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Early cancer theranostics by *in vivo* detection and eradication of circulating tumor cells

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Despite substantial efforts to understand cancer biology, metastases, which cause up to 90% of cancer deaths are still poorly diagnosed and treated. As a result, the mortality rate for metastatic cancer continues to lack significant improvement. In most cases untreatable metastatic disease may already be established at the time of the initial diagnosis with existing diagnostic techniques including circulating tumor cell (CTC) assays. We proposed new concept of early cancer diagnosis by *in vivo* examination of an entire blood volume (~5 L) using photo-acoustic flow cytometry (PAFC) based on the irradiation of a hand blood vessel with laser and detection of laser-induced acoustic waves from single CTC with ultrasound transducer attached to skin. This report summarizes recent advances in this technology with focus on the preclinical studies, the development of clinical prototype and its application for early detection of rare CTCs in melanoma and breast cancer patients. We demonstrate that PAFC has a potential dramatically (1000-fold) improve CTC detection limit, ultimately up to a few CTCs in whole blood volume released from undetectable yet small tumor with size <1-3 mm and provides real-time eradication of CTCs, when metastasis has not yet developed and, hence well-timed therapy is more effective. We present direct evidence that medical procedures such surgery, radiation and chemotherapy may trigger cancer cell release from the primary tumor in the circulation, thus increasing the risk of metastases. This finding indicates the importance of guidance of cancer treatment by real-time monitoring of CTC dynamics followed by preventive anti-CTC therapy.

Biography

Vladimir Zharov is Director of Arkansas nano-medicine Center at Winthrop P Rockefeller Cancer Institute. He received PhD and DSc degrees from Bauman Moscow State Technical University (BMSTU), completed a Postdoctoral fellowship at Lawrence Berkeley National Laboratory and served as the Chairman of Biomedical Engineering Department at BMSTU. His record of innovative achievements is documented in ~200 publications (5 in Nature Journals), 52 patents and 5 books. He is the State Prize Winner, the most prestigious national award in Russia, and the first recipient of the US Maiman Award, named after the inventor of the first laser.

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