The GH-Method

Probable Partial Self-Recovery of Pancreatic Beta Cells Using Calculations of Annualized Fasting Plasma Glucose Based on GH-Method: Math-Physical Medicine (No. 138)

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Abbreviations: T2D: type 2 diabetes; HbA1C: hemoglobin A1C; FPG: fasting plasma glucose; PPG: postprandial plasma glucose

1. INTRODUCTION

In this paper, the author describes his hypothesis on the probable partial self-recovery of some insulin regeneration capability of pancreatic beta cells in a type 2 diabetes (T2D) patient via his collected data of both postprandial plasma glucose (PPG) and fasting plasma glucose (FPG) during the period of 1/1/2014 to 11/23/2019.

2. 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, including 5 cardiac episodes and renal complications, except for having a stroke. Starting in 2013, he reduced the dosages of his three prescribed diabetes medications. On 12/8/2015, he discontinued taking his last remaining medication, the classical metformin HCL. In other words, his body has been free of any chemical compound from medications or insulin injections for 4 years.

Since then, he has completely relied on a stringent lifestyle management program to control his diabetes conditions. As a result, his T2D has been under control (HbA1C ~6.5%) since 2016.

He has kept nearly 2 million data on his own medical conditions and lifestyle details. He also developed sophisticated computer software by using artificial intelligence to analyze, process, and manage this massive health data.

To summarize prominent findings from the glucose data analysis based on his past 4 to 5 years of experience, he has noticed two "opposite" phenomena. For the first observation, his peak PPG value around 60 minutes after the first bite of his meal occasionally reaches 200-300 mg/dL when he does not follow his stringent diet and exercise rules. This shows the existing severity of his diabetes conditions in terms of insulin resistance or lack of insulin production supply. For the second observation, from checking his massive data since 2014, his natural health state of pancreatic beta cells seems to be recovered somewhat, 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

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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 "math-physical medicine", not "biochemical medicine" as used in the above article. Math-physical medicine has three key steps of research methodology. He starts by observing some prominent physical phenomena from his collected biomedical big data. He then forms a reasonable hypothesis from his specific observations. Finally, he derives a few mathematical equations, if possible, to verify his hypothesis. Once verified, he can then use the same equations or formulas to reproduce (or predict) the results.

In his presented papers No.103, 108, and 133, he described his hypothesis and math-physical models to guesstimate the pancreatic beta cells health state by using a data range including FPG (lower bound), pre-periods glucose (medium), and PPG baseline glucose (upper bound). In this particular paper no.138, he will utilize the "baseline of annualized average PPG" over a 6-year period (2014 - 2019) to prove the probable partial recovery of insulin regeneration capability of pancreas beta cells functions either through converting alpha cells into beta cells (as the quoted article) or self-repairing some of the damaged beta cells (as author's own hypothesis).

3. RESULTS

The author has collected a total of 8,646 Finger PPG data from 1/1/2012 through 11/23/2019. Furthermore, he has collected 20,448 Sensor PPG data from 5/5/2018 through 11/23/2019.

First step, he calculated annualized Finger PPG value for 2014-2019 (Figures 1 & 2). It is obvious that the Finger PPG data are declining year after year. This Finger PPG serves as one of the medium levels of beta cells relative health state. The other approach is to use the averaged value of both pre-meals and pre-bed glucose data as another medium level. However, the author could not recreate his "pre-periods" data prior to 5/5/2018 because continuous glucose monitoring devices (CGM) are only recently available to the general public of diabetes patients.

