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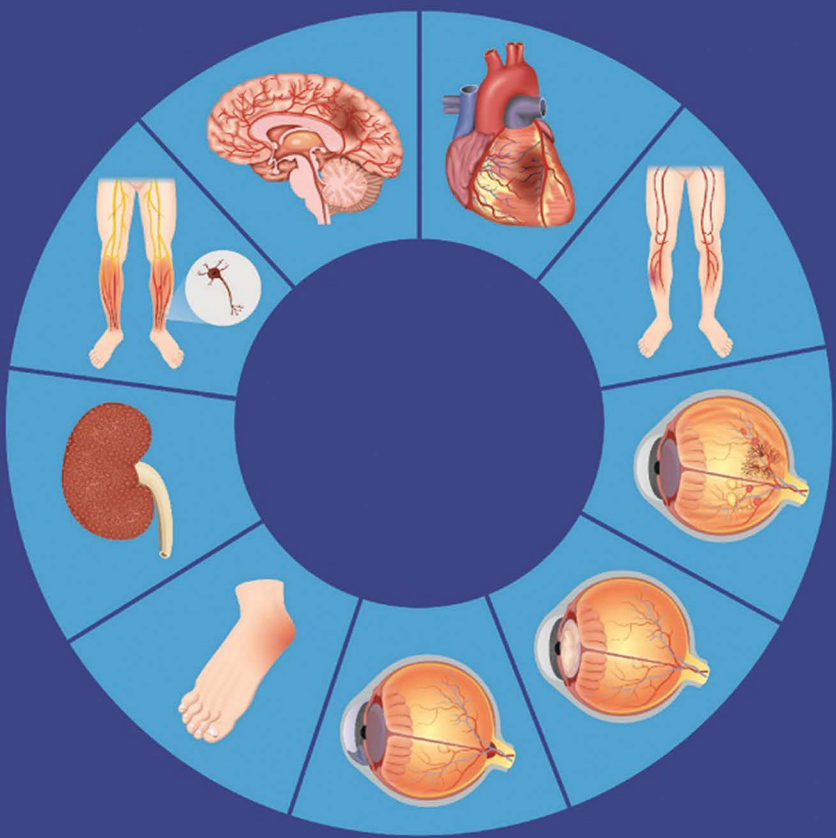
Practical Diabetes Mellitus



Pradeep G Talwalkar

7th Edition

JAYPEE

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8 CHAPTER

Use of Glucometer in Family Practice

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INTRODUCTION

In a day-to-day practice of a family physician or a general duty medical officer, he commonly has to deal with routine management including dosage adjustments and also handle emergencies in a diabetic patient. Thus, a reliable and properly functioning glucometer with all the accessories is a must for him both in the clinic and in the emergency bag. Glucometer is as essential to a clinician as a stethoscope, blood pressure apparatus, and a torch.

Applications of glucometer in family physician's clinic:

- When a patient walks in with symptoms suggestive of diabetes. Even though, one should not solely rely on glucometer readings when hyperglycemia is detected for the first time, availability of on the spot blood glucose value will definitely help in planning of further line of action including the investigations.
- When a known diabetic patient visits the clinic for routine checkup on the eve of his departure from the city and thus does not have a time for formal laboratory tests in near future.
- When a known diabetic patient attends the clinic with symptoms, which may or may not be related to diabetes and does not have a recent laboratory blood glucose report.
- On emergency visit, on the spot blood glucose estimation is a must at every emergency.

Symptoms, such as hunger, palpitations, sudden sweating, giddiness, etc., could be due to hypoglycemia. Random blood glucose on the spot helps to detect or rule out hypoglycemia.

In case of hypoglycemia, one should immediately correct the low blood glucose level by serving a carbohydrate snack like biscuits or refined sugar-containing liquids and subsequently reduce dosage of his antidiabetic medications, if required. In case the patient is semiconscious or unconscious, 50 mL of 25% glucose should be injected intravenously. Hypoglycemia in patients on α-glucosidase inhibitors (acarbose and voglibose) should be treated by administering oral or intravenous glucose as it does not respond to carbohydrate snacks or sucrose or table sugar (α-glucosidase inhibitors slow down the breakdown of carbohydrates, including sucrose to glucose). On the spot blood glucose estimation with glucometer also helps to rule out hypoglycemia and think of alternative condition. Sudden sweating could be a symptom of acute myocardial infarction.

