

SECTION 4

Hospitalisation

People with diabetes can be admitted to hospital for a range of health problems. Sometimes the admission is related to the chronic complications of diabetes and sometimes the admission is not caused by diabetes. Examples of related conditions include coronary artery disease, cerebrovascular accident, renal disease, or vascular problems. Problems directly related to diabetes requiring hospitalisation include the acute complications; diabetic ketoacidosis, non-ketotic hyperosmolar collapse / illness and severe hypoglycaemia. Sometimes people are admitted for the initiation of insulin therapy in special situations, eg insulin pump insertion, continuous blood glucose monitoring. Whatever the reason for admission to hospital it is very important to manage blood glucose for the best outcomes possible.

Section 4 consists of the following topic areas:

1. Admission procedures.
2. Diabetes management principles.
3. Peri-operative care.
4. Management for radiological procedures.
5. Inpatient diabetes management guidelines (where diabetes is a co-morbidity not primary reason for admission).
6. Managing acute complications in hospital (hypoglycaemia, diabetic ketoacidosis and hyperglycaemic hyperosmolar state).
7. Insulin pump therapy.

You may like to refer to the glossary and list of abbreviations contained at the back of this section.

Admission procedure

The nursing assessment indicates the **reason for admission**, and should be clear if diabetes is the reason for the admission or a co-morbidity.

Type of diabetes should be documented as either:

- type 1
- type 2
- type 2 diabetes – insulin requiring.

Assessment

Confidentiality of information and the person's privacy must be maintained.

The interview process may be conducted formally or while admitting the person, ie during observations, ward orientation or physical assessment.

- Relevant medical history, including hypoglycaemia unawareness, foot problem.
- Physical assessment, comprehensive head to toe assessment.
- Patient education and assessment of knowledge, skills and attitude, and modification of self care action plans (Appendix 1).
- Discharge plan.

History – specific to diabetes

A comprehensive history provides health care providers with the information needed to provide adequate care and education. The Queen Elizabeth Hospital Assessment Standards have been used to underpin the following recommendations.¹

Specific symptoms:

- altered vision (blurring)
- polyuria
- polydipsia / dry mouth / fruity breath
- polyphagia / abdominal pain
- weight loss / weight gain
- nocturia / frequency / burning on micturition / thrush
- malaise / fatigue
- neuropathic sensations in feet (burning).

Diabetes history:

- family history of diabetes / cardiac history (elevated BP / lipids)
- duration and type of diabetes (self and family members)
- ethnic group
- obstetric history of large babies / gestational diabetes
- current glycaemic control and self-management
- diabetes education – knowledge / skills / attitude – prior learning
- recent surgery or glucocorticosteroids, recent illness.

Identifying risks:

- hypoglycaemia risk (also hypoglycaemia unawareness)
- smoking
- foot risk status
- hyperglycaemia
- hypertension
- hyperlipidaemia
- alcohol intake
- activity levels.

Attitudes / cultural beliefs / socialisation / literacy

- all people with diabetes should have an opportunity to discuss their self management issues with qualified health professionals.

Physical assessment

| | |
|-----------------------------|--|
| Weight (kg) and Height (m): | calculate body mass index which is weight in kilograms divided by height in metres squared. Healthy range is equal to or less than 25, suitable for use with both men and women from age 18 years onwards. ² |
| Waist | <94cm for men <80cm for women |
| Blood pressure | lying and standing |
| Eyes | visual aids used changes in vision noted by person date of last ophthalmological or optometry review |
| Feet | sensation and circulation (conduct a foot risk assessment) (see <i>Footcare</i> – Section 6). skin integrity interdigital problems (cracked or macerated skin) abnormal bone structure of feet date last seen by a podiatrist, if at all |
| Blood glucose | aim for fasting or pre-meal, if random test done note time of last meal |
| Urinalysis | microalbumin ketones nitrites and / or cells / leucocytes glucose |

Self care

- Medications.
- Self administration of insulin.
- Hypoglycaemia action plan.
- Foot care.
- Sick day action plan.

Education (see *Diabetes education* – Section 3 and Appendix 1)

- Health maintenance knowledge deficits.
- Emergency care.
- Medication therapy.
- Impending procedures / surgery.

Negotiate a management and education plan to address the identified needs with the individual, listing objectives and expected outcomes.

Referral options

- Diabetes educator.
- Dietitian.
- Or other relevant health professionals as deemed necessary, eg social worker, psychologist, podiatrist, vascular nurse, eye department, aboriginal health worker.

Discharge planning

A planned discharge is vital. This should **begin on admission to hospital**. Appropriate information for long term care should be supplied to the person with diabetes and to family members. This will assist the person and family to continue self-management after discharge.

Ensure the person is registered with the National Diabetes Services Scheme and has adequate supplies of:

- syringes / pen needles
- monitoring equipment
- medication
- ensure a plan for access to supplies over public holidays and weekend breaks.

Ensure the person is aware of resources for ongoing supplies, eg Diabetes Australia, National Diabetes Services Scheme (see *Resources* – Section 15).

Ensure appropriate outpatient appointments have been made, eg doctor, dietitian, diabetes educator, podiatrist, ophthalmologist / optometrist.

Assess the ability of the person with diabetes and the family to cope at home and within the community.

Is there a need for extra involvement of family or of community resources?

Are they aware of their long term medical needs, monitoring and liaison with their local doctor?

Ensure the person is aware of the role of their local doctor. The general practitioner is often the principal medical professional, in other instances there may be a 'shared-care' arrangement between specialist, general practitioner and diabetes educator.

Regular follow up visits are encouraged and offer a great opportunity for the general practitioner to get to know the person and explore the person's understanding, fears and concerns about diabetes.

Ensure the person is aware of where to seek assistance / advice for problems and emergency treatment.

Diabetes management principles

This section has been designed to provide information about the diabetes management of patients where diabetes mellitus is a co-morbidity and **not** the primary reason for admission. For information about acute complications of diabetes see page 18 of this section.

General management principles include:

- Blood glucose levels as close to normal as possible improves in-hospital morbidity and mortality rates. Aim for target blood glucose levels (BGL) 5.0 - 10.0mmol/L.³
- Never stop insulin in type 1 diabetes.
- Avoid routine use of sliding scale insulin - this destabilises diabetes in most patients. Sliding scale insulin should only be used for patients who are fasting and in limited circumstances.⁴
- Insulin regimens should target prospective / anticipated blood glucose levels rather than react retrospectively to previous BGLs.⁴
- Avoid random use of short acting insulin in response to a single elevated BGL unless patient is symptomatic, especially overnight. It is better to adjust the overall regimen to prevent further rises in BGL values.⁴
- Adjust insulin daily to meet target BGL.
- If at any stage diabetes management is unclear or targets are not being met contact general practitioner or diabetes specialist (eg endocrinologist) if appropriate.⁴

Improving glycaemic control

Oral hypoglycaemic agents (OHA) (see table 1; page 15)

- Oral hypoglycaemic agents which are started or increased during hospitalisation generally do not act quickly enough to control hyperglycaemia.
- Inpatients who have adequate diabetes control and there are no contraindications (eg patient is not acutely sick or renal impairment) OHAs can continue to be used.

Subcutaneous insulin

- Supplementary basal insulin (see table 2; page 15).
- Basal / bolus intensive insulin regimen (see table 3; page 16).
- Changing usual insulin regimen (see table 4; page 17).
- Sliding scale insulin for patients who are fasting (see table 5; page 17).

