

MORE ABOUT...MANAGEMENT OF DIABETES MELLITUS

HYPERGLYCAEMIC DIABETIC EMERGENCIES

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Diabetic ketoacidosis (DKA) and hyperosmolar non-ketotic coma (HONKC) are serious metabolic emergencies that affect type 1 and type 2 diabetic patients. Serious and potentially fatal complications of diabetes can be reduced by having a high index of suspicion in emergency settings, by recognising metabolic deterioration and precipitating causes earlier, and by optimising accessibility to treatment.

Diabetic ketoacidosis (DKA)

Pathophysiology

The therapeutic approach is defined by the following major abnormalities:

- **Hyperglycaemia** (glucose > 13 mmol/l) caused by insufficient insulin, effects of glucagon and catecholamines (gluconeogenesis).
- **Dehydration** caused by hyperglycaemia.
- **Ketoacidosis** (pH < 7.3; urine ketones > 1+). Because of inadequate glucose the body metabolises existing lipids (fat stores), which form free fatty acids and acetoacetic acid, which in turn is converted to ketones.
- **Hypokalaemia** caused by total potassium loss due to diuresis, and intracellular shift of potassium during DKA treatment and correction of acidosis.

Causes

Although DKA usually develops in patients with insulin-dependent diabe-

tes, it can be the initial presentation in a person with undiagnosed diabetes.

Risk factors/precipitating factors

These can be remembered by the mnemonic of the 6 Is (adapted from ACLS).

- **Infection:** most commonly pneumonia and urinary tract infection.
- **Ignorance:** poor understanding of diabetes, non-compliance and omission of insulin therapy.
- **Infarction:** brain, stroke syndromes.
- **Ischaemia:** acute myocardial infarction.
- **Intoxication:** excessive alcohol consumption and high doses of corticosteroids.
- **Implantation:** gestational diabetes.

Clinical presentation

Presentation can be very nonspecific, but typical symptoms are nausea, vomiting, and vague abdominal pain. Additional symptoms include visual disturbances, leg cramps and symptoms of the precipitating illness. Clinical findings are Kussmaul's respiration, hypothermia, even in the presence of infection, and abdominal guarding in severe ketoacidosis. The level of consciousness varies, with only 10% presenting with coma.

Diagnosis

The diagnosis is made on the clinical presentation, a high index of suspicion, as well as:

- glucose > 13 mmol/l
- arterial pH < 7.3
- urine ketones > 1+.

Common complications

- Hypoglycaemia, hypokalaemia, hypomagnesaemia, hypophosphataemia.
- Gastric dilatation with/without haemorrhage.

- Thrombosis/deep venous thrombosis.

Rare but important complications

- Mucormycosis.
- Adult respiratory distress syndrome.
- Myocardial infarction.
- Cerebral oedema.

Management

DKA is a life-threatening condition and the health care provider must be able to recognise and treat it effectively. Delay in diagnosis and inadequate management in the first few hours after presentation may markedly influence morbidity and mortality. One should make an early and a presumptive diagnosis of DKA based on the typical clinical presentation and test strip values.

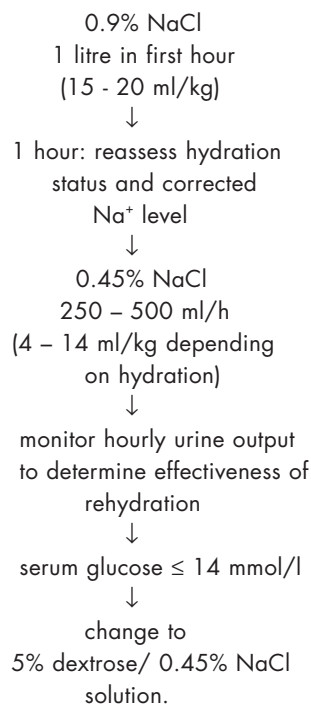
Initial emergency care

- Airway patency and breathing effectiveness (intubation may be necessary in hypoventilation).
- Circulation (dehydration and hypovolaemia).
- Diagnosis: 12-lead ECG, serum electrolytes, arterial blood gas and urinalysis.
- Assess vital signs – temperature, blood pressure, heart rate and rhythm, respirations (rate and pattern), and oxygen saturation.
- Provide oxygen, start intravenous fluids and attach cardiac monitor.

