

Being too sweet... 'to siphon honey'

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Guidelines for Peri-operative management of the Adult Diabetic patient.

Scope of the problem...

Diabetes is a growing global problem, the prevalence has more than doubled since 1980, and predicted to reach epidemic proportions by 2040ⁱ. One in eleven people has been diagnosed with diabetes and 90% of those are type 2, with a large proportion being obesity related. The incidence in New Zealand is 240 000 with 50 newly diagnosed dailyⁱⁱ, in Australia 1.2 million with 280 patients newly diagnosed daily - that is one person every five minutesⁱⁱⁱ! It is the fastest growing chronic condition in Australasia. The financial burden on health is staggering and furthermore a large proportion of these patients presents for surgery.

10-15 % of the surgical population is diagnosed with diabetes, and 40% of those presenting for intermediate or high-risk surgery are yet to be diagnosed. There is a growing reasoning that all those presenting for intermediate or high-risk surgery should be screened.

The significance...

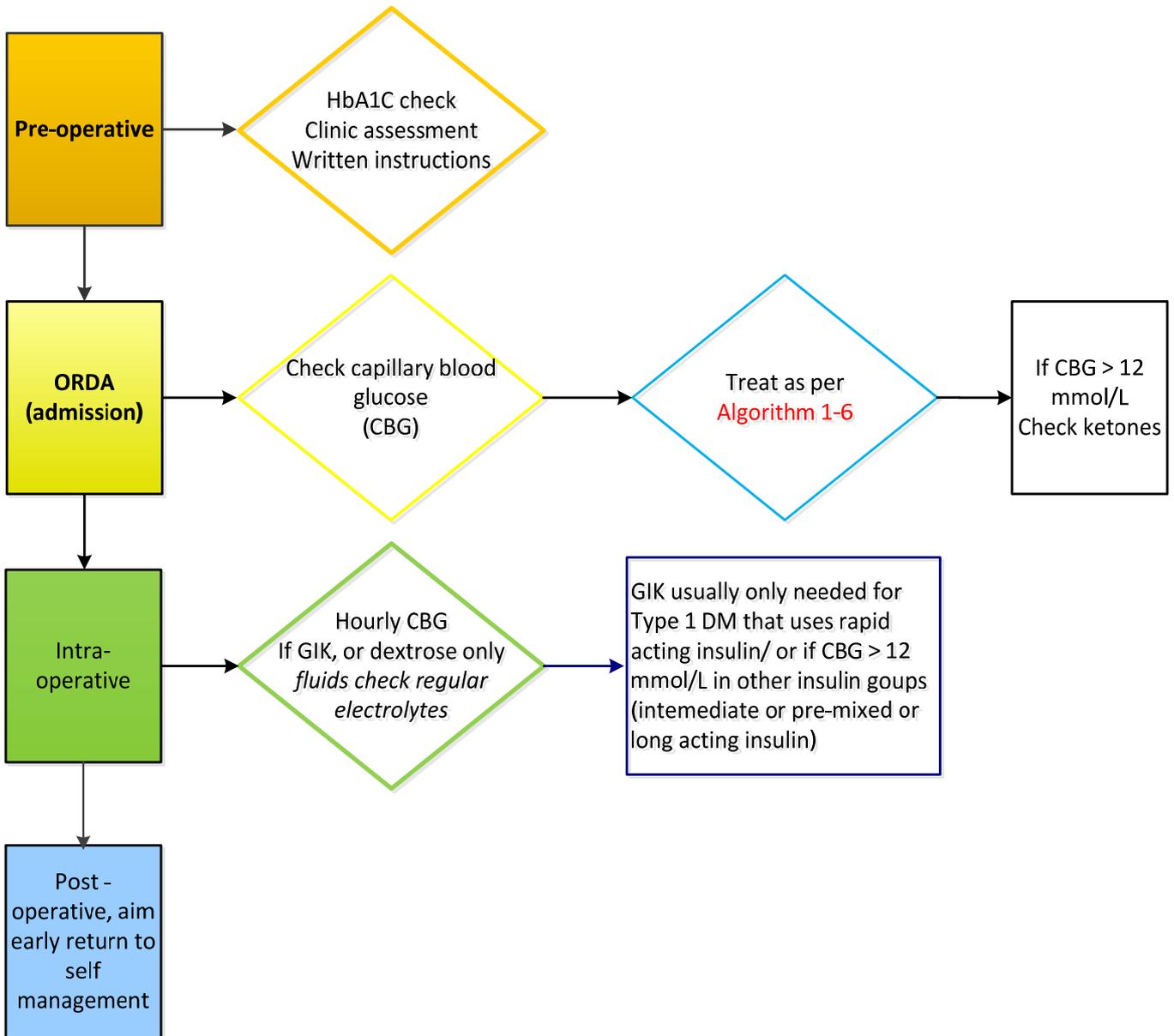
The implication of post-operative complications has a significant impact on the outcome morbidity and mortality in this group^{iv}.

