Inpatient Diabetes Care

Data from the National Diabetes Inpatient Audit suggest that the number of hospital inpatients with diabetes ranges from ~10% to over 30%. This does not mean that up to 1 in 3 inpatients are in hospital *because* of their diabetes, but happen to have diabetes in addition to whatever other condition has necessitated their admission. Whatever the reason for admission, patients with diabetes often have longer lengths of hospital stay. However, the presence of diabetes remains an important co-morbidity that must be dealt with by staff who are competent and confident in its management.

Over the last few years, the Joint British Diabetes Societies Inpatient Care Group has published several national guidelines on the management of several aspects of inpatient diabetes care. The following guidelines are largely derived from those and these will be referenced wherever appropriate. Readers are encouraged to access these valuable resources on the internet

This section is divided into the following:

1. Diabetic Hyperglycaemic Emergencies
    a. Diabetic ketoacidosis
    b. Hyperosmolar hyperglycaemic state
2. Intravenous insulin infusions
3. Hypoglycaemia
4. Peri-operative management of adults with diabetes

5. The management of stroke patients with diabetes who require enteral nutrition
6. The critically ill patient

Diabetic Hyperglycaemic Emergencies[1]

Diabetic ketoacidosis

The diagnosis of diabetic ketoacidosis (DKA) is dependent on the combined presence of 3 biochemical abnormalities:

a) Ketonaemia ≥3mmol/L or significant ketonuria (more than 2+ on standard urine sticks)

b) Blood glucose >11mmol/Lor known diabetes mellitus

c) Bicarbonate (HCO_3^-) <15mmol/Land/or venous pH <7.3

The presence of any of the following on admission should prompt a swift senior review and / or indicate admission to a Level 2 / HDU environment:

- Blood ketones >6mmol/L
- Bicarbonate level <5mmol/L
- Venous/arterial pH <7.1
- Hypokalaemia (<3.5mmol/L)
- Abnormal GCS or AVPU score
- Oxygen saturation below 92% on air (assuming normal baseline respiratory function)
- Systolic BP <90mmHg
- Pulse >100 or <60bpm
- Anion gap >16 **[Anion Gap = ($Na^+ + K^+$) – ($Cl^- + HCO3^-$)]**

The management of DKA [1]

a) Bedside hand held ketone monitors should be used to measure the plasma ketone concentrations (in particular, 3-β-hydroxybutyrate), because this is the direct marker of disease severity. The resolution of DKA depends upon the suppression of ketonaemia, and measurement of blood ketones now represents best practice in monitoring the response to treatment.
b) Where available, the specialist diabetes team should ideally be involved as early as it practical after admission.
c) Venous gases are advocated because the differences in arterial and venous pH, bicarbonate and potassium measurements are not great enough to alter management. Plasma ketones, venous pH, and bicarbonate measurements should be used as treatment markers.
d) A weight-based, fixed rate intravenous insulin infusion (FRIII) should be used. The initial starting dose of a fixed dose per kilogram body weight (0.1 units per kg per hour- i.e. 7 units per hour for a 70Kg individual) enables rapid blood ketone clearance. The fixed rate may be adjusted in insulin resistant states if the ketone concentration is not falling fast enough, and/or bicarbonate levels are not rising fast enough. There is no need to give a bolus dose of insulin if the intravenous (iv) insulin infusion is set up promptly.
e) Subcutaneous injections of long acting insulin analogues should be continued. They provide background insulin when the IVII is discontinued, and should avoid excess length of stay. This does not obviate the need for giving short acting insulin before discontinuing the IVII.

f) Bicarbonate should not be given because it may worsen intracellular acidosis, and it may precipitate cerebral oedema, particularly in children and adolescents.

Metabolic treatment targets (this may be in a box)

The recommended targets are

- Reduction of the blood ketone concentration by 0.5mmol/L/hour
- Increase in venous bicarbonate concentrations by 3mmol/L/hour
- Reduce capillary blood glucose by 3mmol/L/hour
- Potassium kept between 4.5 and 5.5mmol/L

If these rates are not achieved then the FRIII needs adjusting.

