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# THE ROLE OF INFLAMMATION IN ATHEROSCLEROSIS AND IMPLICATIONS FOR HEART TREATMENT

***Gabriely Marjorie Dorner Rosa***
Medicine Course at: Centro Universitário São Lucas (Porto Velho – RO)
http://lattes.cnpq.br/6298600950022029

***Giovana Elisa Rosa Galiassi***
Medicine Course at: Universidade de Cuiabá, campus Beira Rio (Cuiabá – MT)
http://lattes.cnpq.br/2800195550208504

***Gustavo Henrique Cavalca Olavarria de Pinho***
Medicine Course at: Centro Universitário de Várzea Grande (Várzea Grande – MT)
http://lattes.cnpq.br/2810734585950391

**Abstract:** Atherosclerosis, a chronic disease characterized by the accumulation of plaque on arterial walls, is driven by complex inflammatory processes. Inflammation plays a central role from endothelial injury to the formation of atherosclerotic plaques. Inflammatory cells such as monocytes and macrophages trigger the inflammatory cascade, releasing cytokines and adhesion molecules that perpetuate the inflammatory response and promote the progression of atherosclerosis. This understanding has led to the development of new therapeutic strategies, including the use of anti-inflammatory therapies to modulate inflammation and reduce cardiovascular risk. Implications for cardiac treatment include the use of inflammatory cytokine inhibitors and other therapies aimed at modulating the inflammatory response as an integral part of treatment plans. The multifactorial, personalized approach to the prevention and treatment of cardiovascular disease now considers inflammation as a significant therapeutic target, providing a new perspective on cardiac care.
**Keywords**: Atherosclerosis. Cardiovascular risk. anti-inflammatory therapy.

## INTRODUCTION

Cardiovascular diseases remain one of the leading causes of morbidity and mortality worldwide, representing a significant burden on public health and the health care system.[1] Among these diseases, atherosclerosis, characterized by the progressive accumulation of fatty plaques in artery walls, plays a central role in the development of conditions such as myocardial infarction, stroke, and peripheral arterial disease. However, our understanding of the complex biological interactions underlying atherosclerosis has evolved considerably over the last few decades.[2]

Historically, atherosclerosis was seen predominantly as a process of passive lipid deposition in the arteries. However, more recent research has revealed that inflammation plays a key role in the initiation, progression, and rupture of atherosclerotic plaques.[3]The discovery of this interconnection between inflammation and atherosclerosis laid the groundwork for a new approach in the prevention and treatment of cardiovascular disease, directing the focus towards understanding the molecular mechanisms that connect these processes.[4]

The understanding of atherosclerosis as an inflammatory disease brought with it a promising perspective: the possibility of directing the inflammatory response to interrupt or delay the progression of the disease.[2] In this context, innovative research and developments have emerged, including pharmacological therapies that specifically aim to reduce vascular inflammation. These new therapeutic approaches represent an exciting advance in the search for more effective strategies in reducing cardiovascular risk and improving clinical outcomes.[5]

By exploring the critical role of inflammation in atherosclerosis and its implications for cardiac care, we can not only enrich our scientific understanding, but also envision a future where cardiovascular disease is tackled with more precise and personalized interventions. In this context, we will examine the inflammatory mechanisms involved in atherosclerosis, emerging therapeutic approaches, and the implications of such advances for current and future clinical practice.

## METHODOLOGY

This is an exploratory literature review, organized through an integrative literature review. The collection of scientific data and the systematization of information come from scientific productions published from 2010 to 2023, in Portuguese and English, indexed in

the Virtual Health Library (VHL), Scientific Electronic Library Online (SCIELO) and Google Scholar. The collection of information used in the development of the work was based on the proposed theme, as well as on its objectives.

## RESULTS AND DISCUSSION

Inflammation plays a central role in the development and progression of atherosclerosis, a chronic disease involving the buildup of fatty plaque, cholesterol, and other substances in artery walls. [2]. Understanding the role of inflammation in this process has been one of the most significant discoveries in cardiology, leading to new perspectives on implications for cardiac care. The understanding of inflammatory mechanisms in atherosclerosis has evolved rapidly, revealing an intricate network of events that contribute to the formation and progression of atherosclerotic plaques.[4]

Initially, endothelial injury triggered by factors such as hypertension, smoking and dyslipidemia promotes adhesion of inflammatory cells, such as monocytes, to the arterial wall. These migratory cells penetrate the intimal layer, where they differentiate into activated macrophages that internalize lipids, becoming foam cells. [4]. This process triggers an inflammatory cascade, involving cytokines, chemokines and adhesion molecules, which contribute to the formation of atheromatous plaques.[6]

