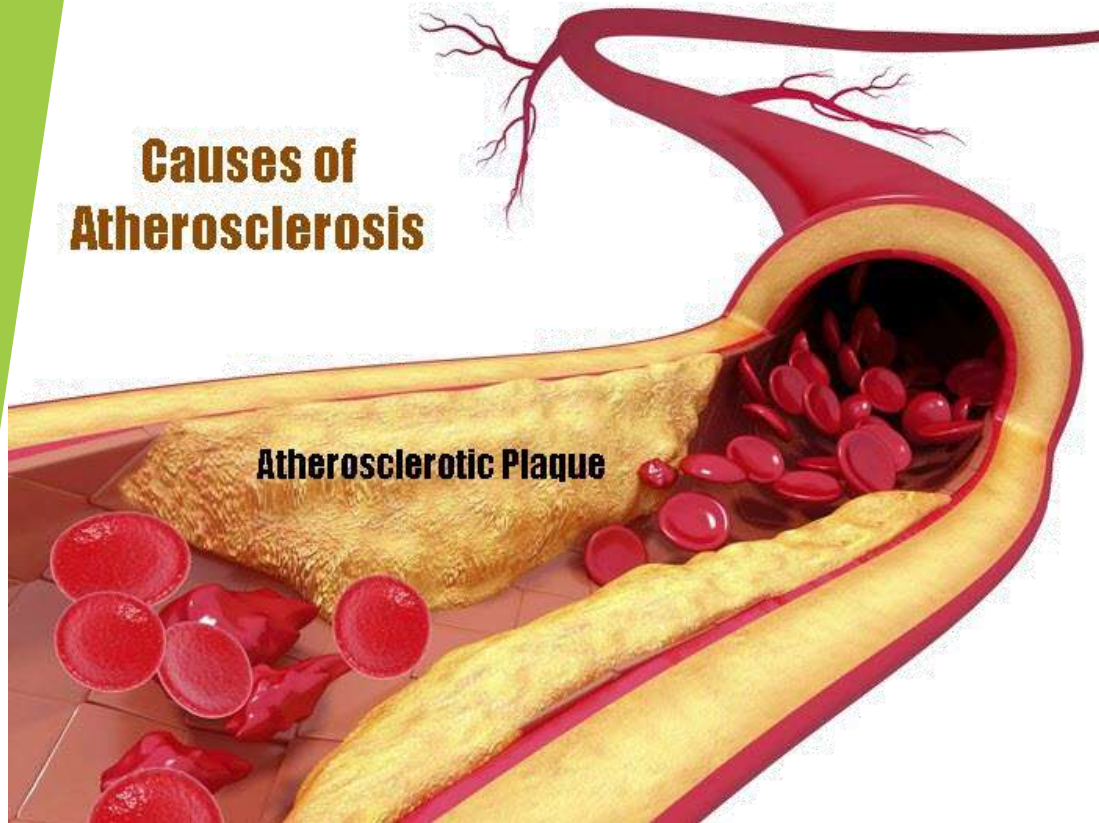


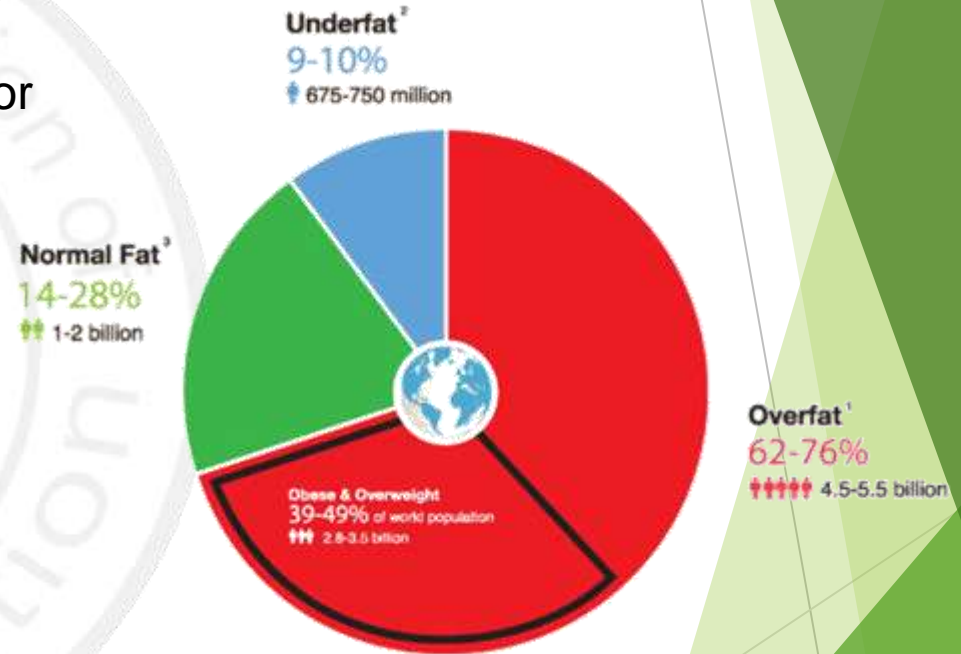
## Causes of Atherosclerosis



# Heart Disease Causes, Prevention and Treatment

# Leading Cause of Death, Worldwide

“Obesity is becoming a global epidemic in both children and adults, and it is associated with numerous co-morbidities such as **cardiovascular diseases (CVD)**, **type 2 diabetes**, hypertension, certain cancers, and sleep apnea/sleep-disordered breathing. In fact, is an independent risk factor for CVD and CVD risks have been also documented in obese children, and is associated with reduced life expectancy. A variety of adaptations/alterations in cardiac structure and function occur in the individual as adipose tissue accumulates in excess amount. As a whole, overweight/obesity predispose or is associated with numerous cardiac complications such as coronary heart disease, heart failure, and sudden death through its impact on the cardiovascular system.



Arteriosclerosis, Thrombosis, and Vascular Biology, May 2006, Vol. 26, No. 5