Intravenous insulin / glucose infusion

In many cases, an intravenous insulin / glucose infusion would be used if patient requires insulin and is fasted for a prolonged period of time (more than 6 hours) or patient is very unstable. An insulin / glucose infusion protocol must be followed. Examples and advice around the use of these protocols can be accessed from hospitals such as the Royal Adelaide Hospital (RAH), Lyell McEwin Hospital (LMH) and Flinders Medical Centre (FMC).

Monitoring

Blood glucose

- As a general guide BGL's should be checked pre-meal (within 30 minutes pre-meal) and 2100 hours for all patients who are not on IV insulin (0200 BGL should be measured only if overnight hypoglycaemia is suspected).⁴
- The frequency for monitoring BGL needs to be assessed regularly and any changes documented. If not requiring adjustment to OHAs or insulin therapy **and** BGLs in target for 24 hours consider reducing the number of BG tests per day. If fasting BGL is out of target do more testing that day.
- Notify GP / MO if BGL is greater than 15mmol/L on 2 consecutive readings or any BGL greater than 20mmol/L.⁵ (Refer to *Unstable diabetes* – Section 11 for further information about hyperglycaemia).

Ketones

- Check for urinary or blood ketones in patients who are on insulin if BGL persistently >15mmol/L or if the patient is very ill.⁴
- If urine ketone levels 3+ or blood ketone levels are above 1.5 or ketoacidosis suspected, contact the GP / MO or diabetes specialist (eg endocrinologist) immediately.⁴

Special circumstances

Enteral or parenteral nutrition

Patients with diabetes who are commenced on enteral or parenteral nutrition may need significant adjustments to the type, doses and / or timing of their diabetes treatment.

- GP / MO to assess the most appropriate treatment regimen, preferably at the commencement of enteral / parenteral feeding.
- Monitor BGLs 4 times per day – more frequently if appropriate.
- Remember to recommence an appropriate insulin / medication regimen when the feeds are ceased and regular oral intake resumes.⁴

Patients on glucocorticoids

- Patients with diabetes who are commenced on prednisolone, dexamethasone or other glucocorticoids will experience elevated BGLs.
- BGLs should be monitored 4 times per day and diabetes treatment intensified to keep BGL in target.
- Remember to adjust diabetes treatment downwards as dose of steroids are reduced and ceased.⁴

Peri-operative care

Optimal blood glucose levels prior, during and after surgery will assist with wound healing, reduce the risk of post-operative complications and shorten hospitalisation period. Surgery tends to cause an increase in blood glucose levels. Therefore, an increase in oral hypoglycaemic doses or insulin may be required for an extended period eg while the person is under stress and relatively inactive post-operatively.

Pre-op care

Admission the day before surgery may be advisable to thoroughly assess and establish monitoring and treatment plans in a person who:

- has type 1 (or type 2 diabetes, insulin requiring)
- is not well controlled
- is having major surgery and / or is likely to have nothing by mouth for a prolonged period pre or post-operatively.

It is important that an anaesthetist be consulted as part of the patients pre-anaesthetic work-up or that the patient's management is discussed with the anaesthetist. Advice regarding insulin regimens can be obtained by contacting an endocrinologist if necessary (eg by phone if not available in person).

People with type 2 diabetes and on Metformin should have their Metformin ceased 48 hours prior to surgery. Sulphonylureas will need to be withheld on the day of surgery (long acting sulphonylureas such as Glibenclamide may need previous night's dose withheld).

Management is determined by the results of blood glucose monitoring, and whether the person is eating or not.

* **ALL** people with diabetes should have their blood glucose level checked within 1 hour prior to going to theatre. Report to the anaesthetist if the level is <5mmol/L or >10mmol/L.

People with type 1 diabetes are particularly at risk from ketosis. Notify GP / MO if ketones are present in blood or urine.

Before giving insulin to a person who is fasting make sure there is an IV glucose infusion in place running at an appropriate rate.

Intra-op care

- The type of IV fluid given will depend on whether the person is receiving insulin or not. Glucose infusion must be used if patient has received insulin prior to or during surgery.
- Monitor BGL at least 2 hourly (1 hourly if IV insulin / glucose infusion *in situ*).

Post-op care

Check blood glucose on arrival in recovery:

- then 4-6 hourly (or 1 hourly for continuous insulin / glucose infusion) for 24 hours or until stable and eating
- then before meals.

All people with type 1 diabetes require a check for ketones:

- at least 8 hourly
- more frequently if blood glucose $>15\text{mmol/L}$, if the person is vomiting or is generally unwell.

Before discharge, the person should be advised that their medication dosages should return to pre-operative doses as they recover and become more active.

Recommence anticipated discharge regimen for at least 24 hours prior to discharge.

Management for radiological procedures

To minimise problems all people with diabetes should be booked into the **earliest possible appointment time**.

The Radiology Department should be informed that the person has diabetes and of their current medication.

Ensure the GP / MO has discussed the procedure with the person and obtained consent (if applicable). Medication orders may be modified according to the type of diabetes and medication, and the type and time of procedure. Reduction in dosages requires discussion with the GP / MO and the person with diabetes.

Well controlled by diet or oral hypoglycaemic agents

The person should omit the morning dose of tablets if fasting is necessary.

Note: Metformin should be stopped 48 hours prior to preparation and ensure serum creatinine level assessed before restarting Metformin.

Receiving insulin

If fasting, as per inpatient guidelines. **Individual advice is essential based on type of diabetes and insulin schedules.**

Precautionary measures

Blood glucose monitoring equipment should be accessible for use by an accredited nurse in the Radiology Department.

Blood glucose should be checked before, during and after the procedure, if the person feels unwell or complains of hypoglycaemic symptoms.

All people with diabetes should bring the following to the Radiology Department as a precaution:

- quick carbohydrate eg sugar containing soft drink, glucose tablets - in case of a hypoglycaemic episode
- Radiology Department should have a hypoglycaemia protocol, hypoglycaemia kit and blood glucose meter on the emergency trolley for treatment of hypoglycaemia.

Special precautions may be necessary for people having any radio contrast study (even using low ionic agents). This includes angiography, CT scan with enhancement intravenous pyelography.

Those at special risk of problems include those with:

- **impaired renal function** – creatinine clearance less than 30ml per minute.
In elderly people glomerular filtration rate (GFR) may be significantly reduced in the presence of a marginally increased or normal plasma creatinine.
- **dehydration or effective reduction in blood volume**
For example, people with congestive cardiac failure, hypotension, septic shock or intensive diuretic therapy.
- **other nephrotoxic drugs or concomitant medications that may contribute to decreasing GFR**
This includes medications such as gentamicin, diuretics, angioconverting enzyme inhibitors, angiotensin II receptor antagonists, non-steroidal anti-inflammatory medications, cyclo-oxygenase 2 inhibitors, cyclosporin, vancomycin, tacrolimus, amphotericin and others.

If radio contrast studies are necessary, the following precautions should be considered by the GP / MO:

- stopping other medications several days before the procedure (eg diuretics, non-steroidal anti-inflammatory drugs)
- hydration before, during and after the procedure using intravenous saline.

After the procedure

Once eating / drinking, recommence medications (except for Metformin – ensure serum creatinine is normal prior to re-starting this).

