

Management of type 1 diabetes in family practice

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Highlights / Hoogtepunte

- Practical guidelines for the GP to diagnose and monitor diabetes.
- How to individualise an insulin regimen?
- How to deal with hypo- and hyperglycaemia in a patient on chronic insulin treatment.
- Praktiese riglyne vir die algemene praktisyn om diabetes te kan diagnoseer en te monitor.
- Hoe om 'n insulien doseringsplan op te stel vir 'n spesifieke diabetiese pasiënt.
- Hoe om die hipo- en hiperglukemiese episodes te hanteer in 'n pasiënt wat op chroniese insulien behandeling is.

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INTRODUCTION

About 135 million people live with diabetes. In the next two decades it is expected to go as high as 300 million.¹ About 10% of patients with diabetes mellitus have type 1 diabetes. Type 1 diabetes is usually diagnosed in children and young adults (before 30 years of age) and was previously known as juvenile diabetes or insulin dependent diabetes mellitus (IDDM). Subtype 1A is due to autoimmune destruction of β cells of islets of Langerhans in the pancreas and associated with certain HLA types and subtype 1B is idiopathic. Both types lead to almost absolute deficiency of insulin. While susceptibility to type 1 diabetes is genetically determined, only a portion of susceptible individuals go on to develop disease. It is necessary to differentiate type 1 diabetes from type 2. Besides age, type 1 diabetes is generally associated with weight loss and ketosis, but insulin resistance is not a major factor. A distinct variant of type 2 diabetes, known as non insulin dependent diabetes of young (NIDDY) is due to genetic defects of β cell functions. This presents in early adult life with moderate hyperglycaemia,

which does not require insulin treatment. It runs a relatively benign long-term course without major complications. Diabetes can be secondary to endocrinopathies (Acromegaly, Cushing syndrome, pheochromocytoma, glucagonoma or pheochromocytoma) or induced by drugs like glucocorticoids, thyroid hormone, diazoxide, adrenergic agonists, phenytoin, protease inhibitors, clozapine and β -adrenergic antagonists. Infections like rubella, cytomegalovirus and coxsackie may cause hyperglycaemia. Genetic diseases like Down's syndrome, Klinefelter's syndrome and Turner's syndrome may be associated with hyperglycaemia. Gestational

diabetes (GDM) is seen during pregnancy. Most women revert to normal glucose tolerance but some patients (about 30%) have substantial risk of developing the disease. Type 1 diabetes is treated with a combination of insulin, diet and exercise.

DIAGNOSTIC CRITERIA

Any person with a fasting venous plasma glucose level of 7 mmol (126 mg/dl) or more on two occasions is considered diabetic.² Other criteria based on plasma glucose are summarised in **table I**. Urine examination for glucose is simple and cheap in the

Table I: Diagnostic criteria

Normal:	
Venous plasma glucose	< 6.1 mmol/l (110 mg/dl)
2-hour PPG	<7.7 mmol/l (140 mg/dl)
Diabetic:	
Any two of the following:	
Fasting venous plasma glucose (on two occasions)	>7 mmol/l (126 mg/dl)
2-hr PPG	>11.1 mmol/l (200 mg/dl)
Random venous plasma glucose in symptomatic patient	>11.1 mmol/l (200 mg/dl)

Table II: Relationship of Hb A_{1c} and average blood glucose

% Hb A _{1c}	Average blood glucose mmol/l	% Glycosylated Hb
4	2,6	4.2
5	4,7	5.7
6	6,3	7.2
7	8,2	8.8
7.2	8,8	9.1
8	10,0	10.2
9	11,9	11.7
10	13,7	13.1
11	15,6	14.6
12	17,4	16.1

clinical setting. However, it is an unreliable criteria for diagnosis or monitoring the treatment. Glycated or glycosylated haemoglobin is now commonly used to assess the level of diabetic control and is related directly to average blood glucose concentration over the past two to three months (Table II). Generally, it is used to monitor the treatment. It is expensive but a good indicator of glycaemic control. However, it is not used as a diagnostic criterion due to the lack of standardisation of the methods used.

INSULIN TREATMENT

Insulin therapy is the mainstay of treatment for all patients with type 1 diabetes mellitus and about one-third of those with type 2 diabetes. Numerous studies have shown that controlling blood glucose levels to close to normal prevents diabetic microvascular and possibly macrovascular complications.^{3,4} Appropriate goals of intensive diabetes treatment are the following:

- Fasting and pre meal blood glucose level (4-6 mmol/L)*.
- Post-prandial glucose level (4-8 mmol)*.
- Bedtime glucose level (6.1-8.3 mmol/L).
- Glycated haemoglobin (HbA_{1c}) level less than 7%*.