Since hypoglycemia is more common, there is a tendency in patients to assume that they are having hypoglycemia and to consume two teaspoons of sugar every 10 minutes. In case of heart attack, it leads to late diagnosis and loss of vital time before the patient is admitted in intensive care unit. Thus, timely on the spot blood glucose estimation can save precious time and life, as well as lots of money by avoiding delay in hospitalization in case of serious condition, such as acute myocardial infarction or other cardiac emergencies, or by avoiding unnecessary hospitalization in case of simple hypoglycemic episode. Prompt use of glucometer and swift appropriate action in only one episode will more than compensate for the entire investment cost of glucometer.

EQUIPMENT REQUIRED FOR HOME BLOOD GLUCOSE MONITORING

- Reliable glucometer
- Chemically treated strips compatible with the meter
- Lancets or fine needles to prick the finger for a drop of blood
- Cotton swabs
- Methyl alcohol or medicated spirit

Glucometer: It is a small electronic instrument which analyzes the concentration of glucose in a drop of blood transferred on chemically treated plastic strip from patient's finger. The strip

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is inserted in a slot on the meter. Glucometer runs on batteries. Several brands are available in our country.

The cost of the meter varies from ₹850 to 3,000. For those with high consumption of strips, many companies offer free glucometers. The high-end meters have additional features such as varying memory capacity to store previous readings along with date and time, automatic calculation, and display of mean blood glucose value of last 7 and 14 days, warning beep and message if the values are out of range on either side, facility to download the readings to computer, bluetooth connectivity, coding free operations, etc.

Once a drop of blood from finger after a prick with the lancet or needle is deposited on the designated area on the plastic strip, which is inserted in the slot on the meter, the blood glucose value is digitally displayed on the meter screen in 5 seconds. One plastic strip is required for each test. The cost of strip works out to be in the range of ₹14 to 25, depending upon the meter and the number of strips purchased at a time. These strips are available in vials; usually each vial contains 25 strips. They have unopened expiry period of about 18 months and a separate independent expiry period, usually of 6 months, after the seal is opened. The disposable lancets and needles cost approximately ₹1 to 4. The pain following finger prick, particularly when spring-loaded lancet device is used, is minimal and easily bearable. All meters come with a spring-loaded lancet device at no extra cost.

RELIABILITY OF GLUCOMETER

More than 40 years have elapsed since the introduction of glucometers. During this period, technology has been continuously updated and deficiencies found in earlier meters have been gradually overcome. The modern meters are reliable provided one understands and follows the instructions mentioned in the manual, stores the strips properly, and avoids using outdated strips (expiry dates of unopened and opened vials are mentioned on the vial). It must be noted that with glucometer, capillary whole blood is tested for glucose; while during laboratory test, venous plasma component of blood is tested for glucose. While in fasting state, glucose levels in capillary whole blood and venous plasma are more

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or less equal; in the fed state, level in former is about 20 mg% higher than the latter. Even after accounting for the abovementioned difference, up to 15% difference between capillary whole blood values and laboratory test is acceptable. Thus, one need not doubt reliability of glucometer if the values of laboratory test and reading done at the same time are not identical.

However, glucometer requires periodic calibration. This can be done every 2–3 months by simultaneous testing of blood glucose in laboratory and with glucometer. One should also remember that hypoperfusion and anemia affect capillary blood glucose. Former gives false low values while latter results into false high values. Family physicians should also strongly recommend glucometer to all the diabetic patients for self-monitoring of blood glucose (SMBG).