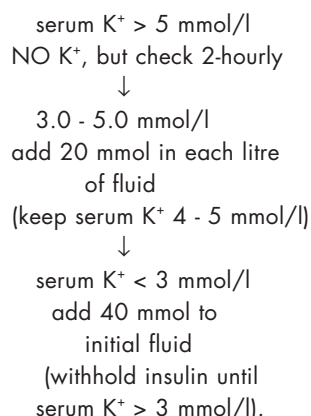
Specific therapy in the following order of priority (algorithm adapted from The Pretoria Approach, 2004):

1. Correct the dehydration.
2. Correct the hypokalaemia.
3. Correct the hyperglycaemia.
4. Correct the ketoacidosis.

1. Correct the dehydration

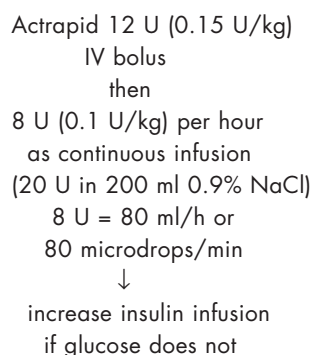


2. Correct the hypokalaemia



Potassium depletion and the intracellular shift of potassium in correction of acidosis should be anticipated and intravenous potassium therapy should be started early.

3. Treat the hyperglycaemia



decrease by at least 5 mmol/h (or 10% per hour) (if serum glucose is corrected too fast, there is an increased risk of cerebral oedema).

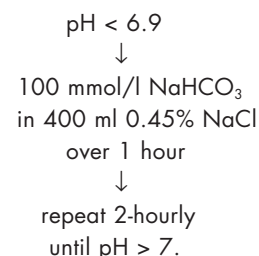
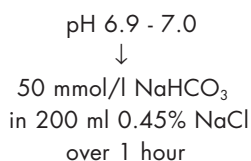
Once insulin therapy begins, further ketone formation should cease, the anion gap should lessen, and bicarbonate should increase.

DKA is resolved when:

- glucose < 11 mmol/l
- serum bicarbonate ≥ 18 mmol/l
- venous pH > 7.3.

4. Correct the ketoacidosis

ONLY give bicarbonate in DKA if:



Remember to take above fluid volume into account when determining the amount of intravenous fluids needed.

The use of bicarbonate in DKA has potentially harmful and beneficial effects.

Harmful:

- possible hypokalaemia and arrhythmia
- cerebral oedema and intracerebral acidosis
- increased serum osmolality.

Beneficial:

- reduced cardiac irritability
- reduced respiratory discomfort
- reduced intravenous chloride load.

Other important aspects to remember:

- urine microscopy, culture and sensitivity

- blood cultures if pyrexial
- chest X-ray
- subcutaneous heparin if comatose, obese or HONKC
- nasogastric tube if comatose
- urinary catheter
- oxygen if PO₂ < 80 mmHg
- central venous pressure line if
 - > 65 years
 - underlying cardiovascular disease
 - hypotension
- adequate treatment of the underlying disease
- glucose monitoring flow chart
 - hourly until glucose ≤ 14 mmol/l, then
 - 2-hourly
 - 4-hourly for at least the first 12 hours.

Hyperosmolar non-ketotic coma (HONKC)

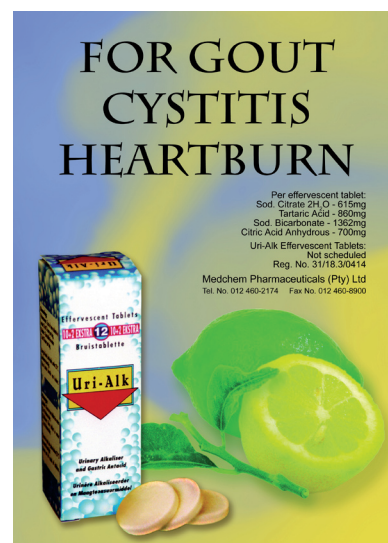
This is a life-threatening acid-base abnormality that occurs almost exclusively in type 2 diabetic patients. It is characterised by hyperglycaemia and high plasma osmolality. Ketones are absent or less marked, because residual insulin secretion effectively inhibits the breakdown of lipids and ketogenesis. Onset is gradual and precipitants are usually underlying infections.

