

INTRODUCTION

A non-diabetic individual maintains their blood glucose level within a narrow range from 3.0 to 5.6mmol per litre. This is achieved by a balance between glucose entering the blood stream (from the GI tract or from the breakdown of stored energy sources) and glucose leaving the circulation through the action of insulin.

HYPOGLYCAEMIA

A low blood glucose level is defined as <4.0mmol/L, but it must be remembered that the clinical features of hypoglycaemia may be present at higher levels. Clinical judgement is as important as a blood glucose reading. The reversal of hypoglycaemia is an important pre-hospital intervention. Hypoglycaemia if left untreated may lead to the patient suffering permanent brain damage and may even prove fatal.

HISTORY

Hypoglycaemia will occur when glucose metabolism is disturbed through:

- inadequate carbohydrate intake
- excessive physical activity
- insulin or other hypoglycaemic drug treatments.

Other factors, which should be considered, are:

- excessive or chronic alcohol intake may also precipitate hypoglycaemia.

Any person whose level of consciousness is reduced or who is having a seizure should have hypoglycaemia excluded.

SIGNS AND SYMPTOMS

These can vary from patient to patient. Some patients are able to detect the early symptoms for themselves, but others may deteriorate rapidly and without apparent warning. Common symptoms include:

- confusion
- headache
- drowsiness
- aggression
- sweating
- fitting
- unconsciousness

- abnormal neurological features may occur. These can include a one-sided weakness, identical to a stroke.

Symptoms may be masked due to medication or other injuries, for example, with beta-blocking agents.

ASSESSMENT AND MANAGEMENT OF HYPOGLYCAEMIA

Follow medical emergencies guideline, remembering to:

Assess and start correcting:

- **AIRWAY**
- **BREATHING**
- **CIRCULATION**
- **DISABILITY** (mini neurological examination)

Consider and look for patient history signs (medical alert bracelets, chains and cards)

Obtain and record blood glucose levels **pre** and **post** treatment.

Specifically consider:

- where the patient is conscious, oral glucose (sugary drink, chocolate bar/biscuit or **glucose gel**) may be given until the glucose level has improved to at least 5.0mmol/L
- where the patient has impaired consciousness, is uncooperative or there is a risk of aspiration or choking, administer IV glucose 10% (**refer to glucose 10% protocol for dosage and information**) by slow IV infusion. **In all cases, administration of IV glucose should be titrated against effect. Re-check blood glucose after 10 minutes to ensure that it has improved to a level of at least 5.0mmol/L, in conjunction with an improvement in level of consciousness.** An improvement in the patient's condition should be seen almost immediately, as the effects of glucose IV are very rapid. **A further dose of glucose IV may be required**
- if IV glucose cannot be administered, glucagon (**refer to glucagon protocol for dosage and information**) may be given via the IM route. It may take 5-10 minutes for glucagon to begin to work and it requires the patient to have adequate glycogen stores. Thus, it may be ineffective in intoxicated, alcoholic, anorexic patients or non-diabetic patients regardless of age.

Once patients are alert and able to swallow, they should be given a drink containing glucose and a carbohydrate food.

Glycaemic Emergencies in Adults

If no improvement is seen after a further 5-10 minutes, **immediately transfer to the nearest suitable receiving hospital.**

Provide a hospital alert message/ information call. Continue patient management en-route.

It may be appropriate to leave certain categories of patients at home with advice to take further food by mouth. This includes diabetic patients who are **fully recovered** after being treated with 10% glucose IV and have a blood glucose of $> 5.0\text{mmol/L}$, **and are in the care of a responsible adult.** They must also be advised to call for help if any symptoms of hypoglycaemia recur. *Ambulance Services may arrange locally for a message to be forwarded to the local diabetic nurse/ primary health care team.*

All other patients who have been hypoglycaemic and have received treatment should be encouraged to attend hospital, especially if they:

- are elderly
- **are taking oral hypoglycaemic agents, as hypoglycaemia may recur**
- have no history of previous diabetes and have suffered their first hypoglycaemic episode
- have a blood glucose level $< 5.0\text{mmol/L}$ after treatment
- have not returned to normal mental status within 10 minutes of IV glucose
- have been treated with glucagon
- have any additional disorders or other complicating factors, e.g. renal dialysis, chest pain, cardiac arrhythmias, alcohol consumption, dyspnoea, seizures or focal neurological signs / symptoms
- signs of infection (urinary tract infection, upper respiratory tract infections) and/or unwell (flu-like symptoms).

