O-12.2 Invited speaker

The metastatic cascade- does oncology need the physics of cancer?

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Despite that genetic changes are the origin of cancer, gene expression only contains 50% of the information to fully understand the disease. 90% of all cancer deaths can be attributed to metastasis. Collective, collaborative processes in the metastatic cascade that are emergent are optimally described by tissue and cell mechanics based on the basic requirement that cancer cells have to squeeze through dense tissues. The onset of cancer cell motility as a prerequisite of metastasis requires a shape-induced unjamming transition. Collectively elongated cells can pass by each other by performing topological T1-transitions. The interactions of these motile cancer cells with the surrounding ECM lead to self-organization. Actively moving streams of cancer cell clusters are embedded in the ECM and can be described as active nematic droplets embedded in a passive nematic scaffold. Elongated cell und nucleus shape (CeNuS) as well as the distribution of topological defects in the ECM can serve as potential prognostic tumor markers in the clinic. First retrospective clinical trials indicate that we can improve diagnosis by more than 25%. These two markers define a new approach in digital histolgy: pathomechanics that connects tumor dynamics and geometry. Ultimately, this may lead to a novel types of therapy, so called migrastatics therapies that inhibit cancer cell motility.