

Chromosome synapsis and recombination in intraspecific and interspecific heterozygotes for chromosomal rearrangements in voles of the genus *Alexandromys*

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Motivation and Aim: In the early stages of speciation, an increase of genetic or karyotypic divergence can lead to the formation of postzygotic reproductive isolation. In mammals, one of the key mechanisms of reproductive isolation is hybrid sterility that occurs gradually. Closely related vole species of the genus *Alexandromys* (Rodentia; Arvicolinae) provide a convenient model for studying the formation of hybrid sterility between species with a high level of chromosomal polymorphism. Heterozygotes for chromosomal rearrangements form different synaptic configurations in prophase I of meiosis that leads to synaptic and recombination disorders. These aberrations, in turn, lead to the apoptosis of gametocytes and stop of gametogenesis.

Methods and Algorithms: To elucidate the cytological mechanisms of the formation of hybrid sterility between three species of the genus *Alexandromys*, we analyzed the dynamics of spermatogenesis in intraspecific (*A. evoronensis*) and interspecific male hybrids (between *A. evoronensis*, *A. maximowiczii* and *A. mujanensis*). Using immunolocalization of key meiotic proteins, we analyzed synapsis and recombination at pachytene stage in hybrids and parental species.

Results: Despite the formation of a large number of heteromorphic bivalents and trivalents, the frequency of recombination events per cell in male intraspecific hybrids of the *A. evoronensis* was comparable to that of the parental species. We also did not observe negative heterosis for this trait in interspecific hybrids between the *A. mujanensis* and *A. maximowiczii*. However, a number of different meiotic anomalies between interspecific hybrids of different interspecific crosses was found. According to the results of histological analysis, intraspecific hybrid males of the *A. evoronensis* were fertile, while interspecific hybrid males of three closely related species of *Alexandromys* voles were sterile with spermatogenesis stopped during meiosis.

Conclusion: Multiple disturbances in autosomal synapsis and an increased frequency of sex chromosome asynapsis seemed to be the main cause of meiotic arrest and spermatocyte apoptosis in interspecies hybrids. The severity of meiotic disorders in the vole hybrids analyzed varied significantly, which reflects the presence of chromosomal polymorphism in the two out of three species examined, as well as the phylogenetic similarity of all three species and the high rate of karyotypic divergence.

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