

Research Article

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Probable Self-Recovery of Pancreatic Beta Cells Insulin Regeneration Using Annualized Postprandial Plasma Glucose (GH-Method: Math-Physical Medicine)

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Received: June 10, 2020; Accepted: June 16, 2020; Published: June 18, 2020

Introduction

In this paper, the author describes his hypothesis on the probable partial self-recovery of some insulin regeneration capability of pancreatic beta cells on one type 2 diabetes (T2D) patient via his collected data of postprandial plasma glucose (PPG) during the period of 1/1/2014 to 4/5/2020.

Methods

The author has had T2D for 25 years and took various diabetes medications to control his elevated glucose levels since 1998. For the last 20 years, he has suffered many T2D complications, except a stroke. Starting from 2013, he reduced the dosages of his three prescribed diabetes medications. On 12/8/2015, he discontinued his last medication, metformin HCL. Since then, he has completely relied on a stringent lifestyle management program to control his diabetes conditions.

Here are the six rules of his lifestyle management program:

1. Eat <15 grams of carbs/sugar each meal and keep a balanced nutritional menu.
2. Walk >4,000 steps (2 miles or 3 kms) after each meal (~18,000 steps per day).
3. Drink ~3,000 cc water each day.
4. Sleep >7 hours each night.
5. Live an almost “stress-free” life.
6. Keep a simple, regular daily life routine and pattern.

As a result, his HbA1C has been reduced from 10% in 2010, while taking many diabetes medications, to an average 6.63% during 2016-2019 without any medication or use of insulin injection (Figure 1).

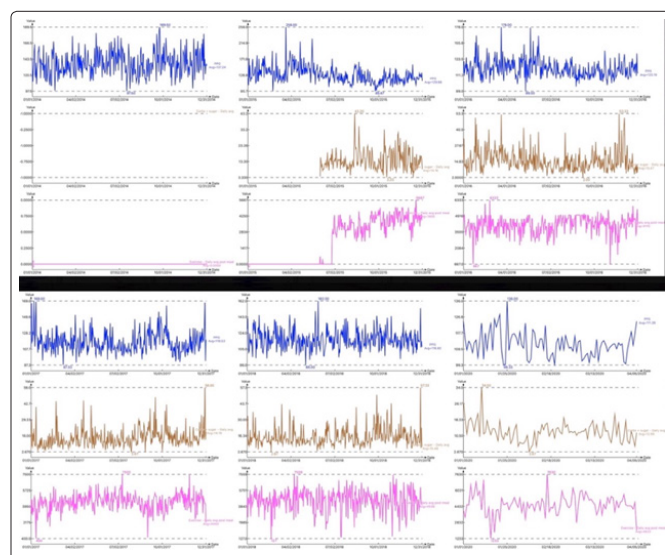


Figure 1: HbA1C history (2000-2019 and 2016-2019)

He has kept approximately 2 million data of his own medical conditions and lifestyle management details. He also developed a sophisticated computer software by using big data analytics and artificial intelligence to analyze, process, and manage his stored massive data.

To summarize his prominent observations based on past 8-years of personal experience from glucose data analysis, he has seen two “opposite” phenomena. First, his PPG occasionally will reach to 200-300 mg/dL when he does not follow his stringent diet and exercise rules. This shows the existence of his severe diabetes in

terms of insulin resistance or lack of insulin supply. Second, from checking his massive data since 2014, his natural health state of pancreatic beta cells seems to follow a path of “self-repair and improvement”, even though it might be on a small scale.

Recently, he read an article online, “Diabetes: Can we teach the body to heal itself?” on *Medical News Today*, which was published on January 8, 2019. Here is an excerpt:

“A new study by researchers from the University of Bergen in Norway, Maria Cohut, Ph.D. And Luiza Ghoul, suggests that, with just a small “push,” we may be able to train the body to start producing adequate levels of insulin once more, on its own. The researchers were able, for the first time, to uncover some of the key mechanisms that allow cells to “switch” identity, looking specifically at pancreatic alpha- and beta-cells in a mouse model. They found that alpha-cells respond to complex signals they receive from neighboring cells in the context of beta-cell loss. Approximately 2 percent of alpha-cells can thus “reprogram” themselves and start producing insulin. By using a compound able to influence cell signaling in the pancreas, the researchers could boost the number of insulin-making cells by 5 percent.”