In poorly-controlled diabetics there is a **greater than 50% increase in mortality, a 2.4-fold increase in the incidence of postoperative respiratory infections, a doubling of surgical site infections, a threefold increase in postoperative urinary tract infections, a doubling in the incidence of myocardial infarction, and an almost twofold increase in acute kidney injury^v.**

Key points for modern management of the surgical patient:

- Optimal pre-operative HbA1c < **69mmol/mol**
- The target blood glucose range perioperative is **6-10 mmol/L** (but acceptable range is 5-12mmol/L) *If a patient's usual BSL level is high normal, aim for high normal peri-operatively*
- **Hyperglycaemia defined as >12mmol/L**
- **and check for ketones if >12 mmol/L (> 15mmol/L in Australia)**
- For patients with Type 1 Diabetes: **NEVER STOP** the subcutaneous **basal insulin** (e.g. Lantus®, Protaphane® or Humulin NPH®). The dose may need adjusting in some population groups e.g. 'grazers'
- Insulin pumps - if the patient is able to 'self-manage' during the perioperative period, the insulin pump therapy should be continued using the '**sick day regime**'. If not able to self-manage, the pump should be discontinued and diabetes managed with a GIK infusion
- Those patients with poor glycemic control (**HbA1c > 69 mmol/mol**) should be **deferred** if possible and referred to a diabetologist /diabetes nurse specialist before elective surgery
- Note: **Risk of hyponatremia** with use of only 5% or 10% Dextrose as IV fluid, if running a GIK (Glucose/ Insulin/ Potassium Infusion) require at least daily checks of electrolytes, especially sodium
- Written advice for all surgical patients including hypo- and hyperglycemia management advice

Basic Patient flow diagram peri-operatively:

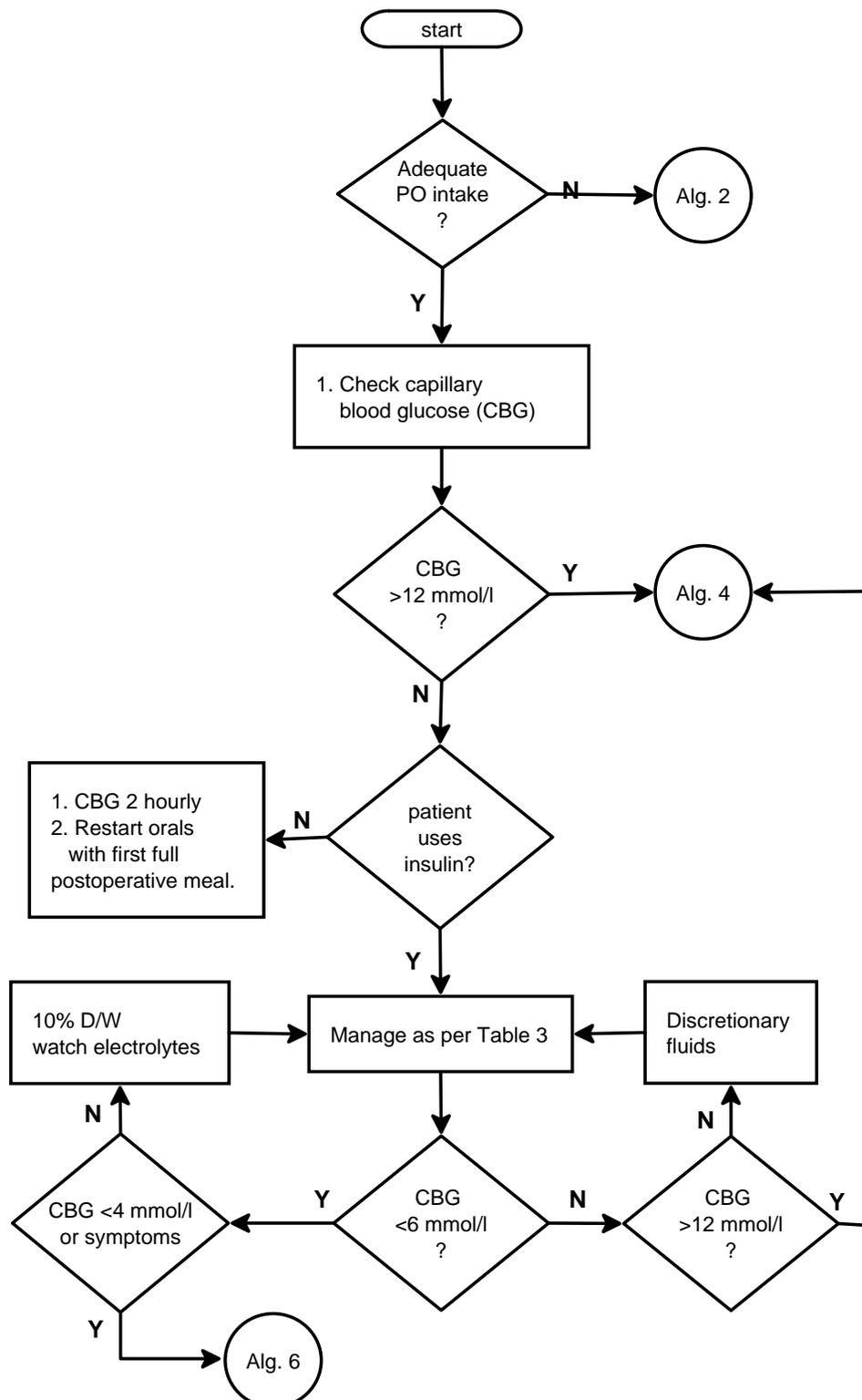


Algorithm 1

PATIENTS WHO CAN EAT WITHIN 6 HRS AFTER SURGERY

Special considerations

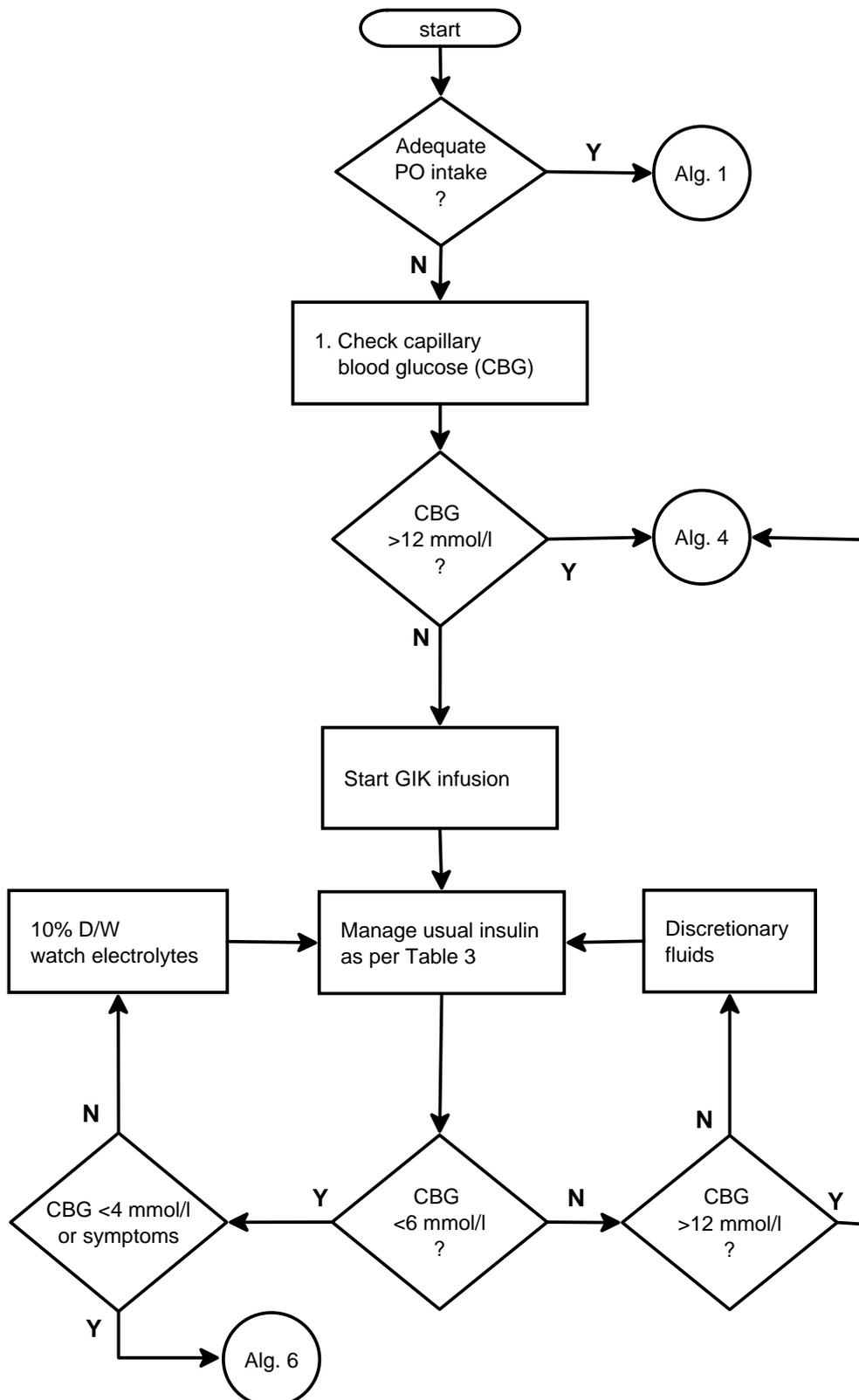
1. Patients on insulin pump *must attend* a preoperative anaesthetic clinic. On the day of surgery, use 'sick day' or basal 'sleep' rate.
2. A patient on long acting glargine (Lantus™) or detemir (Levemir™) can have their usual basal dose irrespective of the type of surgery. Use in conjunction with GIK, if GIK is required peri-operatively.