Initial Actions: Intravenous access and initial investigations (time 0 to 60 minutes)

- Rapid assessment of airway, breathing, and circulation
- Large bore iv cannulae and commencement iv fluid replacement
- Full clinical examination with assessment of:
    - Respiratory rate; temperature; blood pressure; pulse; oxygen saturation
    - Assess Glasgow Coma Scale. Consider NG tube with airway protection to prevent aspiration if GCS is <12
- Initial investigations should include:
    - Bedside capillary ketones, and capillary glucose
    - Venous gases for glucose, U&E's, pH, HCO_3^-

- FBC, blood cultures
- ECG, CXR, MSU

- Continuous cardiac monitoring, and pulse oximetry
- Consider and precipitating causes and treat appropriately

Fluid resuscitation

If the systolic blood pressure is <90mmHg, consider causes other than fluid depletion, such as heart failure, sepsis, etc. Give 500ml of 0.9% sodium chloride solution over 10-15 minutes and repeat if necessary. If there has been no improvement in BP – call for urgent senior help.

If the systolic BP is >90mmHg use the following table

Fluid	Volume
0.9% sodium chloride 1L	1000ml over 1st hour
0.9% sodium chloride 1L with potassium chloride	1000ml over next 2 hours
0.9% sodium chloride 1L with potassium chloride	1000ml over next 2 hours
0.9% sodium chloride 1L with potassium chloride	1000ml over next 2 hours
0.9% sodium chloride 1L with potassium chloride	1000ml over next 4 hours
0.9% sodium chloride 1L with potassium chloride	1000ml over next 4 hours
Re-assessment of cardiovascular status at 12 hours is mandatory, further fluid may be required	

Potassium replacement.

Hypokalaemia and hyperkalaemia are life threatening conditions and are common in DKA.

Potassium level in first 24 hours (mmol/L)	Potassium replacement in mmol /L of infusion solution

Over 5.5	Nil
3.5-5.5	40mmol/L
Below 3.5	Senior review because additional potassium needs to be given

Insulin infusion.

- If weight not available from patient, estimate patient weight (in Kg)
- If pregnant use her present weight and seek senior advice urgently (including senior obstetric advice)
- Start a continuous FRIII via an infusion pump. 50units human soluble insulin (Actrapid®, Humulin S®) made up to 50ml with 0.9% sodium chloride solution.
- Infuse at a fixed rate of 0.1unit/kg/hr (i.e. 7ml/hr if weight is 70kg)
- Only give a stat dose of insulin if there is a delay in setting up a FRIII
- If the patient normally takes insulin Lantus® or Levemir® subcutaneously continue this at the usual dose and usual time

For the management of DKA beyond 60 minutes refer to the 2010 national guideline available at:

http://www.diabetes.org.uk/About_us/Our_Views/Care_recommendations/The-Management-of-Diabetic-Ketoacidosis-in-Adults/

Hyperosmolar Hyperglycaemia State (Scott A et al In press)

Whilst there is no formal definition of Hyperosmolar Hyperglycaemia State (HHS) the following criteria have been adopted nationally across the UK:

a) Hypovolaemia and
b) Marked hyperglycaemia (30mmol/L or more), with no significant ketonaemia (<3mmol/L) or acidosis (pH>7.3, bicarbonate >15mmo/L) and
c) Osmolality usually 320mmol/kg or more **[calculated osmolality = $2Na^+$ + Glucose + Urea]**

NB. A mixed picture of HHS and DKA may occur

HHS typically occurs in the elderly, but as type 2 diabetes is diagnosed in ever younger adults and teenagers so it is likely that HHS will present in younger ages as well. Unlike DKA which usually comes on over a matter of hours, HHS comes on over many days, and consequently the dehydration and metabolic disturbances are more extreme.

The up to date management of HHS (Scott A et al – in press)

Initial assessment

Hyperglycaemia results in an osmotic diuresis and renal losses of water in excess of sodium and potassium. Fluid losses are estimated to be between 100-220ml/kg. Despite these severe electrolyte losses and total body volume depletion, the typical patient with HHS may not look as dehydrated as they are, because the hypertonicity leads to preservation of intravascular volume.