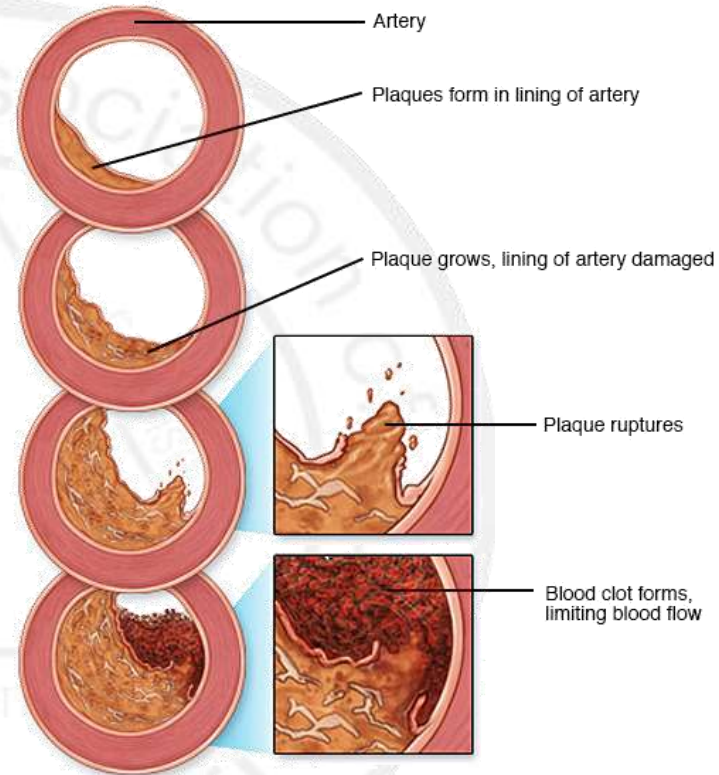
**Obesity and Cardiovascular Disease**, Pathophysiology, Evaluation, and Effect of Weight Loss

Paul Poirier, Thomas D. Giles, George A. Bray, Yuling Hong, Judith S. Stern, F. Xavier Pi-Sunyer, and Robert H. Eckel

# Leading Cause of Death, Worldwide

## “Atherosclerosis

[the damaged hardening of arteries, resulting in impeded or blocked blood flow] is the major cause of morbidities and mortalities worldwide.”



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International Journal of Preventative Medicine. 2014 Aug; 5(8): 927–946.

**Atherosclerosis: Process, Indicators, Risk Factors and New Hopes**

Mahmoud Rafieian-Kopaei, Mahbubeh Setorki,<sup>1</sup> Monir Doudi,<sup>2</sup> Azar Baradaran,<sup>3</sup> and Hamid Nasri<sup>4</sup>

# Known Factors Increase Risk of Atherosclerosis

- Hyperglycemia [high blood sugar]
  - Hypercholesterolemia
  - **Diabetes**
  - Smoking
  - Hypertension
  - Male sex
  - Family history or genetic susceptibility
  - Obesity
- are all predisposing factors for plaque development.