Algorithm 2

THE PATIENT CAN'T EAT WITHIN 6 HOURS

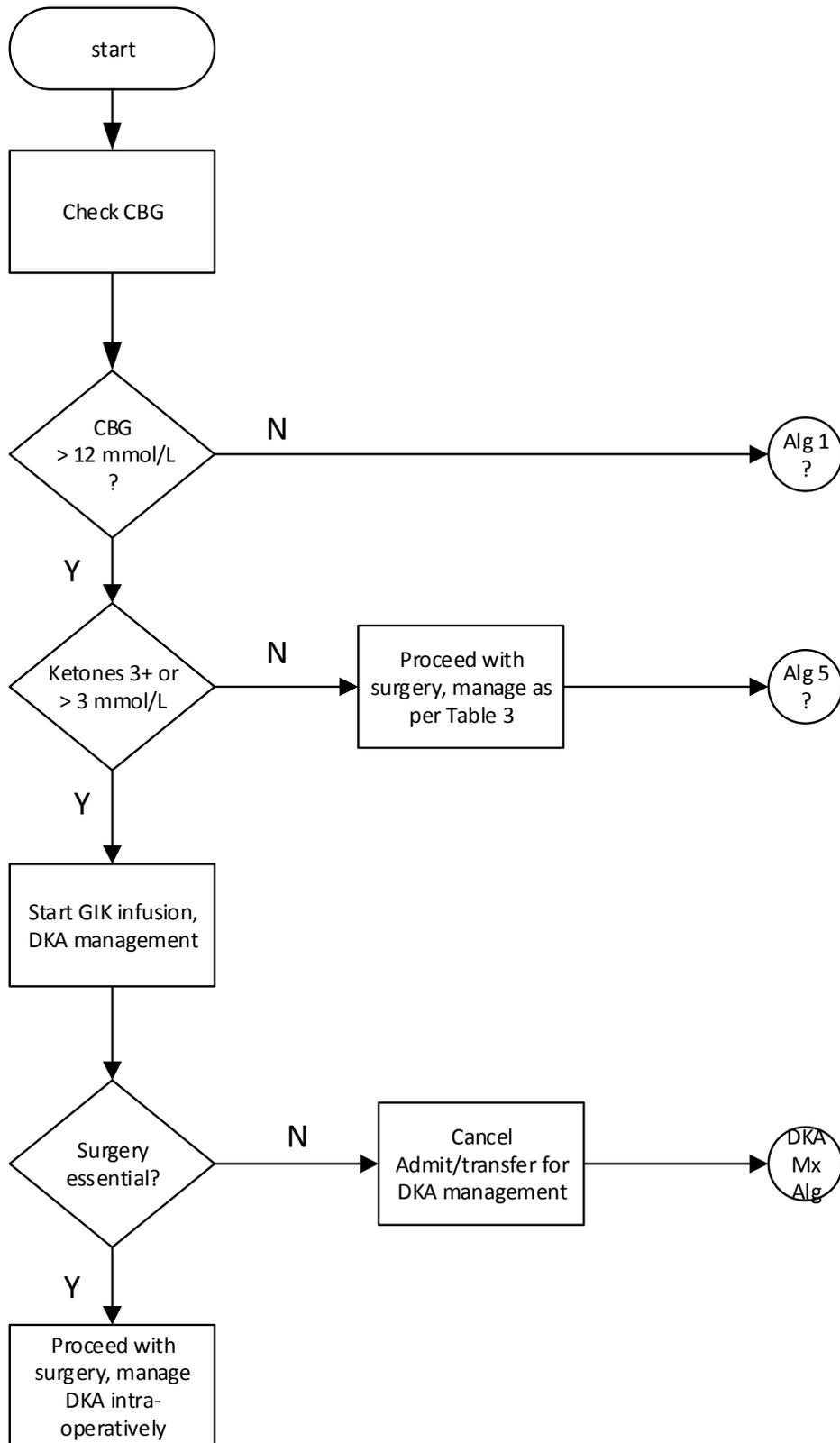
This section applies to a **diabetic patient** undergoing any procedure for which they will be NBM pre- or post-procedure. It does not apply to ophthalmology patients (see [perioperative management - ophthalmology](#)). **NB. Starvation starts at point of first missed meal.**