It may be necessary to reduce the dose of insulin if food intake is reduced. Discuss medication adjustment with the GP / MO or diabetes educator.

Guidelines for inpatient diabetes management

The following material is based on the Royal Adelaide Hospital (RAH) Inpatient Guidelines (2008).⁴ The guidelines are not to be used for patients who are receiving enteral or parenteral nutrition. They are not to be used for patients who have been admitted with unstable diabetes as the primary diagnosis such as diabetic ketoacidosis (DKA) or hyperglycaemic hyperosmolar state (HHS).

There are 5 guidelines to assist with practice:

1. Patient is eating (figure 1).
2. Patient is not eating or will fast >6 hours after a procedure (figure 2).
3. Patient is not eating but will eat within 6 hours of procedure (figure 3).
4. Hypoglycaemia (figure 4).

Figure 1

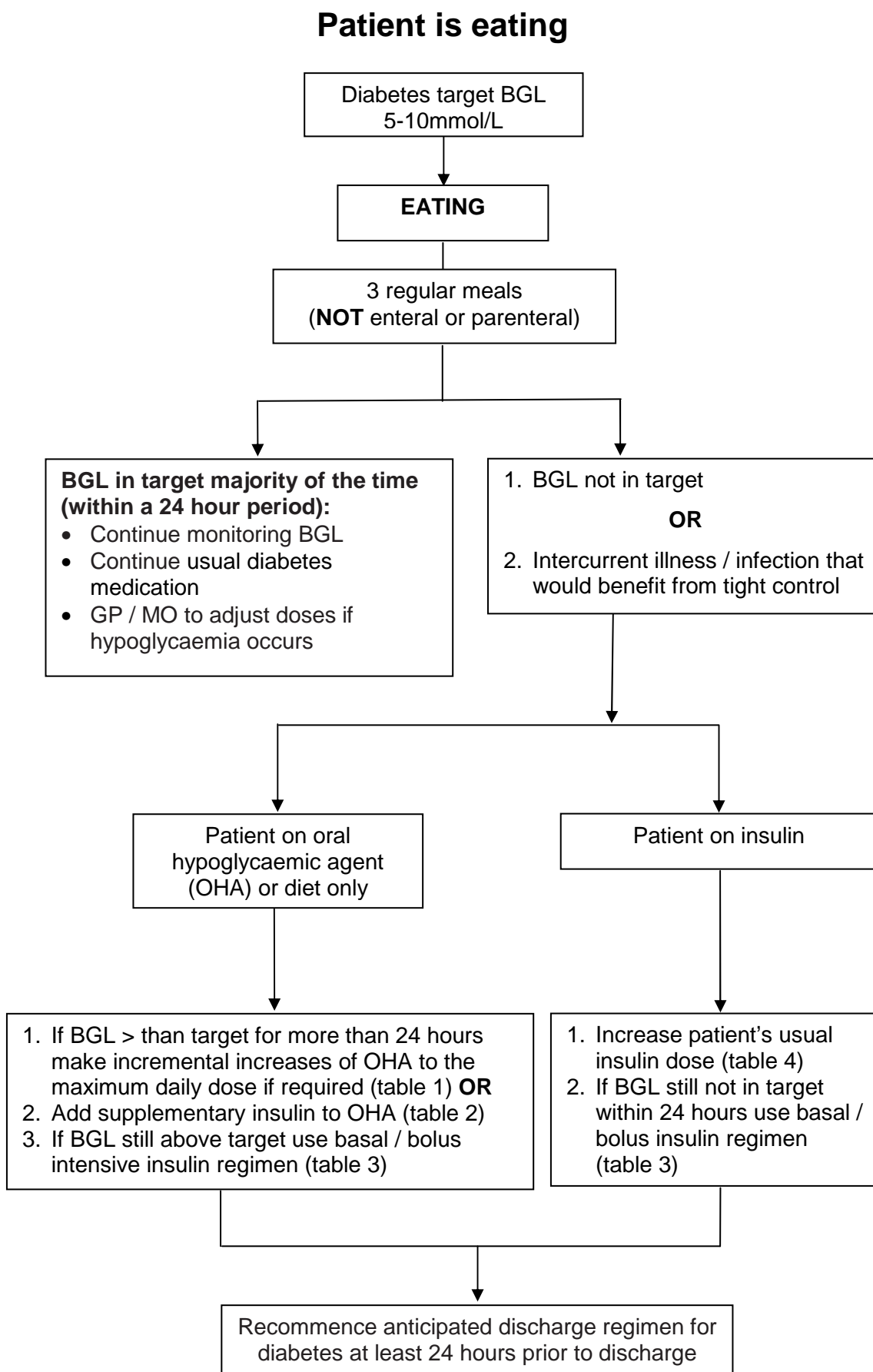
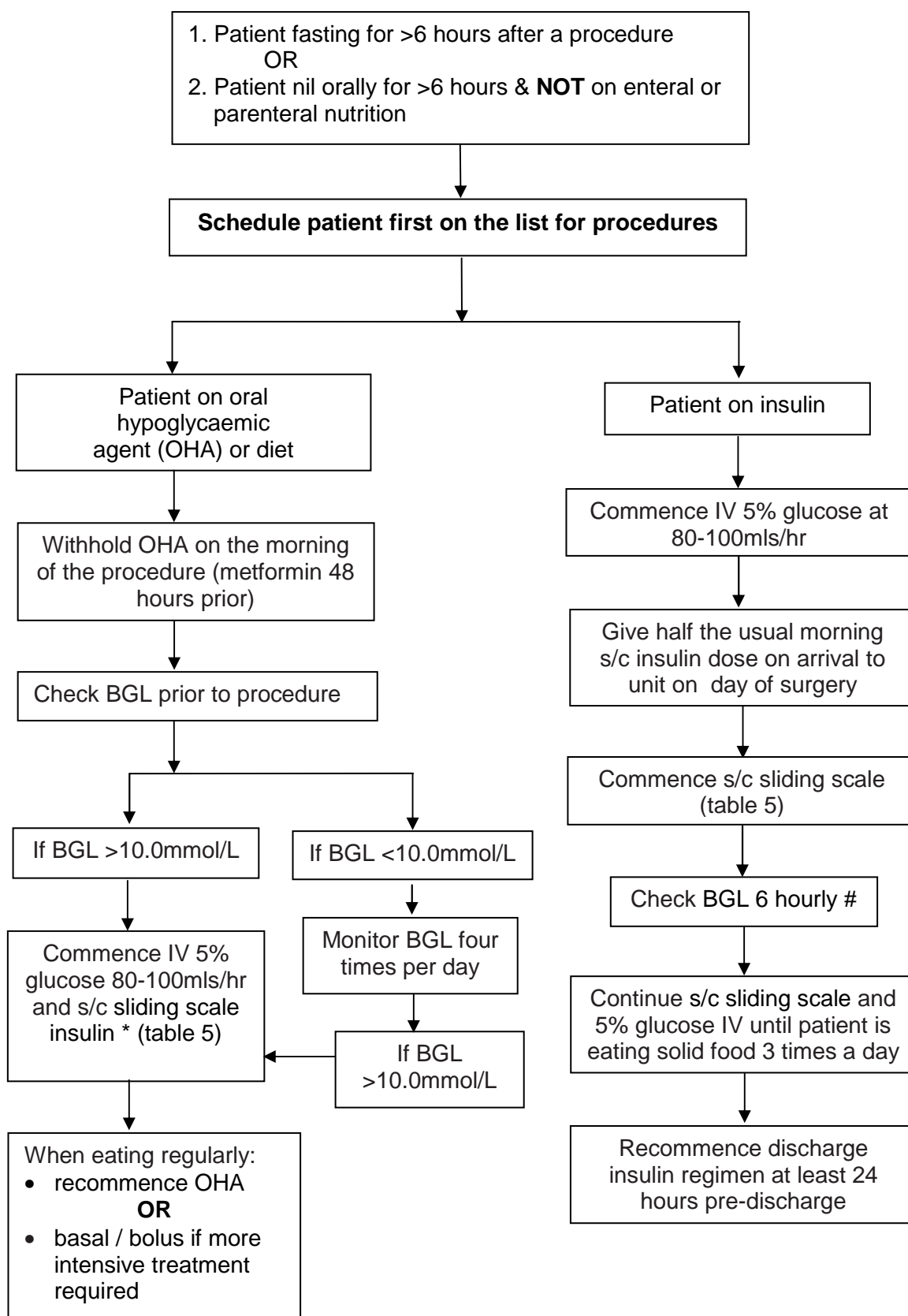