The goals of treatment of HHS are to gradually and safely:

- Normalise the osmolality
- Replace fluid and electrolyte losses
- Normalise blood glucose
- Treat the underlying cause
- Prevent arterial or venous thrombosis
- Prevent other potential complications e.g. cerebral oedema/ central pontine myelinolysis
- Prevention of foot ulceration

As with DKA, venous blood can be used to assess pH, bicarbonate, U&E's, glucose, etc in a blood gas analyser.

The presence of any of the following should prompt a swift senior review and / or indicate admission to a Level 2 / HDU environment:

- Osmolality >350mosm/kg;
- Sodium >160mmol/L;
- Venous/arterial pH <7.1;
- Hypokalaemia (< 3.5mmol/L) or hyperkalaemia > 6mmol/L);
- Glasgow Coma Scale (GCS) <12 or abnormal AVPU (Alert, Voice, Pain, Unresponsive) score;
- Oxygen saturation <92% on air (assuming normal baseline respiratory function);
- Systolic blood pressure <90mmHg;

- Pulse >100 or <60bpm
- Hypothermia
- Acute or serious co-morbidity, e.g. MI, CCF or CVA
- Urine output <0.5mls/Kg/hr or other evidence of acute kidney injury

Fluid replacement and changes in osmolality

The goal of the initial therapy is expansion of the intra and extravascular volume and to restore peripheral perfusion. The fluid replacement of choice is 0.9% sodium chloride. Measurement or calculation of osmolality should be undertaken every hour initially and the rate of fluid replacement adjusted to ensure a positive fluid balance sufficient to promote a gradual decline in osmolality. Fluid replacement alone (without insulin) will lower BG which will reduce osmolality causing a shift of water into the intracellular space. This inevitably results in a rise in serum sodium.

The aim of treatment should be to replace approximately 50% of estimated fluid loss within the first 12hr and the remainder in the following 12 hours although this will, in part, be determined by the initial severity, degree of renal impairment and associated co-morbidities, which may limit the speed of correction.

A BG target of between 10 and 15mmol/L is a reasonable goal. Complete normalisation of electrolytes and osmolality may take up to 72h hours.

The role of insulin in HHS

If significant ketonaemia is present (3β-hydroxy butyrate is >1mmol/L) this indicates relative hypoinsulinaemia and insulin should be started at time zero. If significant ketonaemia is not present (3β-hydroxy butyrate <1mmol/L) do not start insulin. Fluid replacement alone with 0.9% sodium chloride will result in a falling blood glucose and because most patients with HHS are insulin sensitive, there is a risk of lowering the osmolality precipitously. Insulin treatment prior to adequate fluid replacement may result in cardiovascular collapse as water moves out of the intravascular space, with a resulting decline in intravascular volume.

The recommended insulin dose is an FRIII given at 0.05 units per kg per hour (e.g. 4 units/hour in an 80kg person) is used. A fall of glucose at a rate of up to 5mmol/L per hour is ideal, and once the blood glucose has ceased to fall following initial fluid resuscitation, reassess fluid intake and renal function. Insulin may be started at this point or, if already in place, the infusion rate increased by 1unit/hr.

Potassium replacement

This is the same as DKA and the same principles can be applied using the table shown above.

Anticoagulation

Because of the increased risk of arterial and venous thromboembolism, all patients should receive prophylactic low molecular weight heparin for the full duration of admission unless contraindicated. Full treatment dose

anticoagulation should only be considered in patients with suspected thrombosis or acute coronary syndrome.

Other electrolytes

Hypophosphataemia and hypomagnesaemia are common in HHS, however as with DKA, routine replacement is not recommended.

Foot protection

These patients are at high risk of pressure ulceration. An initial foot assessment should be undertaken and heel protectors applied in those with neuropathy, peripheral vascular disease or lower limb deformity. The feet should be re-examined daily

Intravenous insulin infusions

These can be either fixed rate intravenous insulin infusions (FRIII) or variable rate (VRIII)

Fixed rate intravenous insulin infusions

These are used in the initial stages of DKA until ketones are <0.3mmol/L**and** pH>7.3 **and** venous bicarbonate >18mmol/L, or in patients with HHS once their blood glucose has stopped dropping at 5mmol/L/hr with the initial use of 0.9% sodium chloride. The starting doses are 0.1 unit/Kg/hr for DKA, and 0.05unit/Kg/hr for HHS.