The author’s research methodology is a “math-physical medicine” approach, rather a “biochemical medicine” approach as used in the above article. Furthermore, the author uses his own body, a “live human being”, instead of a “mouse model” cited in Norway’s lab test. Math-physical medicine approach has three key steps of research method. It starts with *observing phenomena* of some prominent physical characteristics from his collected big biomedical data. He then forms a reasonable *hypothesis* from these specific observations. Finally, if possible, he derives a few *mathematical equations*, to verify his hypothesis. Once verified, he can then use these *prediction equations* to reproduce future outcomes or final results.

In his papers No. 103 and No. 108, he described his hypothesis and math-physical models to guesstimate the pancreatic beta cells health state by using a data range including annualized PPG (lower bound), and a mathematical expanded PPG baseline glucose (upper bound). In this particular paper No. 242, he will utilize the “annualized average Finger PPG” over a 6+ year period (2014 - 2020) by subtracting the influences from both diet and exercise from measured PPG value. As a result, he has produced a new term known as the “Baseline PPG”. He then observes and analyzes those baseline PPG data to identify the probable partial self-recovery rate of insulin regeneration functions either through converting alpha cells into beta cells (from the quoted article above) or self-repairing some of the damaged beta cells (per his own hypothesis).

During this long period of 6+ years or 2,285 days (from 1/1/2014 to 4/5/2020), he had 6,855 meals. Usually, he collects at least three primary data per meal, i.e. PPG, carbs/sugar intake, and post-meal walking steps. Therefore, he has collected and utilized 20,565 data for this particular analysis.

In his earlier research papers, he has demonstrated that diet contributed ~39% and exercise contributed ~41% to the PPG value formation. There is approximately 20% of PPG influenced by other 17 identified factors which was identified via application of signal processing of wave theory. It cannot be denied that, for diabetes patients, the so-called “remaining” or “survived” capacity of insulin production by the pancreatic beta cells is the most prominent contributing factor among these 17 factors.

This big unknown factor of the beta cells remaining or survived functionality strength and self-recovery rate is the aim of this particular research.

Results

Figure 2 shows the annualized curves of PPG in mg/dL, carbs/sugar intake in grams, and post-meal walking steps from 1/1/2014 through 4/5/2020. There are three sets of information which are needed to point out: (1) the diet and exercise data of 2014 are re-created based on a set of less detailed recording data; (2) the diet and exercise data of 2015 started from 7/1/2015; and (3) the 2020 data only consists of the first three months of the year.

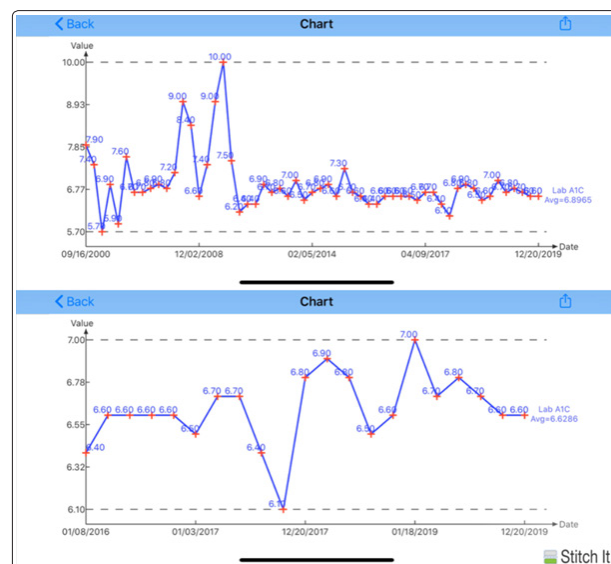


Figure 2: Annualized PPG, carbs/sugar intake, & post-meal walking steps (1/1/2014-4/5/2020)

Nevertheless, the focus is to study the PPG value change’s trend and pattern, in particular the “baseline PPG” which is defined as follows:

Baseline PPG = Measured PPG - Adjustment: (carbs * B - walking steps/1000 * C)

Where B and C are different multipliers derived from the author’s previous research work.

