Worcestershire Acute Hospitals NHS Trust

Guideline for the perioperative management of diabetes for Adult patients undergoing surgery

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Key Amendments

Date	Amendment	Approved by
21st January 2019	Inclusion of advice for edoxaban. Additional information for the management of medicines for diabetes	Medicines Safety Committee
25th June 2020	Document extended for 6 months during COVID-19 period.	QGC
4th January 2021	Pre-operative assessment Key Documents approved for 3 years	Pre-op Directorate Governance Meeting
31st January 2023 28th March 2023	Updates include advice on SGLT2 inhibitors (omit dose day before surgery), further advice on key responsibilities for pre-op, admissions and anaesthesia teams and contact details when diabetes optimisation required. Updates on insulin advice (on day before surgery take normal dose of long acting insulin if taken in morning). Addition of section for patients who take lunchtime long acting insulin. Review of insulin types in Appendix 1 (addition of admelog / trurani / fiasp / lyumiev / insuman comb 25. Removal of hypurin lente and hypurin protamine zinc. Additiion of Semglee as preferred glargine brand.	Pre-op Directorate Governance/ SCSD Governance/ MSC
7th November 2023	Minor update to long basal insulin types	Dr Hutchinson/Alison Hall/ Alison Smith
5th February 2025	Addition of paragraph into Diabetic Management in Emergency Surgery	Dr Harsha Mistry

INTRODUCTION

This guideline summarises the recommendations of the NHS Diabetes document [(1)] (written by the Joint British Diabetes Societies, Inpatient Care Group and representatives from the specialist societies of surgeons and anaesthetists) for the management of adults with diabetes undergoing surgery and elective procedures.

The aim of the guideline is to improve standards of care, covering all stages of the patient pathway, for people with diabetes undergoing operative or investigative procedures requiring a period of starvation.

The terminology 'sliding scale insulin' is no longer be used, instead substituted by variable rate intravenous insulin infusion (VRIII)

Day case procedure criteria

- ✓ The operation should be an elective procedure suitable for day case.
- ✓ Patient to be starved for 6 hours only (i.e.-not to miss more than one meal) as per trust guidelines.
- ✓ HbA1c < 8.5% or 69mmol/ mol in the last three months – refer back to GP if HbA1c not within this range
- ✓ Patient suitable as a day case as fit to resume self management of diabetes after surgery

Pre-operative assessment

- ☐ The patients type of diabetes must be recorded
- ☐ Ensure glycaemic control is adequate for elective surgery (HbA1c < 8.5% or 69mmol/ mol in the last three months) see section below if HbA1c not within this range.
- ☐ Identify any co-morbidities and relay these to the anaesthetic team
- ☐ Ensure that Urea and Electrolytes and ECG has been requested as a minimum for all diabetic patients

Develop an individualised care plan, written and shared with the person with diabetes and visible for the perioperative team including:

- ☐ Location of surgery
- ☐ Time of surgery – ideally patient should be first on a list
- ☐ Document medication history, noting usual antidiabetes medications and insulin types and doses.
- ☐ Omission of high carbohydrate drinks for people who are treated with insulin. There is some evidence that oral carbohydrate loading may be safe in patients with type 2 diabetes. If a VRIII is to be used carbohydrate loading drinks can be given.
- ☐ Instructions regarding necessary changes to medication using the below protocols
- ☐ Instructions for the person with diabetes on how to seek advice if required during their admission
- ☐ Instructions on what to bring to hospital including a reminder to bring their own diabetes medications and insulin pens
- ☐ Instructions on the importance of travelling to hospital with resources to manage looming hypoglycaemia (i.e. travel with BM monitor and oral glucose gel / dextrose tablets)

Be aware of newer methods of diabetes management:

- ☐ Continuous Subcutaneous Insulin Infusion (CSII) is increasingly being used to manage diabetes. Please consult guideline 'Perioperative Management of Insulin Pump Therapy'. Refer for support from diabetes specialist team.
- ☐ Capillary Glucose Monitors (CGM) i.e. Sensor Libre. These are increasingly being utilised to provide continuous BM monitoring. They can be left in situ during surgery but they are not licensed for use near radiation or diathermy. Therefore the patient should be advised to replace the sensor postoperatively.

