ECRONICON OPEN ACCESS

EC CARDIOLOGY
Mini Review

The Application of Nanocarbon Onion-Like Fullerene (NOLF) Materials in the Human Cardiovascular System

Nicholas A Kerna[1]* and John V Flores[2,3]

[1]*SMC–Medical Research, Thailand*

[2]*Beverly Hills Wellness Surgical Institute, USA*

[3]*Orange Partners Surgicenter, USA*

***Corresponding Author:** Nicholas A Kerna, POB47 Phatphong, Suriwongse Road, Bangkok, Thailand 10500. Contact: medpublab+drkerna@gmail.com.

Received: July 22, 2020; **Published:** August 11, 2020

DOI: 10.31080/eccy.2020.07.00742

Abstract

Since the 1980s, carbon fullerene materials have been investigated for medical applications in humans. Fullerene materials are composed of carbon atoms and are compatible with the human body. They reduce free radicals in cells, provide anti-inflammatory effects, and inhibit tumor growth in the body. However, the primary antioxidant benefit of fullerene materials might be through the activation of Nrf2. Nanocarbon onion-like fullerene (NOLF) materials have a high surface area to volume ratio, making them viable for transportation in the cardiovascular system. These NOLF materials regulate the effects of free radicals in humans and animals, reducing tumor formation. They aid in targeted drug delivery systems for various conditions, such as cancer therapy. However, nanocarbon onion-like fullerene materials' safety, manufacture and dosage should be further evaluated and established for their therapeutic use in humans [1].

Keywords: *Biocompatibility; Free Radical; Graphitization; Nanocarbon; Targeted Drug Delivery; Van-Der-Waals Bonds*

Abbreviations

CNO: Carbon Nano-Onion; CNT: Carbon Nanotube; NOLF: Nanocarbon Onion-Like Fullerene; Nrf2: Nuclear Factor (Erythroid-derived 2) Factor 2

Introduction

Carbon-based nanomaterials have been investigated since the discovery of the fullerene C60 by Curl and Kroto in 1985. Such nanomaterials include carbon nanotubes (CNTs), nanodiamonds and carbon nano-horns. Later on, scientists found a way to isolate gram quantities of fullerene compounds into carbon nano-onions (CNOs) or nanocarbon onion-like fullerenes (NOLFs). These substances are multilayered fullerene materials comprised of closed carbon shells in the form of a sphere [2]. They have a polyhedral shape. Their structure represents an onion, hence their name. NOLF materials have been applied in various medical specialties owing to their properties and characteristics [3]. This paper focuses on the experimental application of NOLF materials in the human cardiovascular system. Also, the paper summarizes the benefits as well as adverse effects of using these materials.

Carbon nano-onions differ in specific aspects, such as size, morphology, and chemical composition. These aspects are dependent on the method of synthesis. The most common method used to synthesize carbon nano-onions is the graphitization of nano-diamonds, usually at

a temperature of more than 1700 degrees [4]. The resultant carbon onions are relatively small and can be used in numerous applications in, the biomedical field. Their sufficiently small size allows them to be carried easily in the cardiovascular system [4]. Also, carbon nano-onions show high biocompatibility, allowing them to integrate with other biological components for maximum effect.

Discussion

The biocompatibility of nanocarbon onion-like fullerene (NOLF) materials

The actions of NOLFs on the cardiovascular system arise from their chemical and physical properties. Such properties include high solubility, transportation ability, and thermal stability [2]. NOLFs have a high surface area to volume ratio making them viable for transportation in the cardiovascular system. Also, the materials have high cellular intake and low level of cytotoxicity [4]. They also exhibit low inflammatory potential compared to other forms of carbon nano-materials, such as nano-tubes.

Targeted drug-delivery properties of NOLFs

NOLFs are utilized in a targeted drug delivery system for various medical conditions, such as in cancer therapy. Other applications include biological imaging and delivery of therapeutic agents. In the cardiovascular system, NOLFs are used as drug carriers or delivery vehicles. Fullerene materials are used to detect a defect in the cardiovascular system. The materials then transfer the drug to the specific site, making it easier to cure or treat cardiovascular diseases. Their use in drug delivery systems is enabled by the external graphite layers that protect the substances being transported [4].

The application of NOLFs in the cardiovascular system is favored due to a number of factors. NOLFs' small size allows them to function as carriers for drugs and agents to be delivered in the cardiovascular system. Since they are small in size, they can easily be carried throughout the cardiovascular system. The small size is also a key factor in the increased mobility of these materials. Their high surface area to volume ratio allows for surface modification and multi-functionalization [5]. NOLFs also possess the ability to be easily functionalized which makes them excellent intracellular transporters.