Algorithm 3

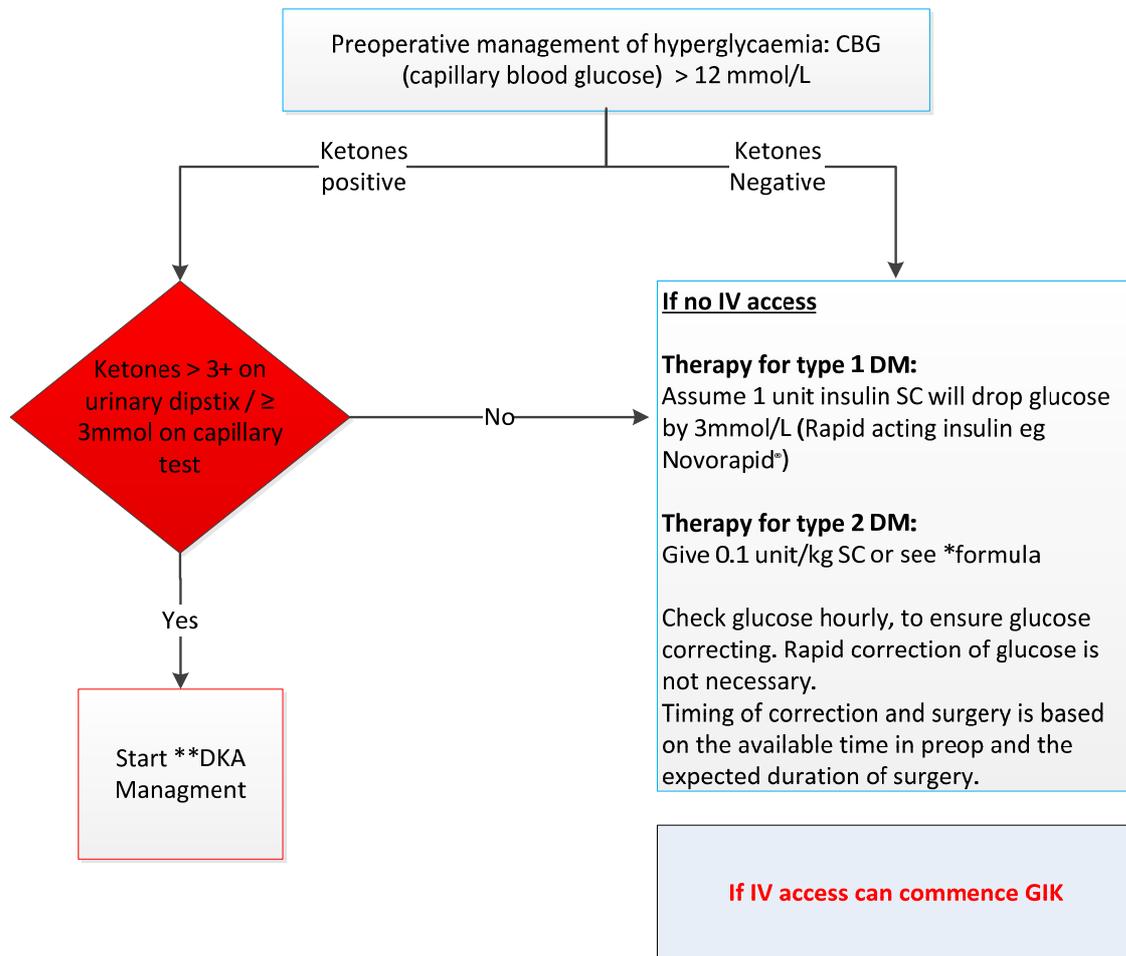
POOR GLYCAEMIC CONTROL (HBA1C > 69)

