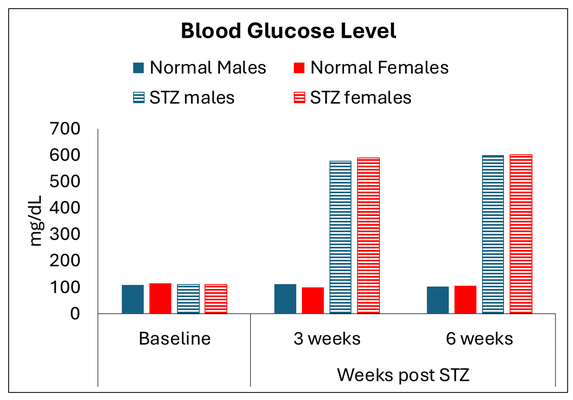


Figure 2: **Blood glucose level**. Following STZ dosing, blood glucose levels increased in all animals, with no observed sex differences.

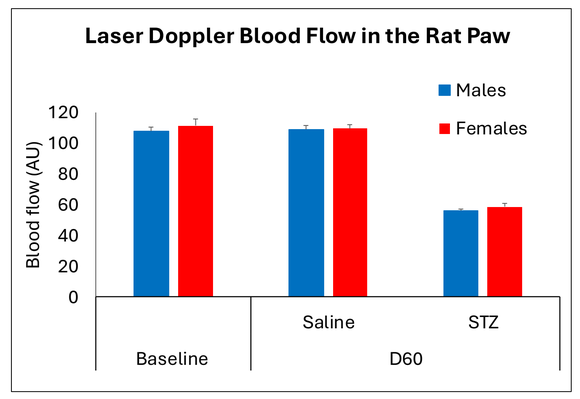


Figure 3: Laser Doppler blood flow. Following STZ dosing, foot blood flow was reduced, with no difference between females and males.

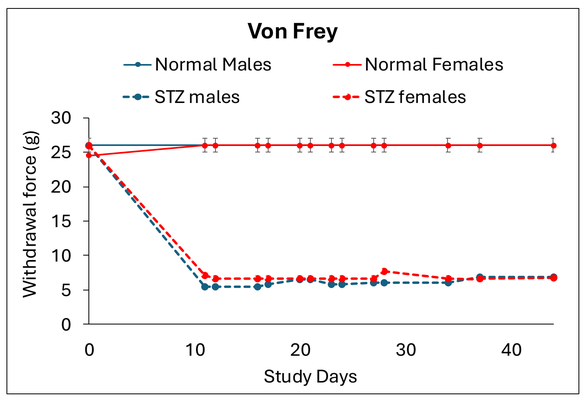


Figure 4: **Response to von Frey**. Following STZ dosing, the withdrawal force of all animals was reduced. There was no difference between female and male animals.

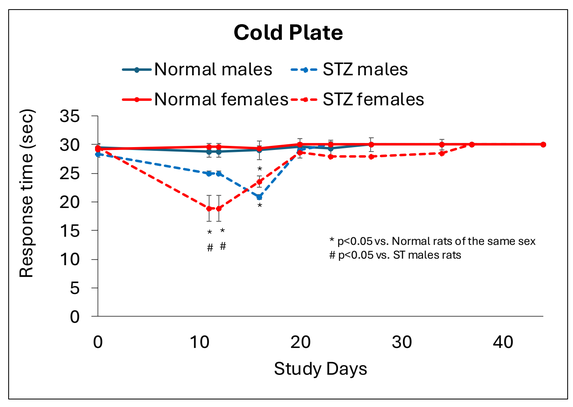


Figure 5: **Response to cold plate (0+2ºC).** Following STZ dosing, response time was reduced in all animals; however, the reduction was more pronounced in females.

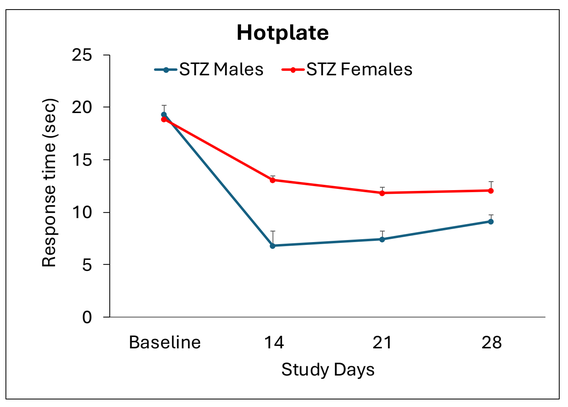


Figure 5: Response to hot plate (50±2ºC). Following STZ dosing, response time was reduced in all animals; however, the reduction was more pronounced in males.

VEP Recordings 2 Months Post-STZ Administration

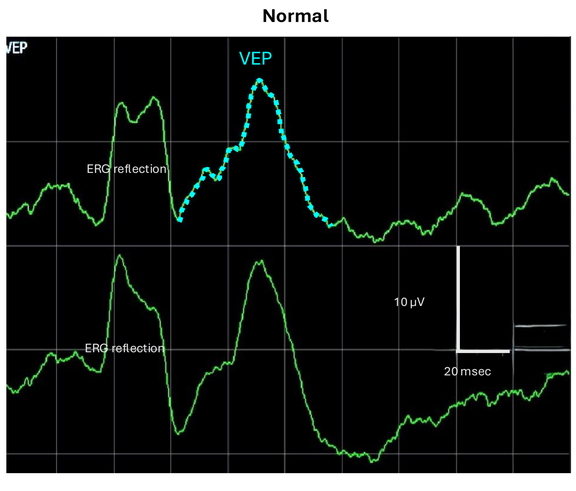


Figure 6: VEP wave in a normal animal.

