

HIGH- OR HYPER-ABSORBING CELLS IN SMALL INTESTINE IS THE CAUSE OF TYPE 2 DIABETES: A HYPOTHESIS

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Abstract

We hypothesize that high- or hyper-absorbing cells for carbohydrates in small intestine, especially located in jejunum, might be the cause of type 2 diabetes. Rapid absorption of carbohydrates contributes to hyperglycaemia, or high blood sugar (HBS), which causes many complications, such as kidney, eye, heart, and neural damage problems, some of severe complications could be life threatening. Stopping the function of high- or hyper-absorbing cells for carbohydrates is the key to lowering HBS or curing type 2 diabetes. High- or hyper-absorbing cells for carbohydrates come from intestinal stem cells (ISCs) and therefore, killing high- or hyper-absorbing cells for carbohydrates and their ISCs by surgical operation might be a novel strategy for curing type 2 diabetes.

Keywords: Type 2 Diabetes, High- or Hyper-Absorbing Cells, Intestine Stem Cells (ISCs), Origin of Type2 Diabetes, Surgical Operation.

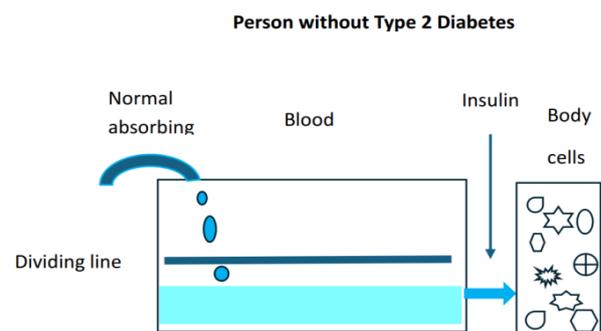
INTRODUCTION

Diabetes can be roughly divided into two types. One is type 1 diabetes that accounts for 10% of diabetes, which is a condition where the patients cannot produce insulin and are mainly seen in children and young adults. If there is autoimmune disease which makes the pancreas cannot produce insulin, any adults can have type 1 diabetes. The other is type 2 diabetes that accounts for 90% of diabetes [1], which is the condition where the patients have high glucose levels, and the insulin produced cannot solve this problem. Type 2 diabetes are the most common type of diabetes worldwide. In 2021, about 537 million individuals globally suffered from diabetes, and a surge in diabetes numbers is expected to 783 million by 2045 [2]. Diabetes caused over 1 million deaths per year and was the ninth leading cause of mortality [3]. Currently, to counter type 2 diabetes, three strategies are handled, first is impaired insulin function, second is lifestyle changes (healthy food, weight loss and exercise) and third is drug medications that low sugar levels [4]. It seems no strategy for dealing with the origin of type 2 diabetes. Although diabetes was first recognized around 1500 B.C. [5], the cause of diabetes remains unknown. To cure diabetes, treatment of the cause is of paramount importance. More Intake of carbohydrates (sugars, starches and fibre) increase sugar levels in diabetes patients, which means that absorption of essential nutrients by small intestine plays a role in occurrence of diabetes. In this paper, we want to explore more on the function of absorption of small intestine, especially on the function of small intestinal stem cells

Hypothesis of high-or hyper- absorbing epithelial cells in causing type 2 Diabetes

The plasticity of intestinal stem cells (ISCs) exhibits remarkable capability to renewal and differentiate into different epithelial cells [6][7]. We hypothesize that starting from serving the body most efficiently, ISCs may renew and

differentiate into epithelial cells with different adsorbing ability for nutrients, such as proteins, fats and carbohydrates. The absorbing epithelial cell in healthy person is called normal absorbing speed. High-absorbing speed is server times fast than normal absorbing speed. The hyper-absorbing speed is decade times fast than normal absorbing speed. The location of these three absorbing epithelial cells is in jejunum that is part of small intestine between the duodenum and the ileum. But more high- or hyper-absorbing cells are mainly located in proximal part of jejunum near to duodenum. Conclusively, Jejunum plays a key role in digestion and absorption. The nutrient pressure decides which absorbing ability is produced. If proteins, fats and carbohydrates are taken in all the time, the high- or hyper- absorbing epithelial cells for these three major nutrients will be differentiated by ISCs. This person could be obesity or morbid obesity and might have type 2 diabetes as well. Some people due to genetic reason could have a high-absorbing epithelial cells which highly absorb proteins and fats, they could be obese, but might not have type 2 diabetes because they only have normal-absorbing epithelial cells for carbohydrates (sugars, starches and fibre). Now we might say that the type 2 diabetes is caused by high- or hyper-absorbing epithelial cells for carbohydrates in jejunum. Large amount of sugar is absorbed, but only small amount of sugar is entered into the body’s cells by insulin deficiency. This is the real reason why type 2 diabetes patients have high blood sugar (HBS), also known as hyperglycaemia (Figure 1).



