

## Research Paper

# In vivo assessment of inflammation in carotid atherosclerosis by noninvasive photoacoustic imaging

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## Abstract

**Objectives:** The objective of this study was to demonstrate the feasibility of using noninvasive photoacoustic imaging technology along with novel semiconducting polymer nanoparticles for in vivo identifying inflammatory components in carotid atherosclerosis and assessing the severity of inflammation using mouse models.

**Methods and Results:** Healthy carotid arteries and atherosclerotic carotid arteries were imaged in vivo by the noninvasive photoacoustic imaging system. Molecular probes PBD-CD36 were used to label the inflammatory cells to show the inflammation information by photoacoustic imaging. In in vivo imaging experiments, we observed the maximum photoacoustic signal enhancement of 4.3, 5.2, 8 and 14.3 times between 24 h post probe injection and that before probe injection in four carotid arteries belonging to three atherosclerotic mice models. In the corresponding carotid arteries stained with CD36, the ratio of 0.043, 0.061, 0.082 and 0.113 was found between CD36 positive (CD36(+)) expression area and intima-media area ( $P < 0.05$ ). For the CD36(+) expression less than 0.008 in eight arteries, no photoacoustic signal enhancement was found due to the limited system sensitivity. The photoacoustic signal reflects CD36(+) expression in plaques, which shows the feasibility of using photoacoustic imaging for in vivo assessment of carotid atherosclerosis.

**Conclusion:** This research demonstrates a semiconducting polymer nanoparticle along with photoacoustic technology for noninvasive imaging and assessment of inflammation of carotid atherosclerotic plaques in vivo.

**Key words:** molecular imaging, PBD-CD36, noninvasive photoacoustic imaging, carotid atherosclerosis, inflammation

## Introduction

The vascular system dysfunction due to atherosclerosis is the leading cause of severe health, mortality, and economic problems around the world.

The plaque buildup in the walls of carotid arteries subsequently leads to luminal stenosis, low blood supply to the brain, and even acute stroke incidents

# Noninvasive Techniques For Assessment Of Atherosclerosis In Peripheral Carotid And Coronary Arteries

**B Lingard**

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### **Noninvasive Techniques for Assessment of Atherosclerosis in Peripheral, Carotid, and Coronary Arteries**

Thomas F. Bundinger,1982      Pathobiology of the Human Atherosclerotic Plaque Seymour Glagov,William P., III  
Newman,Sheldon A. Schaffer,2012-12-06 Seymour Glagov The last meeting devoted exclusively to an examination of the atherosclerotic plaque took place in Chicago 25 years ago under the joint auspices of the Council on Arteriosclerosis of the American Heart Association and the Chicago Heart Association The proceedings were published subsequently in a volume entitled Evolution of the Atherosclerotic Plaque edited by Richard J Jones 1 Both experimental and human lesions were considered and several provocative new approaches to the disorder were discussed The electron microscope was being applied systematically to the study of blood vessels at that time so that details of the infrastructure and cellular composition of the artery wall and of atherosclerotic lesions were presented in some detail There was as one result of these explorations considerable discussion of morphologic evidence suggesting that the principal cell involved in the atherogenic process was neither the fibroblast nor the macrophage as had been supposed but the smooth muscle cell In particular the findings indicated that this cell could incorporate lipid and become a foam cell      **Arteriosclerosis, 1981** National Heart, Lung, and Blood Institute. Working Group on Arteriosclerosis,1981      Current Catalog National Library of Medicine (U.S.),1983 First multi year cumulation covers six years 1965 70      **Federal Register** ,1979-12      **Chronic Total Occlusions** Ron Waksman,Shigeru Saito,2023-10-16 Chronic Total Occlusions Understand and remedy chronic total occlusions with the third edition of this comprehensive guide Chronic Total Occlusions offers the most comprehensive overview of chronic total occlusions CTO on the market authored by two internationally recognized physician educators It covers both the diagnostic modalities and treatment methods required to tailor a treatment program to individual cardiological patients with the greatest possible chance of success Thorough and informed by the latest research and field data the third edition of this guide is an indispensable resource for interventional cardiologists In Chronic Total Occlusions A Guide to Recanalization Third Edition readers will also find Full color images to guide diagnosis of CTOs Expert tips and tricks for key procedures involved in treating challenging cases Clinical case studies illustrating specific scenarios and frequently encountered complications Chronic Total Occlusions A Guide to Recanalization Third Edition is a must have for interventional cardiologists who want to maximize their patient outcomes      Extracoronary Atherosclerosis Alessandro Ventura,Gaetano Crepaldi,Umberto Senin,1986      National Library of Medicine Current Catalog National Library of Medicine (U.S.),1983  
    **NIH Publication** ,1981      Social System Accounts Karl A. Fox,1997-11-30 Non Invasive Imaging of Atherosclerosis is a primer reference and review of some of the key features of current activities in the field of atherosclerosis The Editors goal is to provide material and stimulating ideas to basic scientists and clinical researchers in order to extend the application of vascular imaging and to further develop methods suitable for investigation of the arterial wall The first section presents