Figure 2

Management of a patient who is NOT eating or will fast for >6 hours after a procedure



* If you wish to use an insulin infusion and require a protocol please contact RAH, LMH or FMC.
Refer to page 7 of this section for information on pre-op, intra-op and post-op BGL monitoring.

Figure 3

Management of a patient who is FASTING but will eat within 6 hours of procedure

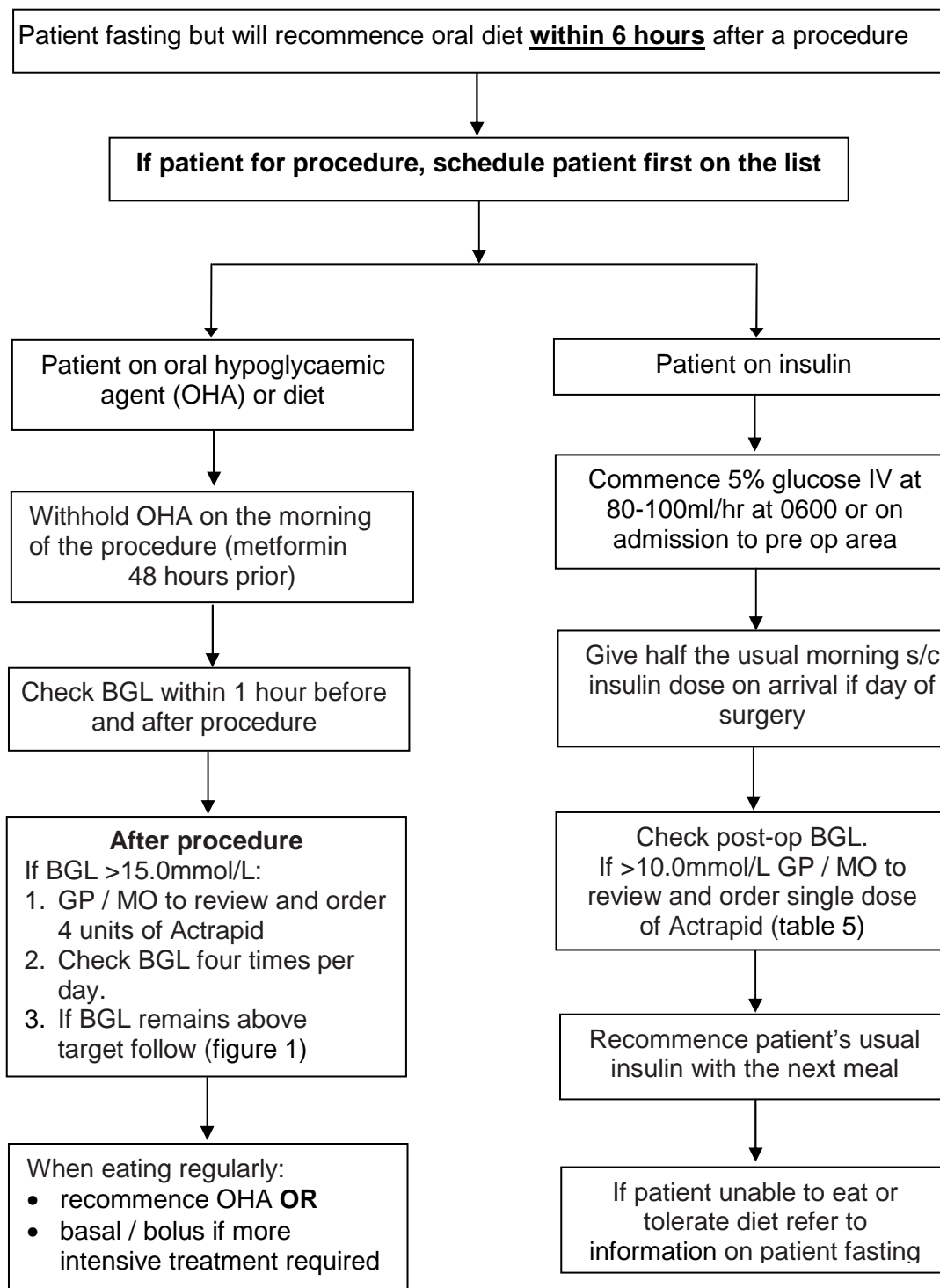


Table 1

| Oral Hypoglycaemic Agents (OHA) | | |
|--|------------------------|---|
| Name | Tablet Strength | Maximum daily dose |
| Metformin | 500mg, 850mg, 1000mg | 1000mg TDS if CrCl > 90mL/min 1000mg twice daily if CrCl 60-90mL/min 500mg twice daily if CrCl 30-60L/min |
| Metformin XR | 500mg | 2000mg night if CrCl>90mL/min 1000mg night if CrCl 30-60mL/min |
| Cease Metformin if CrCl < 30mL/min | | |
| Glibenclamide | 5mg | 10mg twice daily |
| Gliclazide MR | 30mg | 120mg morning |
| Glimepride | 1mg, 2mg, 3mg, 4mg | 4mg morning |
| Glipizide | 5mg | 20mg twice daily |

Table 2

| Supplementary basal insulin: |
|---|
| <ul style="list-style-type: none"> • Supplementary insulin can be added in conjunction with OHA in situations where a temporary rise in BGL occurs: eg: patient on a short course of corticosteroids OR patient has an infection • Add Glargine 10-12 units at breakfast in addition to maximum OHA to provide a temporary 'top up' for a few days. (Dose may need adjustment based on response). • Cease this additional dose of insulin when no longer required and/or prior to discharge. • <u>Avoid</u> random short acting insulin (particularly overnight) in response to a single high BGL unless patient is symptomatic as this is more likely to cause hypoglycaemia. |

Table 3**Basal / bolus intensive insulin regimen:**

This is an intensive four times a day insulin regimen using short acting insulin with each main meal and long acting analogue insulin at bed time.

Initial Dose Calculation:

0.3 to 0.5 units/kg as a total daily dose divided over four doses a day

OR

the patient's previous total daily insulin dose divided over four doses a day.