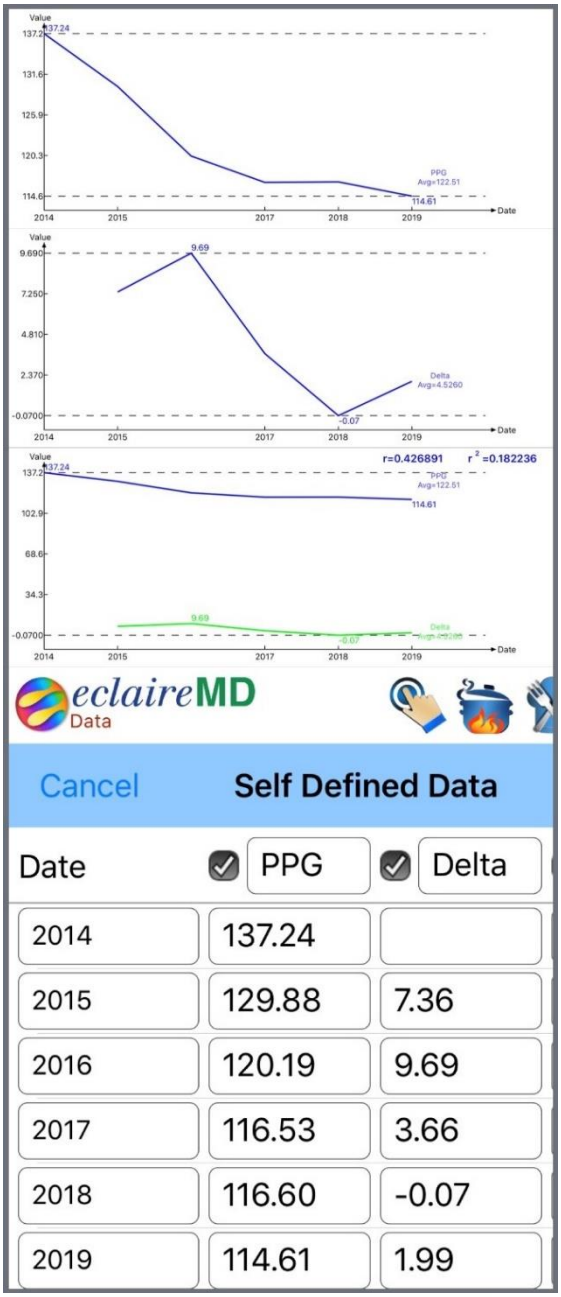

Figure 1: Annualized finger PPG (1/1/2014 - 11/23/2019).

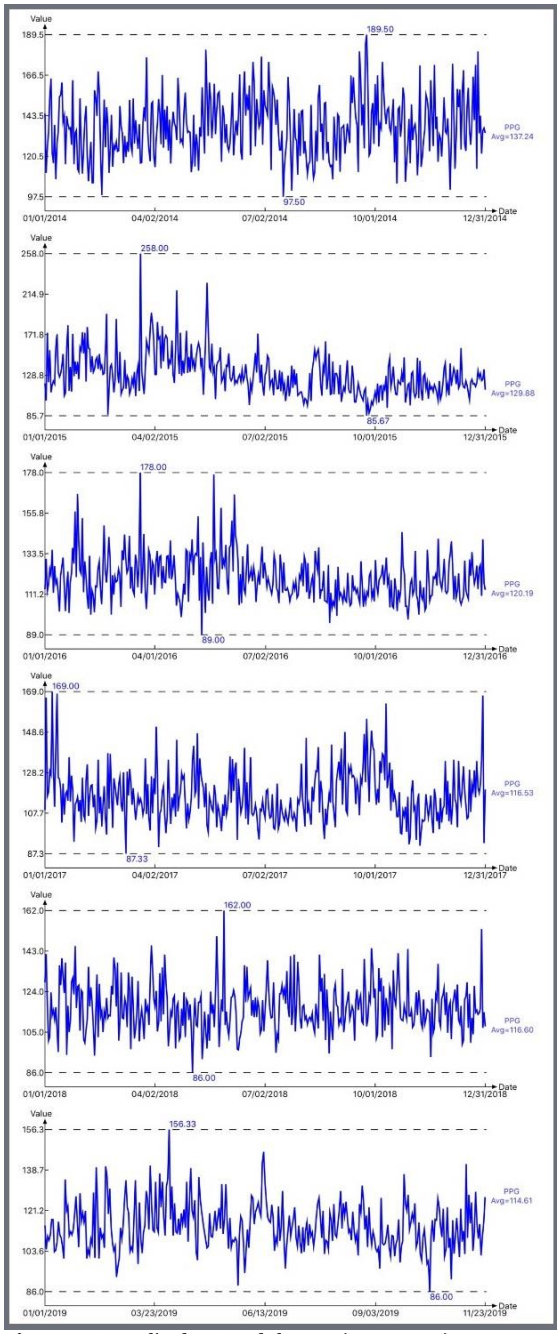

Figure 2: Annualized PPG and changes (2014 - 2019).

Second step, as shown in Figure 3, he synthesized all of his Sensor PPG data (~80 times per day and 12 times per meal) into one PPG waveform between 0 minutes (open) and 180 minutes (close). He named it the "OHCA - open, high, close, average" Model of PPG. He then calculated to get a ratio of 1.13 (i.e. 13 % higher) between the higher PPG baseline connecting open PPG and close PPG vs. the lower Finger PPG. He used this ratio to recreate his PPG "extended sensor baseline" values based on his collected annual Finger PPG data (Figure 4). These annual PPG baseline data are served as the upper bound of beta cells relative health state.

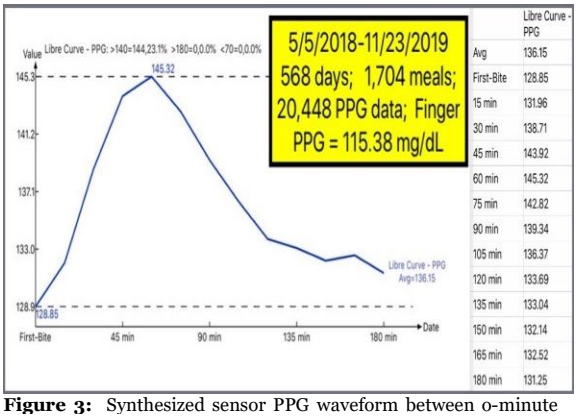

Figure 3: Synthesized sensor PPG waveform between 0-minute and 180-minutes (5/5/2018-11/23/2019).

