INSULIN PUMP ADJUSTMENTS
BASAL RATE TESTING

INTRODUCTION

Intensive insulin therapy with an insulin pump attempts to provide insulin to the body in a manner similar to the way insulin is delivered by the normal pancreas. This handout discusses making adjustments in *basal* insulin based on glucose measurements. If the terms or concepts in this handout are unfamiliar, please read the handout "Intensive Insulin Therapy," which can be obtained from www.boulderendo.com.

BASAL RATE TESTING

Blood sugar is affected at any given moment by (1) basal insulin, (2) food (carbohydrate) intake, (3) bolus insulin (mealtime and/or correction boluses), (4) activity, and (5) other factors, such as stress or illness. Basal rate testing is a process to examine the basal rate provided by an insulin pump, while trying to eliminate or minimize the influence of the other factors.

Notes about basal rate testing:

- Basal rate testing is most useful when performed 2 or 3 times prior to making adjustments
- Basal rate testing should be performed when there have been no unusual circumstances in the prior 24 hours
  - No significant high or low blood sugars
  - No unusual exercise, activity, or stress
  - No acute illness
- Usually, overnight testing is done initially, followed by testing of the daytime intervals (see below)
- If you have a low blood sugar during testing, correct the low blood sugar and stop the test. Discuss reducing the basal insulin (during the time interval tested) with your doctor and plan to retest the new basal rate
- If your blood sugar rises above 200 during the test, stop the test and take a correction bolus for the high blood sugar. With your doctor, discuss increasing the basal rate and plan to retest the new rate

Overnight basal rate testing

- Eat dinner (and take your usual insulin bolus) at least 4 hours prior to bedtime. Then do not eat or take any correction boluses for high blood sugar until the start of the test (i.e. your last food intake and insulin bolus should be at least 4 hours before bedtime)
- Check your bedtime blood sugar
  - If your bedtime sugar is out of the desired range, correct the sugar appropriately. Skip the basal rate testing for now and try again another night
  - If your bedtime sugar is acceptable (for example, 100-160), proceed with testing
- Set your alarm to wake you up, and check your blood sugar halfway between bedtime and morning
- Check your blood sugar on awakening
- For example, if your bedtime is 10 pm and you get up at 6 am:
  - Eat dinner by 6 pm, and cover dinner with your usual insulin bolus
  - Check your blood sugar at 10 pm. If your sugar is in the goal range, proceed with testing. Otherwise, correct the blood sugar and try testing again on another night
  - Check your blood sugar at 2 am
  - Check your blood sugar at 6 am
  - End the test and eat breakfast

Daytime basal rate testing

- Generally, you can think of the day broken into intervals to test as follows:
  - Morning to lunch
  - Lunch to supper
  - Supper to bedtime
- Eat your last meal (and take your usual insulin bolus) at least 4 hours prior to the testing interval. Then do not eat or take any correction boluses for high blood sugar until the start of the test (i.e. your last food intake and insulin bolus should be at least 4 hours before the test)

INSULIN PUMP ADJUSTMENTS
BASAL RATE TESTING

- Check your blood sugar at start of interval
  - If your sugar is out of the desired range, correct the sugar appropriately. Skip the basal rate testing for now and try again another day
  - If your sugar is acceptable (for example, 80-160), proceed with testing
- *Skip the meal* at the start of the interval. Do not have anything with calories to eat or drink
- Check your blood sugar every 1-2 hours until the end of the interval
- For example, to test morning to lunch:
  - Check your blood sugar on awakening. If your sugar is in the goal range, proceed with testing. Otherwise, correct the blood sugar and try testing again on another morning
  - *Skip breakfast*. Do not have anything with calories to eat or drink until lunchtime
  - Check your blood sugar every 1-2 hours until lunchtime
  - End the test and eat lunch

USING RESULTS OF TESTING TO ADJUST THE BASAL RATES

- If your basal rate is adjusted properly, your blood sugar will not rise or fall by more than 40 points from the start of the interval through the end of the interval
- Using the blood sugar values obtained during testing, you can increase or decrease your basal rates to achieve a consistent blood sugar. Generally you will need to start a new basal rate 2-3 hours before your blood sugar began to change:
  - For example:
    - If your sugar rises by more than 40 points between 2 am and 6 am, the basal rate may be increased by 0.05-0.1 units/hour, starting at midnight (through 6 am)
    - If your sugar falls by more than 40 points between breakfast and mid-morning, the basal rate may be decreased by 0.05-0.1 units/hour, starting 2-3 hours before the usual breakfast time, through mid-morning
  - Many people do best with more than one basal rate. The following are useful principles:
    - The amount of basal insulin given in 24 hours is usually 40-50% of the total daily dose. Some people (such as teenagers, people who eat by "grazing," and people on low carbohydrate diets) may do better with 50-60% of the daily total as basal insulin.
    - A lower basal rate is often needed between 8 pm and 2 am (when insulin sensitivity is usually higher) and during the day between 10 am and 4 pm (when people are often more physically active)
    - A higher basal rate is often required starting at 1-3 am and ending at 9-10 am, to offset the "dawn phenomenon"
    - People who tend to eat by "grazing" or those who eat most of their carbohydrate late in the day often do well with a higher basal rate during periods of increased food consumption
- Keep in mind that insulin delivery and absorption can be variable, so it is always best to test a given interval 2-3 times, and then make adjustments based on the typical response
- Once a basal rate is adjusted, plan to *repeat the testing* of that interval to see if the new settings are working appropriately
- *If you are a new pump user or are uncomfortable making adjustments on your own, please review the results with your doctor before making changes*

RESOURCES

1. Book Pumping Insulin, by John Walsh and Ruth Roberts. *This is an excellent resource that reviews all aspects of insulin pump therapy, including basal rate testing.*
2. Book Smart Pumping, by Howard Wolpert. *Another excellent resource for insulin pump therapy.*
3. Website www.insulin-pumpers.org/howto.shtml. *A good, web-based resource for adjusting insulin pump therapy, including "How to Profile Your Basal Rates."*
4. Website http://www.diabetesnet.com. *Most of the information comes from the authors of #1. See the sections "Improve Control," "Diet/Nutrition," "Technology," and "Diabetes Tools."*