current knowledge about pathology vascular mechanics and compensatory mechanisms active during atherogenesis It explores the early lesion complications of plaques and early detection of plaques Section II reviews several key methodological issues of B mode ultrasound imaging and some of the most current data Quantitative B mode ultrasound is an established non invasive tool widely used in large epidemiologic studies and interventional clinical trials of atherosclerosis The last section addresses the most promising areas of development in vascular imaging This involves new techniques to evaluate the atherosclerotic bed to follow atheroma progression regression and to evaluate vascular mechanics in atherosclerotic arteries The last chapter places the application of non invasive imaging in perspective

*Report of the Director, National Heart, Lung, and Blood Institute* National Heart, Lung, and Blood Institute, 1981-03

**Arteriosclerosis 1981** National Heart, Lung, and Blood Institute. National Institutes of Health, 1981

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*Federal Register Index* , 1979

**Arteriosclerosis, 1981** National Heart, Lung, and Blood Institute. Working Group on Arteriosclerosis, 1981

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is designed to fight infectious agents for example bacteria and other foreign invaders One of the mechanisms that the immune system uses to fight infections is the production of antibodies Patients with lupus produce abnormal antibodies in their blood that target tissues within their own body rather than foreign infectious agents Because the antibodies and accompanying cells of inflammation can involve tissues anywhere in the body lupus has the potential to affect a variety of areas of the body Sometimes lupus can cause disease of the skin heart lungs kidneys joints and or nervous system When only the skin is involved the condition is called discoid lupus When internal organs are involved the condition is called systemic lupus erythematosus SLE      **Atherosclerotic Plaques** Robert W. Wissler, M. Gene Bond, Michele Mercuri, Piero

Tanganelli, Giorgio Weber, 2013-03-09 The philosophy of this NATO Advanced Research Workshop and the monograph it has yielded is that if you put a small number of very talented and creative scientists of different backgrounds and documented accomplishments together in a cloistered place for a few days to consider a very important and timely topic many new ideas will be generated The keynote of this conference was the Future By this we mean the expected future developments of highly reliable sequential quantitative measurements of atherosclerotic plaque size and components in living human subjects Some of the best minds and the most experienced and talented individuals at the leading edges of imaging of arteries were involved some of the best scientists and students of the atherosclerotic plaque and its components participated and some of the leading investigators of the cell biology or as we call it in the USA the pathobiology of atherosclerosis contributed important new information All of these individuals were actively involved in the conference and each obviously had carefully prepared and was able to communicate effectively      **Pollock's Textbook of Cardiovascular Disease and Rehabilitation** J. Larry

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In a global defined by information and interconnectivity, the enchanting power of words has acquired unparalleled significance. Their ability to kindle emotions, provoke contemplation, and ignite transformative change is truly awe-inspiring. Enter the realm of "**Noninvasive Techniques For Assessment Of Atherosclerosis In Peripheral Carotid And Coronary Arteries**," a mesmerizing literary masterpiece penned with a distinguished author, guiding readers on a profound journey to unravel the secrets and potential hidden within every word. In this critique, we shall delve into the book's central themes, examine its distinctive writing style, and assess its profound affect on the souls of its readers.

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#### Introduction

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