* These are SEMDSA figures.

These goals may be modified on the basis of the frequency of hypogly-

caemia, patient compliance, and the experience of the physician.^{3,4} Tighter control is recommended for pregnant women. Looser control may be appropriate in young children; elderly patients with active cardiac, cognitive, or visual disorders; and patients who have hypoglycaemic unawareness or recurrent severe hypoglycaemia, abuse alcohol or drugs, have poor social support, or in whom a hypoglycaemic event might put them or others in danger (e.g. bus drivers).⁵

Types of insulin

All people with type 1 diabetes and some with type 2, need insulin to make up for the insulin that their pancreas is unable to produce. Many types of insulin are used, and they differ in pharmacokinetic profile (Table III).

Individualising insulin regimen

Insulin therapy must be individualised to maintain good blood glucose control and minimise hypoglycaemia. In healthy patients with recently diagnosed type 1 diabetes, the starting insulin dose during the "honeymoon period" is typically 10 to 15 U/day (or 0.2-0.6 U/kg per day). Two-thirds of the total dose of intermediate-acting isophane insulin suspension is given in the morning and one-third at dinnertime. Short-acting regular insulin (R) or more rapid-acting insulin, such as lispro (LP) or aspart is given with breakfast and dinner. Over time, patients who have type 1 diabetes without intercurrent illness typically need 0.5-1 U/kg per day. Higher doses

may be required during pregnancy and the adolescent growth spurt. If the patient's condition is unstable because of diabetic ketoacidosis, the insulin requirements may rise in the short term to 1-1.5 U/kg per day or higher. A number of techniques are available to help patients adjust their mealtime insulin doses. The simplest method is to suggest a range of insulin doses for various-sized meals (e.g. 4 U mealtime insulin for small meals, 6 U for medium-sized meals, 8 U for larger meals). Another technique is carbohydrate counting, in which 1 U of mealtime insulin is given for every 10-15 g of carbohydrate eaten.

HYPERGLYCAEMIA

Hyperglycaemia happens from time to time to people who have diabetes due to insufficient insulin administration, eating more or exercising less than planned. The signs and symptoms include high blood sugar, high levels of sugar in the urine, frequent urination, and increased thirst. Part of keeping diabetes under control is testing blood sugar often. Patients can be educated on the use of glucose test strips that can be used visually or with a glucometer at home. It is important to treat hyperglycaemia as soon as it is detected. Failure to treat hyperglycaemia can result in ketoacidosis, which is life threatening and needs immediate treatment. Symptoms include shortness of breath, breath that smells fruity, nausea and vomiting, and a very dry mouth. Ketoacidosis often requires hospitalisation and referral to a specialist.

How to treat hyperglycaemia?

Often, one can lower blood glucose level by exercise. However, if blood glucose is above 240 mg/dl, check urine for ketones. If ketones are present, exercise is not recommended. Exercising when ketones are present may make the blood-glucose level go even higher. Cutting down on the amount of food helps. If exercise and changes in diet don't work, changes in insulin type, doses or timings may be helpful. Monitor blood glucose level everyday to detect hyperglycaemia before it can become worse.

Table III: Types of insulin

Classification according to onset of action	NovoNordisk Time-action: • Onset • Peak • Duration	Eli Lilly Time-action: • Onset • Peak • Duration
Ultrafast-acting insulin: Insulin lispro*	Novorapid®(aspart) • 10-20 min • 1 to 3 h • 3 to 5 h	Humalog® (lispro) • 0-15 min • 1 h • 3-5 h
Short-acting insulin: Plain solution of insulin clear	Actrapid® • 30 min • 2.5 – 5 h • 8 h	Humulin R® • 20 – 30 min • 1 – 3 • 5 – 7 h
Longer-acting insulin**: Neutral suspension of insulin with basic proteins (protamine insulin, isophane insulin, NPH) Cloudy	Protaphane® • 1.5 h • 4-12 h • 12-24 h	Humulin N® • 1 h • 2-8 h • 18-20 h
Longer-acting insulin**: Neutral suspension of insulin complexes with small amounts of zinc ions (mixtures of amorphous and crystalline zinc insulin) Cloudy	Monotard® • 2.5 h • 7-12 h • 12-24 h	Humulin L® ± 2 h • 6-8 h • 22-24 h
Ultralong-acting insulin**: Suspension of crystalline zinc-insulin complexes Cloudy	Ultratard® • 4 h • 8-24 h • 28 h	Humulin U® • 4-6 h • 8-20 h • 24-28 h
Biphasic insulin***: Souble + isophane insulin	Actraphane ®0/70	Humulin 30/70® 20/80 40/60
Biphasic Insulin Analogue + isophane like insulin		Humalog Mix25 • 30 min • 1-8 hrs • 14-16 hrs
<p>* <i>Insulin lispro</i></p> <p>** <i>By creating insulin-protein or insulin-zinc suspensions the absorption characteristics of insulin are changed and we get a longer duration of action.</i></p> <p>*** <i>By mixing short-acting and longer-acting insulin we get a biphasic response with an early and a delayed peak of action. We can use premixed insulins or we can make an individual mixture before injection.</i></p>		