Promote ways to prepare for surgery including:

- ☐ Stopping smoking
- ☐ Exercising every day
- ☐ Ensuring good nutrition
- ☐ Aiming for good weight management before surgery
- ☐ Reduce alcohol consumption in line with government guidelines (i.e. <14 units per week)
- ☐ Make necessary adjustments to their responsibilies (i.e. work and caring) and homes to ensure discharge from hospital can happen as smoothly as possible

Refer for specialist management if diabetes not well controlled

- ☐ High HbA1C is associated with poor surgical outcomes.
- ☐ Actions when diabetes is poorly controlled (i.e. HbA1C >69mmol/L within 3 months):

- Where surgery is totally elective (i.e. no urgency) the surgery should be postponed pending improved control. Written correspondence should be sent from the POA clinic to the patient and GP informing them of need to improve HbA1C and an instruction from the GP to re-refer to surgeon when HbA1C is improved (i.e. to below 69mmol/L).
- In certain situations, improved control may not be possible and surgery may proceed after a shared decision making process with patient and surgeon.
- Where surgery is more urgent (i.e. due to cancer, severe pain or ongoing complications from surgical condition) it may be acceptable to proceed. This decision should be a shared decision between pre-assessment anaesthetist, surgeon and patient. The patient must be advised to improve their diabetes control while awaiting surgery. In some cases the patient can see their community diabetes nurse or GP. However, in some cases the hospitals specialist diabetes team should be asked to optimise diabetes control (i.e. no community diabetes nurse contact or impending operation).
- Please contact the diabetes teams using the following methods:
  - Generic **email** for **Worcester** and **Redditch** patients requiring hospital team optimisation: wah-tr.wrhacutediabetes@nhs.net
  - Generic **email** for **Kidderminster** patients requiring hospital team optimisation: wah-tr.wyreforestdiabetes@nhs.net
  - Worcestershire Royal Hospital: **Bleep** 315 for urgent advice
  - Alexandra Hospital: **Bleep** 1030 for urgent advice
  - Kidderminster Treatment Centre: **Bleep** 3323 for urgent advice
  - Community team for Redditch and Bromsgrove patients : At time of writing best contact for these patients is email: wah-tr.redditchbromsgrovediabetes@nhs.net.

Perioperative admission team

- ☐ Patients should have their diabetes medication prescribed as early as possible and ideally before or on admission to hospital.
- ☐ Ensure rescue medication is prescribed to allow prompt treatment of looming hypoglycaemia.
- ☐ Document whether the person with diabetes will be self-managing their diabetes or whether medication will be administered by the ward team
- ☐ Monitor CBG regularly and aim to keep in the range of 6-10 mmol/L (up to 12 mmol/L is acceptable)
- ☐ For those treated with diet alone, or oral medications which do not cause hypoglycaemia (i.e. metformin or DPP4 'gliptins') an acceptable blood glucose range is 4-12 mmol/L
- ☐ In the majority of people with diabetes on glucose lowering medication (i.e. any insulin preparation or insulin secretagogues) consider intervening at a CBG of below 6 mmol/L. However for many optimally managed people with diabetes a range of 4-6 mmol/L may be normal when they are not eating. In these cases it is important to have a discussion with the person about the need to avoid severe hypoglycaemia and the need to aim for higher levels than they are used to. In these cases, the decision about whether to intervene at a CBG of < 6 or <5 mmol/L should be a joint decision.
- ☐ Measure capillary blood ketones is the person with diabetes becomes unwell or has persistent hyperglycaemia (two or more blood glucose values over 13mmol/L)
- ☐ Measure capillary blood ketones daily if the person with diabetes is normally on SGLT2 inhibitors (gliflozins) even if glucose concentrations are normal (these medications can be associated with a euglycaemic ketosis).
- ☐ Inspect foot and pressure areas regularly and take necessary preventive action to prevent pressure injury

