NanoMedicine – Targeted Drug Delivery

The use of conventional pharmaceutical drugs has been significantly limited by inadequate delivery of therapeutic doses of drugs to the target tissues as well as by occurrence of massive side effects on healthy tissues. Therefore, the development of targeted delivery of therapeutic agents to specific sites in the body has become an important area of biomedical research. Recent progress in nanotechnology enables creation of useful, functional biomaterials, devices, and systems of nanometer scale in a dimension which can be manipulated for targeted delivery of specific molecules. Growing body of evidence has demonstrated that application of nanotechnology to medicine ("NanoMedicine") is becoming one of the most emerging and rapidly developing research areas. Indeed, biomedical applications of nanotechnology have shown great promises in the improvement of diagnosis and treatment of various human diseases. One of the most attractive applications of nanotechnology is the novel drug delivery system by conjugating target molecules and therapeutic drugs onto a functionalized nanoparticle. A variety of nanoparticles including polymer, liposomes, dendrimers, quantum dots, and noble metals have been investigated to develop novel multi-functional and targeted drug delivery systems. This technique has provided great possibilities in developing novel systems that can deliver drugs selectively to targeted tissues or cells and minimize systemic side effects. The potential for using nanoparticles bioconjugated with a specific ligand and biologically active compound to target cell surface molecules, however, has not been fully explored. The long-term goal of our laboratory is to create an innovative and multi-disciplinary research program by developing novel, effective intervention strategies to improve the quality of health through biomedical applications of nanotechnology. The Laboratory of Vascular Biology currently focuses on the development of novel bioconjugated nanoparticles and validation of their effectiveness for targeted drug delivery. The specific objectives include: (1) to design, synthesize, and characterize novel bioconjugated nanoparticles for targeted drug delivery; (2) to determine the ability of the novel bioconjugated nanoparticles to target specific tissues or cells; and (3) to determine the effectiveness of the novel bioconjugated nanoparticles in human chronic diseases such as atherosclerosis and cancer using animal cell culture and experimental animal models.

VIRGINIA TECH WAKE FOREST UNIVERSITY
School of Biomedical Engineering and Sciences
Laboratory of Vascular Biology

The prime innovative strength of this research is the introduction of nanotechnology into the field of therapeutic applications of human chronic diseases such as atherosclerosis and cancer. Studies in this area are anticipated to advance the understanding of how nanotechnology can contribute to improvements in human health as well as to providing new opportunities for diagnostic and therapeutic explorations. Additionally, it will generate and disseminate knowledge to improve human health by interdisciplinary collaborations in biomedical sciences, molecular imaging, polymer chemistry, and nanotechnology. Therefore, the successful execution of this research will have a broad impact on both basic and clinical sciences, and will benefit a wide range of science and non-science communities. More specifically, it will have the potential to translate basic laboratory discoveries into clinically effective treatments that eventually make great contributions to the development of new therapeutic approaches.