TRAINING THE PATIENTS USING GLUCOMETERS

Frequency of Self-monitoring of Blood Glucose

The frequency of SMBG depends on several factors such as subtype of diabetes, degree of stability of blood glucose, presence of special situations (pregnancy, perioperative period, emergency situations, etc.). In stable and well-controlled type 2 diabetics, SMBG is required once or twice a week; while in type 1 diabetics, those diabetics on multiple insulin injections daily, those with brittle blood glucose control, and in pregnant diabetic women, at least three tests per day are required. These are rough guidelines which will require modifications in an individual case.

Timing of Blood Glucose Examination

Routine Tests

The timing of blood glucose will depend on individual case. The usual test timings are premeals (before breakfast, lunch, and dinner), and postmeals (2 hours after breakfast, lunch, and dinner). Usually, initially, emphasis is on premeal monitoring and adjustment of dosages of antidiabetic medications based on premeal blood glucose values. Once these are stabilized, attention is shifted to postmeal monitoring. One also has a choice

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of estimating premeal and postmeal values on the same day. One can plan to test the blood glucose at different times in a rotating manner, e.g., on Monday, prebreakfast, postlunch, and predinner blood glucose estimation; on Tuesday, prebreakfast, prelunch, and postdinner blood glucose estimation. In addition to premeal and postmeal estimation, occasionally, particularly in those on insulin (once a week in those on multiple insulin injections and once a month in those on one long-acting or intermediate-acting injection), one should test at 3 AM. These values give more precise idea about the level of overnight control and help in taking correct decision regarding adjustment of predinner and bedtime insulin dosage. In some patients, particularly with relatively large dose of predinner intermediate-acting insulin, (NPH insulin such as Insulatard) early morning (around 3 AM) blood glucose dips in hypoglycemic range and reactive hyperglycemia occurs in morning (around 8 AM), as a result of early morning hypoglycemia. Detecting early morning hypoglycemia and making appropriate changes in insulin dosage can break this vicious cycle.

SOS Tests

In addition to the test timings mentioned above, patients should be advised to do random blood glucose estimation in following circumstances: during symptoms such as hunger, palpitations, sudden sweating, giddiness, etc. These symptoms could be due to hypoglycemia, which needs to be confirmed or ruled out on the spot. However, anxiety-related nonspecific symptoms are also common in the community including diabetic patients. Anxious diabetic patients, who do not have glucometer or do not use it during sudden symptom, are likely to be caught in a trap if they interpret their anxiety-related symptoms as those due to hypoglycemia and reduce the dose of their antidiabetic medications without consulting their doctor and avoid doing a laboratory blood glucose test. They also eat snacks every time they get these symptoms. Symptoms disappear on their own; however, since they have taken a snack, they assume that they really had hypoglycemia. These two uncalled-for actions lead to hyperglycemia and expose them to the complications of diabetes.

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Five Important Points for Mastering Your Blood Glucose Estimation Technique

Choose Good Glucometer

Modern glucometers give results in 5 seconds; they require extremely small amount of blood; the area on the strip containing blood remains outside the meter and thus meter does not get clogged with the blood. Moreover, many of these meters do not require coding when you change over to blood glucose estimation strips manufactured in different batch. Thus, these meters are far superior to older meters, which required longer time to flash blood glucose values on their screens, and which required coding and a larger amount of blood drop. If you are still using one of the older meters, changeover to modern glucometer. Bayer's "Contour", Johnson and Johnson's "OneTouch" and Roche's "Accu-Chek" are some of the leading brands. Each of these leading brands has more than one model. Ensure that you select one in which coding is not required as there is a likelihood of forgetting to do recoding whenever you start using new vial manufactured in different batch. Always purchase glucometer locally from formal sources so that servicing and continuous supply of strips are available. Do not depend on relatives, sending or bringing glucometers from the western countries as these are not serviceable and their strips are often not available locally. Remember, strips of one manufacturer are never compatible with meters of other manufacturers and most of the manufacturers have several models of meters and strips of one model are not compatible with all the models of same manufacturer.

Care of Blood Glucose Estimation Strips

Store the strips properly; avoid contact with moisture by immediately closing the vial stopper tightly after taking out a strip. Do not use strips after their expiry. These strips have two expiry periods, which are mentioned on the vials. There is an unopened expiry period, which means that all the strips should be discarded at the end of that period. There is another expiry period, the period after breaking the seal. This is usually shorter, about 6 months. This means that once the seal is broken you can use the strips for

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6 months after which remaining strips should be discarded even if they are still within their unopened expiry period.