Intravenous crystalloid solution must always be given with an FRIII. In DKA if the blood glucose levels are >14mmol/L then this should be 0.9% sodium chloride, if it is <14mmol/L, then 10% dextrose solution should be run alongside he saline infusion.

Variable rate intravenous insulin infusions

The aim of the VRIII is to achieve and maintain normoglycaemia. It should be made up of a 50 ml syringe with 50 units of Soluble Human Insulin (e.g. Human Actrapid®) with 49.5 mls of 0.9% sodium chloride – making a concentration of 1 unit per ml.

Principles

• If the patient is already on a long acting insulin analogue (e.g. Levemir® or Lantus®) these should be continued.

• Hourly bedside blood glucose measurement should be taken initially to ensure that the intravenous insulin infusion rate is correct.

• If the blood glucose remains over 12mmol/L for 3 consecutive readings and is not dropping by 3mmol/L/hr or more the rate of insulin infusion should be increased.

• If the blood glucose is less than 4.0mmol/L, the insulin infusion rate should be reduced to 0.5 units per hour, and the low blood glucose should be treated as per the National Guideline for the Management of Hypoglycaemia in Adults with Diabetes [2] irrespective of whether the patient has symptoms. However, if the patient has continued on their long acting background insulin, then their VRII can be switched off, but the regular blood glucose measurements need to continue.

Initial rate of insulin infusion – an example

Bedside capillary blood glucose (mmol/L)	Initial rate of insulin infusion (units per hour)
<4.0	0.5 (0.0 if a long acting background insulin has been continued)
4.1 – 7.0	1
7.1 – 9.0	2
9.1 – 11.0	3
11.1 – 14.0	4
14.1 – 17.0	5
17.1-20	6

>20	Seek diabetes team or medical advice

Hypoglycaemia[2]

Hypoglycaemia is the commonest side effect of insulin and sulphonylurea treatment. Hypoglycaemia results from an imbalance between glucose supply, glucose utilisation and current insulin levels. Hypoglycaemia should be excluded in any person with diabetes who is acutely unwell, drowsy, unconscious, unable to co-operate or presenting with aggressive behaviour or seizures. The hospital environment presents additional obstacles to the maintenance of good glycaemic control and the avoidance of hypoglycaemia.

Definition

Hypoglycaemia is a lower than normal level of blood glucose. It can be defined as “mild” if the episode was self treated or “severe” if assistance by a third party was required. For the purposes of patients with diabetes requiring hospital admission, any blood glucose less than 4.0mmol/L should be treated

Clinical Features

Edinburgh Hypoglycaemia Scale

Autonomic	Neuroglycopenic	General malaise
• Sweating • Palpitations • Shaking • Hunger	• Confusion • Drowsiness • Odd behaviour • Speech difficulty • Incoordination	• Headache • Nausea

Causes and risk factors

Causes and risk factors for hypoglycaemia	
Risk factors	Causes
• Impaired awareness of hypoglycaemia • Previous exposure to severe hypoglycaemia • Increasing age • Increasing duration of diabetes • Strict glycaemic control • Sleep • C-peptide negativity	• Insulin doses are excessive, ill timed or of the wrong type of insulin • Inadequate exogenous carbohydrate (e.g. missed meal or snack, overnight fast) • Endogenous glucose production is decreased (e.g. following alcohol ingestion) • Glucose utilisation is increased (e.g. in the middle of the night and following weight loss, improved fitness or glycaemic control) • Insulin clearance is decreased (e.g. renal failure)

Impaired awareness of hypoglycaemia

Impaired awareness of hypoglycaemia (IAH) is an acquired syndrome associated with insulin treatment. IAH results in the warning symptoms of hypoglycaemia becoming diminished in intensity, altered in nature or lost altogether.