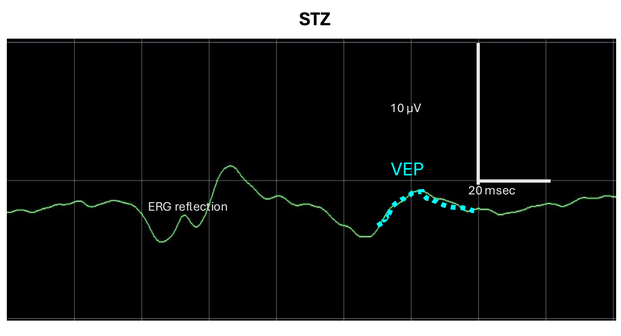


Figure 7: VEP wave in a STZ animal. A significant reduction in VEP was recorded 2 months after STZ administration.

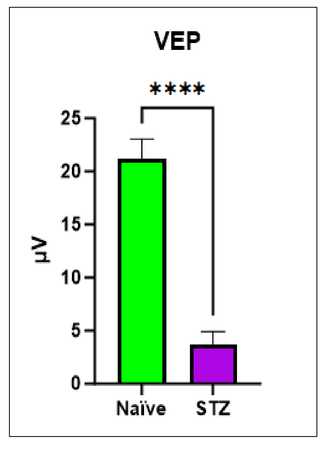


Figure 8: Mean VEP amplitude by group. Green bar: normal VEP amplitude (21.13 ± 3.75 mV); Purple bar: VEP amplitude 2 months post-STZ (3.74 ± 1.19 mV; p < 0.0001).

Electroretinogram (ERG) Recordings 2 Months Post-STZ Administration

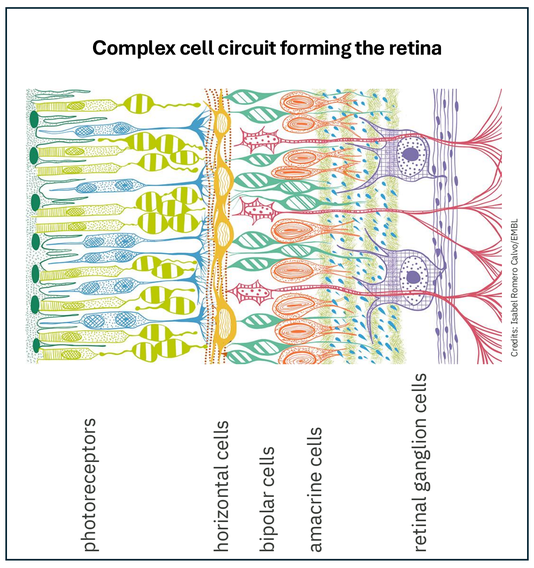
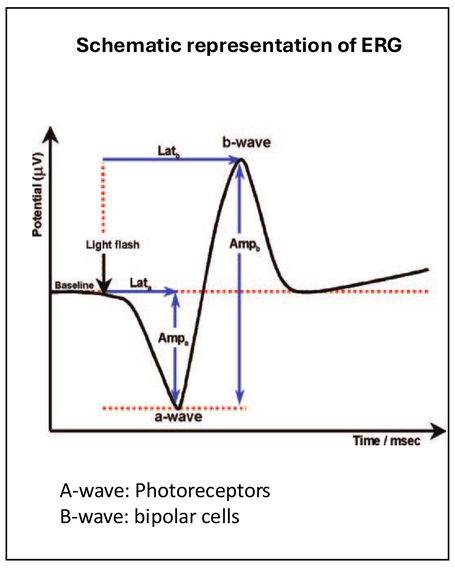


Figure 9: Schematic representation of the complex cell circuit forming the retina.



A-wave: Photoreceptors
B-wave: bipolar cells

Figure 10: Schematic representation of ERG waves and their features.

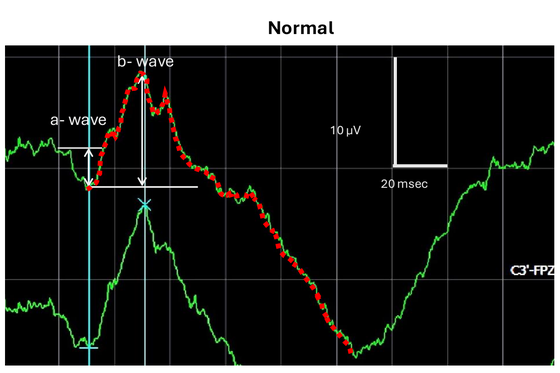


Figure 11: **ERG wave in a normal animal**. The A-wave and B-wave are clearly visible, with the B-wave highlighted in red. The A-wave was not quantified due to its small size and variability.

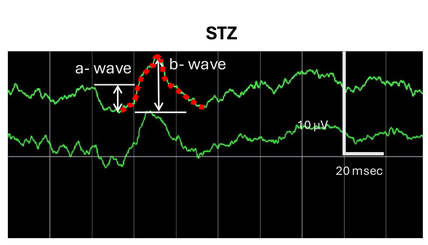


Figure 12: **ERG wave in a STZ animal.** The B-wave, marked in red, shows a clear reduction at 2 months post-STZ induction.

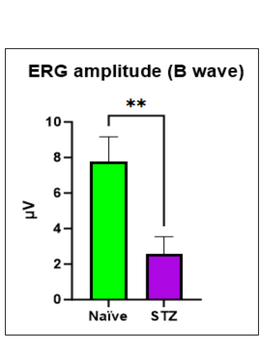


Figure 13: Mean B-wave amplitude by group. Green bar: normal ERG amplitude (7.76 ± 0.35mV); Purple bar: ERG amplitude 2 months post-STZ (2.58 ± 0.96mV; p < 0.001).