Researcher uses micro-fabricated blood vessels to study tumor growth and anti-angiogenic cancer therapy

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Researchers have established a 3-D microfluidic system to study a biological process known as endothelial sprouting. This process represents an early step in new blood vessel growth called angiogenesis.

Breakthroughs in an integrated understanding of angiogenesis will benefit researchers in broad biomedical fields, including cancer, vascular science, and tissue engineering. The reason for this interest in the cancer field is that tumors must access the host blood supply to obtain nutrients essential for growth. They do this by co-opting nearby blood vessels, causing them to sprout into and vascularize the tumor bulk in angiogenesis. The progression of the tumor results in fatal cancer.

Scott Verbridge, assistant professor in the School of Biomedical Engineering and Sciences at Virginia Tech, along with senior investigators at the Cornell University Physical Sciences-Oncology Center, developed the system using in vitro models, or living engineered tissues, with support from the National Cancer Institute's Physical Sciences in Oncology.

In the scientific community, relatively little is known about the integrated physico-chemical processes involved in angiogenesis. Blood vessel intrinsic processes can augment or inhibit cell sprouting initially driven by chemical signals from the tumor cells, such that drugs designed to block these tumor-derived chemical triggers may not always be effective. However tools to study these important details have been lacking.

"Angiogenesis has been extensively studied in this field and is one of the areas where innovative microenvironment-targeted therapies have actually made it to patients. However these treatments do not work nearly as well as people hoped," said Verbridge. "Developing in vitro models will help us understand the various regulators of angiogenesis, how these may influence the efficacy of current treatments, and motivate new treatment ideas."

The system uses natural tissue materials, consisting of three defined microchannels embedded in type I collagen hydrogels, designed to imitate the structural support into which new blood vessels regenerate. Two parallel side channels provide the means to create biochemical gradients that cross the endothelial cell-coated central channel.

New blood vessel sprouting transpires when gradients of vascular endothelial growth factor (VEGF) are applied across the central channel, however blood vessel geometry and density were also unexpectedly found to strongly regulate sprouting dynamics.

The results are described in a paper published in the *Journal of Biomedical Materials Research Part A* and highlight the importance of mechanical factors, as well as biochemical ones.

More information: onlinelibrary.wiley.com/doi/10.... 002/jbm.a.34587/full

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