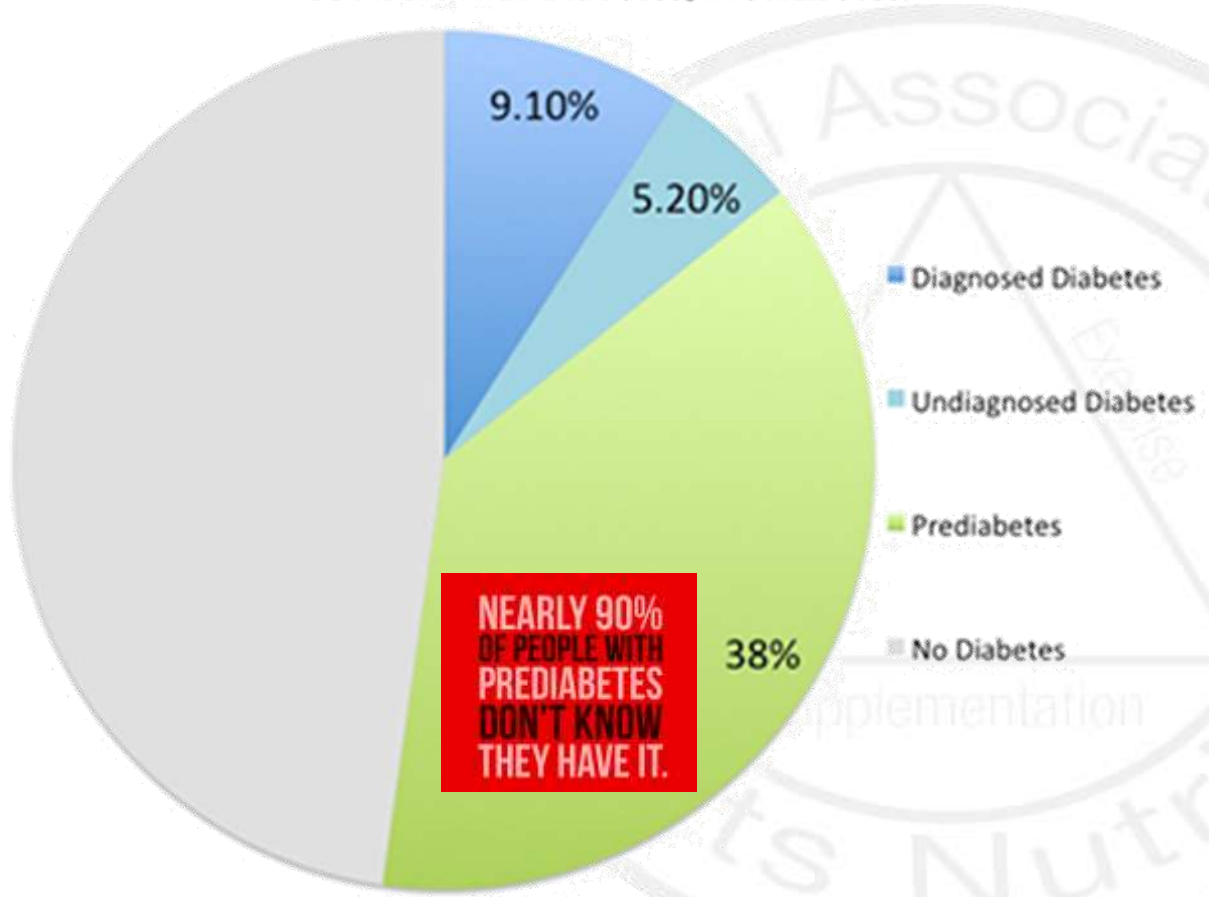


**How do these conditions lead to atherosclerosis?  
What are the mechanisms?**

Mechanisms of Vascular Defects in Diabetes Mellitus, 2017, pp 95-107  
**Pathogenesis of the Plaque Vulnerability in Diabetes Mellitus**  
Vikrant Rai, Devendra K. Agrawal