Anaesthetic team

- ☐ Aim for capillary blood glucose concentration of 7-11 mmol/l*
- ☐ Check serum electrolytes are satisfactory within laboratory reference range
- ☐ Ensure patient is operated on early in the list
- ☐ Avoid continuous variable rate insulin infusion (VRIII) unless more than one meal is missed or not expected to return to normal diet within 12 hours after surgery

- ☐ If the patient has type 1 diabetes ensure they have received basal/background insulin. If the patient is usually on an insulin pump which needs to be discontinued for surgery please discuss this with the diabetes team.
- ☐ Check blood glucose concentration: prior to induction (if not done in the last one hour) AND hourly during procedure Document capillary blood glucose (CBG), insulin and substrate infusion on the anaesthetic chart as per AAGBI guidelines
- ☐ Use techniques to decrease post-operative nausea /vomiting
- ☐ Multimodal analgesia and antiemetic's recommended (NB dexamethasone may affect serum glucose concentration – consider avoiding completely in diabetic patients. If dexamethasone is used, ensure that CBG is measured at least two hourly for 8 hours after administration)
- ☐ Recommended fluid regimen for elective surgical patients (0.45% sodium chloride and 5% glucose with 0.15% potassium if a VRIII is required)
- ☐ Avoid pressure damage to feet
- ☐ Hand over to recovery staff and document any post-operative instructions including:
    - Medications given in theatre
    - CBG levels
    - Plan for ward based management of diabetes:
        - The need for VRIII
        - Instructions on prescription of subcutaneous insulin at least 30 minutes prior to the discontinuation of VRIII to prevent an 'insulin gap'
        - Criteria for contacting the diabetes, anaesthetic or physician teams supporting postoperative care

* Blood glucose of 4-12mmol/l is acceptable but if level consistently above 13 mmol/l for more than 1 hour commencement of VRIII is recommended.

Surgeons

- ☐ Avoid listing diabetic patients on evening lists
- ☐ Make an early referral to the pre-op assessment clinic in poorly controlled patients
- ☐ Document co-morbidities
- ☐ Highlight day case/in patient (British association of day case surgery)
- ☐ Highlight if the patient has diabetes on Bluespier
- ☐ Prioritize diabetic patients for theatre list
- ☐ Refer any patients with sub optimal diabetes control to diabetes team
- ☐ Encourage primary care to use the diabetes referral sheet
- ☐ Avoid unnecessary overnight pre-op admission and extended pre-op fasting

Theatre Recovery

- ☐ Maintain blood glucose at 7-11 mmol/l
- ☐ Check CBG hourly
- ☐ Ensure VRIII is labelled, connected to the patient via a working infusion device and prescribed
- ☐ Check that antiemetics, intravenous fluids and VRIII are prescribed if required.
- ☐ Encourage early return to oral fluids
- ☐ Contact available anaesthetist for any problems
- ☐ Handover to ward staff of any specific plan

If insulin needs to be given NEVER USE INTRAVENOUS SYRINGES; insulin pen devices or insulin syringes must be used

Prescribers

- ☐ Be aware of the terminology VRIII instead of sliding scale infusion
- ☐ DO NOT use abbreviations for insulin doses (write "units" rather than "u").
- ☐ For patients with VRIII ensure suitable fluids are prescribed. Use of **0.45% sodium chloride and 5% glucose solution with 0.15% potassium is recommended.**

Diabetes Mellitus type 2

DIET ALONE: Check CBG pre-operatively and hourly until able to eat. If glucose level rises to 13mmol/l or more for more than an hour, commence a VRIII (regimen 1) and intravenous fluid.

ORAL HYPOGLYCAEMICS +/- GLP-1 AGONIST:
Please follow guidelines as shown in the table for oral hypoglycaemics. Check capillary blood glucose pre-op and hourly until able to eat. If CBG rises to 13mmol/l or more, commence VRIII and intravenous fluids using VRIII using the dedicated prescription chart. Once able to eat, discontinue any IV treatment and recommence usual oral hypoglycaemics (ref- WHAT END-011[i]). Patients taking metformin who received IV contrast during the procedure must omit Metformin for 48 hours following the procedure if GFR <60ml/min.
If any further advice needed please contact diabetic team.