Figure 3 illustrates that both measured PPG and baseline PPG values are clearly decreasing year after year since 2014. In Figure 4, we can see a set of near-constant values for carbs/sugar intake ~14 grams per meal and post-meal walking ~4,300 steps.

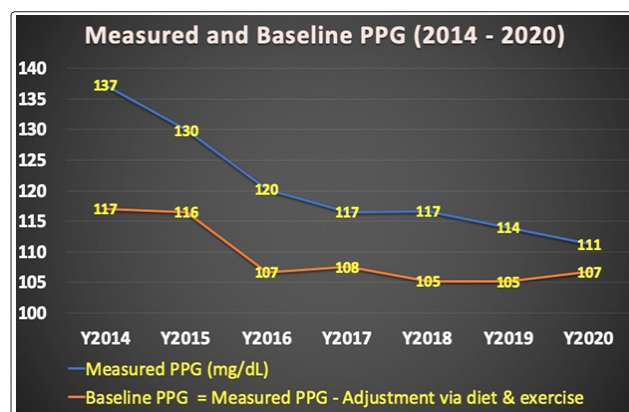


Figure 3: Annualized average values of Measured PPG and Baseline PPG (2014 - 2020)

Year	2014	2015	2016	2017	2018	2019	2020	Average
Measured PPG (mg/dL)	137	130	120	117	117	114	111	121
(IX): Carbs/Sugar per meal (grams)	16	14	15	14	15	13	13	15
(IY): Post-meal Walking (Steps)	3000	3681	4110	4440	4558	4038	4623	3968
PPG Adjustment = $(IX) \cdot (IY) / 1000 \cdot C$	20	13	13	9	11	9	5	12
Diet & Exercise contribution % on Measured PPG	15%	10%	11%	8%	10%	8%	4%	9%
A: PPG Baseline = Measured PPG - Adjustment	117	116	107	108	105	105	107	109
Measured PPG improvement = previous Y - current Y	NA	7	10	4	0	3	3	4
Baseline PPG improvement = previous Y - current Y	NA	1	10	-1	2	0	-2	2
(Measured PPG - 89) / 89 mg/dL	54%	46%	35%	31%	31%	28%	25%	36%
(Baseline PPG - 89) / 89 mg/dL, i.e. Beta cells health state	32%	31%	20%	21%	18%	18%	20%	23%
(Measured - Baseline) / 89 mg/dL	23%	15%	15%	10%	13%	10%	5%	13%
YYZ Baseline change = (previous - current) / previous		0.5%	8.4%	-0.8%	2.1%	0.1%	-1.5%	1.5%

Figure 4: Calculation table of Baseline PPG and its decreasing speed at 1.5% per year

Following data also demonstrate the results derived from above equation of Baseline PPG:

Average Baseline PPG (109 mg/dL) = measured PPG (121 mg/dL) - diet/exercise adjustment (12 mg/dL)

Finally, the most important datasets in Figure 4 is that **the annualized baseline PPG values are decreasing at an averaged linear rate of 1.5 % per year during this 6+ year period.**

This observation is closely related to the statements from the quoted article above (without knowing that article's experiment's timing period):

"2% of alpha cells reprogram themselves to start producing insulin; and 5% insulin-making capabilities are boosted". In other words, based on Norway's laboratory experiment, there might be a 3% (i.e. 5% - 2%) increase of insulin-making by original "beta cells".

This reduction of baseline PPG value, excluding both diet and exercise influences, could be interpreted as the direct outcome of the pancreatic beta cells "partial self-recovery" of insulin generation capability at a rate of 1.5% per year. This conclusion is quite close to the findings from Norway's report of 3%.

Conclusions

The author observed a vast improvement in his diabetes conditions after following a stringent lifestyle management since 2014, the year he developed his mathematical model of metabolism index (MI). From examining his own PPG data including the existing vulnerable conditions of his long-term "damaged" beta cells due to his high carbs/sugar intake and/or lack of post-meal exercise, he hypothesized that beta cells are still be able to "self-repaired" to a certain degree.

The author decided to write a few articles from his in-depth research to encourage other medical scientists to conduct similar work, even though they may use different research methods, to further explore this subject of "probable pancreatic beta cell's self-recovery" [1-5].

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