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ROLE OF NEW TECHNOLOGY AND ADVANCE STUDY IN TREATMENT OF CAD (CORONARY ARTERY DISEASE)

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ABSTRACT

Coronary Artery Disease (CAD) is a prevalent cardiovascular condition that poses a significant global health burden. This abstract provides an introduction to CAD, highlighting its etiology, risk factors, clinical manifestations, and diagnostic approaches. CAD is primarily caused by atherosclerosis, a process characterized by the accumulation of plaque within the coronary arteries, leading to the narrowing or complete occlusion of blood vessels. The key risk factors for CAD include hypertension, dyslipidemia, diabetes mellitus, smoking, obesity, sedentary lifestyle, and a family history of premature cardiovascular disease. The clinical manifestations of CAD can vary widely, ranging from asymptomatic to life-threatening events such as myocardial infarction (heart attack) or sudden cardiac death. Common symptoms include chest pain or discomfort (angina), shortness of breath, fatigue, and palpitations. Accurate diagnosis of CAD is crucial for appropriate management. Diagnostic approaches encompass a combination of patient history, physical examination, non-invasive tests, and invasive procedures. Non-invasive tests include electrocardiography (ECG), stress testing, echocardiography, nuclear imaging, and computed tomography angiography (CTA). Invasive procedures, such as coronary angiography, provide direct visualization of the coronary arteries and can be accompanied by percutaneous coronary intervention (PCI) to relieve blockages. CAD management involves a comprehensive approach that includes lifestyle modifications, pharmacotherapy, and, in some cases, invasive interventions. Lifestyle modifications encompass adopting a healthy diet, regular physical activity, smoking cessation, weight management, and stress reduction. Pharmacotherapy aims to control risk factors such as hypertension, dyslipidemia, and diabetes The treatment landscape for Coronary Artery Disease (CAD) has been significantly influenced by advancements in technology and the emergence of new studies. This abstract

explores the role of new technology and advanced studies in the treatment of CAD, aiming to improve patient outcomes and enhance the management of this prevalent cardiovascular condition.

KEYWORDS: Coronary artery disease, nanotechnology, robotics, stem cell, stem cell therapy, atherosclerosis, non-invasive technique, catheterization, 3D-Printing.

INTRODUCTIONS

CAD is a term which is used to refer to the effect of narrowing of coronary arteries due to the accumulation of plaque in coronary arteries which prevents the adequate flow of blood entering the myocardium, It usually happens due to atherosclerosis. It can lead to a situation where the heart muscles get damaged due to the lack of blood and oxygen supply, the damage can lead to heart failure, myocardial infarction (MI), and arrhythmias.

Coronary arteries disease (CAD) was analyzed to affect 16.8 million people in 2009 in the US (United States); out of the given data 9.8 million people have angina pectoris, and just about 8 million suffer from myocardial infarction (MI).

According to the data of 2005, only CAD was single-handedly the most frequent cause of American men's and women's death, prompting 607,000 deaths, which means about 1 in every 5 deaths was caused by CAD (which now become 1 in every 4 deaths), it's the leading cause of death and mortality in the United States. (Cassar et al., 2009) According to the data of 2006, about 1.76 million people got discharged from a US hospital with a diagnosis of CAD. (Cassar et al., 2009) In 2009 the total analysis of direct and indirect economical costs in the United States for CAD was $165.4 billion. (Cassar et al., 2009) Globally, every year cardiovascular diseases are analyzed to take 17.6 million lives. (Cassar et al., 2009) In India it is rising as an epidemic, CAD is a reason for 26.9% of certified deaths in 2015. (Cassar et al., 2009) Cardiovascular disease is taking the form of a pandemic day by day. (Cassar et al., 2009 Mortality by cardiovascular disease is estimated to reach 23.4 billion by the end of 2030. (Cassar et al., 2009) In developing countries, CAD tends to target people at younger ages which means it can indirectly affect the workforce and economic productivity of the developing world. (Cassar et al., 2009).

NEED OF THE STUDY

There are several reasons why advanced study in the treatment of Coronary Artery Disease

(CAD) is crucial: Aadvanced study in the treatment of CAD is essential for staying updated with the evolving nature of the disease, improving patient outcomes, developing personalized treatment approaches, identifying new targets, advancing diagnostic techniques, optimizing treatment strategies, and fostering future innovations. By investing in advanced research and education, we can continually improve our understanding and management of CAD, ultimately benefiting the millions of individuals affected by this prevalent cardiovascular condition.

OBJECTIVES OF THE STUDY

The objectives of using nanotechnology and robotics in the treatment of Coronary Artery Disease (CAD) include.

- Enabling minimally invasive interventions,
- Targeted drug delivery,
- Improved imaging and diagnosis,
- Tissue engineering and regeneration,
- Robotics-assisted surgeries,
- Improved procedural guidance, and
- Fostering innovation in the field.

These objectives aim to enhance treatment outcomes, reduce patient morbidity, and advance the overall management of CAD.

CURRENT SCENARIO

The current scenario of advanced study in CAD treatment: Interventional Techniques: Advanced-interventional-techniques (AIT), such as percutaneous- coronary-intervention (PCI), continue to evolve, the use of drugeluting stents, bio-resorbable scaffolds, and advanced-imaging-technologies (AIT) (such as intravascular ultrasound and optical coherence tomography) has improved procedural outcomes and reduced complications. (Kern et al., 1997).

Transcatheter Aortic-Valve-Replacement (TAVR): TAVR is a minimally invasive procedure used to treat aortic-valve-stenosis in patients with CAD, on-going studies are focusing on expanding the indications for TAVR, refining procedural techniques, and comparing its longterm outcomes with surgical aortic-valve-replacement. (Goel et al., 2013).

Pharmacotherapy: Advanced studies are being conducted to optimize pharmaco-therapy for CAD, this includes the development of new anti-platelet agents, anti-coagulants, lipid-lowering-medications, and novel anti-inflammatory drugs targeting specific pathways involved in CAD pathogenesis. (Chait & Eckel, 2016).

Precision Medicine: There is a growing interest in the application of precision medicine in CAD treatment. (Chait & Eckel, 2016) Advanced studies are exploring the use of genetic testing, bio- markers, and imaging techniques to identify patients at higher risk of CAD and tailor treatment strategies accordingly. (Chait & Eckel, 2016) This personalized approach aims to optimize treatment out-comes and minimize adverse events. (Chait & Eckel, 2016).

Novel Therapies: Researchers are investigating various novel therapies for CAD, including gene-therapy, stem-cell-therapy, and tissue engineering approaches. (Velianou, Suwaidi, & Lerman, 1999) These studies aim to promote tissue re-generation, improve angio-genesis, and enhance myocardial function in patients with CAD. (Velianou, Suwaidi, & Lerman, 1999).

Digital Health Technologies: The inte-gration of digital health technologies, such as wearable devices, mobile applications, and remote monitoring systems, is being explored in CAD management. (Khan et al., 2017) These technologies enable real-time monitoring of patients' vital signs, medication adherence, and lifestyle behaviors, facilitating early detection of CAD events and enhancing patient engagement in self-care. . (Khan et al., 2017).

Artificial Intelligence (AI): AI and machine learning algorithms are being developed to assist in CAD diagnosis, risk stratification, and treatment planning. (Kudo et al., 2019) These technologies can analyze large datasets, identify patterns, and provide decision support to healthcare professionals, potentially improving diagnostic accuracy and treatment outcomes. (Kudo et al., 2019).

It is important to note that the field of CAD treatment is rapidly evolving, and there may have been significant advancements.

LITERATURE SURVEY ABOUT CAD AND ADVANCE TREATMNT OF CAD

Definition of CAD – Coronary-artery-disease (CAD) is a condition in which the narrowing or blockage of the coronary-arteries occur, these arteries supplied the oxygen-rich-blood to the heart muscle.(Alamdari et al., 2008) It is primarily caused by athero-sclerosis, it’s a condition in which a build-up or formation of plaque consisting of cholesterol, fatty deposits, calcium,

and other substances occur on the inner walls of the arteries. (Alamdari et al., 2008) This build-up inhibits the blood flow or supply to the heart, leading to ischemia (insufficient blood supply) and potentially causing various cardiovascular events such as angina (chest pain), heart attack, or even sudden cardiac death. (Alamdari et al., 2008).

CAD is a prevalent and serious cardio-vascular-disorder (CVD). It has significant morbidity-mortality rates all over the world. (Alamdari et al., 2008) It is associated with multiple risk factors, including high blood pressure, high cholesterol levels, smoking, diabetes, obesity, family history of heart disease, and sedentary lifestyle. (Alamdari et al., 2008) Additionally, advancing age and certain medical conditions like chronic-kidney-disease and auto-immune disorders may also contribute to the development and progression of CAD.(Alamdari et al., 2008).

Types of cad – There are the following three main type of CAD (coronary artery disease).

1) Obstructive coronary artery disease – This disease occur when the coronary arteries gradually narrow because of the formation of plaque which is known as atherosclerosis. Its most common and well known disease. (Abbas & Guide, 2015).
2) Non-obstructive coronary artery disease – this disease occur when other problems occur with the coronary arteries and not caused by the formation of plaque.