Guidance on ORAL HYPOGLYCAEMICS Short starvation period (no more than one missed meal)

Oral hypoglycaemic	Day before admission	Day of surgery (AM list)	Day of surgery (PM list)
Acarbose	Take as normal	Omit Morning dose if NBM	Give morning dose if eating
Meglitinide (repaglinidine or nateglinide)	Take as normal	Omit morning dose if NBM	Give morning dose if eating
*Metformin (Procedure not requiring contrast media)	Take as normal	Take as normal	Take as normal
Sulphonylurea (e.g Glibenclamide,Glicazide,Glipizide)	Take as normal	Omit AM dose	Omit AM and PM doses
DPP IV inhibitor (e.g. sitagliptin,Vidagliptin,Saxagliptin)	Take as normal	Take as normal	Take as normal
GLP-1 analogue (e.g.Exenatide,Liraglutide)	Take as normal	Take as normal	Take as normal
Pioglitazone	Take as normal	Take as normal	Take as normal
SGLT-2 Inhibitors (e.g. Dapagliflozin, Canagliflozin, Empagliflozin)	Omit on day before surgery	Omit on day of surgery	Omit on day of surgery**

*If patient is on three-times/day regimen omit the middle dose on day of surgery. For patients undergoing IV contrast with normal renal function (GFR >60ml/minute), there is no need to omit metformin. For patients with renal impairment with GFR <60ml/min, stop metformin on the day of surgery and for 48 hours following the procedure. Restart metformin when renal function is satisfactory.

** Withhold SGLT-2 inhibitors until discharge from hospital due to risks of euglycaemic DKA.

Diabetes Mellitus type 1

Guidance on INSULIN (+/- ORAL HYPOGLYCAEMICS):
If only one meal is likely to be missed, give insulin as shown in Table. If more than one meal is likely to be missed, commence VRIII

Insulin		Day before admission	Day of surgery (am) [Morning list]	Day of surgery (pm) [Afternoon list]	Whilst VRII in place
Once daily (morning)		Take usual dose	Reduce usual dose of long acting insulin by 20%. Check blood glucose on admission	Reduce usual dose of long acting insulin by 20%. Check blood glucose on admission.	Give 80% of usual dose
Once daily (evening)		Reduce dose by 20%	Check blood glucose on admission. Give insulin at normal dose when eating and drinking starts.	Check blood glucose on admission. Give insulin at normal dose when eating and drinking starts.	Give 80% of usual dose
Once daily (lunchtime)		Reduce dose by 20%	Restart insulin at normal dose when eating and drinking starts	Restart insulin at normal dose when eating and drinking starts	
Twice daily fixed mixture		Give usual insulin	Halve usual morning dose. Check blood glucose on admission. Take usual evening dose	Halve usual morning dose. Check blood glucose on admission. Take usual evening dose	STOP
Basal bolus regimen	Bolus Insulin	Give usual insulin	Omit the morning and lunchtime short acting insulins. Stop until eating and drinking normally	Take usual morning insulin dose(s). Omit lunchtime dose. Check blood glucose on admission	STOP
	Basal Insulin	Give usual insulin	If the dose of long acting basal insulin is usually taken in the morning then the dose should be reduced by 20%*	Take usual dose.	Continue Basal insulin as per CVRII guideline
Any other regimen (e.g insulin pump)		Consult diabetes team	Consult diabetes team	Consult diabetes team	Consult diabetes team

Check CBG pre-operatively and hourly until the patient is able to eat. If CBG rises to 13mmol/l or more, commence VRIII and intravenous fluids using VRIII using the dedicated prescription chart. Once able to eat, recommence usual insulin and discontinue any IV treatment 1 hour after SC insulin injection.

If more than one meal is likely to be missed, commence a VRIII and intravenous fluids.

Please see Appendix 1 for examples of insulin preparations.