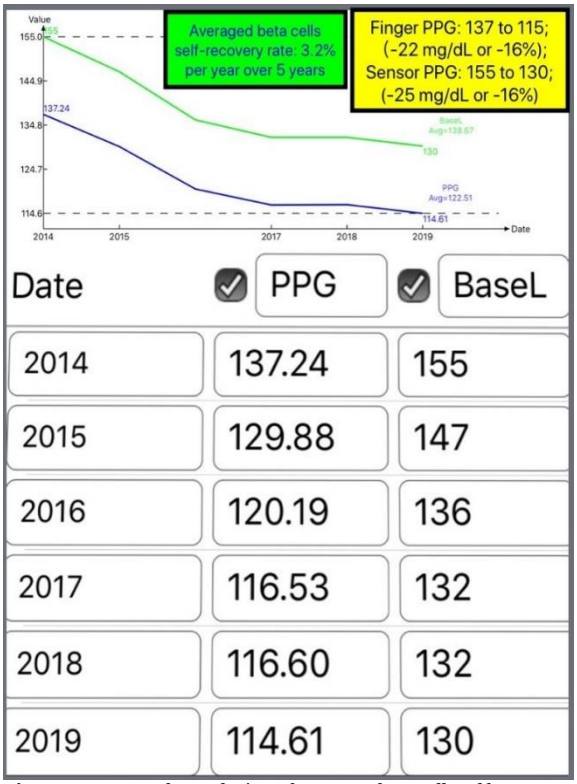

Figure 4: Research conclusion of pancreas beta cells self-recover rate using PPG baseline data (2014-2019).

It should be noted that, as shown in Figure 5, the annualized Finger FPG data (in his paper no.133) served as the lower bound of beta cells relative health state.

Figure 5 shows the range of pancreas beta cells health state (the lower level the better health state, as "glucose").

It is the combination of these three sets of annualized data:

(1) Finger FPG (lower bound),
(2) Finger PPG (medium),
(3) Extended Sensor PPG baseline (upper bound)

	PPG	BaseL	FPG
Avg	122.51	138.67	118.83
2014	137.24	155	128
2015	129.88	147	121
2016	120.19	136	117
2017	116.53	132	120
2018	116.60	132	114
2019	114.61	130	113

Figure 5: Comparison among FPG (lower bound), finger PPG (medium), and extended sensor baseline glucose (upper bound).

In conclusion, during the period of 2014 through 2019, the Finger FPG value decrease at a linear speed of 2.3% per year and the extended baseline PPG value decrease at a linear rate of 3.2% per year. These two reduction rates of glucose values could be interpreted as the direct outcome of the pancreatic beta cells partial "self-recovery" of insulin generation capability. Furthermore, these two percentages are closely related to the above-quoted article result that 2% of alpha cells "reprogram" themselves and start producing insulin.

It is interesting to further examine the 2019 PPG data comparing against a "normal and healthy" person's "standard" PPG waveform. The author's open (0 minutes) and close (180 minutes) baseline level of 131 mg/dL is 48 mg/dL or 37% higher than the normal standard PPG baseline level of 83 mg/dL. This higher amount is due to both his damaged beta cells condition and the "left-over" effect from fruit/snack intake between meals. However, his peak PPG level (60 minutes) of 146 mg/dL is 12 mg/dL or ~8% lower than the standard normal PPG peak level. This is due to his stringent lifestyle management, including both carbs/sugar intake and post-meal walking steps (Figure 6).

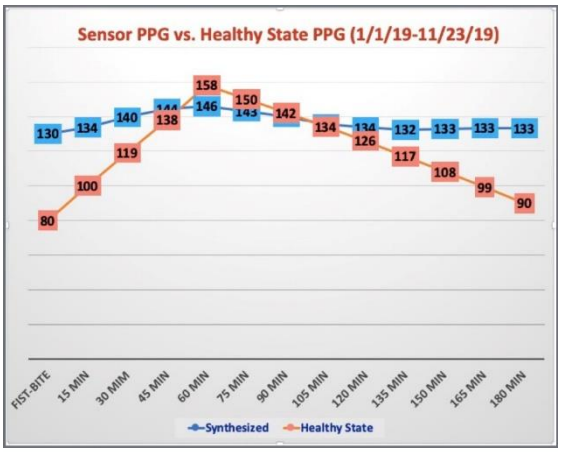

Figure 6: Comparison between synthesized sensor PPG (blue curve) vs. healthy-state PPG (orange curve) of 2019 data.

4. CONCLUSION

The author observed improvement in his diabetes conditions after following stringent lifestyle management since 2014. From examining his own glucose data in 2018 including the existing vulnerable conditions of his "damaged" beta cells due to his high carbs/sugar intake, he hypothesized that beta cells are still able to "repair" themselves to a certain degree. This "dual phenomena" can be observed with his higher open and close PPG values and his ultra-high PPG values when he violated his own strict control rules of diet and exercise during the same period of pancreatic beta cells partial recovery.

The author decided to work off his research and write a few articles 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".