THE EFFECT OF DIRECT ELECTRIC CURRENT ON MOTION BEHAVIOUR IN A TRANSGENIC β-AMYLOID MODEL OF CANEORHABDITIS ELEGANS: AN IN-VIVO STUDY

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INTRODUCTION and AIM

Alzheimer's disease (AD) is a neurodegenerative disease that occurs due to neuron and synapse losses in various parts of the central nervous system, resulting in decreased cognitive functions, self-care deficiencies, and various neuropsychiatric and behavioral disorders. It is accepted to be associated with neuronal accumulation of β-amyloid (Aβ) protein resulting in neuronal dysfunction, cognitive disorders, dementitia, behavioural and personality changes. Caneorhabditis elegans (C. elegans) is a microscopic, non-pathogenic organism that is approximately 1 mm tall, living in the bottom of trees in nature. It is a nematode that can survive by feeding with bacteria (Escherichia coli OP50 strain) in a petri dish under laboratory conditions. This organism has two genders, hermaphrodite and male. Males make up less than 0.5% of the population. C. elegans has four (L1-L4) larval stages for about 3 days continued with adult form that can produce embryos (1) (Figure 1). The main reasons why C. elegans was chosen as a model organism in this study were its 60 – 80% similarity of human genome and its short life of 20 days. Aβ1-42 accumulates in an oligomeric form in body muscle cells of transgenic C.elegans leading to paralysis at 25ºC within 24 hours. Aβ1-42 oligomerizes, accumulates in muscle cells in the body walls, resulting in severe and fully penetrating age-related progressive paralysis (2). Mild electrical stimulation has been shown to have a positive effect on wound healing, mental illness, neuromuscular activity, and inflammation and pain reduction (3). As we could reach the literature, C. elegans, AD and electricity issues have not been studied within the same study, though there have not been adequate studies related with C. elegans and electricity. The aim of our study was to investigate the effects of direct electric current on AD and to diminish the prominent effects of dementitia symptoms in an in-vivo transgenic β-amyloid model of C.elegans.

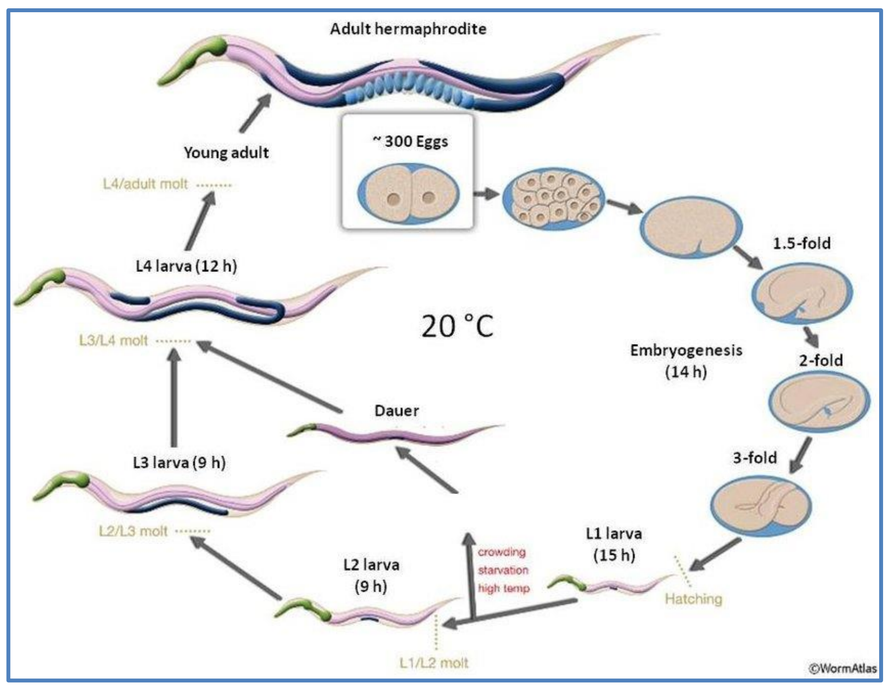

Figure 1: Life cycle of C. elegans

METHODS

Transgenic C.elegans were maintained in 50 mL Nematode Growth Medium (NGM) placed in rectangular petri dishes (6x9x3 cm)plated with copper on two sides. Killed 500 µL OP50-1 E. coli containing 25 µM 5'-fluorodeoxyuridine was added in the middle of NGM and this setting was dried overnight. Adult transgenic β-amyloid model C. elegans were synchronized with a concentration of 30 micro-organisms in each petri dishes at 25ºC. Petri dishes were exposed to direct electric current for 10 minutes per one hour within periods via the copper plates placed on their two edges (Figure 2). The study groups were classified as 1 V Group, 1,5 V Group and control group with no electric exposure. Healthy, dead and paralyzed C. elegans for every study group were counted after every exposure to electric current (Figure 3). Dead or paralyzed C. elegans were destroyed by fine-tipped loop at high temperatures.The direct electric current exposure was repeated until no alive C. elegans could be seen in petri dishes. Kaplan–Meier Survival Analysis was conducted for survival analysis (Figure 4).

