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Hereditary predisposition to seizures in response to handling and its relation to life expectancy in the water vole (*Arvicola amphibius* L.)

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Motivation and Aim: Individuals predisposed to seizures were found in natural and captive-bred populations of water voles. Finding out the genetic factors of predisposition to seizures in response to specific external stimuli (such as flashes of light, auditory, olfactory, or tactile stimuli) is important for understanding the causes of seizures and developing new methods for prevention and therapy of convulsive states.
Methods and Algorithms: The data of long-term maintenance and breeding of water voles in vivarium were analyzed in order to find out a hereditary predisposition to convulsive seizures in response to handling, and the influence of sex and age on their development.
Results: Under vivarium conditions, seizures in water voles were provoked by handling. A seizure typically commenced with jerks with the vibrissae, gradually increasing in magnitude. The next stages were a tonic tension of the muscles of the anterior part of the body, rhythmic movement of limbs, "wild" running. Seizures were observed in 2.4 % of voles taken from the natural population with cyclic fluctuations in abundance and in 29.8 % of descendants of captive-born water voles. The minimum age of the first observation of seizures was 39 days, the maximum age – 1105 days, and the median age – 274 days. Predisposition to seizures was not related to sex. We hypothesize that the seizure is a behavioral anti-predator adaptation that evolved through evolution. Seizure-prone individuals may have a selective advantage at the peak phase of population cycle, when predation increases. Propensity to seizures is a heritable trait. The proportion of individuals prone to seizures increased significantly if one or both parents had seizures. In parent–offspring pairs, a positive correlation was found between the average age of the onset of the first seizures in parents and their offspring, $r = 0.42$, $p < 0.01$. Genes, that control the occurrence of seizures, have a pleiotropic effect on life expectancy: seizure-prone individuals live longer, than individuals with a normal phenotype (Fig. 1). The presence of an interconnectedness of the effects of genes that control the occurrence of seizures and life expectancy confirms the data on the effect of maternal convulsive status on the life expectancy of offspring. The offspring of seizure-prone mothers live longer than the offspring of mothers with a normal phenotype. The life expectancy does not depend on the convulsive status of the father. It is possible that predisposition of females to seizures is genetically correlated with physiological parameters during pregnancy, lactation, or maternal behavior, which, in turn, determine the life expectancy of the offspring. Thus, the water vole can serve as a suitable model object for studying the causes of convulsive states and the evolution of longevity.

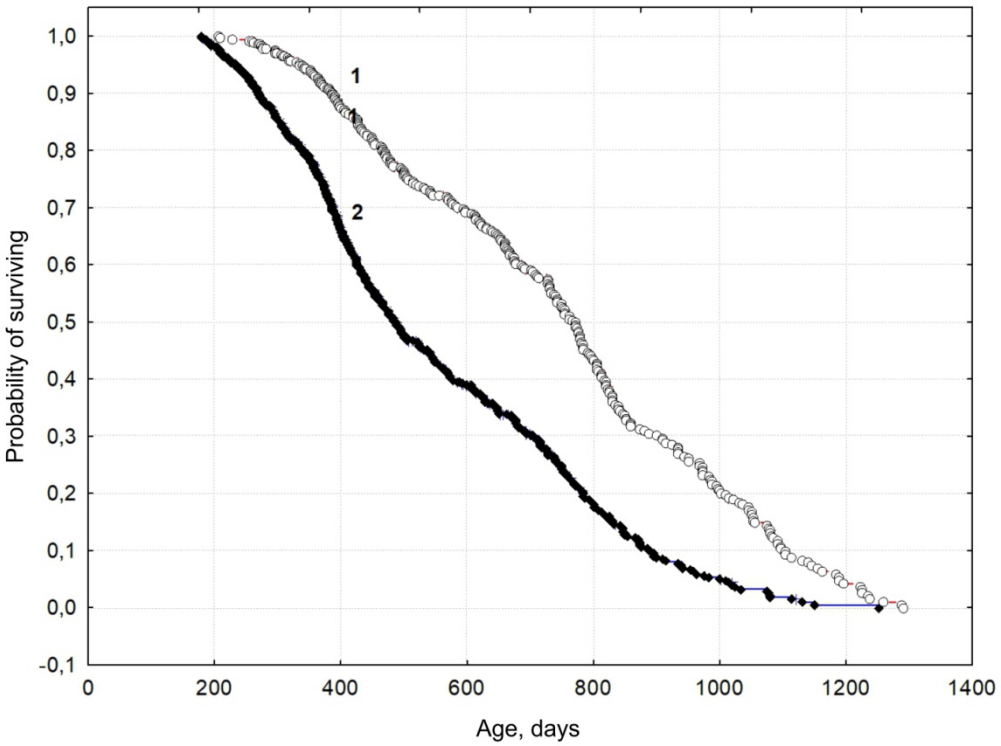

Fig. 1. Survival curves for two groups of voles: seizure-prone (1) and seizure-free (2)

Conclusion: The data obtained indicate the possibility of selection for the predisposition to seizures in response to handling in water voles, in order to study the mechanisms of epileptogenesis and longevity.

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