# Known Factors Increase Risk of Atherosclerosis

US Adult with Diabetes, Prediabetes

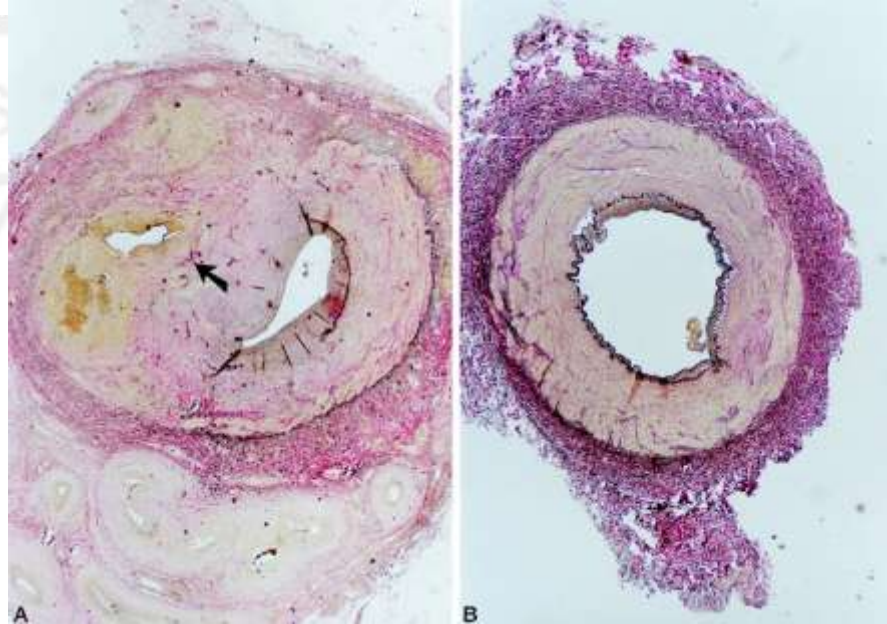


The majority of Americans are becoming diabetic.

[http://www.aicr.org/cancer-research-update/2015/09\\_16/cru\\_Half-of-US-Adults-Have-Diabetes-PreDiabetes.html](http://www.aicr.org/cancer-research-update/2015/09_16/cru_Half-of-US-Adults-Have-Diabetes-PreDiabetes.html)

# What is the cause of the initial arterial damage?

“Our understanding of atherosclerotic plaque morphology comes only from static histology of lesion morphology in patients dying of acute coronary syndromes.”



**We are analyzing things after the fact!**

CT of the Heart, Published 2008 – 2019, pp 211-226

**Pathology and Pathophysiology of Coronary Atherosclerotic Plaques**

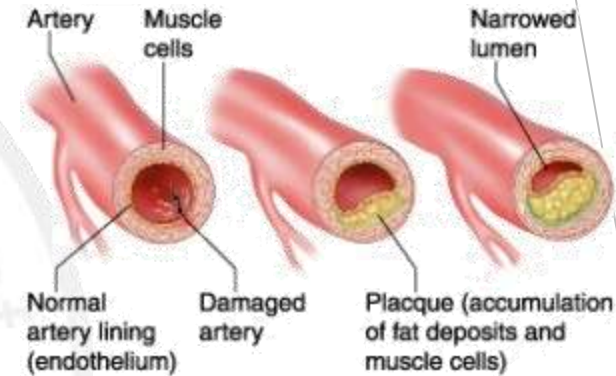
Hiroyoshi Mori, Frank D. Kolodgie, Alope V. Finn, Renu Virmani, Hiroyoshi Mori, Frank D. Kolodgie, Alope V. Finn, Renu Virmani

# How does Atherosclerosis Start?

## What are the mechanisms?

“**Inflammation** has a crucial role in pathogenesis of atherosclerosis. The disease is accompanied by excessive fibrosis of the intima, fatty plaques formation, proliferation of smooth muscle cells, and migration of a group of cells such as monocytes, T cells, and platelets which are formed in response to inflammation.”

Therefore, **inflammation** of the arterial lining is the initial cause of the disease as it increases the adherence of plaque, thickening the arterial wall and increasing arterial scarring.



International Journal of Preventative Medicine. 2014 Aug; 5(8): 927–946.

