NIH Award from the National Heart, Lung, and Blood Institute

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- Project: A Revolutionary Therapy for Atherosclerosis: Liquid Cast Arterial Stents
- Start Date: September 30, 2009
- Total Award Amount: $994,105

How the results of this project will benefit society:
The development of a bioactive and biodegradable liquid cast arterial stent will lead to a radical departure in the treatment of atherosclerosis. To our knowledge, this is the first proposal to create a biodegradable arterial stent that forms in the body and is tailored to the patient’s individual anatomy. Given the widespread nature of atherosclerosis, and the prevalence of arterial stenting, this highly innovative and novel translational research has the potential to impact millions of Americans. Thus, this project has tremendous relevance to public health as it will change the way we think about promoting arterial health following vascular interventions.

The problem the project is trying to solve:
The broad, long-term objective of this proposal is to develop new and improved stent technology that will radically change the way we view arterial stenting. We propose to develop a liquid drug-eluting biodegradable stent that will polymerize in the body and mold to the contour of the freshly angioplastied artery. We will use a biocompatible elastomeric citric acid-based polymer, polydiolcitrate (PDC) that will be diazeniumdiolated to spontaneously release nitric oxide (NO) when placed in the circulation. Given that NO inhibits platelet aggregation and vascular smooth muscle cell proliferation and stimulates endothelial cell growth, and given the biocompatible nature of PDC, this technology will serve to protect the freshly angioplastied artery from thrombosis while simultaneously promoting vascular healing. This approach will overcome the challenges of bare-metal, drug-eluting, and pre-formed biodegradable stents by being tailored to the contours of the individual artery and coat the entire surface of the artery, thereby greatly reducing the thrombogenic potential and providing the greatest surface area for drug delivery. The strength of PDC can be modified by varying the degree of acrylation, thereby giving PDC physical properties ideal for the vasculature.

This stent will be simple to deliver, obviating the need for a complicated delivery device, and be cost-effective to manufacture and use. Lastly, the stent will degrade over time, leaving a healthy prosthetic-free artery.

How the project will work:
Our hypothesis is that a liquid cast NO-eluting biodegradable PDC stent will have superior patency rates compared to conventional bare metal stents following percutaneous balloon angioplasty. The specific aims of this 2-year proposal are to: (1) optimize NO release from the diazeniumdiolated PDC; (2) determine the optimal conditions to polymerize the NO-PDC using thermal or photo polymerization in situ that will provide suitable stent characteristics; (3) develop a liquid cast stent system (i.e., triple balloon infusion/occlusion catheter) and evaluate this system in an ex vivo perfusion circuit; and (4) evaluate the liquid cast NO-eluting PDC stent system in a swine model of atherosclerosis to evaluate the in vivo polymerization of the device as well as overall outcome.

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