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Regulating Intestinal Microbes to Decrease the Incidence of Heart Disease

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Abstract: This paper studies the correlation between intestinal microbes and heart disease. In the paper, the process of human body producing Trimethylamine-N-oxide (TMAO) under the role of intestinal microbes has been analyzed, and the ways to reduce the level of TMAO which can increase the incidence of heart disease has been designed. The expected result is that the level of TMAO in plasma is successfully reduced by regulating intestinal microbes. This paper can provide useful information for further studies in self-healing therapy by regulating intestinal microbes.

Keywords: Intestinal Microbes; Heart Disease; Ways to Reduce TMAO

1. Introduction

There are over 2,000 microorganisms in human body, and most of them are in gut. Among them, there are harmful bacteria that cause diseases and beneficial bacteria that are indispensable to the human body. As Neish (2009) said that human and normal microbes in the body have evolved together for thousands of years, optimizing the body's complex immune mechanisms to defend against and attacking pathogens that invade the human body. Although modern medical science has highly developed, some limitations are still existing, such as the side effects caused by medical treatments. In recent years, more and more research on intestinal microbiota. Patients who are unable to treat with modern medicine may reach the therapeutic goal by increasing the self-healing power through intestinal bacteria restoration. According to Trøseid et al. (2015), Trimethylamine-N-oxide (TMAO), which is a metabolite from dietary phosphatidylcholine and carnitine is related to the chronic heart failure (HF); TMAO depends on gut microbiota, and the high level of TMAO can increase the HF. In order to find out new therapies to prevent or cure heart disease, this paper examined how intestinal microbes affect the development of heart disease and focused on some of the ways to decrease the level of TMAO by manipulating gut microbiota.

2. Method

2.1 Association between heart disease and intestinal microbes

In recent years, many studies have found that high concentration of TMAO in plasma has connections with incidence of heart disease. According to Wang et al. (2011), by feeding choline-containing foods to mice, atherosclerotic plaque was observed in the aortic root and found that it's area was positively correlated with the concentration of TMAO. At the same time, the parallel experiment of this experiment confirmed that the formation of plaque has no correlation with cholesterol, triglyceride and blood glucose level. They also found that if mice were given antibiotics in their drinking water, the effect of TMAO on atherosclerosis was eliminated. This shows that the production of TMAO is dependent on intestinal microbes. In addition, Tang et al. (2013) found that under the same cardiovascular risk factors, patients with high plasma TMAO level had a higher prevalence of atherosclerosis than those with lower plasma level in 3 years. TMAO inhibits the transport of cholesterol, resulting in the accumulation of cholesterol in the cell, which becomes a risk factor for atherosclerosis. As Tang and Hazen (2014) mentioned, intestinal microflora can use substances that containing choline or trimethylamine structure to produce trimethylamine (TMA), and these TMAs are oxidized to TMAO in the liver. High concentration of TMAO can increase the occurrence of heart disease, so reducing the level of TMAO is very important.

2.2 Ways to decrease TMAO level

2.2.1 Eat less choline or trimethylamine oxide analogues

Phosphatidylcholine (PC), L-carnitine contain the structure of TMA. PC is the main source for the formation of TMAO. Eggs, milk, red meat, shellfish, and fish contain amounts of PC. The chemical structure of L-carnitine is similar to choline, which contains the structure of TMA, and it is rich in red meat. Therefore, we can eat less trimethylamine oxide analogues to protect from heart disease.

2.2.2 Inhibit the metabolism of choline to TMA

Intestinal microbes produce trimethylamine (TMA) by cutting the choline portion of Phosphatidylcholine (PC) at the carbon-nitrogen bond. TMA, a gas that diffuses in the body, is oxidized in the liver to trimethylamine-N-oxide (TMAO). It is possible that all trimethylamine-based nutrients produce TMA by cleavage and that TMA oxidizes TMAO to cause atherosclerosis. Therefore, preventing intestinal microbes cut trimethylamine-based nutrients can reduce TMAO level. Intestinal microorganisms may act by catalyzing an enzyme that cleaves the carbon-nitrogen bond. Wang et al. (2011) had already used the choline chemical structure analogue 3,3-dimethyl-1-butanol (DMB), and through experiment they found that DMB can inhibit the formation of TMA.