Use approximately 2/3 of the total daily dose evenly split into 3 bolus doses; 1/3 of total daily dose as basal bedtime dose

eg. 60kg patient - Total daily insulin dose calculated as 0.5units/kg/day = 30 units.

Split doses as:

| | |
|-----------|-------------------|
| Breakfast | 6 units NovoRapid |
| Lunch | 6 units NovoRapid |
| Dinner | 6 units NovoRapid |
| 2100 | 12 units Glargine |

OR

Patient previously on twice daily insulin of 40 units with breakfast and 25 units with dinner = 65 units daily.

Split doses as:

| | |
|-----------|--------------------|
| Breakfast | 14 units NovoRapid |
| Lunch | 14 units NovoRapid |
| Dinner | 14 units NovoRapid |
| 2100 | 24 units Glargine |

Dose Adjustments:

Review patient's 24 hour BGL profile each afternoon and adjust insulin orders prospectively.

Adjust each dose up or down by 10% of current dose as required.

Example: Based on 24 hour BGL profile: mmol/L

| | | | |
|------|------|------|------|
| 0600 | 1100 | 1600 | 2100 |
| 15.0 | 8.0 | 2.8 | 6.0 |

| | Current order | Adjusted order |
|-----------|----------------------|------------------------------|
| Breakfast | 6 units NovoRapid | 6 units NovoRapid |
| Lunch | 6 units NovoRapid | 5 units NovoRapid (decrease) |
| Dinner | 6 units NovoRapid | 6 units NovoRapid |
| 2100 | 12 units Glargine | 14 units Glargine (increase) |

As the BGL at 0600 was high, the bedtime dose of Glargine is **increased** to prevent the next morning's reading from being high again. As the patient had hypoglycaemic episode at 1600, the lunch time insulin dose is **reduced** to prevent a similar occurrence the next day. The other two doses (breakfast and dinner) were left unchanged as the blood glucose responses to them (at 1100 and 2100) were in the target range.

The recommendations of NovoRapid® has been made on the basis of standardisation. Humalog® and Apidra® are considered clinically equivalent and can be used as an alternative NovoRapid®.

Table 4

Changing usual insulin regimen:

- Review patient's blood glucose profile over 24 hours.
- Alter insulin dose to **prevent prospective** blood glucose rise or fall (eg. If the before breakfast BGL is high then increase the bedtime basal insulin dose to prevent the next morning reading being high).
- Alter doses by 10% of the current dose.

Table 5

Sliding scale insulin for patients who are fasting - Subcutaneous only

- To be used ONLY in patients that are nil orally or fasting post-operatively.
- Commence 5% glucose infusion.
- Check BGL 6 hourly (**not** QID: best timing is 0600, 1200, 1800, 2400hrs).
- Administer Actrapid subcutaneously 6 hourly based on the blood glucose level.

| BGL (mmol/L) | ACTRAPID insulin dose subcutaneous |
|---------------------|---|
| 0 - 5.0 | No insulin |
| 5.1 - 8.0 | 2 units |
| 8.1 - 12.0 | 4 units |
| 12.1 - 16.0 | 6 units |
| 16.1 - 20.0 | 8 units |
| > 20.1 | 12 units and notify medical staff |

- Review patient's BGL daily and increase insulin doses by 1 unit at each level of the sliding scale if target BGL not achieved.
- Recommence patient's usual OHA or insulin regimen when oral intake is adequate and regular.

(The doses above may be used to determine a single stat dose of insulin when that is required).

The recommendations of NovoRapid® has been made on the basis of standardisation. Humalog® and Apidra® are considered clinically equivalent and can be used as an alternative NovoRapid®.

Managing acute complications

Further reading about hypoglycaemia, diabetic ketoacidosis and hyperglycaemic hyperosmolar state can be found in *Unstable diabetes* – Section 11. The following information focuses on managing these acute complications in a hospital setting or a health service.

Hypoglycaemia

A 'hypo' kit and the hypoglycaemia protocol should be assembled and placed in a prominent position in every health service, ward or clinical area. The following is an example of a hypo kit:

| Hypoglycaemia Management Kit | |
|--|----------------|
| Glucagon 1mg (IU) - eg GlucaGen Hypokit | |
| Glucose Intravenous Infusion 25g in 50mL (50%) | |
| 1 roll of 2.5 cm micropore | |
| 1 x 20 mL syringe | |
| 1 x 21 G x ¾ inch winged infusion set | Example |
| 3 alcohol wipes | |
| 1 x InterLink vial access cannula | |
| Glucose drink equal to 15g CHO* | |
| 50 mL measure cup | |
| 2 biscuit serves (15g each)* | |

It is recommended that hospitals and health services make a decision about which glucose drink and which biscuit option to have in their hypo kit. The protocol on the next page can be accessed in electronic format from the authors to enable modification for an individual service.

* Suitable alternatives (equivalent to 15 grams carbohydrate)

- Give 60 mls Carbotest or Glucosan (75gm carbohydrate in 300 mls) **OR**
- Give 100 mls Carbotest or Glucosan (50gm carbohydrate in 300 mls) **OR**
- Give 90mls Lucozade **OR**
- Give 150mls of Lemonade

* Biscuit serve options

- 2 plain Milk Coffee, Arrowroot or similar
- 6 Jatz or 3 Sao

Figure 4

Treatment of Hypoglycaemia

For patients on insulin or oral hypoglycaemia agents(sulphonylurea).

Indication: Blood glucose level (BGL) less than 4.0mmol/L irrespective of symptoms.

| | | | | |
|----------|---|---|--|---------|
| A | <p>Safe to Swallow</p> <p>(i.e. awake and co-operative)</p> <p>Go to B ↓</p> | <p>Unsafe to swallow or Fasting</p> <p>(i.e. drowsy and / or uncooperative or dysphagic)</p> <ul style="list-style-type: none"> Notify doctor immediately Give 1mg glucagon IM If glucagon therapy is unsuccessful then doctor must review and may give IV glucose <p>When safe to swallow go to B ↓</p> | <p>Unconscious</p> <ul style="list-style-type: none"> Place in coma position Notify doctor immediately Give 1mg glucagon IM Doctor MUST review and may give 10 – 20ml IV glucose 50% <p>When safe to swallow go to B ↓</p> | EXAMPLE |
| B | <ul style="list-style-type: none"> Give 90 ml of Lucozade (15g equivalent) <i>(See previous page for options)*</i> Give 2 biscuits (15g equivalent) <i>(See previous page for options)*</i> | | | |
| C | <ul style="list-style-type: none"> Repeat BGL 15 minutes after initiation of treatment If BGL is less than 4.0mmol/L <ul style="list-style-type: none"> - If safe to swallow Repeat B ↑ - If unsafe to swallow Repeat A ↑ If BGL greater than 4.0mmol/L AND symptoms are no longer present go to D ↓ | | | |
| D | <ul style="list-style-type: none"> Repeat BGL in 1 hour If BGL is less than 4.0mmol/L OR patient has symptoms – Repeat B ↑ If BGL is greater than 4.0mmol/L AND symptoms are no longer present <ul style="list-style-type: none"> - Cease hypoglycaemia treatment - Investigate cause | | | |

* See previous page

^ See previous page

If symptomatic with BGL above 4mmol

- Re test after ensuring patients finger is clean(simple hand washing) and ensuring quality control is up to date.
- Provide reassurance and ensure meal/snack is not delayed.
- If any concerns, treat as hypo.

