Nitric Oxide-Producing Hydrogel Materials

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Technology description

Nitric Oxide-Producing Hydrogel Materials for Preventing Arterial Blockage
Endothelial cells, normally present as a monolayer in the arterial wall, are believed to play an important role in the regulation of smooth muscle cell proliferation in vivo. Endothelial cells are seriously disrupted by most forms of vascular injury, including by angioplasty and similar procedures. Approximately 35 to 50% of patients treated by percutaneous transluminal coronary angioplasty experience significant re-narrowing of the artery, termed restenosis, within six months of the initial treatment.
Restenosis is partly due to migration and proliferation of smooth muscle cells within the arterial wall accompanied by increased secretion of matrix proteins to form an obstructive layer within the arterial wall. The processes that regulate arterial wound healing following vascular injury, such as by angioplasty, remain poorly understood, but are believed to involve a complex cascade of blood- and vessel wall-derived factors. In particular, it appears that diabetics are at risk for an especially severe form of restenosis known as "occlusion," in which the vessel almost completely closes, according to Eric Van Belle, MD, PhD, of the University of Lille, in France. Preventing the onset of occlusive restenosis in diabetic patients is likely to save lives. Numerous factors that stimulate restenosis have been identified. These participants come from blood or thrombus formation, and from the vessel wall itself. Endothelial cells, when they are not damaged in vascular injury, produce a number of substances known to down-regulate smooth muscle cell proliferation, including nitric oxide. Nitric oxide (NO) is an endothelium-derived target molecule useful for the prevention of restenosis because, in addition to limiting the proliferation of smooth muscle cells, NO reduces platelet aggregation, increases endothelial cell proliferation, and attenuates leukocyte adhesion, all of which are highly desirable for the reduction of restenosis.
Rice professor Jennifer West has led the development of biocompatible polymeric materials which release or produce NO for prolonged periods of time. The technology makes use of polymerizable biodegradable hydrogels, capable of releasing physiological amounts of NO, which are applied to sites on or in a patient in need of treatment thereof for disorders such as restenosis, thrombosis, asthma, wound healing, arthritis, penile erectile dysfunction or other conditions where NO plays a significant role. The polymeric materials can be formed into films and coatings. As well, they can be formed into microparticles for application to medical devices, such as stents, vascular grafts and catheters. Most importantly, the polymeric materials can also be applied directly to biological tissues and can be

polymerized in situ. The hydrogels are formed of macromers, which preferably include biodegradable regions having bound groups that are released in situ to elevate or otherwise modulate NO levels at the site where treatment is needed. The macromers can form a homo or hetero-dispersion or solution, which is polymerized to form a hydrogel material. In the form of a solution, the macromers can be a semi-interpenetrating or interpenetrating network. Compounds to be released can be physically entrapped, covalently or ionically bound to macromer, or actually form a part of the polymeric material. The hydrogel can be formed by ionic and/or covalent crosslinking. Other active agents, including therapeutic, prophylactic, or diagnostic agents, can also be included within the polymeric material.

Advantages

This innovation presents a breakthrough in the prevention of vascular tissue damage, which could otherwise lead to major vascular blockage in susceptible patients.

Institution

Rice University

Inventors

Jennifer West

叶先生

电 话：021-65679356

手 机：13414935137

邮 箱：yeyingsheng@zf-ym.com