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Streszczenie rozprawy doktorskiej w języku angielskim

Biofunkcjonalizacja powierzchni stentów kardiowaskularnych za pomocą przeciwciał promujących progenitorowe komórki śródbłonka

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Summary

Atherosclerosis is currently, one of the most serious civilizational diseases of cardiovascular system, which causes coronary circulation disorders, through the formation of atherosclerotic plaque and successive blood vessels occlusion. Angioplasty procedure, using cardiovascular stents, became a direct solution to coronary artery lumen narrowing.

Stents can be divided into separate groups, which among others, include functionalized drug eluting stents (DES), biodegradable stents (BRS) or stents with immobilized biomolecules, which promote the proliferation of mature endothelium cells (ECs) (such as Genous stent with immobilized anty-CD34 antibodies). According to current literature and recent clinical findings, all of the mentioned types of intravascular implants have major long-term flaws, related to biocompatibility.

Scientific aim of conducted research was to develop highly biocompatible biofunctionalized coating for cardiovascular stents, used in coronary angioplasty procedures. Implantation of such biomaterial is supposed to minimize the risk of post-operative complications of percutaneous coronary intervention (PCI). Anti-CD133 antibodies and anti-VEGFR2 single-chain variable fragments (scFvs), both specific towards endothelial progenitor cells (EPCs), were used in experimental work.

Through the course of the research, multistep chemical and biochemical biofunctionalizations of cardiovascular surfaces were conducted and successfully monitored with the use of spectroscopic methods, such as Attenuated Total Reflection Fourier Transform Infrared Spectroscopy Spectroscopy (FTIR-ATR) and FT-Raman spectroscopy. Furthermore, microscopy techniques were used for evaluation purposes as well, this included Scanning Electron Microscopy (SEM), Atomic Force Microscopy (AFM) and fluorescence microscopy. After structural and nanostructural characteristics were evaluated, series of *in vitro* experiments were performed for preliminary assessment of biocompatibility properties of developed biofunctionalized biomaterials. *In vitro* testing was conducted with the use of endothelial progenitor cells, vascular smooth muscle cells (VSMCs) and human umbilical vein endothelial cells (HUVECs).

Obtained *in vitro* results were promising, hence the prototypes of biofunctionalized, cardiovascular stents were further evaluated in *in vivo* experiments, with the use of small animals. First group comprised of guinea pigs, used for allergological skin testing, and the second of rats for the analysis of tissue nanotitania distribution, through intraperitoneal implantation and subsequent atomic absorption spectroscopy (AAS) evaluation.

Obtained research results confirm that a successful and effective immobilization of specific antibodies on modified cardiovascular surfaces was achieved. Biofunctionalized materials were characterized by spectroscopic and microscopic methods, which allowed for initial evaluation of biocompatibility *in vitro* and *in vivo* on small animals. Acquired modified materials gave the grounds for the new stent prototype to be developed. Such biomaterial has the potential to minimizing the risk of post-operative complications occurrence, thus improving the survivability and well-being of patients that underwent the intravascular implantation. Such outcomes may constitute a great basis for future clinical trials.

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