Pros and cons of fullerenes' application in the human body and cardiovascular system

The application of NOLFs has several benefits as well as adverse effects. One benefit attributed to the use of fullerene materials is their ability to target a specified location. This application has been adopted widely in cancer therapies to remove tumors and is gaining widespread use in treating and managing specific cardiovascular conditions. The materials are used to locate a specific defect in the cardiovascular system, making it easy to treat. Also, fullerenes display favorable characteristics, such as high solubility, that enhance their application in treating medical conditions. NOLFs can be used in imaging and sensing, as well as therapeutic interventions [3]. Experiments that have used fullerene materials for treatment have shown notable success, paving the way for further application of these materials in treating diseases that pose a considerable risk to human life.

Among any adverse effects, specific fullerene materials have low solubility in organic and aqueous solvents. This poor solubility is due to strong intermolecular interactions, such as the Van-der-Waals bonds [4]. Some studies have raised concerns about the toxic levels of carbon nano-onions. Some scientists claim that specific fullerene materials result in have high toxic levels that limit their effectiveness and use in medical conditions [3]. However, more research is ongoing to ensure that NOLFs and variegated fullerene materials are utilized to their maximum benefits.

Conclusion

Nanocarbon onion-like fullerene materials have proven to be constructs for intracellular transport in various systems of the body, attributable to their size, homogeneity, and purity compared to other forms of carbon nano-materials. The materials have been used in

targeted drug delivery systems, therapeutic imaging, and interventions. Further research is underway to investigate the full potential of NOLFs as avenues for the transportation of therapeutic and imaging agents, and their application in the human cardiovascular system. Also, further research on the potential beneficial effects and possible adverse effects of fullerene materials in human cells or tissues should be conducted to confirm or deny any medical advantages associated with their chemical structures and properties [1].

Conflict of Interest Statement

The authors declare that this paper was written in the absence of any commercial or financial relationship that could be construed as a potential conflict of interest.

Supplementary Note

This paper, as a mini-review, is designed as a brief introduction to nanocarbon onion-like fullerenes (NOLFs), regarding their application in cardiovascular medicine. Other articles have been or will be published on the application of NOLFs in the respiratory system, digestive system, neurological system, veterinary medicine, agriculture, pharmacology and toxicology, and other topics. These distinct mini-review articles could have been combined into a much lengthier review or research article. However, to have done so, the subject matter would have resulted in only one publication in one journal, to the exclusion of other medical specialties. The purpose of these papers is to disseminate the purported biocompatibility and beneficial effects of NOLFs to the broadest audience of students, researchers, and medical practitioners as possible. The authors hope that the introduction to NOLFs' application in various and diverse disciplines spawns curiosity and research regarding NOLFs and fullerene materials. Fullerene materials seem poised to become a vital part of the future of medicine, veterinary medicine, and agriculture. However, more research is needed to determine any adverse effects of their long-term use. Also, the NOLF manufacturing process requires standardization to provide consistent quality and batch samples. Dosage and duration of treatment with fullerene materials for specific conditions need to be established by evidence-based research.

References

1. Kerna NA. "The Application of Nanocarbon Onion-Like Fullerene (NOLF) Materials in the Human Respiratory System". *EC Pulmonary and Respiratory Medicine* 9.8 (2020): 77-80. https://www.ecronicon.com/ecprm/pdf/ECPRM-09-00659.pdf

2. Bhinge SD. "Carbon nano-onions-An Overview". *Journal of Pharmaceutical Chemistry and Chemical Science* 1.1 (2017): 2. https://www.alliedacademies.org/articles/carbon-nanoonions-an-overview-8569.html

3. Xu BS. "Prospects and research progress in nano onion-like fullerenes". *New Carbon Materials* 23.4 (2008): 12. https://www.sciencedirect.com/science/article/abs/pii/S1872580509600019

4. Bartelmess J and Giordani S. "Carbon nano-onions (multi-layered fullerenes): Chemistry and applications". *Beilstein Journal of Nanotechnology* 5.2 (2014): 18. https://www.beilstein-journals.org/bjnano/articles/5/207

5. D'Amora M., *et al.* "Carbon Nano-Onions as Non-Cytotoxic Carriers for Cellular Uptake of Glycopeptides and Proteins". *Nanomaterials (Basel)* 9.8 (2019): 1069. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6722779/

Volume 7 Issue 9 September 2020
© 2020. All rights reserved by Nicholas A Kerna and John V Flores.