These could be the following reasons

i) Myocardial bridging (compression of heart muscle). (Abbas & Guide, 2015).
ii) Microvascular dysfunction (malfunction of smaller branches of artery). (Abbas & Guide, 2015).
iii) Coronary vasospasm (construction at improper time). (Abbas & Guide, 2015).
iv) Endothelial dysfunction (artery lining damage). (Abbas & Guide, 2015).

2) Spontaneous coronary artery dissection – this type of disease is a result of tear in the wall of coronary arteries, which block the blood flow partially or completely in coronary arteries. This sudden tear of coronary arteries presents as a heart attack. (Abbas & Guide, 2015).

Geographical variation in coronary artery disease – Coronary-artery-disease (CAD) exhibits geographical-variation in its prevalence, incidence, and risk factors.(Yusuf, Reddy, Ôunpuu, & Anand, 2001) Several factors contribute to these regional differences, including genetic predisposition, lifestyle factors, socioeconomic status, and healthcare disparities.

(Yusuf, Reddy, Ôunpuu, & Anand, 2001) Here are some key aspects of geographical variation in CAD.

Prevalence and Incidence: CAD rates vary across different regions of the world. Developed countries, like as the United-States (US), Canada, Western-European nations, and Australia, generally have a higher incidence of CAD compared to developing countries. (Yusuf, Reddy, Ôunpuu, & Anand, 2001) However, there are also significant variations within regions and populations. (Yusuf, Reddy, Ôunpuu, & Anand, 2001).

Risk Factors: The impact of risk factors for CAD can vary geographically. (Yusuf, Reddy, Ôunpuu, & Anand, 2001) Traditional risk factors like as hypertension, dyslipidemia, smoking, obesity, and diabetes are prevalent all over the world, but their prevalence and impact can differ between regions. (Yusuf, Reddy, Ôunpuu, & Anand, 2001) Additionally, certain regions may have specific risk factors unique to their population, such as a higher prevalence to certain genetic disorders. (Yusuf, Reddy, Ôunpuu, & Anand, 2001).

Socioeconomic Factors: Socioeconomic status plays an important role in the geographical-variation of CAD. (Yusuf, Reddy, Ôunpuu, & Anand, 2001) Lower-income regions or areas with limited access to healthcare and resources may have higher CAD rates due to a lack of preventive measures, delayed diagnosis, and limited treatment options. (Yusuf, Reddy, Ôunpuu, & Anand, 2001).

Lifestyle and Dietary Factors: Geographical-differences in lifestyle and dietary habits contribute to CAD variations. (Yusuf, Reddy, Ôunpuu, & Anand, 2001) For example, regions with a diet and high in processed foods, saturated fats, and added sugars tend to have higher CAD rates. (Yusuf, Reddy, Ôunpuu, & Anand, 2001) Conversely, regions with a diet rich in fruits, vegetables, whole grains, and healthy fats have been associated with lower CAD risk. (Yusuf, Reddy, Ôunpuu, & Anand, 2001).

Ethnic and Genetic Factors: Different ethnic groups have varying susceptibilities to CAD, leading to geographical variations. (Yusuf, Reddy, Ôunpuu, & Anand, 2001) For example, South Asians, African Americans, and certain Native American populations tend to have a higher predisposition to CAD compared to other ethnic groups.(Yusuf, Reddy, Ôunpuu, & Anand, 2001).

Environmental Factors: Environmental factors, such as air pollution, exposure to toxins, and

climate, may also contribute to geographical differences in CAD.(Yusuf, Reddy, Ôunpuu, & Anand, 2001) Urban areas with higher pollution levels have been associated with increased CAD risk(Yusuf, Reddy, Ôunpuu, & Anand, 2001).

Understanding these geographical-variations in CAD is essential for developing targeted prevention and intervention strategies. (Yusuf, Reddy, Ôunpuu, & Anand, 2001) Public health initiatives should consider the specific risk factors and cultural contexts of different regions to effectively address CAD and reduce its burden on populations worldwide. (Yusuf, Reddy, Ôunpuu, & Anand, 2001).

Coronary Artery Simple Anatomy – Normally coronary arteries are made up of three layers called intima, media, and adventitia(Abbas & Guide, 2015)Intima is separated by media through a thin internal elastic membrane.(Abbas & Guide, 2015) Media is separated from adventitia by a thin external elastic membrane.(Abbas & Guide, 2015) Intimal layer is closest to the arterial lumen and is made up of single-layer endothelium cells.(Abbas & Guide, 2015) Media is mostly made up of smooth muscle cells and extracellular matrix which makes it the thickest layer of tissue.(Abbas & Guide, 2015) Adventitia is the outermost layer and is mostly made up of fibro elastic tissue.(Abbas & Guide, 2015).

Normal Anatomy – The Origin from the Sinus of Valsalva -- The initial part of ascending aorta is formed by the aortic roots.(Loukas, Sharma, Blaak, Sorenson, & Mian, 2013) It consists of relatively similar three semilunar leaflets, three Sinus of Valsalva, and three inter-leaflet triangles, Sinu- tubular junction separates roots from ascending aorta.(Loukas, Sharma, Blaak, Sorenson, & Mian, 2013).

Out of the three Sinus of Valsalva, two adjoining to the pulmonary root, and major coronary arteries have their origin inside these sinuses.(Loukas, Sharma, Blaak, Sorenson, & Mian, 2013) Dawning of coronary arteries above the sink-tubular junction, in the non-adjacent coronary sinus, or close to peripheral attachments of the zones of apposition between valvar leaflets, represents anatomical variation. (Loukas, Sharma, Blaak, Sorenson, & Mian, 2013).

Minor deviations are considered as a normal variation and greater deviations like taking off at least 1 cm distal to the sinus-tubular junction, associated with hemodynamic changes, are the cause of several pathologies, take off greater than 2.5 cm is considered as ectopic ostium.(Loukas, Sharma, Blaak, Sorenson, & Mian, 2013) High take-off with atherosclerosis

changes within coronary arteries, associated with increased cases of sudden death.(Loukas, Sharma, Blaak, Sorenson, & Mian, 2013) Dawning adjoining to the peripheral attachment to the zone of apposition at the sinus-tubular junction, commissural junction origin, present when the arterial orifice is in 5 mm of the commissure.(Loukas, Sharma, Blaak, Sorenson, & Mian, 2013).

Coronary arteries rarely originate from the aortic sinus which is non-adjacent to the pulmonary root, therefore this sinus is called a non-coronary sinus, this happens very rarely so it is more appropriate to call it a non-adjacent sinus. (Loukas, Sharma, Blaak, Sorenson, & Mian, 2013).

The Right Coronary Artery (RCA) – The artery originated from the right sinus Valsalva enters directly into the atrioventricular groove, comes down anteriorly and inferiorly towards the right border of the heart, and issues many branches before going posterior and inferiorly respectively.(Cassar, Holmes Jr, Rihal, & Gersh, 2009).

The usual dominant RCA is about 12-14 cm in length, luminal diameter from1.5-5.5 mm or a mean of 3.2 mm. (Abbas & Guide, 2015) Infundibular is the first branch of RCA and the conus branch is 50% of the population, it supplies the right ventricular outflow tract is usually anastomoses with an infundibular branch of the left anterior descending artery which forms the circle of viruses. (Abbas & Guide, 2015).

In the other half, the conus branch originates from right coronary sinus of Valsalva from separate ostium, second branch of RCA is the sinus nodal artery (in 60% of the population), and in the remaining 40% of sinus nodal artery is the branch which is originated from the circumflex artery. (Abbas & Guide, 2015).

RCA gives small branches supplying to the right ventricle and atrium, out of these the largest one is an acute marginal artery, which is used to supply much of right ventricle-free wall. (Abbas & Guide, 2015).

In case arteries are dominant it plies two major branches

1. Posterior descending artery. (Abbas & Guide, 2015).
2. Posterolateral branches. (Abbas & Guide, 2015).

The Left Coronary Artery – Origin of the left coronary artery occurs from left sinus of

Valsalva and travels anteriorly and to the left toward the sternocostal surface of the heart, its position is between the left pulmonary trunk and atrial appendage.(Loukas, Sharma, Blaak, Sorenson, & Mian, 2013).

It's very short, after 1-2 cm it divides into circumflex and descending arteries and anterior interventricular arteries, these major branches did supply most of the left ventricle, the ventricular septum, and the left atrium, and 2/5th of the population give rise to the sinus node.(Loukas, Sharma, Blaak, Sorenson, & Mian, 2013).

Except in individuals who are left dominant, the main stem give rise to the third branch, an intermediate artery in some individual.(Loukas, Sharma, Blaak, Sorenson, & Mian, 2013).

The Anterior Interventricular Artery – It's the direct anterior prolongation of the main stem.3 Before itinerant to the apex of the heart, it goes into the anterior interventricular groove, then passes on all sides to the apex.(Loukas, Sharma, Blaak, Sorenson, & Mian, 2013) It provides branches to the apical surface of both ventricles.(Loukas, Sharma, Blaak, Sorenson, & Mian, 2013).

It brings about two vessels group named diagonal arteries and septal perforators, both of them be different in their number as well as course, diagonal arteries provide to the left ventricle's parietal wall and deep perforator provides to the muscular ventricular septum's two third anterior part.(Loukas, Sharma, Blaak, Sorenson, & Mian, 2013).