Important points

- Document events and treatment given.
- Notify doctor.
- Observe pulse and blood pressure with event.
- Post glucagon – vomiting is not uncommon.

If patient is receiving naso-gastric enteral feeding

- Administer 100 ml Carbotest via naso-gastric / enteral tube as per **B**.
- Recommence feeds at usual regime as per **B**.

Length of observation

Be aware that the risk of having further hypoglycaemic events is increased in the hours immediately following a hypo. For example older people on oral hypoglycaemic agents (sulphonylureas) are at greater risk of recurrent hypoglycaemia and may need intravenous infusions of dextrose 5%.

Patients should be monitored more closely for the next 12-24 hours. The BGL frequency will depend on the severity of the hypo as well as the person's individual risk factors. If unsure, discuss with senior nursing staff or MO / GP. Observe person for at least 24 hours and blood glucose levels monitored 2 hourly if needed, up to 12-24 hours depending on severity and duration of episode.

Document hypoglycaemic episode, action taken, outcome, monitoring progress and possible cause.

Note: some form of fast acting, rapidly absorbed carbohydrate should be left with the person.

Preventing hypoglycaemia

Identify Cause

- missed / delayed meals / snacks
- has vomited / insufficient intake
- over medication
- increased activity
- weight loss without medication
- possible self-induced
- excessive alcohol
- fasting for procedure
- if patient receiving enteral feeding-tube blocked or turned off
- extremes of weather temperature

Education

- check knowledge / skills
- recognition
- treatment
- prevention
- medical alert
- to carry fast acting CHO and has near bedside

Staff Education

- appropriate meals
- appropriate snacks
- correct medication
- alert medical officer of recurrent low BGL's
- accurate monitoring results
- encourage patient to report symptoms
- if patient receiving enteral feeding, consider IM glucagon 1mg prescribed as a standing order

For further assistance and education contact diabetes educator or dietitians.

Diabetic ketoacidosis (DKA) and hyperglycaemic hyperosmolar state (HHS)

The following information outlines the basic principles of managing diabetic ketoacidosis (DKA) and hyperglycaemic hyperosmolar state (HHS) in hospital. For additional information about DKA or HHS refer to *Unstable diabetes* – Section 11.

For specific clinical guidelines for hyperglycaemia in Country Health SA please refer to the SA Rural and Remote Emergency Clinical Guidelines for Adults, 2007. The guidelines are available from Country Health SA

We highly recommend you consult with a Diabetes Service experienced in managing hyperglycaemic crises and ensure that there are local treatment protocols in place.

Diagnosis

The process of HHS usually evolves over several days or weeks, whereas the evolution of an acute DKA episode is much shorter. HHS only occurs in type 2 diabetes.⁶ DKA is associated with type 1 diabetes but has been known to occur in people with type 2 diabetes in the presence of an acute event such as septicaemia, respiratory collapse, myocardial infarction etc.⁷

Clinical presentation

For both DKA and HHS the clinical picture consists usually of polyuria, polydipsia, polyphagia, weight loss, vomiting, abdominal pain (only in DKA), dehydration, weakness, altered level of consciousness or mental status, and finally coma. Other physical findings may be poor skin turgor, Kussmaul respirations (in DKA), tachycardia, hypotension, alteration in mental status, shock and ultimately coma (more common in HHS).⁶

Nursing considerations

- Capillary blood glucose
- Blood or urine ketones
- Baseline observations
- Prep for IV cannulation
- Cardiac monitor
- O₂ saturation
- Start fluid balance
- Ice chips or oral fluids if tolerated
- Consider in-dwelling catheter

Laboratory tests

- plasma glucose
- blood urea nitrogen / creatinine
- serum ketones
- electrolytes (with calculated anion gap)
- osmolality
- urinalysis
- urine ketones by dipstick
- arterial blood gases
- complete blood count
- ECG
- Bacterial cultures if infection suspected

Treatment

Successful treatment of both DKA and HHS requires correction of:

- dehydration
- hyperglycaemia
- electrolyte imbalances, and
- the identification of co-morbid precipitating events and frequent patient monitoring is crucial.

Fluid therapy

The initial fluid therapy is aimed at expansion of the intravascular volume and restoration of renal perfusion. Subsequent choice for fluid replacement depends on the state of hydration, serum electrolyte levels and urine output.⁶

Insulin therapy

Unless the DKA is mild, intravenous insulin infusion is required.

Potassium

Even though total body potassium may be depleted, mild to moderate hyperkalaemia is not uncommon in patients with DKA or HHS. Insulin therapy, correction of acidosis, and volume expansion decrease serum potassium concentration. Close monitoring of potassium is needed to identify hypokalaemia. Replacement potassium may be needed. Refer to your hospital clinical guidelines.

Bicarbonate

Severe acidosis in DKA can lead to a number of adverse vascular effects. The use of bicarbonate in DKA will depend on the pH level.

Complications

The most common complications of DKA and HHS includes hypoglycaemia from over administration of insulin, hypokalaemia due to insulin administration and treatment of acidosis with bicarbonate and hyperglycaemia secondary to interruption / discontinuation of IV insulin therapy without adequate cover from subcutaneous insulin. Cerebral oedema is rare but when it occurs it is frequently fatal.⁶

Insulin pumps in an inpatient setting

Insulin pump therapy during an inpatient stay is possible as long as the person (or a parent or spouse) and the endocrinologist are consulted and nursing staff are confident to supervise and document the treatment. Hospital staff are not expected to be experts in insulin pump therapy. It is important to seek assistance from the diabetes team who is managing the persons pump therapy. It is essential that contact be made with the person's endocrinologist and / or their diabetes educator to develop a plan for the persons admission and discharge. See *Medication* – Section 10 for background information about insulin pump therapy.

**Patient needs to be able to fully self manage the insulin pump
OR
MO needs to order alternative treatment if patient unable to self manage
the pump**

If the person is unable to self manage the pump (eg simply too unwell, in pain, impaired cognition or conscious state) it is recommended that the insulin pump is stopped and replaced by an insulin infusion. **The pump should not be removed until there is another method of insulin replacement eg insulin infusion.** If an insulin infusion is not possible then multiple insulin injections will be required (long acting and short acting insulin). Transition insulin dosing must be discussed with the patient's endocrinologist.

If a patient is self managing the pump it is essential that nurses oversee and record blood glucose results, insulin doses and carbohydrate (CHO) intake. This includes checking the bolus doses with the patient before it is administered. Ensure accurate documentation at all times.

In a hospital setting the pump should not be turned off unless:

- For the treatment of severe hypoglycaemia (less than 2mmol/L). Following treatment for hypoglycaemia and return to target blood glucose levels, the insulin pump must be re-commenced.
- Showering and person is not hyperglycaemic. Ensure pump is turned back on within 60 minutes.