Diabetic ketoacidosis

Diabetic ketoacidosis (DKA) is an emergency. Every family practitioner should know about the initial management. Often, hospitalisation is required in serious cases.

- Confirm diagnosis (raised plasma glucose, positive serum ketones). Admission to an intensive-care setting may be necessary for

frequent monitoring if pH < 7.00 or unconscious.

- Assess serum electrolytes, pH, HCO₃⁻, PCO₂. Renal functions.
- Replace fluids: About 2 l normal saline over first 1-2 h; subsequently, hypotonic saline (0.45%) at 150-300 ml/hour; until plasma glucose reaches 10 mmol/l and then fluid should be changed to 5% dextrose

100-200 ml/hour.

- Administer regular (soluble) insulin: 20 units IV or IM, then 5-10 units/h by continuous IV infusion; increase 2- to 10-fold *if no response* by 2-4h.
- Measure capillary glucose every 1-2 h; electrolytes (especially K⁺) every 4 hours for first 24 hours. Monitor blood pressure, pulse, respiration, mental status, fluid intake and output every 1-4 hours.
- Replace K⁺: 10 mmol/h when plasma K⁺ < 5.5 mmol/l, 40-80 mmol/h when plasma K⁺ < 3.5 mmol/l.
- Goal of treatment is blood glucose level of 8-10 mmol/l. Administer intermediate or long-acting insulin as soon as patient is eating

HYPOGLYCAEMIA

Hypoglycaemia happens from time to time in diabetics. Hypoglycaemia can happen even during those times when patients are doing their best to control their diabetes. Factors that commonly precipitate hypoglycaemia are summarised in **table IV**. Daytime episodes of hypoglycaemia are often recognised by autonomic symptoms. Hypoglycaemia during the night may produce no symptoms or cause night sweats, unpleasant dreams and early morning headache. As diabetes progresses, particularly with development of neuropathy, autonomic symptoms may become blunted and lose their effectiveness as warning signals. Consequently CNS symptoms may predominate. It is often dubbed *hypoglycaemia unawareness*. Part of keeping diabetes in control is testing blood glucose often. Patient should be advised to test his/her blood whenever an insulin reaction seems to be coming on. As soon as hypoglycaemia is detected after the test, it should be treated quickly. When a test cannot be done but the patient feels a reaction coming on it's best to treat the reaction rather than wait. Remember this simple rule: *When in doubt, treat hypoglycaemia because a little more blood sugar for a brief period is better than low blood sugar.*

How to treat hypoglycaemia?

Patients should be educated that the

Table IV: Common causes of hypoglycaemia

- Meals or snacks that are too small, delayed, or skipped.
- Excessive doses of insulin or some diabetes medications, (including , alpha-glucosidase inhibitors, biguanides, and thiazolidinediones which normally do not cause hypoglycaemia if used alone).
- Increased activity or exercise
- Excessive drinking of alcohol.

Other causes :

- Some illnesses that affect the liver, heart, or kidneys can cause hypoglycaemia. Sepsis (overwhelming infection) and starvation are other causes of hypoglycaemia. In these cases, treatment targets the underlying cause.
- Hormonal deficiencies may cause hypoglycaemia in very young children, but usually not in adults. Shortages of cortisol, growth hormone, glucagon, or epinephrine can lead to fasting hypoglycaemia. Laboratory tests for hormone levels will determine a diagnosis and treatment. Hormone replacement therapy may be advised. Insulinomas, insulin-producing tumours, can cause hypoglycaemia by raising insulin levels too high in relation to blood glucose level. These tumours are very rare and do not normally spread to other parts of the body. Laboratory tests can pinpoint the exact cause. Treatment involves both short-term steps to correct the hypoglycaemia and medical or surgical measures to remove the tumour.

quickest way to raise blood sugar is with some form of sugar, such as three glucose tablets, half cup of fruit juice, or 5-6 pieces of hard candy. A soft drink,

banana or chocolate is an alternative. Wait for 15-20 minutes and repeat the treatment if symptoms persist. Patients with hypoglycaemic coma will need 50% Dextrose 20-40 ml intravenously.