**Atherosclerosis: Process, Indicators, Risk Factors and New Hopes**

Mahmoud Rafieian-Kopaei, Mahbubeh Setorki,<sup>1</sup> Monir Doudi,<sup>2</sup> Azar Baradaran,<sup>3</sup> and Hamid Nasri<sup>4</sup>

# Known Factors Increase Risk of Atherosclerosis

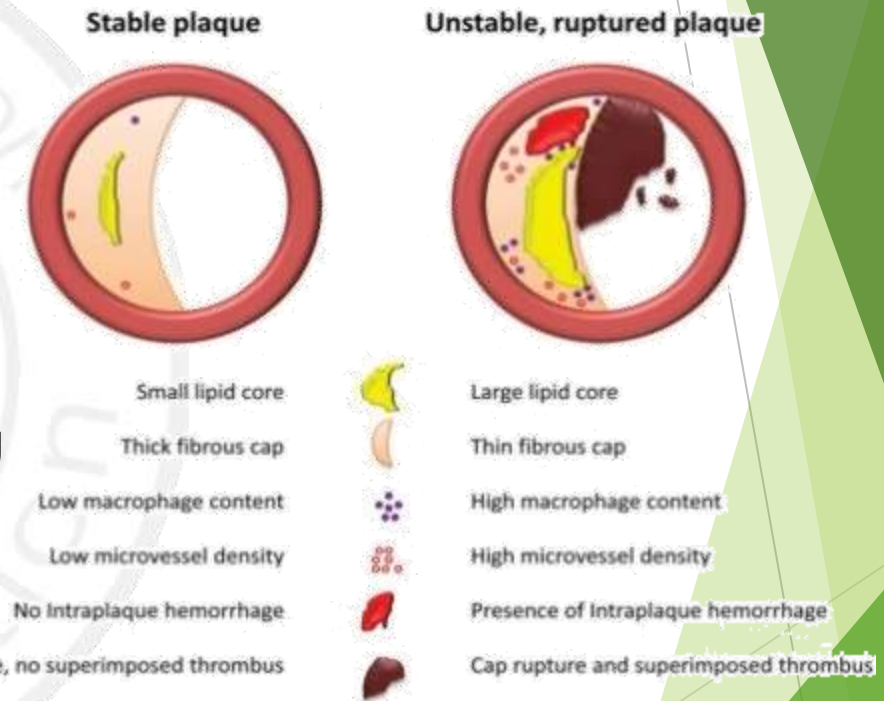
## What are the mechanisms that cause atherosclerosis?

Mechanisms such as increased inflammation, foam cell deposition, impaired repair mechanism, endothelial cell dysfunction, vascular smooth muscle cell proliferation, angiogenesis, intra-plaque hemorrhage, and calcification which facilitate the plaque rupture are increased in diabetes mellitus. **Thus, diabetes mellitus increases the prevalence of plaque formation and rupture.** Diabetes mellitus affects various cellular and molecular effectors involved in plaque development and rupture. Understanding these cellular and molecular effectors and involved mechanisms in association with diabetes mellitus is essential for the development of potential therapeutic strategies.

**Therefore, diabetes leads to atherosclerosis.**

Mechanisms of Vascular Defects in Diabetes Mellitus, 2017, pp 95-107,  
**Pathogenesis of the Plaque Vulnerability in Diabetes Mellitus**, Vikrant Rai, Devendra K. Agrawal

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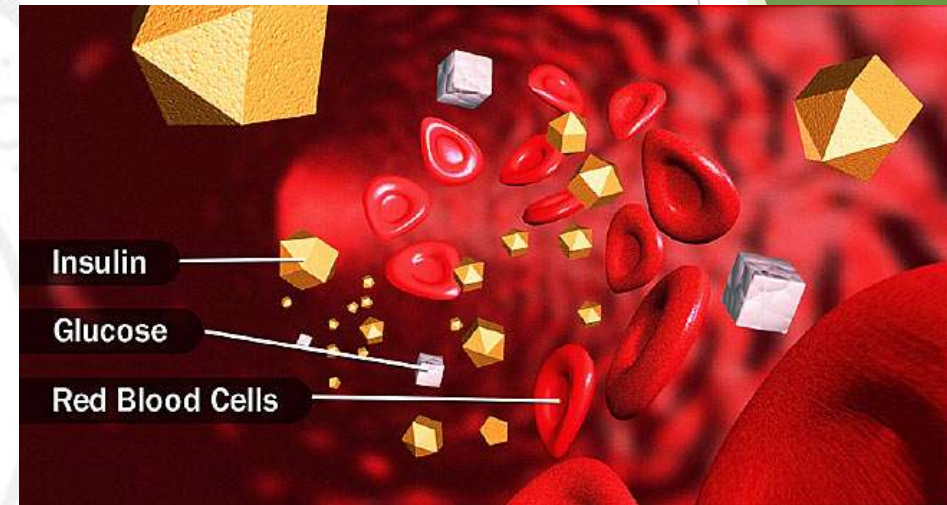