Management of the insulin pump and procedures

- The person should have recent information from their last endocrinologist visit stating the person's usual basal rates etc.
- The surgeon or medical practitioner should contact the person's endocrinologist well prior to the procedure to get specific advice regarding management of insulin.
- The insulin pump should not be worn during an X-ray, CT or MRI.
- Ensure a detailed admission and discharge plan is put in place. Contact the person's diabetes educator or endocrinologist to develop this. They will give advice about the management of diabetes during planned procedures. If the procedure is unplanned (trauma, medical emergency) stop the pump and commence an insulin infusion.
- If the person is having a general anaesthetic, the insulin pump must be disconnected / removed and insulin must be administered via insulin infusion or subcutaneous insulin injections.
- If the person is having a local anaesthetic an assessment of the person's ability to self manage pre, during and post the procedure must be considered.
- Ensure a new line is put in place the day before the procedure (not the morning of the procedure).
- Ensure cartridge volume is enough to carry the person through to a suitable time frame (eg will not run out in the middle of the night).
- In case of pump failure or other emergency obtain contact phone numbers from the patient including endocrinologist, family member, pump support person, pump manufacturer. It is also important to write down any instructions that the patient has been given regarding insulin doses should pump failure occur.

Caring for the insertion site and line change

To reduce the risk of infection and ensure line patency:

- Change the infusion line and site every three days.
- Ensure thorough handwashing before procedure.
- Protect the infusion line from contamination when disconnected.
- Some health services recommend the use of an anti-bacterial agent such as Solu-I-V or Persist Plus to clean the area prior to insertion of the cannula.
- Document date and time of insertion site and line change in the case notes.

Potential problems to look for

- Subcutaneous site eg infection, allergies, tunnelling.
- Line kinks, leaks, clogs.
- Pump may have mechanical problems.
- **There is an accelerated tendency for diabetic ketoacidosis** (this can occur within 3-6 hours of ceasing the pump as the insulin supply stops).

Blood glucose monitoring and insulin pumps

Patients using insulin pump therapy are usually required to test their BGLs at least 6 times a day.

Blood glucose monitoring times can be:

- before breakfast, lunch and dinner (checks the basal rate)
- before bed (checks the basal rate)
- 2 hours after food (checks the meal bolus dose)
- between 2 and 3.00am (to detect overnight hypo / hyperglycaemia)
- test more frequently if the person is unwell.

Medical record documentation

The following table outlines what should be recorded.

| What to record | Where to record it |
|--|--|
| Basal rate | medication chart |
| Meal bolus dose or carbohydrate insulin ratio | medication chart |
| Correction bolus dose or insulin sensitivity factor (the amount that 1 unit of insulin lowers the individuals BGL in mmol/L) | medication chart |
| Blood glucose levels | fluid balance chart / diabetes record chart |
| Carbohydrate intake | fluid balance chart / diabetes record chart |
| Ketonuria | fluid balance chart / diabetes record chart |
| Hypoglycaemia | case notes and fluid balance chart / diabetes record chart |
| Hyperglycaemia | case notes and fluid balance chart / diabetes record chart |

Management of hypoglycaemia

Causes of hypoglycaemia on an insulin pump

- The basal rate is too high.
- The carbohydrate:insulin ratio (or meal bolus) or insulin sensitivity factor or correction bolus doses are too high,
- Accidentally giving too much insulin.
- Overestimated carbohydrate intake.
- Delaying a meal after a bolus dose.

Management of hypoglycaemia

If the person is conscious the hypo is treated as a person who does not have an insulin pump (hypoglycaemia protocol – figure 4). However if the BGL is less than 2.0mmol/L then the pump must be suspended / disconnected and hypoglycaemia protocol followed (figure 4). After 30 minutes of pump suspension – and if the BGL is over 4mmol/L – recommence / connect the pump. If BGL remains less than 4mmol/L, contact MO as person may need IV glucose.

Monitor

- Investigate cause.
- Document the event.
- After 30 minutes of pump suspension and if the BGL is over 4mmol/L recommence / connect the pump. If BGL remains less than 4mmol/L, contact MO.
- It is necessary to review insulin administration rates to ensure that hypoglycaemia does not recur and blood glucose level remains within target range.

Hyperglycaemia and pump therapy

The key points in the management of hyperglycaemia are the same for insulin pump users as for those on insulin injections. However, it is important to realise that patients on pumps are only using rapid acting insulin and do not have a background reservoir of long acting insulin. **This means that diabetic ketoacidosis can develop rapidly and must be taken very seriously.**^{8, 9}

Potential causes of hyperglycaemia when using an insulin pump

- Current illness / infection.
- The basal rate is too low.
- The carbohydrate:insulin ratio (meal bolus) or insulin sensitivity factor or correction boluses are too low.
- Forgetting to give a meal bolus dose.
- Not counting carbohydrates correctly.
- Overdue to resite infusion set.
- No insulin in the cartridge.
- The cartridge is not sitting in the pump correctly.
- Connections are loose or not connected.
- Tubing or connection is leaking or kinked.
- Infusion set has been pulled out.
- Infection at the insertion site.
- The pump is in stop mode.
- The pump has failed (electronically).
- The pump has flat batteries.
- There is air in the cartridge or infusion set.

Current guidelines for the management of hyperglycaemia recommend that the pump should not be used to correct hyperglycaemia when ketones are present.⁹⁻¹¹

If the blood glucose level is greater than 15mmol/L and there are ketones in the urine or blood but the person **does not** have DKA the following principles apply.^{8, 9}

- Immediately check for problems with the pump or delivery system and infusion site.
- Immediately contact the endocrinologist for instructions about insulin requirements and need for insulin infusion.
- Give correction bolus via syringe.
- Replace the insulin in the pump, and the infusion set and re-site the cannula as soon as possible.
- Recommence the insulin pump.
- Test the BGL hourly.
- Encourage the person to drink extra low joule fluids.

Abbreviations

| | |
|-------------|-----------------------------------|
| MO: | medical officer |
| GP: | general practitioner |
| S/C: | subcutaneous |
| IV: | intravenous |
| BGL: | blood glucose level |
| OHA: | oral hypoglycaemic agent |
| DKA: | diabetic ketoacidosis |
| HHS: | hyperglycaemic hyperosmolar state |
| RAH: | Royal Adelaide Hospital |
| LMH: | Lyell McEwin Hospital |
| FMC: | Flinders Medical Centre |

Glossary

Basal insulin rate: refers to the continuous (24 hours a day) infusion of rapid acting insulin. A person's basal rate is initially calculated using an algorithm by the diabetes team but over time the person learns to adjust their basal rate as required. It is given as units/hour eg 0.4/hr = 9.6 units over 24 hours.

Carbohydrate bolus: refers to the dose of rapid acting insulin that is administered using the bolus feature of the pump when ingesting carbohydrates at meals / snacks. This is calculated using an algorithm by the diabetes team. The carbohydrate bolus is given immediately before eating or after eating eg 1 unit for 12 grams of carbohydrate.

Correction bolus: A correction bolus is an amount of insulin that is given to lower blood glucose levels. A correction bolus is calculated using an algorithm based on the person's insulin sensitivity factor. This calculation is usually different for everyone. This is calculated using the bolus feature of the pump. eg 1 unit of insulin lowers the BGL by 2.4mmol/L.

A correction bolus may be given at any time but is often combined with the carbohydrate bolus dose. For example if the BGL was 11mmol/L before meal then a correction bolus would be needed as well a meal bolus otherwise BGL would still be high after eating.