Diagnosis

- Glucose ≥ 33 mmol/l.
- Arterial pH ≥ 7.3.
- Osmolality ≤ 320 mOsm/kg estimated as 2 × ([Na] + [K]) + [glucose].

Treatment is essentially the same as for DKA but use 0.45% NaCl as initial replacement fluid if serum Na ≥ 155 mmol/l.

Insulin therapy is initially 6 U/h, but with volume replacement serum glucose levels fall rapidly, and after recovery not all patients require insulin treatment.



Conclusion

The main objective for every health care provider should be to prevent these hyperglycaemic emergencies by screening for diabetes and monitoring known patients at regular follow-up visits.

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MANAGEMENT OF THE CONTROLLED DIABETIC AT PRIMARY HEALTH CARE LEVEL

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The Dr George Mukhari Hospital has to be reduced to a 700-bed facility as a directive from the provincial government, which emphasises the need for the family medicine or tertiary wing of the hospital to develop fully. To care for a patient at a level 2 or 3 bed is much more expensive than to care for the same patient at a level 1 facility. This implies that patients who have been seen by physicians at the medical outpatient department are now routed to the family practice, which is manned by level 1 doctors or family physicians. The latter then liaise with the peripheral clinics to continue follow-up on chronic conditions such as diabetes mellitus, hypertension, arthritis and HIV/AIDS-related chronic conditions, and with the local hospices to continue with care of patients.

The challenge that a family physician faces at a diabetic clinic is that sometimes there are no symptoms to

suggest that a patient's blood glucose is raised unless and until a urine test is done, or a haemagglutinin test (HGT) using a glucometer prior to the consultation.

Diabetes mellitus is an important chronic condition that must be properly diagnosed, treated and followed up in order to prevent complications associated with it. It is a condition that can occur alone or in combination with other conditions such as hypertension and nephritic disease.

Unless the condition is managed adequately, the complications may be devastating, e.g. blindness or loss of a limb, especially in the diabetic foot. Health education is important in the management of diabetes at primary health level. Health promotion includes education on healthy eating, foot care weight control, on the importance of regular exercise, and regular eye check-ups.

At the Dr George Mukhari Hospital, diabetic patients who are not controlled are referred to the physicians. Once they are controlled, they are referred to level 1, or family practice for further control, and then back to their nearest clinic for further treatment.

Type 2 (adult-onset) diabetes is the commonest type of diabetes that we have to deal with in the diabetic clinic at primary care level.

Problems encountered at the diabetic clinic run on a medical outpatient basis include:

- The clinic is only open on Mondays and Thursdays.
- Patients come to the primary health clinic when the particular doctors in their allocated firms are absent, or when the medical outpatients department is closed.
- Most patients fail to come on the appointment days, so that they then are not seen.
- Lack of compliance – patients who feel well do not see the need to attend the clinic for follow-up because they have no warning signs.

- Some patients only present when they are in an emergency, e.g. diabetic ketoacidosis (DKA), or when they are hypoglycaemic.
- Patients need education about skin care, since wounds in diabetics do not heal easily.

Problems encountered by family physicians at diabetic clinics and at the level 1 wards include:

- Inadequate information that may assist the doctor to change (or add) from (to) oral to injection/insulin without having to admit the patient.
- For those patients who do not have glucometers it becomes difficult to know the pattern of control, especially those who occasionally become hypoglycaemic.
- While patients may be controlled in the hospital, it becomes difficult to control their blood glucose once they have been discharged.
- Some patients may not be able to follow a required diet for economic reasons.

What are the symptoms?

In practice some patients have their conditions diagnosed by accident. These are patients who present with an unrelated problem, and who have a urine check prior to the consultation with the doctor.

Usual complaints include polyuria, polydipsia, weight loss (type 2), tiredness and fatigue, and the propensity to develop infections, commonly *Candida* of the skin and genitals.