# Known Factors Increase Risk of Atherosclerosis

## What are the mechanisms that cause atherosclerosis?

“The long existence of arterial hypertension in combination with **insulin resistance** inevitably impairs the functioning of all elements of hemostasis. In these circumstances, there is a weakening of the vascular control of platelet aggregation, hemocoagulation and fibrinolysis. This is based on the decreased production in the blood vessels of substances with thromboresistant properties, increasing the permeability of the endothelium to macromolecules, accumulation in the vascular wall lipoproteins, adhesion of platelets and leukocytes....”



**Therefore, hypertension and increased blood insulin leads to atherosclerosis.**

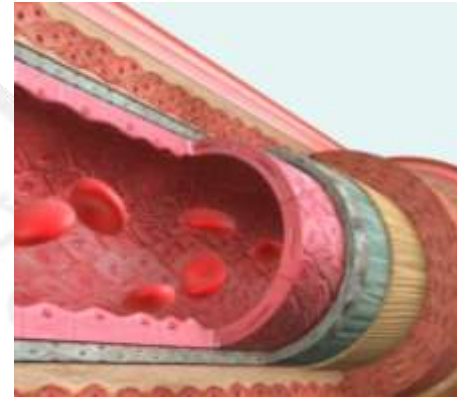
Medvedev IN (2019) Formation of Hemostasiopathy in Arterial Hypertension and Insulin Resistance. Prensa Med Argent, Volume 105:4. Department of adaptive physical training and recreation, Russian State Social University, Moscow, Russia, E-mail: ilmedv1@yandex.ru

# Known Factors Increase Risk of Atherosclerosis

## What are the mechanisms that cause atherosclerosis?

“Concurrent diabetes significantly augments carotid arterial wall inflammation in PAD patients. A further increase in those requiring **insulin** was observed...”<sup>1</sup>

“Genetically elevated fasting plasma **glucose**, ..., was associated with arterial stiffness suggesting a causal stiffening effect of glycemia on the arterial wall...”<sup>2</sup>



**Therefore, increased blood sugar and blood insulin leads to atherosclerosis.**

<sup>1</sup> BMC Cardiovascular Disorders **volume 16**, Article number: 237 (2016)

**Carotid arterial wall inflammation in peripheral artery disease is augmented by type 2 diabetes...**

Sophie J. Bernelot Moens, Robert M. Stoekenbroek, Fleur M. van der Valk, Simone L. Verweij, Mark J. W. Koelemay, Hein J. Verberne, Max Nieuwdorp & Erik S. G. Stroes

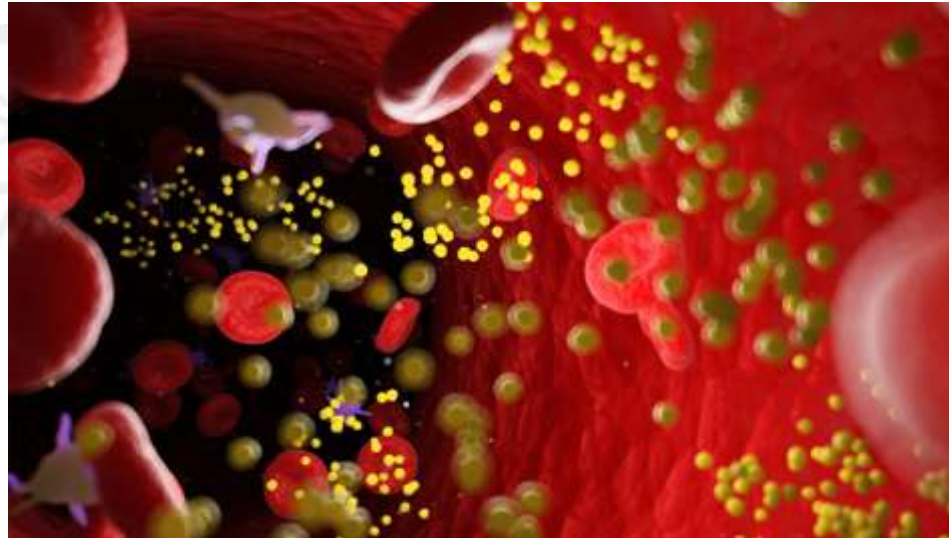
<sup>2</sup> Journal of Hypertension. 2018 Apr; 36(4): 809–814.