Conversion of VRIII back to patient's usual treatment

If a VRIII is required, it must be continued for 30 minutes after the patient has had their subcutaneous insulin injection – transition back to the usual subcutaneous insulin regimen should take place when the next meal-related subcutaneous insulin dose is due. If the patient is taking oral hypoglycaemics and requires a VRIII, stop the VRIII once the patient is able to eat. Recommence oral hypoglycaemic agents once the patient is ready to eat and drink. Withholding or reducing the dose of sulphonylureas may be required if the patient's oral intake is poor

If any doubts, consult the diabetes team

Diabetic Management in Emergency Surgery

For all diabetic patients undergoing emergency surgery, use of a VRIII should be considered the default technique, due to the difficulty in predicting starvation times pre-operatively and the timing of recommencing a normal oral diet post-operatively.

The aim should be for the patient to be taken to surgery with a CBG of 7-11mmol/l and after adequate resuscitation.

If the patient has evidence of DKA and requires emergency surgery, senior input from anaesthetic, intensive care, surgical and diabetic consultant staff should be sought to agree an optimal peri-operative plan with regards to pre-operative optimisation, timing of surgery and post-operative care. Operating on a patient with DKA carries a high mortality, and should be avoided or delayed if at all possible.

If a patient having emergency surgery is on a SGLT-2 inhibitor preoperatively (and this is not stopped) then the patient should:

- stop SGLT-2 inhibitor medication
- the patient should have daily blood ketone levels checked
- capillary blood gas should be checked regularly

Management of Intra-operative Hyperglycaemia and Hypoglycaemia

- Death or severe harm due to maladministration of insulin is a 'Never Event". As such, a **two person check MUST be performed and documented before administering subcutaneous insulin intra-operatively**

Hyperglycaemia (CBG >12mmol/l) in a patient with Type-1 Diabetes

- Subcutaneous rapid-acting insulin (e.g Novorapid or Humalog) should be administered to a maximum of 6 International units assuming that 1 unit will drop the CBG by an average of 3mmol/l. The aim is a CBG of 7-11mmol/l

- After administration, the CBG should be checked hourly and a second dose not administered less than 2 hours after the initial dose. If after two doses the patient remains hyperglycaemic, a VRIII should be started

- Ensure the patient has not missed their basal/background/long-acting insulin

Hyperglycaemia (CBG >12mmol/l) in a patient with Type-2 Diabetes

- Subcutaneous rapid-acting insulin (e.g. Novorapid or Humalog) at a dose of **0.1 units /kg** should be administered, up to a maximum of 6 units.
- CBG should be checked at least hourly (aiming for 6-10mmol/l) and a second dose not administered less than 2 hours after the initial dose

- Consider starting a VRIII if the patient remains hyperglycaemic after the second dose

Management of Intra-operative Hypoglycaemia

- If the CBG is 4-6mmol/l, 50ml of 20% glucose should be administered intravenously

- If the CBG is <4mmol/l, 100ml of 20% glucose should be administered intravenously

Fluid Management in the Peri-operative period

When a VRIII is in use

If a VRIII is in use, it is recommended that the fluid that should accompany this is **0.45% sodium chloride with 5% glucose and 0.15% potassium chloride** (0.3% potassium chloride should be used instead if the patient's serum potassium is less than 3.5mmol/l). A CBG must be checked at least hourly when a VRIII is in use.

0.45% sodium chloride with 5% glucose should be administered at a rate that meets the patient's *maintenance* fluid requirements. This will be 25-50ml/kg/day (which is approximately 83ml/hr for a 70kg patient)

Any additional fluid that is required to optimise the patient's intravascular volume status should be given as Hartmann's Solution, at a rate appropriate to correct the intravascular deficit.

When a VRIII is not in use

If a VRIII is not in use, intravenous solutions containing glucose should be avoided, unless the blood glucose is low.

To avoid the hyperchloraemic metabolic acidosis associated with excess administration of 0.9% sodium chloride, **Hartmann's Solution should be used as the default fluid for all patients in the peri-operative period.**

If a prolonged period of post-operative fluid replacement (>24 hours) is likely to be required because of the surgical procedure performed, then use of a VRIII peri-operatively should be considered.

