The researching of the drugs of Cancer

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Abstract

Nowadays, cancer is a severe problem in many countries. Moreover, Aspirin and Bleomycin are two kinds of anti-cancer drugs. However, none of these two drugs can bring cancer under permanent control. There are remarkable differences between Aspirin and Bleomycin because of their different mechanics driven by their chemical structure. How Aspirin can treat cancer is still uncertain. The paper uses physics laws, Equation of continuity to assume that Aspirin reduces the risk of cancer by decreasing the blood pressure in the blood vessel. As a result, there is less opportunity for a cancer cell to strike and be stuck on the vessel wall. Assumption also says that overusing Aspirin will cause hypotension due to the high blood flow velocity due to Poiseuille's Law.

Keyword: Aspirin, Bleomycin, Cancer, equation of continuity

1. Introduction

Cancer is a malignant tumor caused by cells that can gain without stopping. The blood can translate this kind of cell to other organs in the human body, and when it reaches the essential organs of the human, organ failures will occur, causing death. Several types of cancer; can occur in the lung or digestive system, and so on, and each can bring a high mortality rate. For example, the mortality of digestive cancer is 75%. Among the 2024 subjects in the cohort, the number of deaths is 457, 464 transferred to another location, and the total number of people who had this cancer is 24513[1]. How to treat cancer? The primary factor that causes cancer is cytometaplasia. During ontogeny, most cells can usually complete cell differentiation (the DNA replicates and translates entirely into the new cell). However, due to the role of carcinogens, some cells cannot perfectly transfer their information to the next generation. Because of the wrong message transferring, the new cells become malignant proliferating cells that divide continuously and are not controlled by the body. Therefore, the treatment must prevent cell differentiation or eliminate the malignant tumor [2].

2. The chemical structure and property of drugs

2.1 Aspirin

Aspirin(C₉H₈O₄) is a drug that uses world widely. Figure 1 shows its visible structure of it. This drug can be a treatment for fever and can relieve pain and aches. People also use it as an anti-inflammatory or a blood thinner. How can Aspirin have these effects of inflammatory? Due to an immunosuppressant called Prostaglandin (PG), this substance can cause pain and lead to inflammation. In several experiments, PG production is far higher than the tissues' initial content of the hormones. Aspirin can prevent the biosynthesis of PGs[3-5]. There is an intermediate or enzyme in PG called Cyclooxygenase, a bifunctional enzyme with cyclooxygenase and catalase activities. It is the critical enzyme to catalyze the conversion of arachidonic acid to prostaglandins [6]. It is found that cyclooxygenase has two isozymes, the former one name cyclooxygenase-1 and the latter one cyclooxygenase-2 [5]. Figure 2 shows two substances. The former is a structural type mainly in blood vessels, stomach, kidneys, and other tissues. It regulates vasomotor contraction, platelet aggregation, gastric mucosal blood flow, gastric mucus secretion, and renal function. Its function is related to the protection of gastrointestinal mucus membrane, the regulation of platelet aggregation, the regulation of peripheral vascular resistance, and the regulation of renal blood flow distribution. The latter is inducible. Various damaging chemical, physical and biological factors activate phospholipase A2 to hydrolyze cell membrane phospholipids to produce arachidonic acid. The latter generates prostaglandins through COX-2 catalytic oxygenation. When Aspirin is used, the activation of COX-2 will be limited. Cause the inflammatory to be treated as shown in figure 3.



Figure1.chemical structure of Aspirin. [3]



Figure2. Two important enzyme COX1. [7]



Figure3.COX2.[7]

Aspirin's mechanism seems not to relate to cancer treatment directly, but there will be some connection. A long-term experiment by a group of researchers shows that taking Aspirin for a few years can reduce the risk of cancer in the esophagus, stomach, colon, and rectum [6]. Inflammatory and cancer also have some analogous; they are kinds of immune diseases caused by the derangement of the immune system [2].

2.2 Bleomycin

The other drug Bleomycin(C52H78N13O19S3), as shown in Figure 4, has a directly strong effect on the cancer cell. It can damage the cancer cell by breaking the DNA in the cell. The complex of bleomycin and iron is embedded into DNA, causing DNA strand bonds, and double-strand breaks do not cause RNA strand breakage[8,9]. The first step of the action is that the dithiazole ring of the product is embedded between the G-C base pairs of DNAs, and the positive charge of the terminal tripeptide amino acid acts with the DNA phosphate group to unzip it. The second step is the complexity of this product, and iron causes the formation of superoxide or hydroxyl radicals, causing DNA strand breakage [10,11]. Although the drug has a strong effect in killing cancer, it also harms the body, especially the lung. The bleomycin molecule has two main structural components; a bithiazole component which partially intercalates into the DNA helix, parting the strands, and pyrimidine and imidazole structures, which bind iron and oxygen, forming an activated complex capable of releasing damaging oxidants near the polynucleotide chains. Its effect on DNA by inducing lipid peroxidation. This may be particularly important in the lung and account for its ability to cause alveolar cell damage and subsequent pulmonary inflammation. The lung injury following bleomycin comprises interstitial oedema with an influx of inflammatory and immune cells[12].



