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Learning from Patients: Diabetes or Not
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Our recent series of articles on Patient-Centered Medical Home included a discussion of the value of "story telling." With the patient's permission, today we are telling the story of a patient who has been seen at SETMA over the past several years. His identify will not be disclosed but he will know that this story is about himself.

The intent of telling his story is to identify how it is sometimes difficult to come to the right conclusions immediately and why it is important to keep asking questions and to discuss those questions with the patient. Ultimately, the right answer can be found. In reviewing a case, it is possible to identify how things could have been done better and how the right diagnosis and treatment was ultimately found. Additionally, the lessons learned in this process can benefit others. It has been my experience that patients appreciate when a healthcare providers tells them that the provider does not know what the problem is but will keep seeking the answer. Also, it is far better to admit when you don't know than to pretend that you do.

Our patient was first seen in July, 2015. Due to his age, in addition to screening for cardiovascular risk, an initial screening for diabetes was completed. At that visit, he had a fasting blood sugar (FBS) of 131 mg/dl which is high but his Hemoglobin A1c was 5.1%, which is normal. His urine was negative for glucose (sugar). No intervention was made at that time. Ideally, he would have been given a follow-up appointment in three months to evaluate his blood sugar.

SETMA has created extensive tools for support in the management of diabetes including:

Pre-Diabetes: EPM Tools - Diabetes Prevention Tutorial
Diabetes: EPM Tools - Diabetes
Insulin Resistance: EPM Tools - Cardiometabolic Risk Syndrome Suite of Templates Tutorial

Many of the questions raised by this case study, including the definitions of pre-diabetes, diabetes and insulin resistance can be found in the above referenced material, all of which is posted on SETMA's website at www.jameslhollymd.com.

Patient Presenting With Symptoms of Possible Diabetes

The patient's next visit was July 25, 2016. He was treated for a minor condition. No blood sugar was done at that visit but he did have a significant amount of sugar in his urinalysis. This should have been addressed but was not until the patient was seen one month later, at which time he was complaining of classic symptoms of diabetes, increased thirst (polydipsia), increased appetite (polyphagia) and increased urination (polyuria).

At the August, 2016 visit, the patient had a Hemoglobin A1c of 10.2%. No blood glucose was done but with the 10.2 Hemoglobin A1c, it would be expected that the patient would have had a blood glucose of 296 mg/dl. Among the lessons learned from this patient's care are: always follow up sugar in the urine with a blood glucose and while it is early in the treatment of a patient with diabetes always match the Hemoglobin A1c with a serus blood glucose measurement. The importance of that will be discussed shortly. The patient was appropriately referred to diabetes education and was placed on a diet, exercise program and oral medication.

The patient had an adverse response to the high dose of diabetes medication and developed diarrhea. The medication was stopped. He was seen again on September 14, 2016, but no blood sugar was done. On September 19th, he attended diabetes education classes. He rigorous perused a low carbohydrate, low calorie diet, exercised and lost weight. He was seen again on November 11, 2016 but no laboratory studies were ordered. On November 30, 2016, he was seen by a diabetes specialist and his Hemoglobin A1c was 5.0% which is normal, but no blood glucose or urine was done.

His next visit was December 20, 2016, at that visit his blood sugar was 103 mg/dl, which is almost normal but in the range of early onset pre-diabetes, and his urine was negative for sugar. Because of the recent Hemoglobin A1c it was not repeated. On January 30, 2017, the patient was seen again and this time he was seen by the same person who saw him in July, 2015.

Here is where the Mystery Unfolded

Here is where the "mystery" began to unfold. This visit was made for "weight loss and ankle pain." The patient was on no medication for diabetes at this visit. After reviewing the entire record and not only each lab test but the sequence of those tests, a number of questions arose about this history.

The patient had had four Hemoglobin A1C tests. Three were completely normal but one was very high (July, 2015, 5.1%; August, 2016, 10.2%, 5.0% November, 2016; 4.8% January, 2017). The patient had had three blood sugars which were mildly abnormal (131 mg/dl in July, 2015; 104 mg/dl in December, 2016; 113 mg/dl in January, 2017). There was no blood sugar to correlate with the 10.1% hemoglobin a1c value.

1. Does the patient have diabetes?
2. Was the August, 2016 Hemoglobin a1c Value a laboratory error?
3. Does this patient have an hemoglobinopathy, in which case the Hemoglobin A1c cannot be used to follow the patient's blood sugar history?
4. How should the patient be treated?

