New research project in mathematical oncology

A new interdisciplinary research project aims to uncover information that can help decode hereditary colon cancer with the aid of mathematical models. Mathematicians and tumour biologists of Heidelberg University, the Heidelberg Institute for Theoretical Studies, Heidelberg University Hospital, and the German Cancer Research Center are collaborating on the project. The participating researchers are receiving a three-year grant from the Klaus Tschira Foundation to develop suitable models and prepare the needed medical data. By combining mathematics and medicine, they hope to reach a better understanding of tumour initiation, evolution, and immunology and to develop approaches that may prevent hereditary tumours in the future.

The focus of the planned project is on what is known as Lynch syndrome. Carriers of this genetic predisposition have an increased risk of colon cancer as well as malignant tumours in other organs. It is the early stages of tumour development, in particular, that are crucial for developing effective preventive measures. The researchers in the "Mathematics in Oncology" project expect mathematical modelling to provide new momentum for translational research.

"Based on mathematical models, we can observe and compare different temporal evolutions of tumour development. The comparison with medical data allows us to select scenarios that appear plausible and worthy of closer study," explains Prof. Dr Vincent Heuveline, research group leader at the Interdisciplinary Center for Scientific Computing of Heidelberg University and the Heidelberg Institute for Theoretical Studies. For this approach, hereditary tumour syndromes like Lynch syndrome represent a crucial area of research because the early genetic steps of tumour development are known and initial models for possible cancer development pathways already exist, according to Prof. Dr Magnus von Knebel Doeberitz, Medical Director of the Department of Applied Tumor Biology at Heidelberg University Hospital and head of an eponymous Clinical Cooperation Unit at the German Cancer Research Center.

On the biomedical side, genetic and molecular analyses of tumours and their preliminary stages are of primary importance. They form the basis for the medical data and hence for mathematical modelling. Because certain mutations play a decisive role in tumour development, high-resolution mutation profiles that occur in connection with Lynch syndrome will also be prepared. "The grant from the Klaus Tschira Foundation allows us to use innovative methods that are specifically customised to the mutation spectra of Lynch syndrome tumours," stresses Dr Aysel Ahadova, a researcher in the Department of Applied Tumor Biology.

According to the scientists, the close interdisciplinary cooperation between mathematics and medicine is key for their work. By developing a common "language", it will be possible to check medical hypotheses using mathematical models and in turn glean new medical findings. "From the results of our research, we expect pivotal data to help us better prevent the development of Lynch syndrome tumours in future," emphasises Dr Matthias Kloor, head of the "Immune Biology of MSI Tumours" working group in the Department of Applied Tumor Biology. Other members of the cooperation project include doctoral researchers Valentin Schmid and Saskia Haupt.

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Further information

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