

## Case Study (2) : A 52-Year-Old Woman With Obesity, Poorly Controlled Type 2 Diabetes

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### **Presentation**

A 52-year-old woman with obesity and a 9-year history of type 2 diabetes presents with complaints of fatigue, difficulty losing weight, and no motivation. She denies polyuria, polydipsia, polyphagia, blurred vision, or vaginal infections.

She notes a marked decrease in her energy level, particularly in the afternoons. She states that she has gained an enormous amount of weight since being placed on insulin 6 years ago. Her weight has continued to increase over the past 5 years, and she is presently at the highest weight she has ever been. She states that every time she tries to cut down on her eating she has symptoms of shakiness, diaphoresis, and increased hunger. She does not follow any specific diet and has been so fearful of hypoglycemia that she often eats extra snacks.

Her health care practitioners have repeatedly advised weight loss and exercise to improve her health status. She complains that the pain in her knees and ankles makes it difficult to do any exercise.

Her blood glucose values on capillary blood glucose testing have been 170–200 mg/dl before breakfast. Before supper and bedtime values range from 150 mg/dl to >300 mg/dl. Her current insulin regimen is 45 U of NPH plus 10 U of regular insulin before breakfast and 35 U of NPH plus 20 U of regular before supper. This dose was recently increased after her HbA<sub>1c</sub> was found to be 8.9% (normal <6%).

Past medical history is remarkable for hypertension, hypertriglyceridemia, and arthritis.

On physical exam, her height is 155 cm. and her weight is 130 Kg. Her blood pressure is 160/88 mmHg. The remainder of the physical exam is unremarkable.

### **Laboratory Investigations**

BUN, creatinine, and liver function tests are normal. Thyroid function tests and urine microalbuminuria are also normal.

After an explanation that the increasing insulin doses were contributing to her weight gain and that she would need to decrease her insulin dose along with her food intake to prevent hypoglycemia, the patient agreed to follow a restricted-calorie diet and to decrease her insulin to 30 U of NPH and 10 U of regular insulin twice daily. As she had no contraindications to metformin (Glucophage), she was also started on 500 mg orally twice daily. Her weight

was now 110 km. and her HbA<sub>1c</sub> was 7.5%. She was feeling much more energetic, no longer felt depressed, and was able to start a walking program.

### Learning Objectives

The student should understand the following topic related to this case

1. The symptoms of diabetes mellitus
2. The types of DM
3. The overweight & obesity in DM type 2
4. Laboratory investigations of DM
5. The types of insulin & hypoglycemic drugs

### Questions

1. Can individuals on high insulin doses successfully lose weight?
2. How does fear of hypoglycemia contribute to uncontrolled diabetes?
3. What is a possible approach to obese patients with insulin treated, poorly controlled type 2 diabetes?
4. What is your advice to this patient ?
5. How you will assure this patient that her condition will improve with treatment?
  6. What other types of diabetes mellitus ?
  7. What are the main symptoms of hyperglycemia ?
  8. What other investigations of DM ?
  9. How do we perform GTT ?
  10. What is the management of diabetes mellitus ?

## Commentary

This is a common case that illustrates several issues: high insulin doses contributing to weight gain, fear of hypoglycemia, and the use of combination therapy in type 2 diabetes.

Patients do not often communicate their fear of hypoglycemia and subsequent overeating to their health care providers. When they present with poorly controlled diabetes, practitioners usually increase the insulin dose and advise them to lose weight and exercise. The continual increase in insulin doses to correct hyperglycemia can cause weight gain from cessation of glycosuria, fluid retention, and increased synthesis of fat. When the patient tries to decrease calories, the mismatch of insulin to food intake will result in low blood glucose levels and symptoms of hypoglycemia. The perception of and fear of hypoglycemia is a major problem for individuals treated with insulin, and it is often unrecognized by health care providers.

If insulin doses are not lowered in conjunction with caloric restriction, a cycle begins of hypoglycemia, overeating, further hyperglycemia, increasing insulin requirements, and subsequent weight gain. Even with the use of metformin, which will usually lower insulin requirements, fear of hypoglycemia may persist with increased eating and high blood glucose levels.