The left descending septal artery or artery to the moderator band is the leading artery which contributes to the latter structure before bring to an end at the anterior papillary muscle.(Loukas, Sharma, Blaak, Sorenson, & Mian, 2013) Interference of these muscle can be a reason of the a number of pathogenesis or pathologies like anterior septal infarction, right bundle branch block or it could be a combination of both.(Loukas, Sharma, Blaak, Sorenson, & Mian, 2013).

The circumflex artery – These arteries at perpendicular angle to the main stem, via left atrio- ventricular groove they get in and course to variable extent.3 The circumflex artery bring to an end as left obtuse marginal artery in the individuals who are right dominat.(Loukas, Sharma, Blaak, Sorenson, & Mian, 2013).

These arteries provide to the left ventricle and supero-lateral papillary muscle's posterior and

lateral walls.(Loukas, Sharma, Blaak, Sorenson, & Mian, 2013) The root of aorta and ventricular myocardium adjacent to groove is contributed by smaller unnamed branches arise from the artery. (Loukas, Sharma, Blaak, Sorenson, & Mian, 2013).

According to the study in 1/3rd of the individuals the circumflex artery is dominant which arrives at cardiac crux and bring about atrio-ventricular node's artery, so we can say that circumflex artery generates the inferior interventricular artery.(Loukas, Sharma, Blaak, Sorenson, & Mian, 2013).

In the early course of circumflex arteries a variable branch which is known as left atrial circumflex artery which moving parallel to the parent artery. (Loukas, Sharma, Blaak, Sorenson, & Mian, 2013).

Risk Factors of Coronary Artery Disease – Coronary artery disease (CAD) is influenced by a multitude of risk factors, both modifiable and non-modifiable.(November, 2006).

Modifiable risk factors – These factors include smoking, hypertension, dyslipidemia, diabetes mellitus, obesity, sedentary lifestyle, poor diet, and chronic stress.(Hajar, 2017).

- Smoking tobacco products significantly increases the risk of CAD due to the harmful effects of nicotine and other toxic substances on the cardiovascular system. (Hajar, 2017).
- Hypertension, or high blood pressure, strains the arterial walls, promoting the development of atherosclerosis. (Hajar, 2017).
- Dyslipidemia, characterized by elevated levels of LDL cholesterol and reduced levels of HDL cholesterol, contributes to the formation of atherosclerotic plaques. (Hajar, 2017).
- Diabetes mellitus, particularly type 2 diabetes, impairs glucose regulation and promotes inflammation, accelerating the progression of CAD. (Hajar, 2017).
- Obesity, marked by excessive body weight and increased adiposity, promotes insulin resistance, inflammation, and dyslipidemia, all of which contribute to CAD. (Hajar, 2017).
- Sedentary lifestyle and poor diet, rich in saturated fats, trans fats, and refined carbohydrates, contribute to weight gain, dyslipidemia, and systemic inflammation. (Hajar, 2017).
- Chronic stress, whether psychological or physiological, triggers an array of hormonal and metabolic changes that can negatively impact the cardiovascular system. (Hajar, 2017)
- Non-modifiable risk factors for CAD – These factors include age, gender, family history

of CAD, and certain ethnicities. (Hajar, 2017).

- Age – Advancing age increases the risk of CAD, with the incidence rising significantly after the age of 45 in men and 55 in women. (Hajar, 2017).
- Gender – Men tend to have a higher risk of CAD than premenopausal women, although the risk becomes more comparable after menopause. (Hajar, 2017).
- Family – A family history of CAD, especially in first-degree relatives, indicates a genetic predisposition to the disease. (Hajar, 2017).
- Ethnicities – Certain ethnicities, such as South Asians and African Americans, have a higher risk of CAD compared to other populations. (Hajar, 2017).

Understanding and addressing these risk factors play a crucial role in the prevention, early detection, and management of CAD. (Hajar, 2017)

Symptoms(Miller, 2002) – Symptoms of CAD do not appear until the blood vessels are damaged. Severe damage to blood vessels reduces blood flow to the heart, cause.

- Angina or chest pain that spreads throughout the chest.
- Shortness of breath.
- Heart attack.

If blood vessels are completely blocked, other symptoms include.

- Nausea.
- Sweating.
- Weakness or dizziness.
- Sensation and burning in chest.
- Rapid heartbeat.
- Heart palpitations. (Miller, 2002).

Pathogenesis Of CAD (Coronary Artery Disease) – Atherosclerosis – It's the most common cause of CAD and other heart disease. (libby & Theroux, 2005) The term "atherosclerosis" is derived from the Greek word "athero", meaning wax or gruel, and "sclerosis", meaning hardening of induration. (libby & Theroux, 2005) It's a chronic progressive disease that is caused because of the accumulation or build-up of lipids in the arteries walls which results in thick and hard vessels. (libby & Theroux, 2005) It's a subclinical disease up to the time it reaches a terminal stage or is activated by acute

cardiovascular events. (libby & Theroux, 2005).

Lesion formation – When endothelial vessels encounter certain diseases or problems such as dyslipidemia, vasoconstrictor hormones associated with high blood pressure, glucose oxidation products associated with hyperglycemia, or pro-inflammatory cytokines from adipose tissue, these cells cause expression of adhesion molecules. (libby & Theroux, 2005) Promotes adhesion of blood leukocytes to the inside of the vessel wall. (libby & Theroux, 2005) Migration of adherent leukocytes is mainly dependent on the expression of chemotactic cytokines, which is controlled by the usual atherosclerotic risk-related factors. (libby & Theroux, 2005).

While in the arterial intima, blood leukocytes (mainly mononuclear phagocytes and T lymphocytes) communicate with the endogenous endothelial cells and smooth muscle cells (SMCs) of the arterial wall. (libby & Theroux, 2005) Important exchange messages between cells involved in athero-genesis depend on small molecules that include the inflammatory and immune system, as well as lipid mediators such as prostaglandins and other arachidonic acid derivatives such as leukotrienes. (libby & Theroux, 2005) Other autologous hormones such as histamine normally regulate vascular tone and increase vascular permeability. (libby & Theroux, 2005).

Recently, much attention has been paid to protein mediators of inflammation and immunity, including cytokines and complement components. (libby & Theroux, 2005) Only a decade ago, cytokines, little known to cardiologists, have entered the mainstream of our specialty. (libby & Theroux, 2005).

As a result of inflammatory fermentation in early atherosclerosis, SMCs migrate from the medium to the intima. Cells proliferate and produce a rich and complex extracellular matrix. (libby & Theroux, 2005) Along with endothelial cells and monocytes, they secrete matrix metalloproteinases (MMPs) in response to a variety of oxidative, hemodynamic, inflammatory and autoimmune signals(libby & Theroux, 2005) 1 In parallel with endogenous tissue inhibitors, MMPs regulate many functions of vascular cells, including neovascularization, geometric remodeling, repair, or destruction of the extracellular matrix of blood vessels and cardiomyocytes, as well as activation, proliferation, migration, and cell death of two cells. (libby & Theroux, 2005).

Some of the outer layers (especially proteoglycans) bind lipoproteins, increasing their duration in the intima and sensitizing them to oxidative modification and glycation (non-enzymatic incorporation of sugar). (libby & Theroux, 2005) These modified lipoproteins, including oxidized phospholipids and enhanced glycation products, support and amplify the inflammatory response. (libby & Theroux, 2005) As inflammation occurs, calcification can occur, a process similar to bone formation. (libby & Theroux, 2005)

In atherosclerotic disease, in addition to growth, cell death, including apoptosis, often occurs. (libby & Theroux, 2005) The death of lipid-laden macrophages can lead to cellular aggregation of tissues, some of which are granular. (libby & Theroux, 2005) Extracellular lipid in the intima can coalesce and form a lipid-rich "necrotic" atherosclerotic plaque core. (libby & Theroux, 2005).

Diagnosis – A multi-level approach should be used to evaluate and authorize the use of diagnosis and treatment for CAD according to the level of risk and limitation. (Blanchard & Pfeffer, 1998) Detailed clinical information is important when evaluating patients with suspected or known CAD. (Blanchard & Pfeffer, 1998) The discomfort caused by myocardial ischemia varies from patient to patient. (Blanchard & Pfeffer, 1998) Often defined as discomfort triggered by certain activities and relieved by rest, angina may be triggered by stress (anger or happiness) and exacerbated by a heavy diet or exposure to cold. (Blanchard & Pfeffer, 1998) Angina can sometimes manifest as shortness of breath or pain or numbness in the jaw, back, or arms. (Blanchard & Pfeffer, 1998) Relief and more after cessation of activity. (Blanchard & Pfeffer, 1998) Rapid relief with sublingual nitroglycerin is another important point. (Blanchard & Pfeffer, 1998) An experienced physician will make a minor restriction that can affect myocardial ischemia. (Blanchard & Pfeffer, 1998) However, myocardial ischemic attacks can occur without discomfort (asymptomatic ST-segment depression) and are more common in diabetics and the elderly. (Blanchard & Pfeffer, 1998) Although many conditions, such as aortic stenosis and thyrotoxicosis, can cause angina in the absence of obstructive coronary artery disease, the diagnosis of angina often suggests CAD. (Blanchard & Pfeffer, 1998) A complete physical examination is important to evaluate a patient for possible CAD. (Blanchard & Pfeffer, 1998) Changes in maximum pressure point, dyskinesia precordial beat, and third or four sounds suggest cardiovascular disease but are not specific to CAD. (Blanchard & Pfeffer, 1998) Although tests are often nonspecific and are often negative, it is important to assess the status of the disease specifically. (Blanchard &

Pfeffer, 1998).