Men may have problems associated with loss of libido, which could be a source of frustration for both the patient as well as his wife. Unless the couple is well managed, and the glucose is well controlled, there is a possibility of problems in the marriage.

Health education

Educating the patients about diet and exercise is of vital importance. In the hospital setting it is easy to get the patient to see a dietician, but for those who are from poor communities, or for patients who are unemployed, the family physician in general practice may not have the luxury of

a dietician's service and may have to rely on his/her own knowledge of nutrition to promote control of diabetes and thus reduce associated cardiovascular risk factors.

All diabetics require a diet in which the intake of refined carbohydrate and fat is controlled. The objectives of the diet are to keep to ideal weight (neither fat nor thin), and to keep the blood sugar level as near normal as possible.

This is achieved by:

- eating good food regularly (not skimping)
- spacing the meals throughout the day (three main meals and three snacks) for many type 1 diabetics
- keeping fat intake to a minimum
- avoiding sugar and refined carbohydrates (e.g. sugar, jam, honey, chocolates, sweets, pastries, cakes, soft drinks)
- eating a balance of more complex carbohydrates (starchy foods such as wholemeal bread, potatoes and cereals)
- eating a good variety of fruit and vegetables
- cutting out alcohol or drinking only a little.

While it is important to advise patients to exercise regularly, how many find this to be practical? Taking exercise does not necessarily mean going to a gym, but includes brisk walking, and doing jobs that use various muscles and also take up some energy to perform. In fact some patients may get sufficient exercise running to catch a taxi or even walking up a flight of stairs at work, compared with those who are confined to sedentary office work and walk only short distances daily.

Evidence of the effects on exercise in diabetics is reflected in a randomised controlled trial of weight reduction and exercise for diabetes management in older African-American subjects ($N = 64$) done by Argurs-Collins *et al.*, who found that intervention with exercise improved the glycaemic and blood pressure control of diabetics. The study also showed a decrease in the HbA_{1c}

of modest changes in dietary intake, weight, and activity which reflected indirect programme effects on other aspects of self care.

Maintaining the body mass index within acceptable limits (< 25) is of vital importance.

Foot care

Patients who have not received good advice on foot care may pay a heavy price in losing a limb. Pathogenic factors that lead to the diabetic foot include: neuropathy, abnormal foot biomechanics, peripheral arterial disease, and poor wound healing. Because of loss of sensation due to microvascular pathophysiology of the disease, patients may suffer irreparable damage to their activities and may lose their economic independence. Pressure sores, calices, ill-fitting foot wear, manner of cutting nails, and prevention of fungal infections are among other important considerations for diabetic patients.

Foot examination of a diabetic patient includes checking the arterial blood supply by checking for the dorsalis pedis and the posterior tibialis arteries. Examine skin changes as early signs of gangrene may be detected. Loss of hair is a good indication of impending gangrene. At times patients may not be bothered by a small ulcer on the foot; the physician must take this as a serious indicator of problems to come, especially if the wound becomes infected by *Candida*. Early intervention leads to good management of resources because one may avoid later use of expensive drugs as well as loss of valuable economic time for the patient.

Importance of regular check-ups

Primary health facilities for check-ups include clinics, health centres, hospital outpatient departments and doctors' consulting rooms. Patients can also be taught how to measure their own blood glucose levels and monitor their condition by controlling their diet as well as by taking exercise.

It is important to keep a reliable record of daily glucose, especially important in patients who have a tendency of becoming uncontrolled with time, those who tend to become hypoglycaemic, or those who have developed complications.

During the check-up it is important to do some tests, including HbA_{1c}, lipid profiles, urea and electrolytes.

Insulin resistance syndrome

This syndrome is very common and can also be comparable with syndrome X. There is a constellation of derangements that include insulin resistance, hypertension, dyslipidaemia, central or visceral obesity, and cardiovascular disease.

Polycystic ovarian syndrome: insulin resistance occurs independent of the effects of obesity in this condition.

Importance of HbA_{1c} in primary care of diabetics

HbA_{1c} measures the amount of glycosylated haemoglobin in the patient's blood. The essence of the test is that it gives a good estimate of how well diabetes is managed over time.