HYPERGLYCAEMIA

Hyperglycaemia is the term used to describe high blood glucose levels. Symptoms include thirst, urinary frequency and tiredness. Symptoms are usually of slow onset.

Diabetic ketoacidosis (DKA)

A relative lack of circulating insulin means that cells cannot take up glucose from the blood and use it to provide energy. This forces the cells to provide energy for metabolism from other sources such as fatty acids.

This produces acidosis and ketones. The body tries to combat this metabolic acidosis by hyperventilation to blow off carbon dioxide. High blood glucose level means glucose spills over into the urine dragging water and electrolytes with it causing dehydration and glycosuria.

History

The history, particularly the presence of polydipsia (thirst) and polyuria should alert the pre-hospital provider to the possibility of hyperglycaemia and DKA.

New onset diabetes may present with DKA. More frequently it complicates intercurrent illness in a known diabetic. Infections, myocardial infarction (which may be silent) or a CVA may precipitate the condition. Omissions or inadequate dosage of insulin or other hypoglycaemic therapy may also contribute or be responsible. Some medications, particularly steroids may greatly exacerbate the situation.

Signs and symptoms:

One or more of the following may be present:

Symptoms:

- increased urinary output
- increased thirst
- increased appetite.

Signs:

- fruity odour of ketones on the breath (a smell resembling nail varnish remover). Not everyone can detect this odour
- lethargy, confusion and ultimately unconsciousness
- dehydration, dry mouth and possibly circulatory failure due to hypovolaemia
- hyperventilation
- deep sighing respirations (Kussmaul breathing)
- weight loss.

ASSESSMENT

Assess **ABCD's**

Assess blood glucose level.

Assess dehydration; if the skin of the forearm is raised in a gentle pinch it remains tented, only returning to its normal position slowly. The patient's mouth will be dry. In severe cases this may lead to hypovolaemic shock.

MANAGEMENT OF HYPERGLYCAEMIA

Follow medical emergencies guideline, remembering to:

- administer high concentration oxygen (O₂) via a non-re-breathing mask, using the stoma in laryngectomy and other neck breathing patients, to ensure an oxygen saturation (SpO₂) of >95%, except in patients with Chronic Obstructive Pulmonary Disease (COPD) (**refer to COPD guideline**)
- measure blood glucose level
- undertake ECG.

If time critical, correct life threatening conditions (airway and breathing) on scene then commence transfer to nearest suitable receiving hospital. These patients have a potentially life-threatening condition and they require urgent hospital treatment including insulin and fluid/ electrolyte therapy.

If the patient is shocked, with poor capillary refill, tachycardia, reduced Glasgow Coma Score (GCS) and hypotension, then consider IV access and commence fluid therapy en-route if time permits.

Fluid therapy

Diabetic patients may present with significant dehydration resulting in reduced fluid in both the vascular and tissue compartments. Often this has taken time to develop and will take time to correct. Rapid fluid replacement into the vascular compartment can compromise the cardiovascular system particularly where there is pre-existing cardiovascular disease and in the elderly. Gradual rehydration over hours rather than minutes is indicated.

Central pulse ABSENT, radial pulse ABSENT is an **absolute indication for urgent fluid**.

Central pulse PRESENT, radial pulse ABSENT is a relative indication for urgent fluid depending on other indications including tissue perfusion and blood loss.