Non invasive technique – The resting electrocardiogram (ECG) is a useful and inexpensive test used to evaluate patients with angina and asymptomatic patients, such as elderly and diabetic patients at high risk for asymptomatic ischemia. (Blanchard & Pfeffer, 1998) Most of the patients with CAD will have a normal resting ECG, with the exception of patients with prior myocardial infarction (MI). (Blanchard & Pfeffer, 1998) Therefore, the existence of normal ECGs excludes CAH, even if it is severe. (Blanchard & Pfeffer, 1998) Pathological Q waves often precede myocardial necrosis and coronary artery disease. (Blanchard & Pfeffer, 1998) However, LVH, mitral valve prolapses, and other conditions can cause Q waves or repolarization changes unrelated to previous myocardial infarction. Stress testing to induce myocardial ischemia is important not only for to identify patients with CAD but also for testing to assess the presence of disease and assess the ability to do work. (Blanchard & Pfeffer, 1998) The precision of diagnosing obstructive coronary artery disease depends on the harshness of stenosis and the extent of the disease. (Blanchard & Pfeffer, 1998) Because up to 50% of patients with single vessel coronary artery disease and acceptable exercise can have an exercise ECG. (Blanchard & Pfeffer, 1998) The sensitivity and particularity of the exercise test depend on the prevalence of diseases in the population evaluated (Bayes' theorem). (Blanchard & Pfeffer, 1998) In asymptomatic patients with some risk, exercise ECG serves as a predictor of the presence or absence of CAD. Diagnostic tests are usually exact at a low cost. (Blanchard & Pfeffer, 1998) The mean sensitivity and particularity for obstructive CAD were 68% and 77%, respectively. 81% and 66% for multi-vessel disease, 86% and 53% for triple vessel or left main heart disease, appropriately 3 Correct interpretation of the test requires a link between the data from the ECG (ST segment change) and the action potential. (Blanchard & Pfeffer, 1998) They can follow the recommendation even with a positive diagnosis and if the patient has achieved good working skills reduces the probability of left major coronary artery disease or various CADs. (Blanchard & Pfeffer, 1998) Conversely, significant ST-segment depression or a hypotensive response to low-intensity exercise should be sufficient to order coronary angiography for a definitive assessment of CAD. (Blanchard & Pfeffer, 1998) For rare cases, nuclear or ECG imaging provides additional diagnostic information. (Blanchard & Pfeffer, 1998) Stress echocardiography using adenosine or dobutamine or nuclear imaging is more specific than the standard treadmill test in identifying patients with CAD. (Blanchard & Pfeffer, 1998) This more pricey exercise test case is useful for patients with ECG anomalies who are unable

to exercise. In the presence of CAD, the application analysis is still an important inclusion of the medical history. (Blanchard & Pfeffer, 1998).

Catheterization – Coronary angiography is still an important technique for detecting the existence and intensity of CAD. (Blanchard & Pfeffer, 1998) Afford with the most decent information to make important accord about treatment. (Blanchard & Pfeffer, 1998) Although coronary angiography is an invasive procedure, it is a very safe practice with percent complications. In the records of more than 200,000 patients, the incidence of death was 0.10% and the incidence of myocardial infarction was 0.06%, stroke 0.07%, vascular problems (hematoma, aneurysm, and fistula) 0.46%, and different agents 0.23%.(Blanchard & Pfeffer, 1998) Patients with significant left-sided disease, low ventricular ejection fraction, and NYHA class IV had increased mortality. (Blanchard & Pfeffer, 1998) Local Hematoma is by far the most common complexity usually occurring in patients with uncontrolled hypertension and obesity and may interfere with long-term squeezing. (Blanchard & Pfeffer, 1998).

RECENT ADVANCED TREATMENT AND THE ROLE OF RECENT TECHNOLOGIES IN CORONARY ARTERY DISEASE

Over the years, analysis on various aspects of CAD has received more attention. (Kandaswamy & Zuo, 2018) Thanks to the tireless work of doctors and scientists around the world, significant progress has been made in developing new approaches for patients facing difficulty from CAD and its related problems. (Kandaswamy & Zuo, 2018) These techniques range from medicine to robotic surgery to nanotechnology. (Kandaswamy & Zuo, 2018) This piece will provide information on recent advances in therapy and biomarkers in coronary artery disease research. (Kandaswamy & Zuo, 2018) This piece will cover the following topics.

1. robotic surgery.
2. nanotechnology.
3. stem cells.
4. other developments.

Robotics – Robots have been used in industrial production for many years. However, their introduction to medicine is new, starting with surgery and radiation therapy. (Kandaswamy & Zuo, 2018) They have spent more than a decade in cardiac care in procedures such as mitral valve repair, coronary artery bypass grafting and ventricular septal defect closure.

(Kandaswamy & Zuo, 2018) The technology has evolved rapidly, with many reports of its potential use in percutaneous coronary intervention (Figure 1) and ablation of atrial fibrillation. (Kandaswamy & Zuo, 2018) Robotic technology has many advantages such as improved ergonomics for the operator, precision and sometimes reduced intraoperative time (Figure 2). (Kandaswamy & Zuo, 2018).

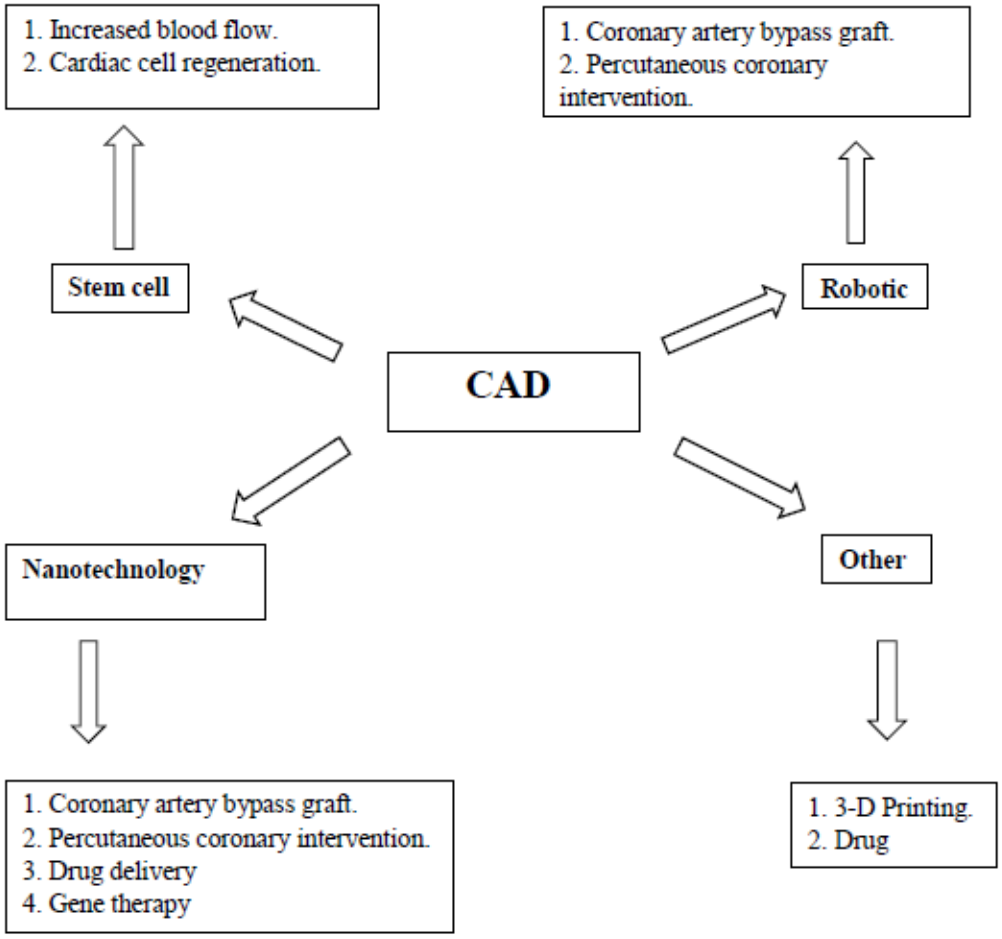

Figure 1: This schematic illustrates the potential applications by which nanotechnology, stem cells, robotics, new drugs and 3-D printing can be used in the treatment of coronary artery disease. (Kandaswamy & Zuo, 2018).

It has been reported that robot-assisted surgery reduces hospital stays and improves patient experience (Figure 2). Robotics is used for catheter surgery in interventional cardiology. (Kandaswamy & Zuo, 2018) While the effect of angiographic radiation routine is approximately 7 mSV in CAD patients, this effect can increase up to 5 times when the process is complicated. (Kandaswamy & Zuo, 2018) Robotic-guided surgery can reduce radiation exposure. (Kandaswamy & Zuo, 2018)

Additionally, they reduced contrast-induced nephrotoxicity and associated mortality in patients (Figure 2). (Kandaswamy & Zuo, 2018) In terms of patient outcomes, robotic surgery is beneficial as it can measure the size of the lesion (which can be miscalculated using 2D angiography), which may result in long-term health(Kandaswamy & Zuo, 2018). Therefore, they reduce the radiation exposure of surgeons and patients and increase accuracy by increasing risk assessment (Fig. 2). Granada J, Delgado J, Uribe M, et al Announced the first robotic intervention for heart patients. They performed coronary angioplasty and reported 100% success in all patients (80 subjects) (as measured by less than 30% residual stenosis and no serious heart problems). (Kandaswamy & Zuo, 2018).