Carbohydrate counting: counting carbohydrates is extremely important for people on insulin pump therapy. Carbohydrates can be counted in grams or exchanges. Most patients will be taught how to count carbohydrates in grams. There are a number of resources for assist people with carbohydrate counting. Pump users do not need to eat snacks if they do not wish to and can vary the timing of their meals and eat to appetite.

| Your Service Name | Patient Identification Label |
|--|---|
| <p>DIABETES ASSESSMENT To be completed by a Registered Nurse on admission. For explanation of the question material please turn over the page. If there are any deficits or issues identified in the care plan please refer to the appropriate health professional in consultation with your patient.</p> | UR No _____ Surname _____ Given Name _____ DOB _____ Sex _____ Doctor _____ Ward _____ OPD _____ |
| <p>1. What type of diabetes does the person have? (each type requires different treatment)</p> <p> <input type="checkbox"/> type 1 <input type="checkbox"/> type 2 <input type="checkbox"/> gestational <input type="checkbox"/> secondary diabetes (eg steroid induced) </p> <p>2. How do they manage/control their diabetes? (different treatment requires different self-care information):</p> <p> <input type="checkbox"/> diet/lifestyle <input type="checkbox"/> sulphonylureas (eg. glibenclamide, gliclazide, glimepiride, glipizide) </p> <p> <input type="checkbox"/> metformin <input type="checkbox"/> acarbose <input type="checkbox"/> repaglinide </p> <p> <input type="checkbox"/> GLP-1 (eg januvia, byetta) <input type="checkbox"/> glitazones <input type="checkbox"/> insulin </p> <p>b) Does the person understand what their treatment regime is? (eg time to administer, side effects, dose. If they are on insulin is the administration technique correct? (Refer to Section 10 in Diabetes Manual)</p> <p> <input type="checkbox"/> yes <input type="checkbox"/> no (please teach) <input type="checkbox"/> carer/nursing home/hostel provides care </p> <p>c) If on sulphonylureas or insulin is the person aware of risk for hypoglycaemia and how they should prevent and manage it if it occurs?</p> <p> <input type="checkbox"/> yes <input type="checkbox"/> no (please teach) <input type="checkbox"/> carer/nursing home/hostel provides care </p> <p>3. a) Does the person monitor their BGLs (blood glucose levels)? (it is highly recommended that persons on sulphonylureas or insulin test their BGLs regularly due to potential for hypoglycaemia)</p> <p> <input type="checkbox"/> yes method _____ any problems _____ <input type="checkbox"/> supplies (NDSS or Chemist) </p> <p> <input type="checkbox"/> no - person states they do not wish to test (ensure they are aware of signs/symptoms of hyper/hypoglycaemia) - diet, metformin or arcabose only (ensure they are aware of signs and symptoms of hyperglycaemia) </p> <p> <input type="checkbox"/> other nursing home or hostel nursing staff are performing the test </p> <p>If the person wishes to monitor please provide appropriate education.</p> <p>b) If the person has type 1 diabetes are they aware of the procedure and action with ketone testing if their BGLs are above 15mmol/L and / or they are unwell? (Sick day management)</p> <p> <input type="checkbox"/> yes <input type="checkbox"/> no (please teach) <input type="checkbox"/> not applicable <input type="checkbox"/> care/nursing home/hostel provides care </p> <p>4. Does the person understand the role of a healthy eating plan in diabetes management?</p> <p> <input type="checkbox"/> yes <input type="checkbox"/> no (please teach) <input type="checkbox"/> care/nursing home/hostel provides care </p> <p> <input type="checkbox"/> person states they do not wish to receive information </p> <p>5. Is the person aware of the need for regular checks by LMO or diabetes specialist? (see over page). Refer to Long-term Management leaflet.</p> <p> <input type="checkbox"/> yes <input type="checkbox"/> no (recommend visit to LMO after discharge for regular review) </p> <p> <input type="checkbox"/> care/nursing home/hostel provides care </p> <p>6. Is there an active foot problem at the moment? (eg callouses, corns, ingrown toenail, infection, signs of pressure or neuropathy or ulcers) – see Section 6, Diabetes Manual.</p> <p> <input type="checkbox"/> yes (refer for foot risk assessment) </p> <p> <input type="checkbox"/> no (recommend yearly risk assessment and appropriate care) </p> <p>7. Check toe nail cutting is uncomplicated – refer to diabetes resource nurse.</p> | |
| RN Signature: _____ RN Print Name: _____ Date: _____ | |

DEFINITION OF TYPES OF DIABETES (It is important to ascertain which type of diabetes a person has so that appropriate treatment/education is provided)

- Type 1: occurs as a result of insulin deficiency following autoimmune destruction of pancreatic beta cells. Dependant on insulin for survival from diagnosis.
- Type 2: characterised by insulin resistance and insulin deficiency. Usually occurs in people over 40 years. Initially controlled by healthy eating, exercise, and OHA's. May eventually need insulin to assist in management.
- Gestational: diabetes detected during pregnancy.
- Secondary: examples include disorders with pancreatic pathology, use of medications (glucocorticoids), liver disease and other endocrine disorders.

MEDICATION ADMINISTRATION (It is a nurse's duty of care to ensure the following is taught prior to discharge)

- Action, side effects, timing, dose, availability of medication (eg chemist with script from LMO).
- Insulin: correct technique, correct timing, correct dose and site. Observe and document administration technique.

MONITORING

- Times to test: before a meal is preferred so that medication can be adjusted accordingly.
- Frequency of testing: depends on their control and how stable.
- Supplies: National Diabetes Supply Scheme is the most cost effective (Diabetes – South Australia U4/159 Sir Donald Bradman Drive, Hilton – Ph 8234 1977).
- Sharps disposal: sealable hard plastic container or with sharps container through councils. Sharps must not be thrown in the bin, as household rubbish becomes landfill.
- Quality control meter: recommended monthly with control solutions.

EMERGENCIES (It is a nurses duty of care to ensure the following is taught prior to discharge)

Hypoglycaemia

- Symptoms: sweating, trembling, weakness, confusion, tingling around mouth, headache.
- Causes: delayed or missed meal, exercise or alcohol with minimum carbohydrate intake, medication/s.
- Management: quick acting carbohydrate followed by slowly digested carbohydrate.
- Glucagon injection: teach family or friend or care giver of those at risk, eg patient with type 1 or with type 2 who is lean and on insulin. They will require education and prescription prior to discharge.
- Advise clients who are at risk to test blood glucose level prior to driving or any dangerous activity (eg climbing a ladder).
- Encourage patient to have a medic alert bracelet or to carry a medical identification care.

Hyperglycaemia

- Symptoms: thirst, lethargy, polyuria, weight loss, blurred vision, recurrent infection.
- Causes: stress, illness, infection, not enough medication, too much carbohydrate.
- During illness medication should not be stopped as insulin requirements generally go up.
- Symptomatic hyperglycaemia should seek medical advice as soon as possible.

HEALTHY EATING

- Encourage regular meals with even distribution of carbohydrates throughout the day.
- Low fat, high fibre and limiting quickly absorbed carbohydrates.

LONG TERM COMPLICATIONS (PREVENTION)

- Importance of regular GP reviews (3-6 monthly) and within one week of discharge from hospital.
- A measure of HbA1c (average blood glucose level) recommended 3-6 monthly.
- 2 yearly eye checks (more frequently if problems stated), yearly kidney checks, regular BP, cardiovascular, nervous system and cholesterol level checks.
- Regular flu and pneumonia vaccinations.
- Footcare: daily inspection, treat problems early, avoid excessive heat or cold. Encourage appropriate footwear. Cut nails following the normal contour of the toe, file sharp edges. See podiatrist if problems occur.

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