Central pulse PRESENT, radial pulse PRESENT **DO NOT** commence fluid replacement² **unless there are other signs of poor central tissue perfusion (e.g. altered mental state, disturbed cardiac rhythm).** If the clinical conditions suggest that significant dehydration has occurred then commence 250ml bolus of crystalloid. Do not give more than one litre of fluid in the first hour, because of specific hazards in hyperglycaemia when electrolyte levels are not yet known.

Re-assess vital signs prior to further fluid administration.

DO NOT delay at scene for fluid replacement; wherever possible cannulate and give fluid **EN-ROUTE TO HOSPITAL**.

Provide a hospital pre-alert message/ information call according to local protocols.

Diabetic monitoring:

Diabetic patients may monitor their blood or urine glucose levels to assess control of their condition. These records provide a valuable source of information. The records should accompany the patient to hospital and should be handed to receiving staff. It is not unusual however, to attend a patient in whom diabetic monitoring is haphazard or omitted altogether.

Key Points – Glycaemic Emergencies

- Clean skin prior to obtaining blood glucose reading (using either soapy solution or an alcohol wipe, allowing the finger to dry).
- If blood glucose reading of <4.0mmol/l treat with oral solids (glucose drinks, chocolate or hypostop solutions) if GCS >13.
- If GCS 13 or less consider IM glucagon or 10% IV glucose 100ml bolus and review patient's condition, titrate to effect.
- Administer high concentration O₂ therapy.
- Consider fluid therapy to counteract the effects of dehydration.

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METHODOLOGY

Refer to methodology section; see below for glycaemic emergencies search strategy.

Glycaemic emergencies search strategy

Electronic databases searched:

- National library of medicine (Pubmed) – (2003-2005)
- Cochrane – (2003-2005)
- Prodigy – (2003-2005)
- CINAHL (Ovid) – (2003-2005)

Search strategy:

Pubmed: limits- English, Humans, 2003-2005 (undertaken Feb 2005)

#1 hypoglycaemia #2 pre-hospital OR pre-hospital #3 emergency AND treatment #4 refusal AND treatment #6 treatment refusal #7 glucagon #8 dextrose 10%.

#2 AND #8, #1 AND #8, #1 AND #8 AND #2, #1 AND #3 AND #8, #1 AND #2 AND #3 AND #6 AND #7, #1 AND #2 AND #3 AND #6, #2 AND #7, #1 AND #3, #1 AND #2 AND #3, #1 AND #6, #1 AND #2. Total= 41 articles, 8 articles considered relevant.

Pubmed: limits- English, Humans, 2003-2005 (undertaken Feb 2005)

#1 hyperglycaemia #2 pre-hospital OR pre-hospital #3 emergency AND treatment #4 treatment AND therapy #5 diabetic ketoacidosis #6 hyperosmolar hyperglycaemic state.

#1 AND #2, #1 AND #3, #1 AND #3 AND #4, #2 AND #5, #3 AND #5, #3 AND #6, #2 AND #6, #4 AND #6. Total= 35 articles, 8 articles considered relevant.

Cochrane: all sections, terms, words= 22 articles, non-relevant or duplicate.

CINAHL: Diabetic Ketoacidosis/ di, dt, ep, ss, th [diagnosis, drug therapy, epidemiology, symptoms, therapy] exp. Limit to 2003-2005. Total= 32 articles, 5 considered relevant.

Hypoglycaemia (limits as above)/dt, rf, th [dryg therapy, risk factors, therapy]. Total= 39 articles.

BMJ- 3 articles considered relevant.

New England Journal of Medicine- 1 article relevant.

NICE/ NeLH- 2 articles considered relevant.

Prodigy- Chlorpropamide, Glibenclamide- risk of hypoglycaemia in type 2 diabetics.

Taking into account duplication across the journals and databases, and duplication of articles already included in Version 3 JRCALC guidelines; a total of 8 articles covering hypo/hyperglycaemia were considered relevant to pre-hospital care.

Electronic journal search

New England Journal of Medicine (all available years)

BMJ (EMJ) (all available years)

Pediatrics

Hand journal search

New England Journal of Medicine (2003-2005)

Hand search reference lists

Additional sources searched:

Department of Health

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