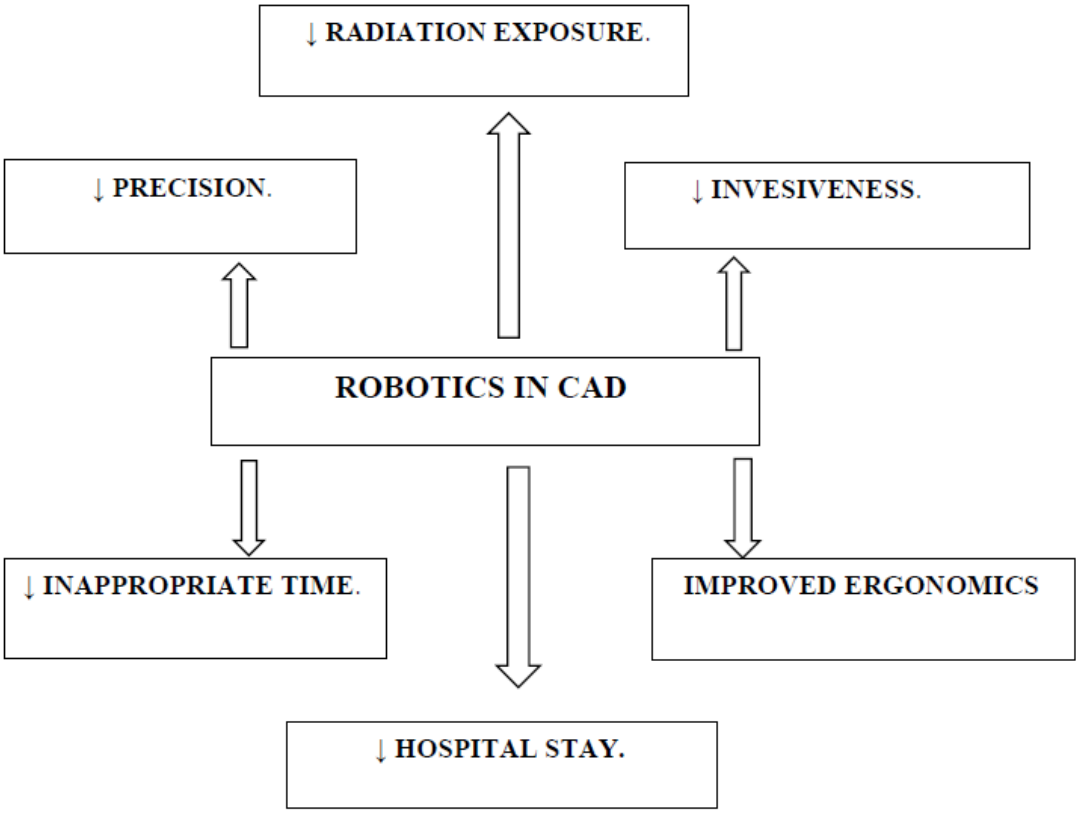

Figure 2: The schematic illustrates the potential advantages of using robotics in the treatment of CAD. Upward and downward arrow represent the increase and decrease in blood flow. (Kandaswamy & Zuo, 2018).

In a multicenter study published by Weisz et al., percutaneous coronary intervention was applied to patients with coronary artery disease. (Kandaswamy & Zuo, 2018) They used similar success criteria (measured by less than 30% residual stenosis and no major heart failure) and reported a 97.6% success rate (164 patients). (Kandaswamy & Zuo, 2018) They also reported a reduction (95%) in workers' exposure to emission. (Kandaswamy & Zuo,

2018).

Robotic technology has also been used to perform coronary artery bypass grafting in CAD patients (Figure 1). (Kandaswamy & Zuo, 2018) The procedure involving removal and anastomosis of the mammary artery can be done endoscopically. Table 1 shows the results of the clinical trial. (Kandaswamy & Zuo, 2018) Despite the reported benefits of robotically assisted bypass grafting, high costs and long run times have slowed its adoption into routine use. (Kandaswamy & Zuo, 2018) Robot- assisted hybrid coronary revascularization, including coronary artery bypass grafting and percutaneous coronary intervention, is also being developed as a treatment for CAD. (Kandaswamy & Zuo, 2018).

Table 1: Summary of clinical studies for robotic assisted coronary artery bypass grafting. (Kandaswamy & Zuo, 2018).

S.no.	Author's name	Result	Additional comments
1	Dagon et al.	They repoted a potency rate of 100%	TECAB was performed on hearts arrested intraoperatively.
2	Kappert et al.	Reduced duration of surgery (down from 260 to 180 minutes); all of them have normal wound healing.	TECAB was performed on a beating heart. 3 patients had to undergo re-exploration due to bleeding.
3	Mohr et al.	Successful procedure in 22 patients (5 of them had to be converted to manual procedure); At discharge, patency was 100% and 95.4% at 3 months; In the TECAB group, success rate was 50%.	TECAB was performed on beating (n = 8) and arrested (n = 27) heart.

Because of the minimal effect of the procedure, benefits such as reduced morbidity and shorter hospital stay have been reported. (Kandaswamy & Zuo, 2018) The current status of robotic surgery is promising in the treatment of CAD. These machines are hi-tech and are the best. (Kandaswamy & Zuo, 2018) The claimed benefits in the form of progress, enhanced visibility, improved ergonomics and decreased electrical emissions have been noted, which adapted into shorter patient turnarounds and reduced the number of hospitals. (Kandaswamy & Zuo, 2018) It also has different advantages for mechanism that are difficult to do with an endoscope or catheter. (Kandaswamy & Zuo, 2018).

However, their adaptation into clinical use has been hampered by the high cost and learning curve required to master this technique. (Kandaswamy & Zuo, 2018) It is not yet clear whether these procedures will be accepted into routine medical care and whether they will

change traditional procedures as technology advances. (Kandaswamy & Zuo, 2018).

Nanotechnology – Nanotechnology has revolutionized many fields, including medicine. It involves the construction of molecules at the nanoscale that have different properties from macromolecules of the same composition. (Kandaswamy & Zuo, 2018) These differences yield clear results and are the main reason for the expansion of nanotechnology research. (Kandaswamy & Zuo, 2018) This technique has been studied in CAD for its potential in clinical (non-invasive) and non-invasive treatments, drug delivery, percutaneous interventions, gene therapy, and coronary artery bypass grafting (Figure 1). (Kandaswamy & Zuo, 2018) Cholesterol is an important factor in the development of coronary artery disease. (Kandaswamy & Zuo, 2018) High-density lipoproteins (LDL) are associated with heart disease, while high-density lipoproteins (HDL) are thought to be protective because they are involved in the transport of cholesterol out of peripheral tissues. (Kandaswamy & Zuo, 2018).

Nanotechnology has been used to synthesize dimyristoyl-phosphatidylcholine, which monitors the surface properties of HDL by treating cholesterol to remove it from the tissue and deliver it to the liver (Figure 3). (Kandaswamy & Zuo, 2018) In animal studies, mice fed a cholesterol-rich diet were treated with dimyristoyl-phosphatidylcholine liposomes to reduce plaque and cholesterol in the aorta. Fumagillin is an anti-angiogenic drug that has been shown to inhibit angiogenesis, thereby promoting plaque formation in the arteries. (Kandaswamy & Zuo, 2018) One of the negative effects of fumagillin use is that it can cause adverse neurocognitive effects at the high doses required for treatment. (Kandaswamy & Zuo, 2018) Winter and other things. It has been shown that Fumagillin can be delivered by the avβ3 integrin-targeted nano-delivery system and achieve a significant anti-plaque effect at one-third of the daily dose (Fig. 3). (Kandaswamy & Zuo, 2018).

The efficacy of several nanoparticle-based antithrombotic agents has been tested. (Kandaswamy & Zuo, 2018) d-phenylalanyl-1-prolyl-Larginyl-chloromethyl ketone is a potent antithrombotic agent that is rapidly eliminated from the body, thus limiting its clinical application. (Kandaswamy & Zuo, 2018) An improvement in anti-inflammatory drugs has been demonstrated when combined with nanoparticles with a perfluorocarbon core, as demonstrated in animal research models by Myerson et al. (Figure 3). (Kandaswamy & Zuo, 2018) On the other hand, Peters et al. used hirudin in combination with fibrin-binding micelle nanoparticles, showing increased targeting of fibrin clots in vivo (Figure 3). (Kandaswamy & Zuo, 2018) Collagen Type IV nanoparticles have been tested in animal research models and

have been shown to improve collagen production while reducing oxidative stress by acting on Annexin A1 (Glucocorticoid Regulatory Protein). (Kandaswamy & Zuo, 2018).

