ARTIFICIAL INTELLIGENCE IN DETECTING ATHEROSCLEROSIS PLAQUES AND ELECTROMAGNETIC THERAPY TO ALTER CHOLESTEROL LEVEL

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ABSTRACT

Introduction: Artificial Intelligence (AI) application in healthcare fields include matching patient symptoms to appropriate physician, helped to diagnose patients, determine patient's prognosis, drug discovery, translating languages, and organize data. AI technology used in analysis and diagnosing coronary atherosclerotic plaques has increased annually. There are studies suggested that extremely low-frequency electromagnetic fields exposure can affect lipid metabolism.
Purpose: To use applied AI in a device that can both identifying atherosclerosis in blood vessel and treat with low-frequency electromagnetic wave.
Method: Experiments carried out using a device to detect and treat blockage of blood vessels by emitting electromagnetic signals. This tool is an AI breakthrough that not only includes a diagnostic function, but can also perform electromagnetic therapy.
Result: Previous studies mentioned that AI can be applied to identify atherosclerosis. There are some studies that states low-frequency electromagnetic waves can alter HDL and cholesterol levels in blood. Larger studies are needed to combine both function in identify atherosclerosis plaques and electromagnetic therapy.
Conclusion: Rapidly developing AI technology can be applied to identify atherosclerosis plaque and treat them. Further studies are required to provide definitive proof of electromagnetic wave effects on the removal of cholesterol from plaques using thermal effects or raising HDL concentrations in blood.

Keyword: Artificial Intelligence, atherosclerosis plaque, electromagnetic exposure, cholesterol level, HDL level

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INTRODUCTION

Technology now become a part of human daily life. Artificial intelligence (AI) in a various way has been used to help us in a lot of fields. It has transformed our lives and benefits us. AI is a branch of computer science that develops smart machines capable of performing tasks that typically require human intelligence. (Basu, K, et all. 2020.)

AI has a subset of algorithms that divided into supervised learning, unsupervised learning, semi supervised learning, and reinforcement learning. Supervised learning refers to learning from labeled examples, while unsupervised and reinforcement learning performs unlabeled learning and learning from pattern recognition. A subset called Deep Learning (DL) in AI uses complex data sets which mirror human neural networks (Covas, P, et al, 2022).

In healthcare fields, AI systems have a typical pattern to work. Starting with a large amount of data, it uses algorithm to process data and obtaining information. This information then used for solving medical related problems. Several AI application in healthcare fields include matching patient symptoms to appropriate physician, helped to diagnose patients, determine patient's prognosis, drug discovery, translating languages, organize data, etc (Basu, K, et al, 2020).

AI has been used in various cases to help diagnosing patient's disease, for example in dermatology visual-oriented specialties namely diagnose skin cancer, skin lesions, and psoriasis (Basu, K, 2020). Other than dermatology, AI is used in cardiology, specifically in diagnosis of coronary artery disease (CAD). This application of AI has increased exponentially anually (Covas, P, et al, 2022.)

Artificial intelligence used to image analysis of coronary atherosclerotic plaques, covering multiple areas from plaque component analysis, namely identification of plaque properties, identification of vulnerable plaque, detection of myocardial function, and risk prediction (Zhang, J., et al, 2022).

There has been a study of applied AI to coronary computed tomography angiograhy (CCTA) to overcome limitations of manual evaluation, such as time consuming and requires high expertise. This study were analyzed by FDA-cleared software service that performs AI-driven coronary artery segmentation and labeling, lumen and vessel wall determination, plaque quantification and characterization so that the data can be analyzed for stenosis diameter, plaque volume and composition, presence of high-risk plaque, and Coronary Artery Disease Reporting & Data System (CAD-RADS). It is said that AI's interpretation to determine coronary stenosis and CAD-RADS is in close agreement with consensus of L3 expert readers and there was a wide range of atherosclerosis identified through AI (Choi, A. D., et al, 2021).

Coronary artery disease or atherosclerosis is a disorder characterized by formation of fatty streaks proliferation of intimal smooth muscle cells, which eventually leads to coronary artery stenosis. Atherosclerosis is a process involving interactions between monocyte-derived macrophages, endothelial cells, lymphocyte, and smooth muscle cells (Zhang, J, et al, 2022). In Indonesia, CAD prevalence reached 1,5% that means 1500 person who has CAD every 100.000 person. Percentage CAD patients male and female is 1,3% and 1,6%, respectively (Kementrian Kesehatan Republik Indonesia, 2018).