DIABETIC COMPLICATIONS

All diabetic may some day face diabetic complications. Over time, diabetes can cause changes in blood vessels or nerves. Large blood vessels may become narrow. When blood flow is slowed, there is a risk of heart disease, stroke, or gangrene. Small blood vessels often get damaged, too. Damage to vessels in the eyes (retinopathy) can threaten vision and may lead to blindness. Microvascular changes in the kidney may also cause damage, leading to nephropathy.⁶ Neuropathy is another common complication of diabetes. It can also impair the function of internal organs such as the stomach, intestines, and bladder. There now is firm evidence that many of the complications associated

GIVEAWAY

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with long-standing diabetes are related to hyperglycaemia *per se*. The DCCT study unequivocally links glycaemic control with microvascular complications. What are less clear are the mechanisms responsible for hyperglycaemia-induced changes in major blood vessels (macrovascular disease), nerves (neuropathy), and other tissues. The importance of identifying the biochemical mechanisms responsible for these changes is critically important.⁷

Warning signs

Some complications, such as kidney disease, do not cause symptoms early on. But they can be detected through special screening tests. You should get alarmed when your patient tells you about one or more of the following warning signs. And of course they should be advised to bring to your notice any changes in their health, e.g. blurry or spotty vision, fatigue, numbness or tingling in hands or feet, chest pain and infections that occur often or cuts that heal slowly. New treatments exist for the complications, e.g. laser surgery for retinopathy, and kidney transplantation for kidney disease.

NUTRITION FOR DIABETICS

A well balanced eating plan is cornerstone of good blood glucose control in any type of diabetes. The so-called "diabetic diet" is not any special diet but healthy diet which the whole family can easily adopt. Follow the food pyramid, which consists of more starches, moderate protein and less fat. The plate model is equally good in general practice and can easily be modified to suit individual taste and eating habits. Patients can be advised to divide their plates as follows:

- 2/5 of plate to be filled with starchy foods like rice, pasta, potatoes, mealies, etc.
- 2/5 of plate to be filled with fruits and vegetables, and
- 1/5 of plate should have meat, fish and chicken, etc.

Some general tips, which are easy to follow in practice, include the following:

- Try to eat a variety of food.
- Cut down on fat. Use as little fat as possible in cooking – grilling, baking, boiling or steaming are preferred cooking methods.
- Eat less or avoid refined food and sugars.
- Eat less salt. Cook with herbs, spices or lemon juice for flavour rather than salt. Don't add salt to food at the table.
- Limit alcohol intake.
- Have three small meals each day rather than one or two big meals.
- Don't skip a meal.
- Eat at approximately the same time each day.

ROLE OF EXERCISE

Physical exercise is an integral component of diabetes care that can have multiple positive benefits. Exercise is helpful in reducing blood glucose and increasing sensitivity to insulin. Despite the benefits, exercise presents several challenges for individuals with type 1 diabetes. They are prone to hypoglycaemia or hyperglycaemia during exercise depending on pre exercise plasma glucose, circulating insulin, and exercise-induced release of catecholamines. Therefore these patients should be advised to check blood glucose before, during and after exercise. Exercise should be delayed if blood glucose is more than 14 mmol/l or if ketones are present. Before vigorous exercise they should take a small meal and supplemental carbohydrate feeding every 30 minutes.

CONCLUSION

Sometimes, no matter how hard you work with your patients, complications cannot be prevented or treated. Patients should be educated about complications and how to cope up with them. The following advice will suffice:

- Do not smoke.
- Keep your blood sugar levels as close to normal as possible.
- Have a healthy, balanced meal plan.
- Exercise regularly (with your doctor's advice).
- See your doctor, dentist and eye doctor regularly, even if you feel great.

- Check your feet each day for small cuts or blisters. Your doctor should check your feet at least once a year – more often if you have foot problems.
- Keep your weight under control.
- Keep your blood pressure and blood fat levels within normal range. □

Please refer to the CPD questionnaire on page 61.

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