Modifications studied are liposomal glucocorticoid transporter (delivers anti-inflammatory drugs, thereby reducing cell walls), lipid nanoparticles (transmits CC chemokine type 2 pro-inflammatory receptor that antagonizes siRNA), and HDL nanoparticles (delivers stimulating Agent Vastatin, inhibits monocyte uptake). (Kandaswamy & Zuo, 2018) The combination of gel-based nanoparticles with rapamycin (antiproliferative and antiapoptotic effects) has been studied in animal models, showing that they can repair vascular damage and reduce hyperplasia. (Kandaswamy & Zuo, 2018) Smart nanoparticles such as pH-dependent antioxidant delivery developed by Tang et al. It shows promise in the treatment of heart disease. nanotechnology works well when percutaneous coronary intervention is used. (Kandaswamy & Zuo, 2018) They examined their ability to release drugs, promote healing, and reduce pain (Figure 3). (Kandaswamy & Zuo, 2018) A nanoscale layer of hydroxyapatite for the controlled release of the anti-inflammatory drug sirolimus has been successful in clinical trials. (Kandaswamy & Zuo, 2018) Similarly, sirolimus release was investigated using carbon nanoparticle coated stents with drug release similar to reported in vitro studies. (Kandaswamy & Zuo, 2018) The sirolimus-eluting stent was compared with the pitavastatin nanoparticle-eluting stent. (Kandaswamy & Zuo, 2018) The latter has been shown to be effective in healing endothelial cells more rapidly compared to other defects (Fig. (Kandaswamy & Zuo, 2018)Rapamycin-loaded magnetic silica nanoparticles were plated onto the scaffolds and exhibited rapid endothelialization in in vivo studies. (Kandaswamy & Zuo, 2018) Endothelial repair and re-endothelialization help repair damaged blood vessels. It has been shown that polycaprolactone is an effective nitric oxide transporter and reduces inflammation (Figure 3). In animal research models, liposome-encapsulated alendronate, a bisphosphonate, has been shown to reduce inflammation and neointima formation (Figure 3). (Kandaswamy & Zuo, 2018) Similarly, paclitaxel, an anti-inflammatory drug in the form of albumin-based nanoparticles, has been shown to have significant anti-inflammatory effects even when the drug is weak. In this case, nanoparticles are used to increase cell membrane permeability (alendronate) or to bind more tissue (paclitaxel). (Kandaswamy & Zuo, 2018) A carrier in the form of poly (lactic-co- glycolic acid) has been shown to control the release of paclitaxel (nanocoated-64), and polyethylene glycol has been shown to reduce platelet adhesion. (Kandaswamy & Zuo, 2018) Nanomodification could also help researchers target specific drugs such as collagen IV, chondroitin sulfate, tissue or scaffolds. (Kandaswamy &

Zuo, 2018).

Nanotechnology has the potential to promote healing by providing endothelialization of scaffolds (Figure 3). (Kandaswamy & Zuo, 2018) Nanomodifications include nanofibrous meshes (to attract endothelial cells), polyhedral oligomeric silsesquioxane poly(carbonate-urea) polyurethane (to promote adhesion and proliferation of human endothelial cells), peptide amphiphile nanofibrous coatings (to improve endothelial cell growth attachment), and nanoparticles . (Kandaswamy & Zuo, 2018) Specific development of cells to their Structure Structures). Nano-technology also has potential applications in engineering options for coronary supply pathway bypass devices. (Kandaswamy & Zuo, 2018) The researchers explored the potential of electrospun nanoscale robust platforms that could prove to be the fabricated ports of choice for coronary artery bypass attachment techniques. (Kandaswamy & Zuo, 2018) Focusing on healing with drug-resistant stents is another defense against nanotechnology. (Kandaswamy & Zuo, 2018) High- quality elute stents can be used to overcome abdominal pain, stent thrombosis, and slow endothelialization. (Kandaswamy & Zuo, 2018).

Nanocoatings on the framework of some hyaluronic acid etchant (carrying pDNA), nanobiohybrid hydrogel (carrying Tat peptide and DNA) and poly (lactic-glycolic acid co-etching agent) nanoparticles (carrying PDGF receptor-β antisense RNA) were bioassayed. . models with good results. (Kandaswamy & Zuo, 2018) Other effective targets that have been extensively studied include antisense oligonucleotides, chitosan plasmid DNA, Akt1 siRNA, vascular endothelial growth factor, prostacyclin synthase, and endothelial nitric oxide synthase. (Kandaswamy & Zuo, 2018) Tanotechnology opens up new and promising areas in the treatment of CAD. (Kandaswamy & Zuo, 2018) It has significant potential in the delivery of pharmaco--kinetically limited drugs. Its use in stents and large-scale treatments will be helpful in future treatments based on this model. Advanced randomized controlled trials should be conducted to generate evidence to support the use of recent advances in CAD medicine. (Kandaswamy & Zuo, 2018) This should be done in collaboration between analysts, engineers, biomedical engineers, nanotechnologists and doctors. (Kandaswamy & Zuo, 2018).

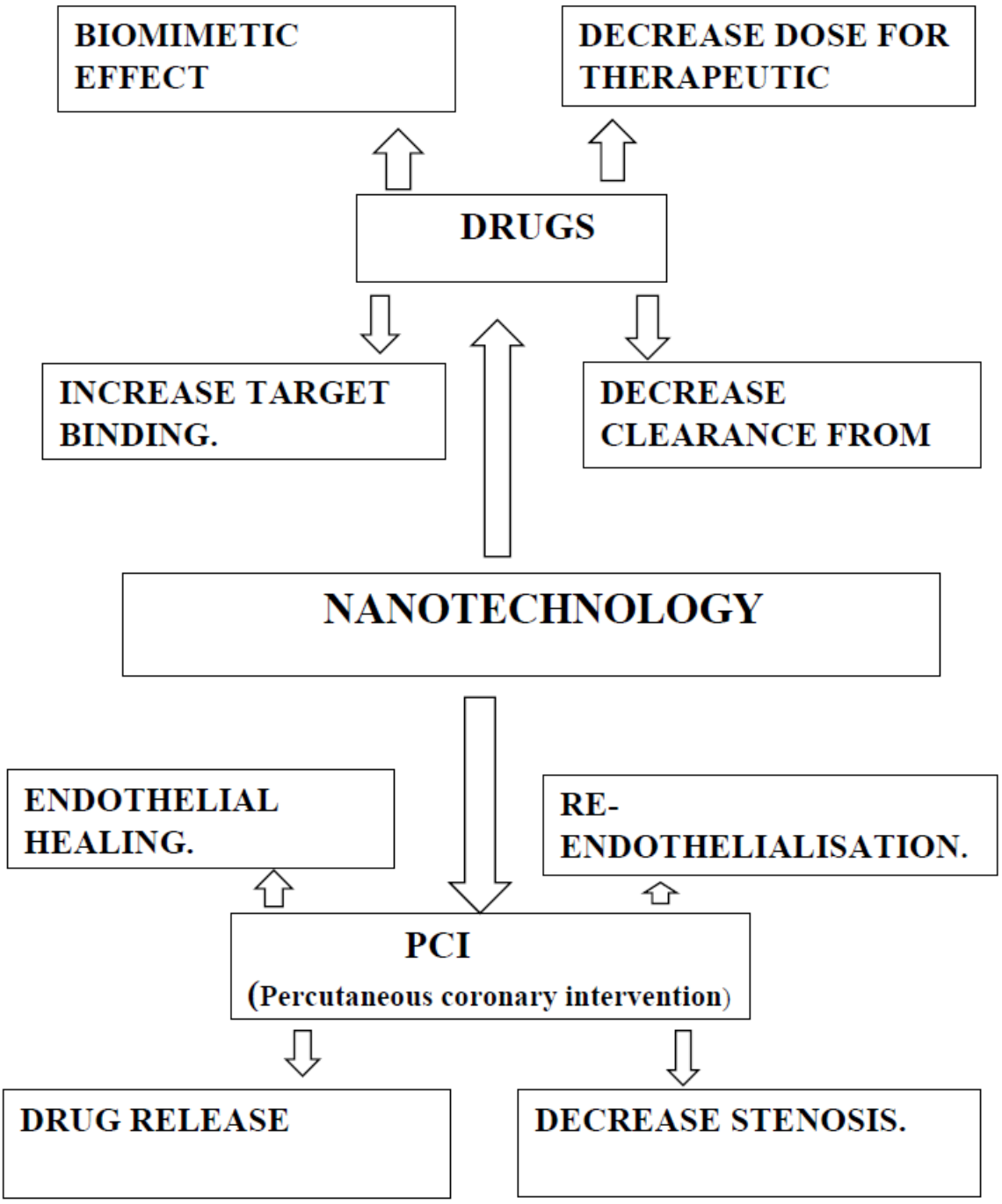

Figure 3: The schematic illustrates the potential advantages of using nanotechnology in the treatment of CAD. (Kandaswamy & Zuo, 2018).

Stem cell therapy – Introduction of Stem Cells – Morbidity and mortality due to malfunctions in critical organs plague even the maximum technologically superior societies. Because of a dearth of transplantable organs, there's a developing desire that stem cells can be the solution to mankind's prayer to have the ability to update tissues wiped out via way of means of vintage age and ravaged via way of means of disease. (Alison et al., 2002) Indeed, it's miles

not possible to open a newspaper in recent times without seeing but any other apparent 'breakthrough' in stem molicular studies; the greater optimistic hoping for an elixir of existence – the promise of immortality. (Alison et al., 2002).