Additionally, TMA can also be reduced by directly regulating the microbes which can promote TMA formation. The experiment can be designed for four parts. First, finding out the microbes that work for forming TMA. A specific group of microorganisms is found by comparing microorganisms in stools of people who regularly eat red meat and eggs which contain choline or trimethylamine oxide analogues (group A) with people in a comparative group who have similar physical fitness but eat food which has no choline or trimethylamine oxide analogues (group B). Second, comparing the species and levels of microbes in the stools of participants in both experiment groups, and separating the high level of microorganisms in group A to study the microorganisms' living environment and characteristics. Third, finding beneficial bacteria that will compete with these microorganisms, and inject the beneficial bacteria into the human intestine. And also, by regulating the intestinal environment making the proportion of such microorganisms smaller than before. Fourth, measuring the microbes' quantity in the stools and the TMAO level in plasma.

2.2.3 Inhibit the oxidation of TMA to TMAO

The TMA formed by the gut microbes is oxidized to TMAO in the liver. This process needs further study.

3. Results

The microorganisms participating in the creation of TMAO will be successfully separated and their characteristics and growth environments will be analyzed. When a microorganism which can compete with the specific microorganisms is injected into the patient's intestine, the amount of plasma TMAO will be reduced and the incidence of heart disease will be lowered.

4. Discussion

Advantages:

1. Although modern medicine has highly devolved, side-effects from chemotherapy and surgery increase the chances of another disease. However, if the intestinal microbes in the human body can be controlled to prevent disease, human body can get rid of the adventures caused by side-effects of modern medicine.
2. Intestinal microorganisms are varied in their variety and number. Therefore, research on beneficial bacteria and harmful bacteria in the intestines has a good prospect. Previous studies have already shown that intestinal microbes are closely related to obesity and diabetes. In addition to the relationship between heart disease and intestinal microorganisms that studied in this paper, it can be a good stepping stone for treating another type of disease by using intestinal microorganisms to increase the immune function and self - healing ability of the human body in the future.

Challenges:

1. Although an incensement in TMAO level is likely to increase the incidence of heart disease, there is no direct proof that the way to reduce TMAO can inhibit the incidence of heart disease. To prove this, many applicants are required to participate in the experiment, and the experiment need to be analyzed for a long period of time.

2. There are many kinds of microorganisms in the human intestine. Therefore, reducing the amount of TMAO by changing the intestinal environment before analyzing all characteristics of microbes is very dangerous. It is possible that changing intestinal environment may increase the amount of other harmful bacteria and give them an opportunity to produce more harmful substances.

Expectations:

Intestinal microbes produce TMAO to increase the incidence of heart disease is a very small part of their role. Intestinal bacteria can make up nutrients which are needed for the natural healing power of human body, and they also can produce more than half of enzymes that human body needed. Additionally, the intestinal microbes can make some nutrients that the human body cannot make itself, so human can increase the self-healing power to prevent and cure diseases. Also, the incidence of diseases is affected by chemicals that produced by intestinal bacteria. Therefore, by increasing the amount of beneficial bacteria and reducing the amount of harmful bacteria in intestine human can become healthier and farther away from cancer. In recent years, intestinal bacterial transplantation has also been achieved. Intestinal bacterial transplantation is a method of injecting a large number of health people's intestinal bacteria into a patient. Although the disease can be treated by transplanting intestinal bacteria, it is not widely used because there are many problems exist such as safety problems.

In the future, research can be focused on studying intestinal microorganisms, classifying them specifically, analyzing all types of intestinal microorganisms and their characteristics and growth environments. In this way, we can analyze the cause of chronic illness and find out new treatment methods. Although intestinal microorganisms have many indeterminate factors, they may contribute to the pathway of self-healing therapy in the future.

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Appendix

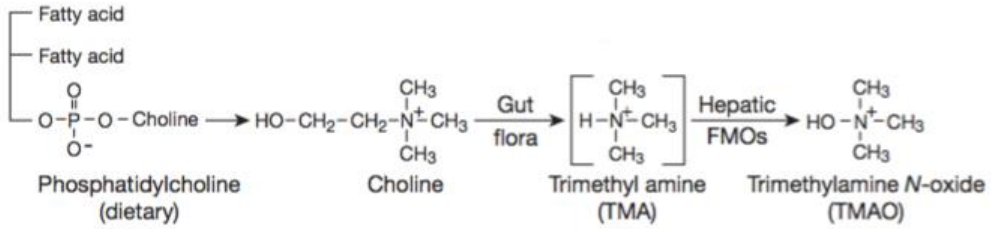

Figure 1: Gut-flora-dependent metabolism of dietary PC (Wang et al., 2011)

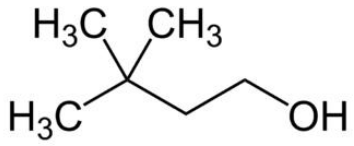

Figure 2: The molecular structure of DMB