Diabetic Management in Enhanced Recovery Protocols

Enhanced Recovery protocols often utilise carbohydrate drinks pre-operatively to both reduce the absolute fasting time before surgery and to improve recovery post-operatively. However, **in insulin-dependent diabetics who are likely to have a short period of fasting, carbohydrate drinks should be omitted on the morning of surgery.**

If use of a VRIII is planned (due to the length of the planned procedure, or a predicted prolonged fasting period post-operatively), then carbohydrate drinks should be administered as per the standard enhanced recovery protocol.

In general, use of enhanced recovery protocols should be encouraged in all diabetic patients, as they promote shortened fasting periods, and may negate the need for a VRIII where one may otherwise be required.

[i] Guideline for use of insulin

REFERENCES

1. Dhatariya K NHS Management of adults with diabetes undergoing surgery and elective procedures: improving standards. Summary. Revised 2015 (amended March 2016). https://www.diabetes.org.uk/About_us/What-we-say/Specialist-care-for-children-and-adults-and-complications/Management-of-adults-with-diabetes-undergoing-surgery-and-elective-procedures-improving-standards/ accessed 8.7.2016.
2. Surgery in patients with diabetes mellitus. G. Gill in Textbook of Diabetes. Eds. Pickup JC, Williams G. 2nd edition 1997 Blackwell Science.
3. Peri-operative management of the surgical patient with diabetes 2015: Association of Anaesthetists of Great Britain and Ireland. P. Barker, P. E. Creasey, K. Dhatariya,1 N. Levy, A. Lipp,2 M. H. Nathanson (Chair), N. Penfold,3 B. Watson and T. Woodcock.
4. Guideline for Perioperative Care for People with Diabetes Mellitus Undergoing Elective and Emergency Surgery. Centre for Perioperative Care. Updated December 2022.

Appendix 1 – Injectable Insulin Table

Injectable Insulin table

Use in conjunction with Guidance on Insulin table (under Diabetes Mellitus Type 1)

1. Rapid Bolus Insulin types

- These may be used as the BOLUS component of the 'Basal Bolus' regime

Brand name	Approved name	Typical dosing
Apidra	Glulisine	Immediately before or within 15 minutes of a meal OR continuous SC infusion via insulin pump system
Admelog	Lispro	
Humalog	Lispro	
Lyumjev	Lispro	
Trurapi	Aspart	
Novorapid	Aspart	
Fiasp	Aspart	

2. Short bolus insulin types

- These may be used as the BOLUS component of the 'Basal Bolus' regime

Brand name	Approved name	Typical dosing
Actrapid	Soluble Insulin	Three times daily 30 minutes before meals OR Actrapid variable rate intravenous insulin infusion (VRIII)
Humulin S	Soluble Insulin	
Insuman Rapid	Soluble Insulin	
Hypurin Neutral (non-formulary)	Soluble Insulin	
Humulin R U 500 (unlicenced)	Human, rDNA origin	Two or three times daily before meals

3. Intermediate basal insulin types

- These may be used as the BASAL component of the 'Basal Bolus' regime

Brand name	Approved name	Typical dosing
Insulatard	Isophane	Once or twice daily, 30 minutes before meals
Humulin I	Isophane	
Insuman Basal	Isophane	
Hypurin Isophane	Isophane	

4. Long basal insulin types

- These may be used as the BASAL component of the 'Basal Bolus' regime
- These may be given once or twice daily. The day before the patient may need to reduce their dose by 20% (depending on whether they take insulin in morning or afternoon – see page 6)

Brand name	Approved name	Typical dosing
Lantus / Semglee Abasaglar	Glargine	Once daily, usually at bedtime
Toujeo	Glargine (high strength)	Once daily, at same time each day
Levemir	Determir	Once or twice daily
Tresiba	Degludec	Once daily

5. Fixed Mixture insulin types

Brand name	Approved name	Typical dosing
Novomix 30	Biphasic Aspartr	Twice daily, before or within 15 mins of meal
Humalog Mix 25 Humalog Mix 50	Biphasic Lispro	
Humulin M3	Biphasic Isophane	Twice daily, 30 minutes before meals
Hypurin 30/70 mix	Biphasic Isophane	Twice daily, 30 minutes before meals
Insuman Comb 25	Biphasic Isophane	Twice daily, 30 minutes before meals