More realistically, the regenerative remedy is already turning in results - for example, biotechnology groups together with Osiris Therapeutics, Inc. are making 'off-the-shelf' merchandise from human mesenchymal stem cells for bone (OsteoCel2) and joint (Chondrogen2) repairs. (Alison et al., 2002) This form of tissue restoration makes use of the body's very own 3-dimensional matrix and increases component milieu; greater tough can be the conclusion of the holy grail of tissue engineering – the advent of entire complicated internal organs together with the liver and kidney out of doors the body. (Alison et al., 2002) ES (embryonic stem) cells can come from the ICM (inner cell mass) of the early blastocyst or fetal gonadal tissue. (Alison et al., 2002) Blastocysts are usually 'spares' from IVF programmed, aleven though a few have been created deliberately. (Alison et al., 2002) Tissues generated from such ES cells have nonetheless conquered the trouble of histocompatibility, however somatic cell nuclear transplant (SCNT – additionally referred to as healing cloning) provides the opportunity of the use of the patient's very own genome to generate ES cells and so triumph over this obstacle. (Alison et al., 2002).

In the human sphere, claims of early human embryonic improvement after SCNT appears pretty premature, given that the maximum superior embryo reached the handiest of the six molecular stages. (Alison et al., 2002) Moreover, such became consternation was generated via way of means of those initial records that 3 contributors to the editorial board of the publishing journal resigned. (Alison et al., 2002) Human reproductive cloning, allowing embryos created via way of means of SCNT to return to term, is unlawful in maximum countries; this might be simple as well, if for no different cause than that at gift nearly all cloned animals expand one or greater abnormalities. (Alison et al., 2002).

Legislation concerning the usage of ES cells additionally varies across the globe, including the problems. (Alison et al., 2002) In countries together with the United Kingdom and Australia, new molecular strains can be constructed from spare embryos, however, within side the US, federal funds can handiest be used on ES molecular strains created earlier than nine August 2001, the purpose being that such cells, at the same time as showing pluripotency, do now no longer have the cap potential to expand into an entire human being, for this reason, the sanctity of human existence isn't always compromised via way of means

of their use. (Alison et al., 2002) While no person without a doubt doubts that ES cells are probable to be the maximum bendy of all stem cells, the moral issues surrounding their use have brought on the quest for opportunity-grownup sources. (Alison et al., 2002).

In particular, hematopoietic stem cells (HSCs) appear the maximum flexible at cutting throughout lineage limitations and seem capin a position to differentiate into many different forms of molecular – so-referred to as trans-differentiation. (Alison et al., 2002) On a cautionary note, a few latest studies have referred to as into query about the plasticity of grownup stem cells. (Alison et al., 2002) HSCs and neural stem cells can now and again fuse with ES cells in vitro, mainly to the hypothesis that perhaps all reviews of trans-differentiation in vivo are without a doubt simply molecular fusion events; we agree with this hypothesis to be greater than only a trifle premature. (Alison et al., 2002) On the different hand, a much-quoted paper reporting the cap potential of clonally-derived neuro-sphere cells to in part reconstitute the bone marrow of sub- lethally irradiated recipient mice has now no longer been confirmed, despite a valiant attempt. (Alison et al., 2002).

The Potential of Stem Cells – Stem cells have various capabilities. (Alison et al., 2002) At the pinnacle of the tree (the maximum primitive) are the fertilized oocyte (the zygote) and the descendants of the primary divisions. (Alison et al., 2002) These cells are totipotent, capable of shaping the embryo and the trophoblasts of the placenta. After approximately four days, those totipotent cells start to specialize, forming a hollow ball of cells, the blastocyst, and a cluster of cells referred to as the internal cellular mass (ICM) from which the embryo develops. (Alison et al., 2002) The ICM cells are taken into consideration to be pluripotent, capin a position to distinguish into nearly all cells that stand up from the 3 germ layers, however now no longer the embryo due to the fact they're not able to present an upward push to the placenta and assisting tissues: ES cells are taken into consideration to be pluripotential. (Alison et al., 2002).

Most tissues have multipotential stem cells, cells able to generate a restricted variety of differentiated molecular lineages suitable to their location, (for example, small intestinal stem cells can produce all 4 indigenous lineages (Paneth, goblet, absorptive columnar, and entero-endocrine), whilst vital nervous system (CNS) stem cells have tri-lineage capability able to producing neurons, oligodendrocytes, and astrocytes(Alison et al., 2002). However, the usage of the period 'multi-potential' can be rather redundant if it's far true, as it seems now to be, that sure grownup stem cells, eliminated from their typical location, can transdifferentiate

into cells that stand up from the 3 germ layers. (Alison et al., 2002)

At the lowest of the tree are uni-potently stem cells, cells able to produce one precise molecular type. In this class, we should area epidermal stem cells within side the basal layer that produces the simplest keratinized squames and sure grownup hepatocytes which have long-time period repopulating ability. (Alison et al., 2002) Some might argue that there may be no such aspect as a uni-potential stem molecular and those cells need to be referred to as devoted progenitors. (Alison et al., 2002) While there may be absolute confidence that during a few tissues, e.g. the gastrointestinal tract and hematopoietic renewal systems, there are devoted stem cells (progenitors) with extra restricted department capability than their multi-potential stem cells, within side the dermis and liver those uni-potent cells do have a big clonogenic capacity. (Alison et al., 2002).

Stem cell therapy in heart disease – cardiovascular research aims to alter the effects of cad by treating mayo-cardial damage and increasing blood flow in ICH in this context vascular growth products and stem cells are of interest as a treatment for patients with cad the rationale behind this treatment is to deliver blood to the ischemic region of the heart via stem cells and stimulate heart cell recovery (figure 1). (Kandaswamy & Zuo, 2018) this can be done in one of two ways through the cooperation of stem cells or through paracrine variants emanating from stem cells in this case hematopoietic stem cells were of particular interest for monocytes endothelial cells (fig 4). (Kandaswamy & Zuo, 2018) There are conflicting ideas about the use of these cells for various types of ischemic heart disease such as acute myocardial necrosis MI and ICH but in this place some ideas have proven useful and tend to affect patients this has led to consideration of other types of stem cells such as those derived from fat a new option is the generation of pluripotent stem cells as opposed to embryonic stem cells in which adult cells are transformed into pluripotent stem cells although, it has a good option the problem of carcinogenesis of stem cells is not a topic to be discussed recently and can be tested on humans. (Kandaswamy & Zuo, 2018).

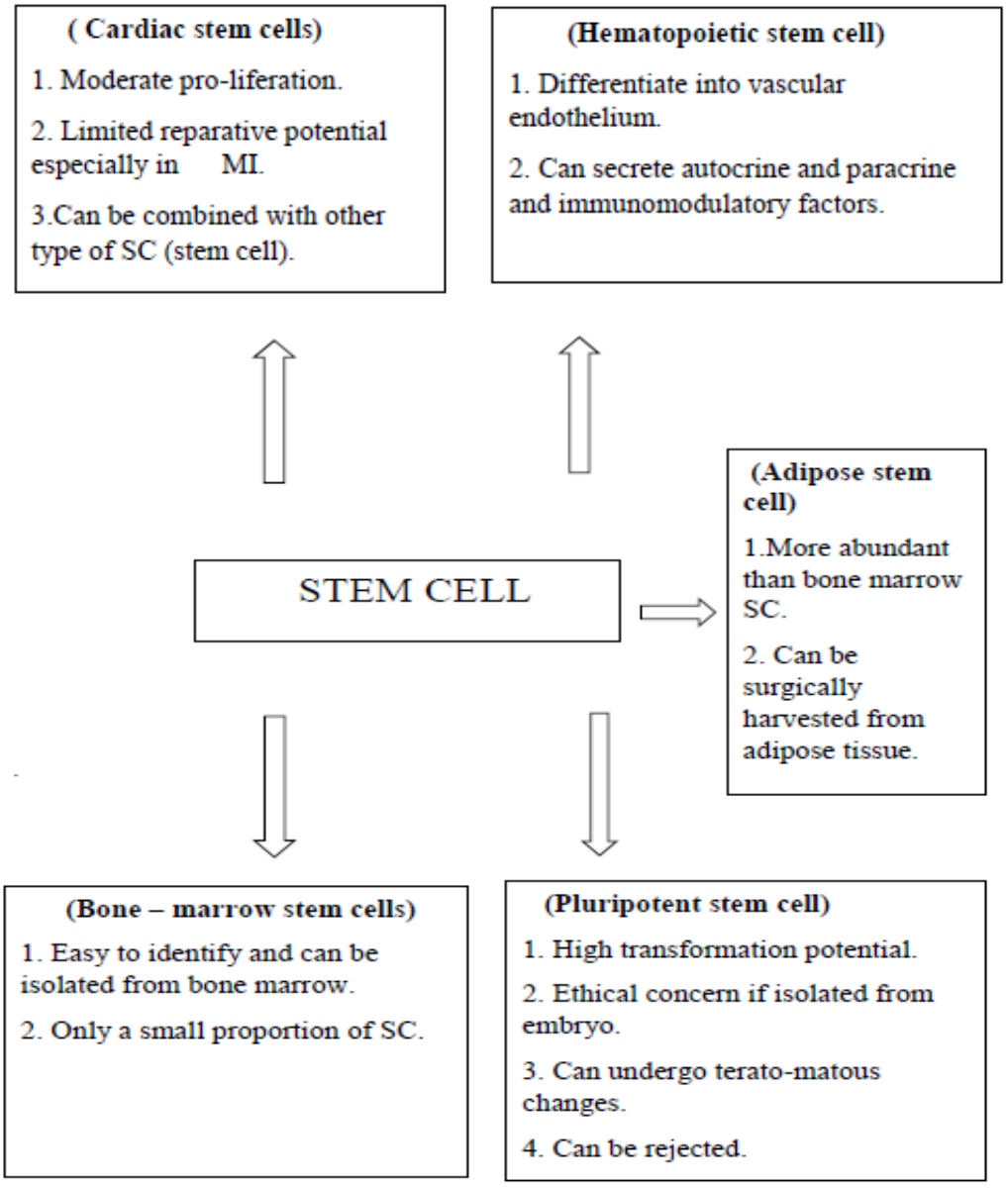

Figure 4: The schematic illustrates and the potential of different types of stem cells in the treatment of CAD. (Kandaswamy & Zuo, 2018).