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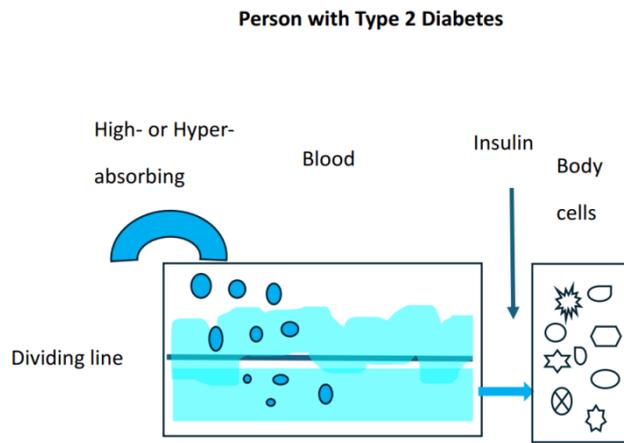


Figure 1. The cause of type 2 diabetes coming from high- or hyper-absorbing epithelial cells for carbohydrates in small intestine. The blue colour represents sugars. The dividing line exhibits the sugar levels, below the line and above the line indicating no HBS and having HBS levels, respectively. The person without type 2 diabetes doesn't have HBS because sugar absorption is slow via normal absorbing cells and the function of insulin is enough to make glucose enter the body's cells for energy or being stored as glycogen. The person with type 2 diabetes has HBS because sugar absorption is very quick via high- or hyper-absorbing cells and the function of insulin is damaged and cannot help the glucose to enter the body's cells and drop the HBS level.

The key risk factor of type 2 diabetes is HBS levels, which causes many complications including the heart, kidney failure, vision loss etc. These complications could lead to life-threatening. Insulin plays important role in control of HBS which causes insulin increase at early stage, but later causes insulin resistance. β -cell function deterioration make pancreas produce less insulin that cannot help all glucose (a type of sugars) to enter cells for energy or being stored as glycogen. Medications are used to control HBS, but no drugs can cure type 2 diabetes. Type 2 diabetes is chronic disease, meaning that formation of high- or hyper-absorbing cells for carbohydrates takes a long time, probably needing decade years. Young people enjoy sweet food and drinks, and take in large amount of sugar, but they will not have diabetes because when they are still young, the high- or hyper-absorbing cells for carbohydrates have not occurred. Unfortunately, when they become old, they might suffer type 2 diabetes because of formation of the high- or hyper-absorbing cells for carbohydrates. Therefore, to prevent type 2 diabetes, control of sugar intake in young people is important. In the future, type 2 diabetes cases increase worldwide might be due to more and more young people who enjoy sugary food and drinks.

Supporting evidence and a novel strategy for curing type 2 diabetes

Our hypothesis has been indirectly supported by gastric bypass operation which is also called Roux-en-Y gastric bypass (RYGB). Gastric bypass is a type of weight-loss surgery that has been used more than 30 years in USA. It has been reported that gastric bypass-treated obese patients with type 2 diabetes had 85% lower risk of diabetes [8]. Gastric bypass surgery provides long-term control for obesity and diabetes [9]. Some researchers suggest that reduced calorie ingestion after RYGB can clearly explain the marked improvement in diabetes [10].

RYGB surgery is a promising strategy for lifelong treatment of type 2 diabetes. But there is little evidence to support the effectiveness of RYGB surgery to treat nonobese patients with type 2 diabetes [11]. But we think that our hypothesis might explain the effectiveness of RYGB surgery to patients who are obese or nonobese persons with type 2 diabetes. The sketch of RYGB scheme is show in **Figure 2**.

