bcdiabetes.ca
Patient Care + Research + Clinical Trials

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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 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 for every 1 unit of rapid insulin given. Rapid insulin lasts up to 6 hours, but most of the action is seen in the first 3 hours. 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 3 hours. If, during a fast, 1 unit of insulin drops your sugar more than 2 mmol/L over 3 hours 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 carbs 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 neutralise - 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 = 500/TDD (total daily dose of insulin). If TDD = 50 then your ICR = 500/50 = 10, or more correctly 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 usually 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 3 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 nothing eaten and no rapid insulin taken for 5 hours. Ideally you do this when your sugar is in a good range, say 4.0-7.0, but you can do it with any sugar providing it is < 10.0. The "test meal" is a 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.

We typically teach that the ICR is correct if your sugar 3 hours after the meal is back to where it started. If your sugar 3 hours after the meal is higher than where it started it means you need to take more insulin next time - thus you need to make your ICR more aggressive by taking your ICR from 1:10 to say 1:9.

If your sugar 3 hours after the meal is below the starting point you need to give less insulin next time - thus you need to make your ICR less aggressive by taking your ICR from 1:10 to say 1:11 or 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 of the time 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.

Counting protein in a fatty meal as "carbs"

Advanced users know that protein in a meal turns to sugar like a low GI food and needs to be considered at some level when doing "carb" counting. The more fat in the meal, the slower the protein turns to sugar. Credit is due to Łucja Zaborowska, who proposed the "Warsaw method" to help with these calculations (see https://bit.ly/FPUcalc). But briefly, to decide how much more insulin is required to cover protein and fat in a meal do the following:

#1 Estimate the grams of fat & multiply by 9 (this gives the calories from the fat)
#2 Estimate the grams of protein & multiply by 4 (this gives the calories from the protein)
#3 Add the total calories from the fat and the protein
#4 Divide the number from #3 by 10 - this is the number of "carbs" coming from the protein in the fatty meal.
#5 Divide the number from the line above by your ICR (carb ratio) and give this as a prolonged or delayed bolus of 4-5 hours (the more fat the more delayed the bolus …

If you are using the Loop app you would select "pizza" for absorption time and enter the number of carbs. Advanced Loop algorithms such as iAPS and AAPS allow you to separately enter the grams of protein and fat and automatically calculate the additional insulin required and time frame.

Example: assume 20 grams of fat and 20 grams of protein and an ICR of 1:13 or "13"
#1 = 20*9 = 180 kcals
#2 = 20*4 = 80
#3 = 180 + 80 = 260
#4 = 260/10 = 26

#5 = 26/13 = 2. So give 2 units with a delayed bolus to cover the protein in the fatty meal.

Short URL = http://bit.ly/3aJ2XZ4