Management of Hypoglycaemia

Algorithm A: *Adults who are conscious, orientated and able to swallow*

1) Give 15-20g quick acting carbohydrate of the patient's choice where possible. Some examples are:
    - 150-200 ml pure fruit juice
    - 90-120ml of *original* Lucozade® (preferable in renal patients)
    - 5-7 Dextrosol® tablets (or 4-5 Glucotabs®)
    - 3-4 heaped teaspoons of sugar dissolved in water
2) Repeat capillary blood glucose measurement 10-15 minutes later. If blood glucose are less than 4.0mmol/L, repeat step 1 up to 3 times.
3) If blood glucose remains less than 4.0mmol/L after 45 minutes or 3 cycles, **call for senior help**. Consider 1mg of glucagon IM (remembering that this may be less effective in patients prescribed sulphonylurea therapy) or IV 10% glucose infusion at 100ml/hr
4) Once the blood glucose is above 4.0mmol/L and the patient has recovered, give a long acting carbohydrate. Examples include:
    - Two biscuits
    - One slice of bread
    - 200-300ml glass of milk (not soya)
    - Normal meal if due (must contain carbohydrate)

    DO NOT omit insulin injection if due (a dose review may be required)

Relative hypoglycaemia

Adults who have poor glycaemic control may start to experience symptoms of hypoglycaemia above 4.0mmol/L. Adults who are experiencing symptoms but have a blood glucose level greater than 4.0mmol/L should consume a small carbohydrate snack only (e.g. 1 medium banana or a slice of bread). All adults with a blood glucose level less than 4.0mmol/L, with or without symptoms of hypoglycaemia, should be treated as outlined below.

Algorithm B: ***Adults who are conscious but confused, disorientated, unable to cooperate or aggressive but are able to swallow***

1) If the patient capable and cooperative, follow algorithm **A**) as above
2) If the patient is not capable and/or uncooperative, but is able to swallow give **either** 1.5 - 2 tubes GlucoGel®/ Dextrogel® squeezed into the mouth between the teeth and gums or (if ineffective) give glucagon 1mg IM (remembering that this may be less effective in patients prescribed sulphonylurea therapy)
3) Monitor blood glucose levels after 15 minutes. If still less than 4.0mmol/L repeat steps 1 and 2 up to 3 times
4) If blood glucose level remains less than 4.0mmol/L after 45 minutes (or 3 cycles of **A**1), consider IV 10% glucose infusion at 100ml/hr
5) Once blood glucose is above 4.0mmol/L and the patient has recovered, give a long acting carbohydrate – as outlined above.

   DO NOT omit insulin injection if due (a dose review may be required)

N.B. Patients given glucagon require a larger portion of long-acting carbohydrate to replenish glycogen stores (double the suggested amount above)

Algorithm C: ***Adults who are unconscious and/or having seizures and/or are very aggressive or patients who are nil by mouth***

1) Check: ABC
Disability (including GCS & blood glucose)
Exposure (including temperature)

If the patient has an insulin infusion in situ, **stop it immediately and call for senior help.**

2) The following two options are both appropriate:

i) Glucagon 1mg IM (remembering that this may be less effective in patients prescribed sulphonylurea therapy and may take up to 15 minutes to work).

ii) If IV access available, give 75ml of 20% dextrose **or** 150mls of 10% dextrose over 12-15 minutes. Repeat capillary blood glucose measurement 10 minutes later. If blood glucose less than 4.0mmol/L, repeat

3) Once the blood glucose is greater than 4.0mmol/L and the patient has recovered give a long acting carbohydrate – as outlined above

DO NOT omit insulin injection if due (dose review may be required)

If the patient was on IV insulin, continue to check blood glucose every 30 minutes until it is above 3.5mmol/L, then re-start IV insulin after review of dose regimen

Peri-operative management of diabetes[3]

There has been work to show that poor peri-operative glycaemic control leads to poor outcomes in a variety of surgical specialities. There is detailed guidance available in the JBDS guideline on the peri-operative management of adult patients with diabetes undergoing surgery or procedures [3]

There are several reasons why patients with diabetes experience problems:

Failure to identify patients with diabetes

Lack of institutional guidelines for management of diabetes

Poor knowledge of diabetes amongst staff delivering care

Complex polypharmacy and insulin prescribing errors

There are seven stages in the journey the patient goes through when having surgery. These are: GP referral; surgical outpatients; pre-operative assessment clinic; hospital admission; theatres and recovery; post operative care; discharge. Each stage has its own set of aims and responsibilities, which are described in detail in the JBDS document [3].