Atherosclerosis is no longer seen as a simple passive deposit of lipids in the arteries, but as a complex inflammatory response. It all starts with damage to the endothelium, the innermost layer of the arteries, caused by factors such as hypertension, smoking and high cholesterol. This injury attracts inflammatory cells, including monocytes, which migrate to the arterial wall. [6]. Once there, monocytes transform into activated macrophages that internalize lipids, becoming foam cells. This starts an inflammatory cascade, where these foam cells accumulate and form atherosclerotic plaques. Inflammatory cells release cytokines, adhesion molecules, and other substances that recruit more inflammatory cells and amplify the inflammatory response.[2]

Advances in understanding the relationship between inflammation and atherosclerosis have opened the door to innovative therapeutic strategies. Interleukin-1 beta (IL-1β) inhibitors and interleukin-6 (IL-6) inhibitors are being investigated in clinical trials as potential anti-inflammatory treatments to reduce cardiovascular risk. These therapies seek to stop the inflammatory processes associated with plaque formation and thus reduce the progression of atherosclerosis.[6]

Remarkable clinical studies, such as the CANTOS study, have demonstrated that anti-inflammatory therapy can effectively reduce the recurrence of cardiovascular events in high-risk patients, even when cholesterol levels are controlled7. These findings have profound implications for clinical practice, highlighting the importance of considering inflammation as an independent therapeutic target beyond traditional approaches.[3]

Recognition of the role of inflammation in atherosclerosis has several significant implications for cardiac care. Understanding inflammation as a critical component of atherosclerosis has opened the door to the development of new therapeutic approaches. Therapies that aim to reduce inflammation have the potential to slow or halt disease progression and reduce cardiovascular risk.[1]

There are several anti-inflammatory therapies that are being investigated to reduce cardiovascular risk, especially in relation to atherosclerosis and its complications. Some of the promising therapies include:

- Interleukin-1 beta (IL-1β) inhibitors: These drugs target an inflammatory

cytokine called IL-1β, which plays a role in activating inflammatory responses in the body. Studies, such as the CANTOS study, have suggested that IL-1β inhibitors such as canakinumab may reduce the risk of cardiovascular events in high-risk patients. [7].

- Interleukin-6 (IL-6) Inhibitors: IL-6 is another cytokine involved in the inflammatory response. Drugs that block the action of IL-6, such as tocilizumab, have been studied for their effectiveness in reducing cardiovascular risk [8].
- Methotrexate: Although it is a drug used primarily to treat autoimmune diseases such as rheumatoid arthritis, methotrexate has also been studied in patients with cardiovascular disease due to its potential anti-inflammatory effect [8].
- Acetylsalicylic Acid (Aspirin): Aspirin, a non-steroidal anti-inflammatory drug, is known for its anti-platelet and anti-inflammatory effects. It is often prescribed to reduce the risk of cardiovascular events in patients with heart disease [9].
- Statins: While statins are primarily known for their role in lowering cholesterol levels, they have also demonstrated anti-inflammatory effects that may contribute to their ability to reduce cardiovascular risk. [10]
- Lifestyle Modification: While not traditional medicine, adopting a healthy lifestyle, including a balanced diet, regular physical activity, stress management, and smoking cessation, can reduce chronic inflammation and contribute to cardiovascular health .[1]

It is important to note that many of these therapies are still in the research and development phase. Furthermore, the choice of appropriate anti-inflammatory therapy must be made in consultation with a healthcare professional, taking into consideration, the individual clinical picture, the potential benefits and risks associated with each treatment. [8]

Despite promising advances, the field of anti-inflammatory therapy in atherosclerosis faces significant challenges, including identifying ideal patients for treatment, monitoring long-term effects, and assessing the balance between therapeutic benefits and potential risks. In addition, issues related to safety, cost, and access to these emerging therapies must also be addressed. [4]

Anti-inflammatory therapy is not without its challenges, including safety issues, appropriate patient selection, and affordability. Balancing potential therapeutic benefits with risks is critical as we explore this emerging approach. [5]

In summary, the role of inflammation in atherosclerosis has ushered in a new era in cardiology, highlighting the importance of understanding inflammatory mechanisms to develop more effective and personalized therapies. Continued advancement of research in this area has the potential to revolutionize the way we prevent and treat cardiovascular disease, opening the door to innovative interventions that have the power to improve global heart health. [6]

## CONCLUSION

The growing understanding of inflammation as a critical component in atherosclerosis has transformed the way we approach the prevention and treatment of cardiovascular disease. Discoveries about the inflammatory mechanisms in atherosclerosis paved the way for new therapeutic approaches that directly target the inflammatory processes involved in the formation of atherosclerotic plaques. While challenges remain, the growing availability of anti-inflammatory therapies and promising results from clinical trials signal an exciting future where inflammation can be the

target of additional treatment, complementing existing strategies in reducing cardiovascular risk and improving overall cardiac health.

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