The normal HbA_{1c} value is 5% or less, and the ranges may vary from one laboratory to the other. In general, the higher the HbA_{1c} value, the higher the risk of problems such as eye disease, kidney disease, nerve damage, heart disease, and stroke. This is especially true if the HbA_{1c} remains elevated on more than one occasion.

Regular check-ups reduce the chances of these complications.

Complications that ought to be prevented

A patient who has developed complications, after being managed by a specialist, ends up in the hands of the family physician to maintain normal blood glucose and to prevent further complications. This implies that the presence of complications or uncontrolled diabetes does not remove a family physician's responsibility of caring for the patient.

Diabetic retinopathy is frequently detected during routine screening of a known diabetic before the onset of symptoms. This necessitates competence on the part of the physician to detect vitreous haemorrhages and also to detect exudates that present as cotton-wool spots. All diabetics should undergo a fundus examination at least once a year. The examination includes direct ophthalmoscopy, indirect fundoscopy using slit lamp microscope and fundus photography. To prevent diabetic retinopathy, a patient should be screened, have optimal control of hyperglycaemia, hypertension and hypercholesterolaemia, and stop smoking.

Another complication relating to the eyes, commonly found in the elderly, are cataracts. A family physician can detect these early by the absence of a 'red reflex' when doing fundoscopy.

During regular check-up of patients, the doctor has to prompt some questions relating to complications as the patient may not attach much significance to these changes:

- Eye examination at least annually results in early intervention by the relevant specialty.
- Care of the feet prevents possible amputations.
- Loss of libido is a concern in many diabetics and can lead to marital problems – a good family physician should be able to identify this problem with the aid of a few questions.

Principles of family medicine in controlled diabetics

A family physician who is committed to a patient as a person will be able to satisfy the needs and expectations of that patient to a great extent.

As mentioned above, a family physician has to be involved in prevention of complications and promotion of health. While a controlled diabetic may develop some complications, health education may reduce the chances of further complications.

In order to prevent complications, a family physician has to make use of or manage resources such as referral to an ophthalmologist early, involve dieticians if available and also social workers, as some of the patients may already have debilitating features that may render them economically disadvantaged.

Ideally, the family physician has to share the same social background as patients. In African communities, the AIDS pandemic has made people very suspicious of a person losing weight. A family physician who has an opportunity of attending community meetings or who addresses people on health matters and is asked questions would know why some people think it is better to die from unnatural causes than to have a disease that results in weight loss. A family physician who then advises on weight reduction must see non-compliance in this context, and address patients' feelings, fears and concerns.

While education of patients is vital, physician education concerning the care of diabetics is equally important, as evidenced by a study conducted at Kalafong Hospital tertiary diabetic clinics on the quality of services rendered by physicians who offered structured care to patients. Important findings significant for this paper are that with proper physician training in the tertiary diabetic clinics, more patients underwent foot examination, eye examination, tests for microalbuminuria, HbA_{1c}, lipid profile, and dietician visits.

Risk factors in diabetics

A family history of diabetes, obesity and hypertension are the most important risk factors in diabetes mellitus.

Race/ethnicity – HDL cholesterol levels < 35 mg/dl and triglyceride levels > 250 mg/dl.

Syndrome X – the deadly quartet:

- upper truncal obesity
- dyslipidaemia – ↑ triglycerides, ↓ HDL cholesterol

- glucose intolerance, i.e. NIDDM
- hypertension.

Conclusion

Controlling diabetes mellitus means a significant change in a patient's lifestyle, involving the whole family as well as health professionals. Advising patients to lose weight should not be done without considering the stigma of HIV-associated weight loss. The patient's concerns, feelings and fears must be taken into consideration. With poverty and socioeconomic problems, it may be difficult to achieve what is ideal in terms of diet and exercise. However, attempts must be optimally utilised to substitute what is available – the family physician must know what basic advice to give to the patient and should assist the patient to obtain government grants, where applicable.

Prevention of complications plays an important part in the care of controlled diabetics, especially eyes and care of the feet.

Further reading

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