Figure 2: Experimental set-up

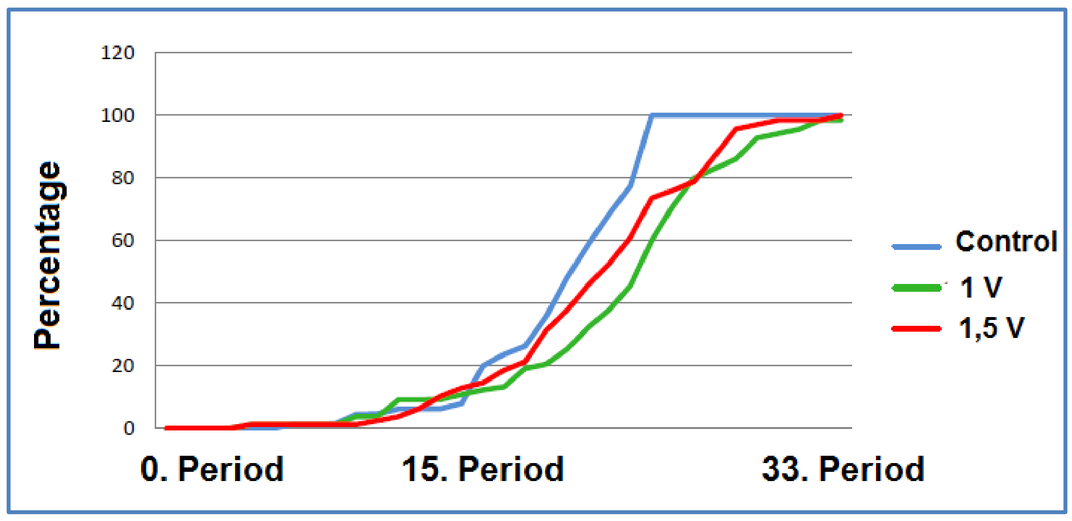

Figure 3: Vital percentage of C. elegans per period

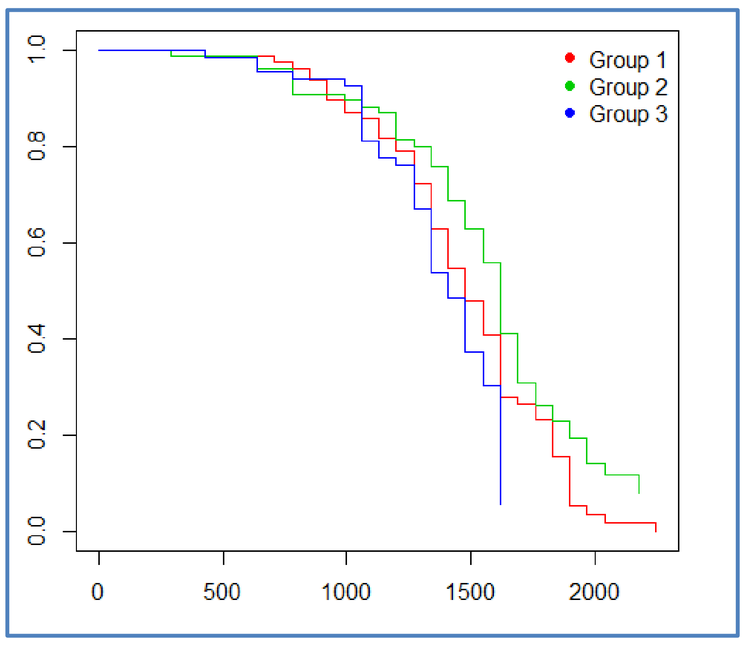

Figure 4: Kaplan-Meier Survival Analysis

RESULTS

The first paralyzed C. elegans was observed in 1 V and 1,5V Groups between 3rd - 6th hours periods. The most paralyzed C. elegans were around 16th hour periods. All C.elegans were paralyzed at 24th period in control group and and at 32nd period in 1.5V Group except the lost ones. One alive C. elegans was observed at 33rd period in 1 V Group. The experiment was ended as all C. elegans were paralyzed in 1,5 V and control groups. The survival estimation for 1 V Group was higher than the other study groups (p=0,001).

CONCLUSION

The statistical significance of 1 V Group compared with other study groups suggests that direct electric current exposure might prevent paralysis in transgenic β-amyloid model of C.elegans, regarding its genomic similarity to human genome. Further studies in human AD should be elucidated by means of implementing direct electric current treatment.

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