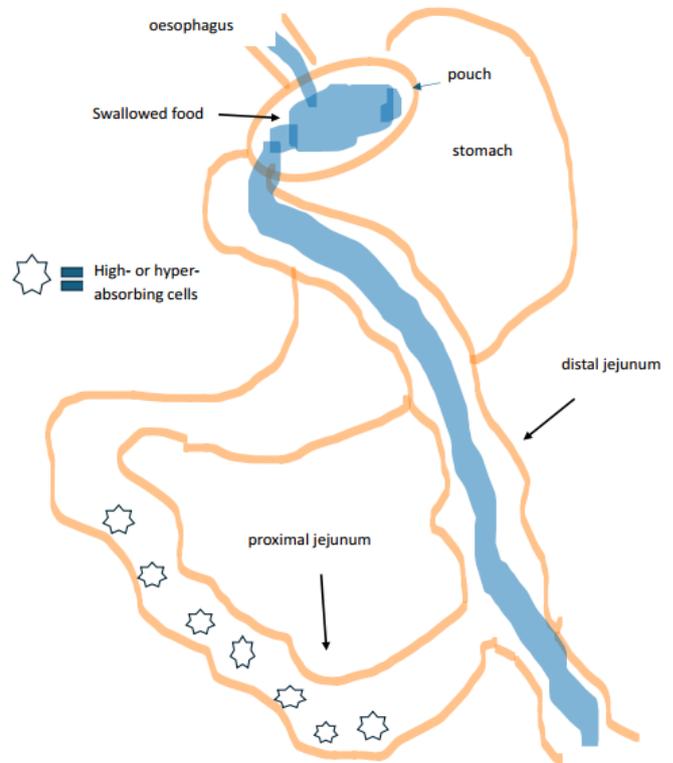


Figure 2. The sketch of RYGB surgery scheme. A small stomach pouch is created on the top of the stomach, and jejunum is cut into 2 sections. The distal section of jejunum is connected to the pouch, and proximal section of jejunum is connected to lower part of distal section of jejunum. The swallowed food from oesophagus into the pouch will go directly into the distal section of jejunum, thereby bypassing most of the stomach and the first section of your jejunum. The reason why RYGB surgery can treat type 2 diabetes is because no food goes through the first section of proximal jejunum that contains lot of high- or hyper-absorbing epithelial cells for carbohydrates (sugars). Without these high- or hyper-absorbing cells for carbohydrates, it is difficult to quickly absorb carbohydrates to raise blood sugar level. This is the reason why RYGB surgery is a lifelong treatment of type 2 diabetes.

Based on our hypothesis, investigation of epithelial cell difference in absorbing ability should be carried out with molecular biology techniques. If high- or hyper-absorbing cells for carbohydrates are discovered in patients with type 2 diabetes, we can use novel strategy to treat or cure type 2 diabetes. First, we can cut a small section of jejunum near duodenum to see improvement of type 2 diabetes. Second, if we can find the locations of high- or hyper-absorbing cells for carbohydrates, laparoscopic surgery could be used to kill the cells, making the locations become scar tissue, which can kill or remove ISCs. Third, medical microrobot could be used to eliminate high- or hyper-absorbing cells for carbohydrates and their ISCs. Of course, all these should be conducted on animals, if the animal results are good, we can do the same on patients with type 2 diabetes.

If no surgical operation can be used, it is possible to let the patients with type 2 diabetes return to long-time remission. Based on our hypothesis, we can replace the high- or hyper-absorbing cells for carbohydrates with high- or hyper-epithelial cells for proteins and fats by constantly eating proteins and fats. The entire intestinal epithelial lining is replaced every 3–5 days [12], which means that ISCs can quickly differentiate into high- or hyper-epithelial cells for proteins and fats. Probably, one or two years are needed to finish this replacement. When high- or hyper-epithelial cells for proteins and fats are produced and high- or hyper-epithelial cells for carbohydrates will be reduced or disappear. The patients might be a bit obese, but their type 2 diabetes will be relieved for a long-time. Collectively, the best treatment for type 2 diabetes is blocking more sugar intake. Once HBS level dropped down, many complications of type 2 diabetes might gradually recover, for example, insulin resistance might disappear, pancreas function might get better, and the damages to kidney, heart, eye, and nerve might be avoided or far away from life-threatening.

Conclusion

In this paper, we proposed a hypothesis that high- or hyper-absorbing cells for carbohydrates in small intestine might be the cause of type 2 diabetes. To cure type 2 diabetes, removing or killing high- or hyper-absorbing cells for carbohydrates and especially ISCs are crucial important, which might end raising HBS levels that cause many complications. In ancient China, when handling water flooding, there is a phrase, saying ‘best to dredge than to dam’. Yes, it is true that to dredge water is better than to dam water. But in dealing with HBS levels, the phrase should be opposite, meaning ‘best to dam than to dredge’, which indicates that blocking more sugar intake is better than increasing insulin supply. To support this hypothesis, more research with molecular biology techniques should be conducted to confirm existence of high- or hyper-absorbing epithelial cells for carbohydrates in small intestine. The surgical operation could be used to clear the high- or hyper-epithelial cells for carbohydrates and their ISCs in animals for curing type 2 diabetes. If the animal results are promising, patients with type 2 diabetes could be treated with the same surgical operation. Conclusively, type 2 diabetes is spreading rapidly worldwide. Since it is a leading cause of severe medical complications and one of the top 10 causes of death [13], finding the cause of type 2 diabetes is of critical importance, which might help to cure type 2 diabetes. Our hypothesis presented here is a try for this purpose.

Conflicts of Interest: The author declares no conflicts of interest.

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