It is advocated that, whenever possible, the HbA1c should be below 69mmol/mol (8.5%) prior to surgery.

Manipulation of glucose lowering agents prior to admission to avoid pre-operative overnight admission for glycaemic ‘optimisation’.

Table 1. Guideline for peri-operative adjustment of non-insulin medication (short starvation period – no more than ONE missed meal)

Tablets	Day prior to admission	Day of Surgery	
		Patient for AM surgery	**Patient for PM surgery**
Acarbose	Take as normal	Omit morning dose if NBM	Give morning dose if eating
Meglitinide (repaglinide or nateglinide)	Take as normal	Omit morning dose if NBM	Give morning dose if eating
Metformin (procedure not requiring use of contrast media*)	Take as normal	Take as normal	Take as normal
Sulphonylurea (e.g. Glibenclamide, Gliclazide, Glipizide, etc.)	Take as normal	Once daily am omit Twice daily omit am	Once daily am omit Twice daily omit am and pm
Pioglitazone	Take as normal	Take as normal	Take as normal
DPP IV inhibitor (e.g. Sitagliptin, Vildagliptin, Saxagliptin, Linagliptin)	Take as normal	Omit on day of surgery	Omit on day of surgery
GLP-1 analogue (e.g. Exenatide, Liraglutide)	Take as normal	Omit on day of surgery	Omit on day of surgery

NBM – Nil By Mouth, OD – Once Daily, BD – Twice Daily, TDS – Three times Daily, AM – morning, PM – afternoon

* If contrast medium is to be used and eGFR less than 50mls/min/1.73m2, metformin should be omitted on the day of the procedure and for the following 48 hours.

Table 2. Guideline for peri-operative adjustment of insulin (short starvation period – no more than ONE missed meal)

Insulins	Day prior to admission	Day of Surgery	
		Patient for AM surgery	Patient for PM surgery
Once daily (evening) (e.g. Lantus® or Levemir®. Insulatard® Humulin I®) Insuman®)	No dose change*	Check blood glucose on admission	Check blood glucose on admission
Once daily (morning) (Lantus® or Levemir® Insulatard® Humulin I®) Insuman®)	No dose change	No dose change*. Check blood glucose on admission	No dose change*. Check blood glucose on admission
Twice daily (e.g. Novomix 30®, Humulin M3® Humalog Mix 25®, Humalog Mix 50®, Insuman® Comb 25, Insuman® Comb 50 twice daily Levemir® or Lantus®)	No dose change	Halve the usual morning dose. Check blood glucose on admission Leave the evening meal dose unchanged	Halve the usual morning dose. Check blood glucose on admission Leave the evening meal dose unchanged
Twice daily - separate injections of short acting (e.g. animal neutral, Novorapid® Humulin S®) Apidra® **and intermediate**	No dose change	Calculate the total dose of both morning insulins and give half as intermediate acting only in the morning. Check blood glucose on admission Leave the evening meal	Calculate the total dose of both morning insulins and give half as intermediate acting only in the morning. Check blood glucose on admission Leave the evening meal dose

acting (e.g. animal isophane Insulatard® Humulin I® Insuman®)		dose unchanged	unchanged
3, 4 or 5 injections daily	No dose change	**Basal bolus regimens:** omit the morning and lunchtime short acting insulins. Keep the basal unchanged.* **Premixed am insulin:** halve the morning dose and omit lunchtime dose Check blood glucose on admission	Take usual morning insulin dose(s). Omit lunchtime dose. Check blood glucose on admission

*Some units would advocate reduction of usual dose of long acting analogue by one third. This reduction should be considered for any patient who 'grazes' during the day.

Warn the patient that their blood glucose control may be erratic for a few days after the procedure.

The use of the VRIII should be limited to those who will miss more than one consecutive meal; those who require emergency surgery; and for whom there was no time to optimise their glycaemic control prior to surgery. The rate of insulin infusion is the same as that shown above.

