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Evolution by tumor neofunctionalization and expression of evolutionarily novel genes in tumors

Earlier I formulated the hypothesis of the possible evolutionary role of tumors. This hypothesis suggests that heritable tumors supply evolving multicellular organisms with extra cell masses for the expression of newly evolving genes. After expression of novel genes in tumor cells, tumors differentiate in new directions and may give rise to new cell types, tissues and organs. In the presentation, the data supporting the positive evolutionary role of tumors will be reviewed, obtained both in the lab of the author and from the literature sources. The following issues will be addressed: the widespread occurrence of tumors in multicellular organisms; features of tumors that could be used in evolution; the relationship of tumors to evo-devo; examples of recapitulation of some tumor features in recently evolved organs; the types of tumors that might play the role in evolution; examples of tumors that have played the role in evolution. The expression of evolutionarily novel genes in tumors was predicted by hypothesis of the possible evolutionary role of tumors. In my lab we described several genes evolutionarily novel genes expressed specifically or predominantly in human tumors (OTP, ESRG, PVT1, ELF1-AS1, HHLA1, DCD, SPRR1A, PBOV1 and others). We also described the evolutionary novelty of the whole classes of genes expressed predominantly in tumors, i.e. CT-X genes and genes of noncoding tumor specifically expressed RNAs. We studied the phylogenetic distribution of the orthologs of genes expressed in tumors and found that different functional gene classes have different evolutionary novelty. Some of them are enriched by evolutionarily novel genes. We showed that evolution of oncogenes, tumor suppressor genes and differentiation genes occurs in a parallel way, which supports the participation of tumors in the origin of new cell types. Some human genes which determine progressive traits originated in fishes and were first expressed in fish tumors. The existing data suggest that genes originated by gene duplication; from endogenous retroviruses; by exon shuffling; and de novo are expressed in tumors, sometimes with high tumor specificity. The conclusion will be made that the expression of evolutionarily novel genes in tumors may be a novel biological phenomenon with important evolutionary role.

Biography

A P Kozlov Graduated from St Petersburg University in 1972. From 1972-1975, he performed his Postgraduate studies at the N N Petrov Institute of Oncology, and defended his PhD. He discovered first cases of HIV infection in Russia, performed the first in Russia isolation of HIV and field studies of HIV/AIDS epidemic, described the nascent phase of HIV/AIDS epidemic which took place in Russia in 1980s and 1990s, and transition to concentrated phase. In 2010, he described the "genetic bottleneck" in HIV transmission among IDUs at St Petersburg. In the field of oncology he developed the concept of the possible evolutionary role of heritable tumors which was recently summarized in his book "*Evolution by Tumor Neofunctionalisation*", Elsevier/Academic Press, 2014. For several years he served as a member of Advisory Board for the Committee of Science and Education of Russian Parliament. He won the Russian national Chumakov, Vernadsky and Mechnikov awards for research in AIDS, immunology and biotechnology, and international Paul Harris Fellowship for his contribution in fighting AIDS and other infectious diseases.

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