The cycle continues as the individual feels exhausted, experiences polyuria, polydipsia, and polyphagia and feels helpless and hopeless. These symptoms can escalate into symptoms of poor self-image, low self-esteem, low energy, difficulty concentrating, and poor self-care. Whether these symptoms represent depression or are a result of severe hyperglycemia is confusing and difficult to determine. There is a high incidence of depression in individuals with diabetes, and uncontrolled diabetes can contribute to or exacerbate symptoms of depression.

Once this woman was convinced that lowering her insulin dose would prevent hypoglycemia and that this would enable her to decrease calories and lose weight, she was much more adherent to her treatment regimen. The use of metformin may have helped decrease her hunger and insulin requirements and thus assisted in her weight loss. In this case, the patient's symptoms of depression improved with improved blood glucose control, which resulted in increased energy. She was then able to exercise, further reducing her insulin requirements and leading to successful weight loss.

1. When recommending caloric restriction to obese, insulin-treated patients, decrease insulin doses at the same time. When assessing obese, insulin-treated patients with diabetes, ask about symptoms of hypoglycemia and overeating.

2. When accessing obese, insulin-treated patients, decrease insulin doses at the same time.
3. Adding metformin to insulin can help decrease insulin requirements and assist with weight loss.
4. Treating hyperglycemia can alleviate symptoms of depression.

### **Targets for Diabetes Control**

The American Diabetes Association (ADA) recommends a target HbA1c of less than 7.0%, fasting glucose less than 130 mg/dL, and postprandial glucose less than 180 mg/dL for most patients. A more ambitious HbA1c target of 6.0% to 6.5% may be appropriate for patients with a long life expectancy and no cardiovascular disease, provided that this can be achieved without adverse effects, such as severe hypoglycemia. On the other hand, a target HbA1c of 7.5% to 8.0% may be suitable for patients with significant comorbidities, limited life expectancy, and a history of severe hypoglycemia. This goal is also reasonable for patients who have not been able to reach lower HbA1c levels with multiple diabetes medications and extensive education about diabetes self-management. Given our patient's overall health profile, her target is an HbA1c level of less than 7.0%, or eventually even 6.0% to 6.5%.

## MCQ's

Which one of the following is most often found in untreated patients with type 1 and type 2 diabetes?

- A. Hyperglycemia.\*
- B. Extremely low levels of insulin synthesis and secretion.
- C. Synthesis of an insulin with an abnormal amino acid sequence.
- D. A simple pattern of genetic inheritance.
- E. Ketoacidosis.

**An obese individual with type 2 diabetes:**

- A. usually shows a sudden onset of symptoms.
- B. usually has a lower plasma level of insulin than a normal individual.
- C. usually shows significant improvement in glucose tolerance if body weight is reduced to normal.\*
- D. usually benefits from receiving insulin about 6 hours after a meal.
- E. usually has lower plasma levels of glucagon than a normal individual.

**An individual with insulin resistance and normal  $\beta$ -cell function:**

- A. usually shows elevated fasting glucose levels.
- B. usually shows elevated fasting insulin levels.
- C. will eventually become diabetic.\*
- D. is rarely obese.
- E. is treated by injection of insulin.

Which one of the following is elevated in plasma during the absorptive (fed) period as compared with the postabsorptive (fasted) state?

- A. Glucagon.
- B. Acetoacetate.
- C. Chylomicrons.\*
- D. Free fatty acids.

**Increased formation of ketone bodies during fasting is a result of:**

- A. decreased levels of circulating glucagon.
- B. decreased formation of acetyl CoA in the liver.
- C. increased levels of free fatty acids in blood\*.
- D. inhibition of  $\beta$ -oxidation of fatty acids in the liver.
- E. decreased activity of hormone-sensitive lipase in adipose tissue.

**Which one of the following is the most important source of blood glucose during the last hours of a 48-hour fast?**

- A. Muscle glycogen.
- B. Acetoacetate.
- C. Liver glycogen.
- D. Amino acids.\*
- E. Lactate.