The management of stroke patients with diabetes who require enteral nutrition (Penfold S, Rees A, et al – JBDS in press)

General principles:

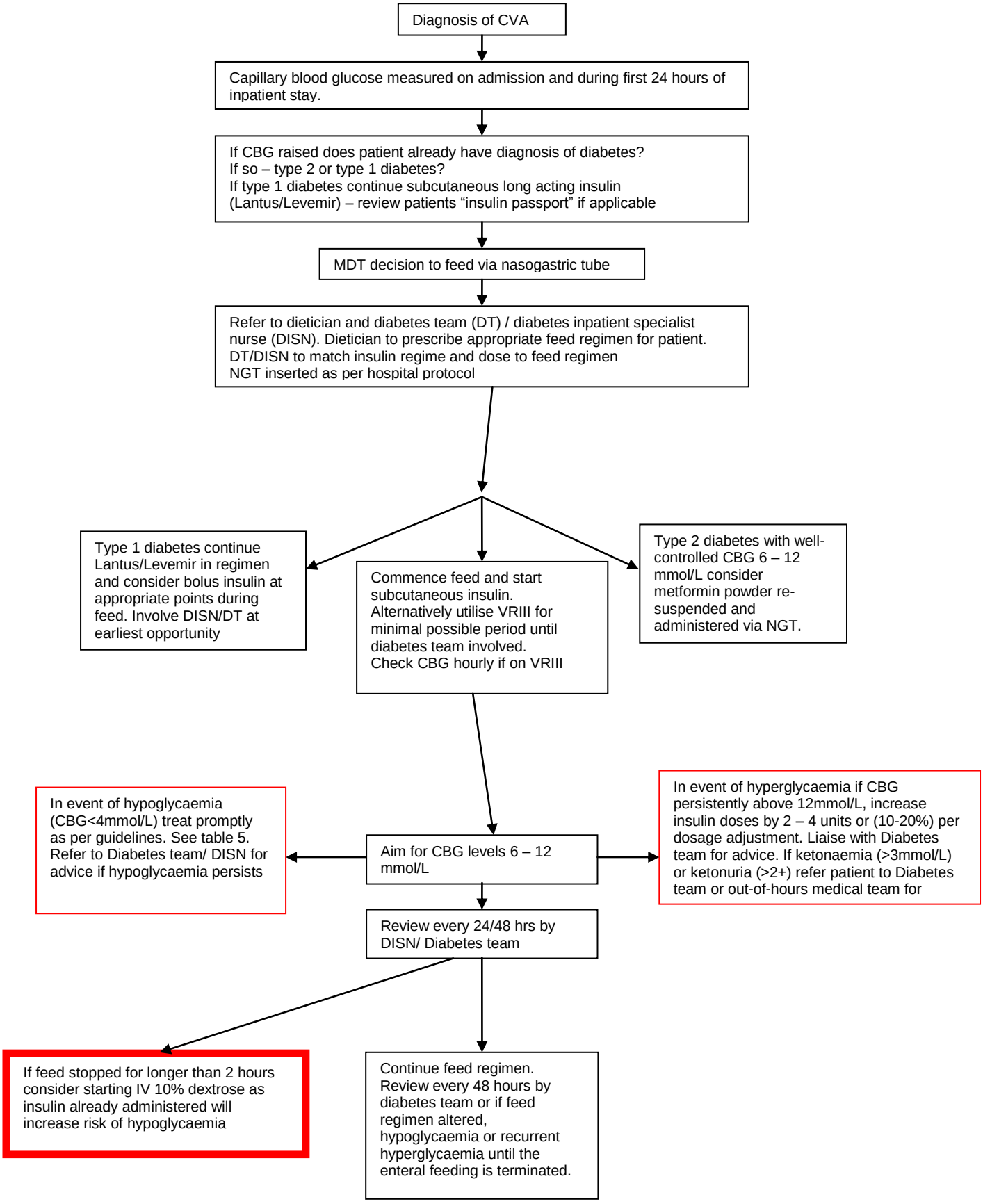
- Regular capillary blood glucose monitoring of all patients presenting with stroke and diabetes or newly recognised hyperglycaemia
- The specialist diabetes inpatient team should be involved at the earliest opportunity
- Type 1 diabetes patients should continue their insulin at all times via the intravenous or subcutaneous route.
- Continue subcutaneous basal insulin in all patients already on it on admission.
- Target blood glucose 6-12mmol/L during enteral feeding.
- Aim to minimise use of a VRIII as far as possible – aiming to establish the patient onto subcutaneous insulin at the earliest opportunity.
- Premixed human insulin at the start and midpoint of the feed, or NPH insulin at the start of the feed are recommended first line options.
- Re-suspension of metformin powder administered via the nasogastric tube may be useful in people with type 2 diabetes.
- Crushing of oral medications for administration via nasogastric tube is not recommended
- Monitor capillary glucose 4-6 hourly when feed running; more frequently when feed switched off.
- Involve the specialist diabetes team immediately in the event of hypoglycaemia or recurrent hyperglycaemia