Figure 4. chemical structure of Bleomycin. [8]

2.3 consumption

Two drugs have appearance differences. Aspirin needs to take a long time to reduce the risk of cancer. Bleomycin can use to kill cancer tumors in a short time. However, it brings lung damage when it has used. Aspirin seems more fitness for the body system. It seems that the connection between the mechanism of Aspirin and cancer is not directly, but here is an assumption for this situation. As Aspirin is used, cyclooxygenase will be less frequent, and COX-1 can adjust the blood movement[4]. When cancer is forming, the cancer cells need to translate to the different parts of the body by blood, and they will be stuck in the narrow blood vessel and start to grow into a tumor. The blood vessel's lack of action by the COX-1 decreases pressure. It is easy to conclude that the pressure decreases the frequency of striking the blood vessel wall, which can reduce the risk of cancer. The basic of this consumption is a physic theory in fluid named continuity equation. Moreover, this theory shows the fluid characteristic in different Areas. Velocity is the difference between two different areas.

The formula is:

$$=A_2v_2 \tag{1}$$

It shows that the fluid that pass the smaller area with the faster speed. Just like the situation as shown in Figure 5.

 $A_1 v_1$



Figure 5. The equation of continuity. [13]

Higher speed cause the lower pressure, which can conclude by Bernoulli equation:

$$\frac{1}{2}\rho v_1^2 + p_1 + \rho g y_1 = \frac{1}{2}\rho v_2^2 + p_2 + \rho g y_2 \qquad (2)$$

To make each same variables to minus the equation shows that

$$\Delta P = -\frac{1}{2}\rho(v_1^2 - v_2^2) + \rho g_{\Delta} y$$
 (3)

In order to find out the pressure differences as the fluid speeds up, to differentiate the pressure with time, and add velocity with dv to represent the increase speed. And to make a assumption that the fluid is moving horizontally. The equation will be shown as:

$$\mathrm{d}p = -\frac{1}{2}\rho\left(\mathrm{d}v\right)^2\tag{4}$$

and divide by dt:

$$\frac{\mathrm{d}p}{\mathrm{d}t} = -\rho v^2 \cdot a \tag{5}$$

The direction of velocity doesn't affect the rate of change in pressure. Only the acceleration may be the factor of the rate of change of pressure. If the fluid speed up, it means that the acceleration is positive and the rate of change of pressure will be negative. If the fluid speed down, the acceleration is negative, the rate of change of pressure is positive.

Back to the consumption, the main reason that cause the reduction of the risk is because the Aspirin reduce the pressure in the blood vessel. The pressure is decreasing that can be represented by the rate of change of pressure is negative, so the acceleration of the blood will be positive. And due to the Newton's second law.

$$F = ma \tag{6}$$

The force act to the direction of blood flow. As the force is always pendulum to the blood vessel shown in the Figure 6. The cell has less opportunity to strike the blood vessel, which is the same as cancer cell. As it has less opportunity to strike on the vessel, the less opportunity for the cancer cell to stuck in part of the body's organ and start to grow.



Figure 6. Blood Flow and Blood vessel. [14]



Figure 7. Blood pressure measurement. [15] However, the Aspirin can not reduce the risk of all cancer [6], so the reason of it is there will be the vessel that is very narrow. Although the force pushes the blood cell to moving faster, there are large amount of blood cell in human body, a research shows that blood cell in mice is more than 10^7 [15], human has bigger system of circulation of blooded and more cells are needed compare to the mice, these cells collide with in a high speed. And due to momentum equation:

$$\Delta p = \sum mv \tag{7}$$

Each cell has higher momentum because of the positive acceleration when Aspirin is used. Moreover, when they collide with the cancer cell, extra momentum acts on the cancer cell's vert side of the moving direction. The blood vessel in that area is narrow so that the cancer cell will strike the vessel. Also, the defect of using Aspirin is assumed by using Poiseuille's Law- the theory established by experiment only [16,17]

$$Q = \frac{\Delta p \cdot \pi \cdot r^4}{8\eta \cdot l} \tag{8}$$

The rate of change in pressure is negative. The sum of the pressure between two blood sides decreases, causing the blood vessel's radius to increase. In order to lower the blood flow, the body system may lower the pressure between two sides of the wall, as shown in Figure 7. So the overuse the Aspirin can mess up the regulation of the body system. The whole body will cycle in slow blood flow. Cause the hypotension. How to suit Aspirin with the body system to reduce the risk of cancer is still questionable.

3. Conclusion

The whole passage discusses the mechanism of anticancer drugs- Aspirin and Bleomycin. Their different chemical structures cause them to have different effects on different stages of cancer. Bleomycin is effective when the cancer is already occurring. It kills the cancer cell but also bring harmful effect to the lung. Aspirin can reduce the risk of cancer. However, the reduction of cancer risk by using Aspirin is still unknown. The paper assumes how Aspirin acts in the human body to reduce cancer risk by using several physics laws (Continuity Equation, Bernoulli Equation, Newton's second law, the conservation of momentum, Poiseuille's law). The defect also occurs if humans overuse Aspirin.

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