All of these questions were discussed with the patient. And, the history and questions where discussed with the diabetes specialists. To get the answers, additional laboratory tests were done. The results and discussion are:

1. Urinalysis shows no glucose in the urine
2. Hemoglobin A1c is 4.8% (normal is below 6.0%; pre-diabetes is 6.0 – 6.4%; diabetes is 6.5% and higher)
3. Fasting Insulin was done and is 8 UIU/ml (normal is 2-19 UIU/ml
4. Fructosamine was done 209 UMOL/ml (normal is 190-270 UMOL/l
5. A 2-hour glucose tolerance test was done

    - Fasting 112 mg/dl
    - 30 minutes 194 mg/dl
    - 60 minutes 193 mg/dl
    - 2 hour 176 mg/dl

    (Note: Normal fasting blood sugar is below 100 mg/dl; pre-diabetes is a fasting blood sugar between 101-125 mg/dl; diabetes is a fasting blood sugar over 126 mg/dl. In the case of a "casual" blood test, i.e., not fasting normal is below 140 mg/dl; pre-diabetes is 140-199 mg/dl; diabetes is greater than 200 mg/dl))

    Urine glucose negative for all samples

6. HOMA-IR 2.3 (normal is less than 2.0)
7. Triglyceride/HDL .71 (normal is less than 2.0)
8. Cardiometabolic Risk Syndrome Assessment -- negative
9. Hemoglobin electrophoresis was normal

With this information, it is possible to answer all of our questions and to treat this patient properly. The one question which is impossible to answer definitively is whether or not the August, 2016 hemoglobin A1c of 10.1% is real or whether it represents a lab error. It is probable that we will never know, but the lesson to be learned is that a blood sugar and a urinalysis should always be done when evaluating a patient in the early stages of treatment for diabetes, pre-diabetes or insulin resistance.

First, remember the August 19, 2016 visit. When the patient's hemoglobin A1c was 10.1% a blood sugar and a urine for glucose should have been done. This is not a new revelation; it is a reminder that new and more exotic test do not take the place of simpler older tests. The patient did not suffer any ill-effects of this oversight but that is not an excuse. Second, the patient's clinical presentation was classic for diabetes which was shown by the 10.1% hemoglobin A1c.

Again, as in this case, while the state of the art in diagnosing diabetes is now defined as two successive hemoglobin a1cs above 6.5%, it can be important, as in this case, to measure the blood glucose with the hemoglobin a1c.

Third, when as in this case, there is doubt or questions about the hemoglobin a1c, it is possible to do a 2-hour glucose tolerance test and a fructosamin to correlate with the hemoglobin a1c. Fructosamine is another marker for abnormal blood sugar for the past 30 days. The hemoglobin a1.c correlates with the blood sugar for the last 90 days. Fourth, in January, 2017, this patient's glucose tolerance test shows pre-diabetes and not diabetes. That will become important in our following discussion.

Fifth, the fundamental metabolic flaw in Type 2 diabetes – formally and incorrectly called non-insulin dependent diabetes – is that the organs are insensitive to insulin. For instances, when the blood sugar goes up, the pancreas produces more insulin which signals the muscles to take up glucose and use it for producing energy. Insulin also signals the liver to stop producing more glucose from the proteins, fats and carbohydrates which have been consumed by the patient. When the patient's body loses its sensitivity to insulin, the glucose in the blood is not taken up by the cells and the liver does not stop producing 'new" glucose.

Insulin Resistance

There are five ways to assess insulin resistance. First, it is implied by the blood glucose, which when it is elevated suggests that the patient, if they do not have Type 1 Diabetes, has Type 2 which is based on insulin resistance. Second, the Triglyceride/HDL Ratio is a marker for insulin resistance. When that ratio is above 2.0, it is highly suggestive that the patient is insulin resistant. A third marker is increased fasting plasma insulin levels. The normal insulin level in a patient's blood is between 2.0 and 19.0 UIU/ml. Insulin normally go up after you eat, so it is very important to measure this level after you have fasted for 8-12 hours. Fasting Insulin levels are not often used in clinical medicine except in the unusual cases where it is hard to know if the patient has diabetes, pre-diabetes or insulin resistance. Fourth, there is a research computation which SETMA has incorporated into clinical medicine for unusually cases and that is the Homeostasis Model Assessment of Insulin Resistance (HOMA-IR). This is a calculation made with fasting glucose and fasting insulin values. If the value is above 2.0, it is diagnostic of insulin resistance.

The fifth way to access the presence or absence of insulin resistance is very interesting. It is a collection of conditions which together have been known as the:

- Syndrome X
- Insulin Resistance Syndrome
- Metabolic Syndrome
- Cardiometabolic Risk Syndrome

These are not four different conditions but different names which have been used at different times for the same condition. They move from earliest to the current designation. Through electronic algorithms, SETMA is able to complete three different computations for this

condition. This patient was negative for all three formulations of the Cardiometabolic Risk Syndrome which we measure.

In summary, our patient does not have diabetes but does have pre-diabetes (next week, we will discuss what that means). Our patient has mild insulin resistance but his markers for that condition are very mild. Because diabetes and pre-diabetes are progressive conditions, without life-style changes – all of which he has made – and often even with them, he will progress over the years to full-blown diabetes. We will never know if the August, 2016 hemoglobin a1c is an lab error or not but we do know that while in the early stages of diagnoses and treatment, we need all three evaluations, hemoglobin a1c, urinalysis and serum blood glucose.

After discussions with the patient we have decided to put him on a medication which improves insulin sensitivity so that he can forestall the development of diabetes. He will be rechecked in two month intervals for six months and after that as needed.

Next week, we will discuss insulin resistance in more detail.