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Blood vessel network remodeling during tumor growth

With the help of a theoretical model the process in which a growing tumor transforms a hierarchically organized arterio-venous blood vessel network into a tumor specific vasculature is analyzed. The determinants of this remodeling process involve the morphological and hydrodynamic properties of the initial network, generation of new vessels (sprouting angiogenesis), vessel dilation (circumferential growth), blood flow correlated vessel regression, tumor cell proliferation and death, and the interdependence of these processes via spatio-temporal changes of blood flow parameters, oxygen / nutrient supply and growth factor concentration fields. The emerging tumor vasculature is non-hierarchical and compartmentalized into different zones. It displays a complex geometry with necrotic zones and "hot spots" of increased vascular density and blood flow of varying size. The origin of these hot spots is discussed. The blood vessel network transports drug injections efficiently, but the computation of the interstitial fluid flow shows that most of the drug is quickly washed out from the tumor after extravasation.