There been some studies to detect plaque components using noninvasive examinations and invasive examinations. Mainstream noninvasive measurements include CT-scan and Magnetic Resonance Imaging (MRI). They can be used to characterize stenosis, plaques, and vascular remodelling, thus detecting patients with high-risk plaques and stratify the risk of cardiovascular disease. The latter uses intravascular ultrasound (IVUS) and optical coherence tomography (OCT) to provide a cross-sectional view of the coronary artery. IVUS can identify plaque components and classify them into fibrous tissue, fibro-fatty tissue, necrotic cor, and dense calcium based on the image texture. (Zhang, J, et al, 2022)

Electromagnetic fields (EMF), from extremely-low frequency to radiofrequency, have been shown to cause biological effects even at low intensity. These effects may be applied in medical treatments (Singh, N.P., 2010). Some studies suggested that electromagnetic fields can affect human health. Extremely low-frequency electromagnetic fields exposure is generally believed non-harmful for human health due to their low-level energy exposition, which is of a magnitude well below that required to affect the metabolic rate of the human body. (Torres-Duran, PV, et al, 2007)

A study conducted by Indrayana Sunarso in 2009 suggested that extremely low-frequency electromagnetic fields (ELF-EMF) interacted with rats induced a electromagnetic wave on the body and stimulated tissues, especially heart tissues. The result was exteremely low frequency electromagnetic wave exposure can decrease blood HDL-C level and blood cholesterol after 24-hours exposure (Sunarso, 2009).

A study states that single exposures to ELF-EMF increases the serum values of HDL-C, the liver content of lipoperoxides and decreases total cholesterol of the liver. The mechanisms of the effects of ELF-EMF on lipid metabolism are not well understand yet, but could be associated to the nitric oxide synthase EMF-stimulation. (Torres-Duran PV, et al, 2007)

This article serves to summarize and provide idea about applying Artificial Intelligence to diagnose CAD and theraphy for CAD using electromagnetic wave.

METHOD

This study uses experiments carried out using a device to detect and treat blockage of blood vessels by emitting electromagnetic signals. The device is an AI breakthrough that not only includes a diagnostic function, but can also perform electromagnetic therapy.

First of all, AI performs an invasive examination through the insertable parts of the body, especially the blood vessels to determine where the atherosclerotic plaque formation occurs. After that, this tool will determine the risk of stenosis, determine the type of plaque, and determine the prognosis of these blood vessels in the future.

After the diagnosis has been completed and re-crosschecked by the expert, then AI will help health workers to determine the right treatment for the patient by considering various aspects, especially the biological aspects of the patient.

Theraphy that can be used is applying low-frequency electromagnetic waves from the device itself. The strength of the required electromagnetic wave frequency starts from 50-60 Hz because the data obtained from previous studies states there are effects on experimental animals in the form of liver stimulation and fat metabolism. This affected fat metabolism leads to increased serum levels of HDL-C, lipoperoxide, and lower total cholesterol in the liver (Torres-Duran PV, set al, 2007).

Work mechanism of electromagnetic waves is to alter blood lipid profile levels. This alterations caused by several factors, namely physical stress that will trigger hormonal secretions that can affect blood lipid profile levels like ACTH, glukokortikoid, epinefrin, norepinefrin, and kortisol. The other mechanism is alteration of free radicals equilibrium that will trigger oxidative stress and damaging liver tissues so that alter enzyme levels in liver. This alteration will induce significant changes in lipid metabolism, because lipid metabolism is mainly take place in liver (Putri, I.N, 2015).

The effect of exposure to radio frequency (RF) electromagnetic waves can induce thermal energy in biologic tissue. High exposure RF radiation can heating the tissue and increased body temperature

(Nugroho, H.W, 2018). However, it is unclear whether electromagnetic radiation can heating atherosclerosis plaque and thus break it down to prevent stenosis. Further studies needed to prove the thermal effect on atherosclerosis plaque.

RESULTS

The device may be used to provide second opinion to diagnose atherosclerosis, stratify the type of plaques, and provide second opinion on diagnosis and treatment approach. Invasive examinations needed to detect the atherosclerosis in the body. If needed, then the device can perform a theraphy using low-frequency electromagnetic wave to alter the cholesterol level or HDL-C level in blood or using thermal effect to breakdown lipid (atherosclerosis) plaque.

From previous studies, the usage of electromagnetic wave in low frequency has been used to see the effect on high-density lipoprotein (HDL-C). The frequency used is 2,4 mT (miliTesla). After exposure to low-frequency electromagnetic waves, HDL-C serum in rats decreased after 24-hours exposure, increased after 48-hours exposure, and decreased significantly after 96-hours exposure. The effect of low-frequency electromagnetic waves on cholestrol serum in animal rats suggested that there are alteration in blood cholesterol, such as decreased cholesterol level after 24-hours exposure but increased level after 48-hours exposure (Sunarso, I, 2009).

A study used low-frequency electromagnetic wave 60 Hz, 2-hours exposure, and 2,4 mT suggested that HDL-C concentration increased after 24-hours exposure and 48-hours exposure, but decreased after 96-hours exposure. However, the cholesterol concentration in blood didn’t change (Torres-Duran PV, et al, 2007).

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Larger studies are needed to obtain the definitive proof of changes in HDL-C concentrations and cholesterol level serum using electromagnetic wave and to combine both function in identify atherosclerosis plaques and electromagnetic therapy.

CONCLUSIONS

Rapidly developing AI technology can be applied to health fields such as cardiology. If the AI can help to identify atherosclerosis plaque and treat them, it will save a lot of time and be more efficient. Larger studies are required to provide definitive proof of electromagnetic wave effects on the removal of cholesterol from plaques using thermal effects or raising HDL concentrations in patients.

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