Stem-cells identified in heart research spread from bone-marrow to adipose-tissue and skeletal muscle, bone-marrow derived monocytes are the most readily available cells for in-vivo transplantation, they are easily recognized by their cell markings and can be separated from the bone-marrow, however because the collected cell have many cell and small stem cell their potential value is very high (figure 4). (Kandaswamy & Zuo, 2018) Bone-marrow derived mesenchymal stem cell have been shown to be less abundant than monocytes, so weeks of growth in the laboratory and significant growth abnormalities are required before medical application, fat- derived stem cells can be harvested from adipose-tissue, it is more

than just bone-marrow cells,this really saves time and involvement in analysis to develop them for medical uses (figure 4). (Kandaswamy & Zuo, 2018) Pluripotent stem-cell have the ability to change although embryos are the most unique form of stem cell, their use is questionable and controversial, also these cell will be removed when transplanted in the recipient, but it is necessary to regenerate adult cells and transform them into pluri-potent cells with similar properties to stem cell, hence the term pluri-potent stem-cell these cells can be replaced so they do not fall behind, however due to their ability to mutate they can undergo teratoma changes including from all three layers of disease in vivo unless closely directed (figure 4). (Kandaswamy & Zuo, 2018) Recent examination of this area requires further study due to the possibility of different teratomas and these can be considered safe for human trials, another interesting aspect of stem cell is heart-disease, although the heart is thought to be an inert organ little or no chance of undergoing mitosis in old age, then a unique insight emerges the heart is now considered to have a remarkable regenerative capacity and undergoes continuous changes through-out adult life (figure 4). (Kandaswamy & Zuo, 2018) The heart appeared with a cardiovascular system which is used to monitors central re-modeling changes throughout adulthood these cell are diverse in the apical chambers and ventricles although these cell are known to be involved in tissue homeostasis and their repair capacity is limited specially during severe damage such as myocardial necrosis (MI). (Kandaswamy & Zuo, 2018) Recently there has been interest in creating and using multiple stem cells that can communicate with each other called cardio-clusters this group of cells is a mixture of cardiac cells mesenchymal cell endothelial precursors and fibro-blasts(figure 4). (Kandaswamy & Zuo, 2018) They support the healing of the heart in diseases such as cad where the cells work less. (Kandaswamy & Zuo, 2018).

Other advancement – 3-D-printing – CVDs frequently require 3D-imaging like echo reverb imaging computed tomography and 3d echography to diagnose and deal with those illnesses,it is able to paintings for a few cardiovascular techniques, modern-day requirements aren't top for extra extreme interventions. (Kandaswamy & Zuo, 2018) 3D- printing has an vital position in CAD, as it now, no longer simplest overcomes those troubles, however additionally permits for visualisation items orientation and making plans surgical treatment and simulation. (Kandaswamy & Zuo, 2018) 3D- printing entails the additive manufacturing of offerings the usage of 3D substances from photograph fashions, as innovation turns into extra not unusual. (Kandaswamy & Zuo, 2018) Researchers are starting to see the entire ability of 3D-printing, it's far powerful withinside the control or therapy of delivery defects

most cancers cardiomyopathies blood go with the drift styles coronary heart disorder CAD, stent placement and different situations withinside the subject of cardiology. (Kandaswamy & Zuo, 2018).

3D- printing offers 3D-revealed visualization of the coronary heart with blocked and narrowed coronary arteries in cad sufferers this version may be used withinside the surroundings, now no longer simplest with out wondering and getting its layout, however additionally construct the consultation. (Kandaswamy & Zuo, 2018) 3d revealed fashions also are vital in CAD, trying to evaluate photos and remedies. (Kandaswamy & Zuo, 2018) An in vitro have a look at illustrating, a scientific scenario confirmed that 3d printing could be extra dependable in setting up and treating hard instances furcation accidents requiring stenting tissue engineering fashions are presently being examined to create stem cells and extracellular meshes tissue printing for implantation. (Kandaswamy & Zuo, 2018) Withinside the frame in vitro research have distinctive tissue- imprinted fashions of cardiovascular gadget in animal research, the implantation of revealed substances into epicardial tissue has been proven to be powerful lowering detrimental adjustments and growing fashions of myocardial infarction. (Kandaswamy & Zuo, 2018).

Drugs – Patients who have CAD usually receive stable rehabilitative and long-term medications to treat the disease itself and comorbidities eg. hypercholesterolemia subsequently success has been achieved in drug development for patients with CAD (fig 1). (Kandaswamy & Zuo, 2018) One of the drugs that cad patients take is oral anti-inflammatory drugs such as ibuprofen and clopidogrel long ago a group of drugs known collectively as oral anticoagulants, was discovered, this list includes the following drugs ximelagatran, darexaban, dabigatran, rivaroxaban and apixaban among them dabigatran, edoxaban, rivaroxaban and apixaban are approved for clinical use edoxaban rivaroxaban and apixaban are coagulation inhibitors Xa. (Kandaswamy & Zuo, 2018)

While dabigatran can be a competitive thrombin inhibitor the use of dabigatran in patients with CAD was studied in a phase 2 study. (Kandaswamy & Zuo, 2018) It was found that at higher sedative doses 110 and 150 mg patients experienced a reduction in ischemic events but this outcome was offset by a twofold increase in mortality. (Kandaswamy & Zuo, 2018) However these trials concluded that low doses could be used for treatment without the risk of death. A key protein in LDL regulation is the proprotein convertase subtilisin ketsin grade 9 PCSK9. Decreases LDL receptors. (Kandaswamy & Zuo, 2018) This lowers LDL cholesterol

levels in the blood. Another important drug that appears to affect PCSK9 activity is alirocumab. (Kandaswamy & Zuo, 2018) The tranquilizers themselves are effective against monoclonal antibodies provided by recombinant DNA innovations. (Kandaswamy & Zuo, 2018) Primary results show a 28-65% reduction in LDL cholesterol based on subcutaneous or intravenous ingestion in a randomized, double-blind, controlled Phase II study. (Kandaswamy & Zuo, 2018) Reductions in LDL cholesterol continued from 182 percent to 67 percent, depending on the magnitude of placebo alirocumab. (Kandaswamy & Zuo, 2018) The combination with atorvastatin reduced LDL-C by approximately 66 to 73 percent, while sham and atorvastatin reduced LDL-C by approximately 17 percent. (Kandaswamy & Zuo, 2018) These results have been confirmed by several phase III studies as high LDL levels are associated with CAD. (Kandaswamy & Zuo, 2018) The newest heart failure treatment, alirocumab, is an angiotensin receptor neprilysin inhibitor ARNi. (Kandaswamy & Zuo, 2018) This drug contains a combination of sacubitril and valsartan and is commonly known as LCZ696 or ARNi. The drug valsartan belongs to the angiotensin receptor antagonist family of drugs and is an angiotensin II receptor antagonist, whereas the Sacubitril component is a neprilysin inhibitor(Kandaswamy & Zuo, 2018). This drug has proven more effective than the angiotensin-converting protein expert inhibitor in treating failed heart disease. (Kandaswamy & Zuo, 2018) Early research is promising, but people are looking forward to Phase III clinical trials. (Kandaswamy & Zuo, 2018).

CONCLUSION

CAD is a complex cardiovascular condition driven by atherosclerosis and influenced by various risk factors. Early detection, accurate diagnosis, and appropriate management strategies play a crucial role in improving outcomes and reducing the burden of CAD. By understanding the etiology, risk factors, clinical manifestations, and diagnostic approaches associated with CAD, healthcare professionals can provide timely interventions and empower individuals to make lifestyle changes to mitigate their risks and enhance their cardiovascular health. The role of new technology and advanced studies in the treatment of Coronary Artery Disease (CAD) has been instrumental in improving patient care and outcomes. The advancements in diagnostic techniques, interventional procedures, and evidence-based guidelines have transformed the management of CAD, leading to more accurate diagnoses, personalized treatment approaches, and reduced cardiovascular events. By leveraging these advancements, healthcare providers can offer personalized care, optimize treatment selection, and improve patient outcomes. The result is a reduction in cardiovascular morbidity and

mortality rates, as well as enhanced quality of life for CAD patients.

As technology continues to advance and research progresses, further innovations are expected in the field of CAD treatment. Continued collaboration between researchers, clinicians, and industry stakeholders will be crucial in harnessing the full potential of new technologies and advancing our understanding of CAD, ultimately leading to more effective interventions and improved patient outcomes.

DECLARATION OF CONFLICTING INTEREST

The author declared no potential conflicts with respect to research, authorship and publication of this article.

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