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Contour instabilities and micro-structures in early tumor growth models MARTINE BEN AMAR, Ecole Normale Supérieure, PASQUALE CIARLETTA, Université Pierre et Marie Curie, CLÉMENT CHATELAIN, THIBAUT BALOIS, Ecole Normale Supérieure — Clinical diagnosis of skin cancers is based on several morphological criteria, among which growth, color, border instabilities and microstructures (e.g. dots, nests) sparsely distributed within the tumor lesion. We use the multiphase mixture models adapted to the skin to explain various patterning occurring in the avascular phase. Restricting to a simple but realistic version of these models with an elastic cell-to-cell interaction and a growth rate dependent on diffusing nutrients, we prove analytically that the tumor cell concentration at the border acts as a control parameter inducing a bifurcation with loss of circular symmetry which explains the instabilities of the tumor border. The finite wavelength at threshold has the size of the proliferating peritumoral zone. We apply our predictions to melanoma growth since these instabilities are crucial for the early diagnosis. The same model is used to show the existence of micro-structures. Taking into account a reaction-diffusion coupling between nutrient consumption and cellular proliferation, we show that two-phase models may undergo a spinodal decomposition even when considering mass exchanges between the phases. The cell-nutrient interaction defines a typical diffusive length in the problem, which is found to control the saturation of a growing separated domain, thus stabilizing the microstructural pattern. The distribution and the evolution of such emerging cluster morphologies are successfully compared to the clinical observation of microstructural patterns in tumor lesions.

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