Blood glucose targets:

- Fasting/Pre-feed 5-8mmol/L
- Feeding 6-12mmol/L
- If capillary blood glucose <4mmol/L or persistently >12mmol/L on two consecutive occasions or evidence of ketonaemia / ketonuria then inform the specialist diabetes team or the on call medical team

The algorithm for managing the diabetes of someone who has had a stroke is shown below

If the patient has an episode of hypoglycaemia then they should be treated as per the algorithm C in the section on hypoglycaemia


Diagnosis of CVA
Capillary blood glucose measured on admission and during first 24 hours of inpatient stay.
If CBG raised does patient already have diagnosis of diabetes?
If so – type 2 or type 1 diabetes?
If type 1 diabetes continue subcutaneous long acting insulin (Lantus/Levemir) – review patients "insulin passport" if applicable
MDT decision to feed via nasogastric tube
Refer to dietician and diabetes team (DT) / diabetes inpatient specialist nurse (DISN). Dietician to prescribe appropriate feed regimen for patient.
DT/DISN to match insulin regime and dose to feed regimen
NGT inserted as per hospital protocol
Type 1 diabetes continue Lantus/Levemir in regimen and consider bolus insulin at appropriate points during feed. Involve DISN/DT at earliest opportunity
Commence feed and start subcutaneous insulin.
Alternatively utilise VRIII for minimal possible period until diabetes team involved.
Check CBG hourly if on VRIII
Type 2 diabetes with well-controlled CBG 6 – 12 mmol/L consider metformin powder re-suspended and administered via NGT.
In event of hypoglycaemia (CBG<4mmol/L) treat promptly as per guidelines. See table 5. Refer to Diabetes team/ DISN for advice if hypoglycaemia persists
Aim for CBG levels 6 – 12 mmol/L
In event of hyperglycaemia if CBG persistently above 12mmol/L, increase insulin doses by 2 – 4 units or (10-20%) per dosage adjustment. Liaise with Diabetes team for advice. If ketonaemia (>3mmol/L) or ketonuria (>2+) refer patient to Diabetes team or out-of-hours medical team for
Review every 24/48 hrs by DISN/ Diabetes team
If feed stopped for longer than 2 hours consider starting IV 10% dextrose as insulin already administered will increase risk of hypoglycaemia
Continue feed regimen.
Review every 48 hours by diabetes team or if feed regimen altered, hypoglycaemia or recurrent hyperglycaemia until the enteral feeding is terminated.

The critically ill patient

There is controversy regarding the best way to treat hyperglycaemia in critically ill patients. There have been a number of studies done in this population, although the vast majority have been done on patients in intensive care or cardiac surgical patients. The results have not been consistent, with some studies showing benefit[4;5], and other showing potential harm[6;7]. In addition, there is currently little consensus on the best way to treat the hyperglycaemia associated poor outcomes following an episode of Acute Coronary Syndrome, however studies to assess this are ongoing. If one accepts the premise that high blood glucose levels are associated with harm, then a pragmatic approach is to keep the blood glucose between 6 and 10mmol/Lusing whatever means necessary – oral medication where appropriate, or a VRIII. Local guidelines should be followed and guidance sought from diabetes specialist teams.

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