Clean and Dry Fingers Properly

Wash patient's hands with soap and water and dry them before pricking. If remnants of sweet eaten by the patient a few minutes back are still on his fingertips, you will get high result. If fingertips are not dry after cleaning, water will get mixed with the blood drop and thus the result will be lower. You can use alcohol instead of soap and water. In that case, wait for a few seconds to allow alcohol to get evaporated otherwise you will end up doing test on diluted drop of blood. Eau de cologne, aftershave lotion, and medicated alcohol, which are available with the chemists, are the substitutes which can be used in place of alcohol (spirit), which is not easily available in our country.

Get Proper Blood Drop for the Test

Generate adequate-sized blood drop by using just adequate force with lancet or number 24 needles. Do not squeeze with excessive pressure as during such process body fluids, which contain a slightly lesser concentration of glucose, get mixed with a drop of blood before it comes out on fingertips. Always wipe out first drop of blood, gently squeeze the finger again, and use second drop of blood for the test as it is less likely to be contaminated.

Periodically Cross-check the Meter Readings

Do not have a total blind faith on the readings obtained with glucometer. It is not a substitute for periodic laboratory blood glucose testing. Always cross-check glucometer reading with laboratory readings. Do not expect exact reading, up to 15% difference is acceptable. Also, periodically cross-check with control solution provided by the manufacturer along with glucometer, after ensuring that control solution is not out of date.

CONCLUSION

Every family physician and general duty medical officer must have his own properly calibrated and functioning glucometer all the time with him in the clinic as well as on the emergency visits.

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TABLE 1: Format for storing self-monitored blood glucose (BG) data.

Date	Fasting BG	Prelunch BG	Postlunch BG	Predinner BG	Post-dinner BG	3 AM BG	Random BG
15/6							
16/6							
17/6							

Note: All blood glucose values are in mg%.

He should also encourage SMBG by the patients. Depending upon type of diabetes, degree of glycemic control, and type of antidiabetic treatment used, give them a structured plan about frequency of testing and properly recording the data. Emphasize that generated data needs analysis and timely action **(Table 1)**.

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Pradeep G Talwalkar is a practicing Diabetologist for four decades. Currently, he is a Senior Consultant Diabetologist and teacher in diabetology at SL Raheja Hospital, All India Institute of Diabetes in Mumbai. His other attachments include visiting consultant at Shushrusha Hospital and Dhanwantari Hospital, Mumbai. Earlier he held a position of Honorary Professor of Medicine, at Grant Medical College, Mumbai, Maharashtra, India. He has been a postgraduate teacher for two decades in Internal Medicine, and currently in Diabetology for the last 10 years. He is a much sought after speaker at various conferences, symposia and CMEs, and he has lectured extensively in various parts across the country. He has authored more than 50 papers in various national and international journals, and has also written and edited books on diabetes for family physicians and internists and for lay persons in Marathi, Gujarati, and English.

He is very active on the patient education front and besides periodically conducting workshops and seminars. He has been using various media such as live interactive programs, print, radio, television; and web conferences to spread the knowledge about diabetes to patients, as well as to those who care for them.

He was an Assistant Editor of API Textbook of Medicine, 6th Edition, a popular textbook with a wide readership in our country. In the course of attending various international conferences on diabetes and visiting centers of excellence in the field of diabetes, he has extensively traveled across the world. He has actively participated in all International Diabetes Federation Conferences, since the 1988 conference in Sydney, Australia.

Other Publications by Pradeep G Talwalkar

1. Handbook of Management of Non-insulin Dependent Diabetes Mellitus
2. How to Live a Good Quality Life in Spite of Diabetes?
3. Metformin: The Gold Standard (Monograph)
4. Madhumeha ani Sukhi ani Samrudhha Jivan (in Marathi)
5. Madhumeha ane Sukhi-Samrudhha Jivan (in Gujarati)
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