**A genetic risk score for fasting plasma glucose is independently associated with arterial stiffness...**

Mikael Gottsäter, George Hindy, Marju Orho-Melander, Peter M. Nilsson, and Olle Melander

# How does Atherosclerosis Start?

“Inflammation has a crucial role in pathogenesis of atherosclerosis. The disease is accompanied by excessive fibrosis of the intima, fatty plaques formation, proliferation of smooth muscle cells, and migration of a group of cells such as monocytes, T cells, and platelets which are formed in response to inflammation.”



Therefore, **LDL cholesterol** is secondary contributor in the progression of the disease as it adheres to the plaque, thickening the arterial wall and increasing arterial scarring.

International Journal of Preventative Medicine. 2014 Aug; 5(8): 927–946.

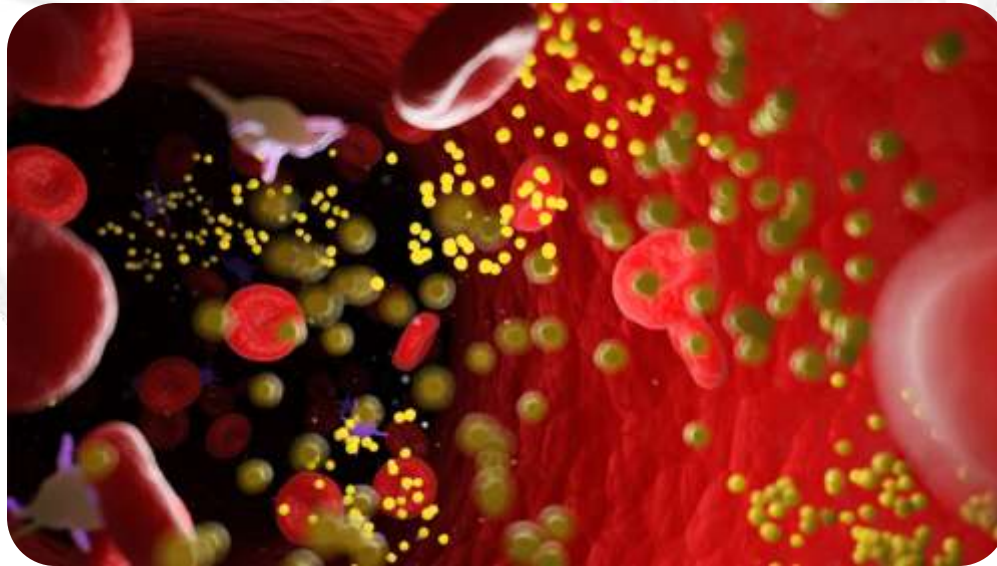
**Atherosclerosis: Process, Indicators, Risk Factors and New Hopes**

Mahmoud Rafieian-Kopaei, Mahbubeh Setorki,<sup>1</sup> Monir Doudi,<sup>2</sup> Azar Baradaran,<sup>3</sup> and Hamid Nasri<sup>4</sup>

# The Root Cause of Atherosclerosis

Chronic increased presence of **Insulin** and **Glucose** in the arteries cause inflammation and damage to the arterial lining, leading to atherosclerosis

**LDL cholesterol** is less likely to adhere to the arterial lining in healthy arteries and in the absence of high levels of glucose and insulin.



# The Prevention and Treatment of Atherosclerosis

- Eat **minimal** amounts of **carbohydrate** to minimize glucose and insulin in the blood.
- Eat less frequently, **intermittently fasting** to provide healing and stabilization of blood vessels without the frequent inundation of food particles.
- Eat natural, unenhanced sources of **essential fat** and **protein** through meat, fish and fowl for growth and repair.
- Eat small amounts of **soluble fiber** like berries, hazelnuts or chia seeds to help remove plaque causing particles from the blood.
- Include frequent short bouts of **vigorous exercise** to increase blood flow, vascular elasticity, lower blood pressure and raise HDL cholesterol.



# Questions and Answers



CEC Certificate Exam