BC Diabetes Foundation

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Insulin experiments: basal insulin, carb ratio, insulin sensitivity

Basal insulin dosing

The simplest way to figure out your optimal basal insulin dose(s) is to take your usual basal insulin and then fast (don't eat) while monitoring your sugar closely with a CGM. Often an overnight fast (nothing after dinner until midday the next day is sufficient). A good target for fasting sugar is 4.0-7.0 mmol/L (=72-125 mg/dL).

If you are taking a shot of basal insulin such as insulin glargine or insulin degludec take your usual dose(s) the morning and/or evening before the fast. If you take a morning shot also take your usual morning shot on the morning of your fast (when you are already fasting).

If you are on an insulin pump with known existing settings simply start by fasting overnight and then following your sugars the next day as long as you need to.

If during a fast your sugar stays in the target range it implies your current basal settings (or current shot(s) of glargine or degludec) are correct. If the sugar drops below target it implies the dose is too high. First you need to eat to prevent a low; then plan to do the fast on another day. Reduce your basal insulin by 20% in preparation for the next fast. If the sugar goes above target the basal insulin dose should be increased by 10% (or more) the next time.

For more information on "fixing the fasting" sugar watch this episode of BCDiabetes' The Weekly from 2020-May. For a more basic approach to basal insulin adjustment follow this link.

Rapid insulin dosing

Corrections & ISF

If your sugar is too high during the fast described above you can give a "correction" dose of rapid insulin to bring it into target (say down to 6.0). Calculation of the correction dose requires knowledge of ISF (insulin sensitivity factor). How much rapid insulin should you take? Your ISF is the amount your sugar drops over the next 4 hours for every 1 unit of rapid insulin given. If you don't already have an ISF, we suggest you start by using a value for ISF = 100/total daily dose of insulin (TDD, the sum of basal + bolus insulin from the previous day). Thus if your TDD = 50 then the ISF = 100/50 = 2. This implies that one unit of rapid (meal-time or bolus) insulin will reduce the sugar by 2 mmol/L over 4 hours. If, during a fast, 1 unit of insulin drops your sugar more than 2 mmol/L then you need to assume a higher ISF, say 3 or more. If, during a

fast, 1 unit of insulin drops your sugar less than 2 mmol/L then you need to assume a lower ISF, say 1.5 or less.

Rapid insulin dose for meals: carb counting & carb ratio

To calculate how much rapid insulin to give with a meal you need to know two things:

1) the number of grams of carbohydrates ("carbs") in the upcoming meal - this estimation is called "carb-counting". To determine the number of grams of carb in your upcoming meal, ask your smartphone ("ok google" or "hey siri") and say "how many carbs in a baked potato" or "how many carbs in a Big Mac" etc.

2) the number grams of carbs that one unit of rapid insulin will neutralize - this is called the "carb ratio", technically known as Insulin-to-Carb Ratio (ICR). To determine your ICR read on.

If you don't already have an ICR, start by assuming ICR = 1:500/TDD (total daily dose of insulin). If TDD = 50 then your ICR = 500/50 = 1:10 (pronounced "one is to ten". An ICR of 1:10 can also be expressed as a fraction as 1/10. Note, an ICR of 1:10 is often stated as "10" but it is important to know that it is a ratio, or a fraction and "10" means "1 is to 10".

For the purposes of this article we will stick with 1:10. An ICR of 1:10 implies that 1 unit of rapid insulin covers 10 grams of carbs/starch. The ICR is correct if your 2 hour post-meal reading is in the 5.0-10.0 range.

Test meal: The best time to start the experiment to determine your actual ICR is at any time during a fast or at breakfast time (assuming nothing eaten and no rapid insulin taken for 5 hours) AS LONG AS your sugar is in the target range (say 4.0-7.0)., you can take a test meal of a known number of carbs to determine your "carb ratio". If you decide on a test meal of a bagel (= 30 grams of starch) you should take 30/10 = 3 units of rapid insulin.

If your 2 hour post-meal sugar is above target you need more insulin - thus you need to raise your ICR from 1:10 to say 1:8). You may ask "why is going from 1:10 to 1:8 considered a raise?" This is because 1:10 is the same as 1/10 = 0.1. 1:8 = 1/8 = 0.125. Thus going from 1:10 to 1:8 is a raise in ICR!

If your sugar 3-4 hours after the meal is below the target you need to give less insulin (and you need to lower your ICR from 1:10 to say 1:12.

If your sugar is not in the target range at the time of a test meal another way to decide if the ICR is correct is to aim to get the sugar back to where it started at 3 hours. If the sugar isn't back to where you started you need to give more insulin (raise the ICR from 1:10 to 1:8). If your sugar is below where you started you need to give less insulin (lower the ICR from 1:10 to 1:12).

For more information on carb counting watch this episode of BCDiabetes' The Weekly from 2020-May. For a more basic approach to rapid insulin adjustment follow this link.

Glycemic Index

Not all carbs are created equal. "Complex" carbs which tend to be grainy/unprocessed/less-cooked, raise sugar less than "simple" carbs which tend to be whiter and more processed such as white rice and white bread. The tendency of carbs to turn into sugar is known as glycemic index or GI. The easiest way to find out the GI of a food is to ask Google or Siri. Carbs with a low GI value (<55) are more slowly digested, absorbed and metabolised and cause a lower and slower rise in blood glucose and require less insulin. Simple sugar has the highest glycemic index = 100 while multigrain kibbled wheat bread = 46.

BCDiabetes recommends you choose GI < 55 as much as possible.

The correct way of carb counting is actually to take the number of grams of carb & multiply it by the glycemic index divided by 100. The glycemic index of two pieces of multigrain kibbled wheat bread (2x15 = 30 grams) = 30*46/100 = 13.8. The value of 13.8, the carb count modified by glycemic index, is known as "carb load".

For more information on the glycemic index watch this episode of BCDiabetes' The Weekly from 2020-July.