Poor pre-operative glycaemic control



Algorithm 4

HYPERGLYCEMIA



Choice of route of administration and other issues

Rapid acting insulin is for subcutaneous use only

Subcutaneous insulin every 1-2 hours provides similar glucose control as IV infusion in patients with DKA

Regular insulin by IV bolus half-life is <10min so will require larger doses by IV for adequate control

Dose determination – traditional sliding scale assumes that all patients have similar insulin sensitivities or that there is no change in insulin sensitivity during different stages of acute illness – which is incorrect.

***Determine insulin sensitivity/resistance for dose determination: 80/100 rule**

Calculate total daily insulin requirement then

If using regular insulin – $80/\text{total daily dose} = \text{expected glucose decrease/unit insulin}$

If using rapid acting insulin – $100/\text{total daily dose} = \text{expected glucose decrease/unit insulin}$.

(Example: daily dose of 60 units - 1 unit insulin will reduce glucose by 1.5 mmol/L)

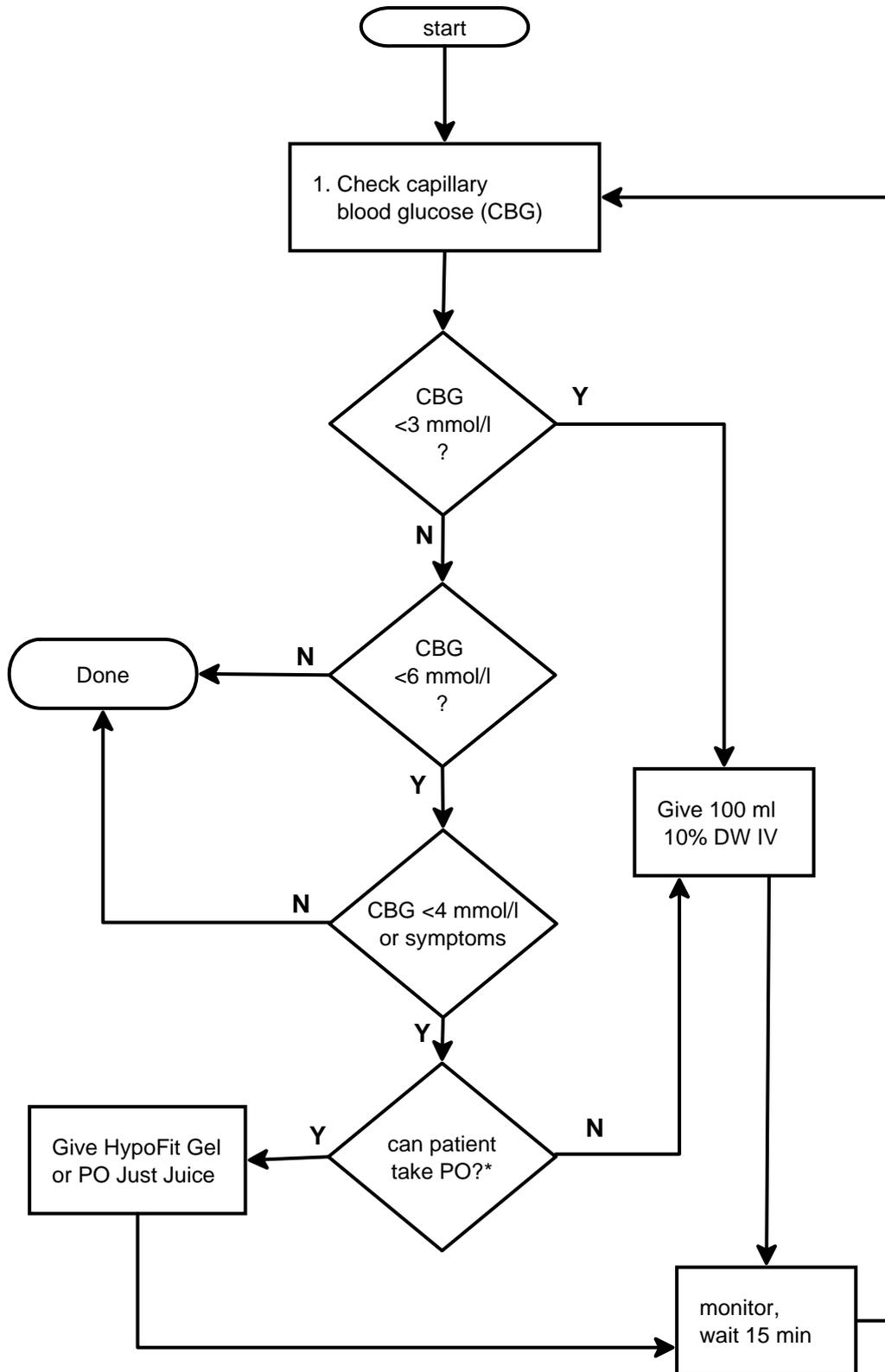
**DKA = Diabetic
Ketoacidosis

*

For Type 2 DM correction with 0.1 mg/kg SC up to a maximum of 6U of rapid acting insulin.

Algorithm 5

HYPOGLYCEMIA



Management of Oral Hypoglycaemic agents -

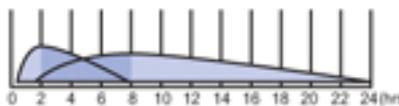
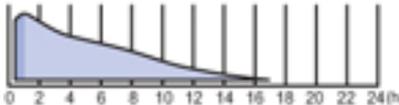
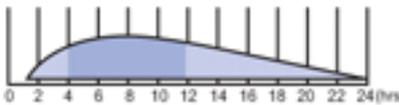
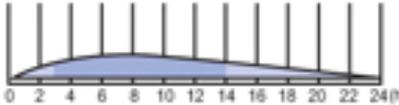
Tablet	AM surgery	PM surgery
Acarbose	Omit morning dose	Take morning dose if eating
Metformin	Take as usual <i>if able to eat within 6 hours</i> post-operatively*	Take as usual <i>if able to eat within 6 hours</i> post-operatively*
	* OMIT if impaired renal function (eGFR < 50mL/ min/m ²) or if having cardiac surgery/procedures requiring contrast, or if starvation period continue for more than 6 hours post-operatively.	
Pioglitazone	Take as normal BUT omit for Cardiothoracic surgery	Take as normal BUT omit for Cardiothoracic surgery
Sulfonylureas (glibenclamide, glipizide, gliclazide)	Omit (restart when eating normally)	Omit (restart when eating normally)
DPP4 inhibitors (saxagliptin, sitagliptin)	Omit	Omit
GLP-1 agonist (exenatide)	Omit	Omit

Note: *If patient is ill with sepsis, has cardiac failure, renal failure or diarrhoea then metformin needs to be withheld - risk of lactic acidosis.*

DPP4 inhibitors: dipeptidylpeptidase-4 inhibitors

GLP-1 receptor agonist: glucagon-like peptide-1

Management for patients on insulin -

Types of Insulin Available	Brand Name	Activity (may vary between patients)	Profile
Rapid Acting	Humalog®* Apidra® Novorapid®	<u>Onset</u> : up to 20 minutes <u>Peak</u> : 1-2 hours <u>Duration</u> : 2-5 hours	
Short Acting	Humulin R® Actrapid®	<u>Onset</u> : 30 minutes <u>Peak</u> : 2-4 hours <u>Duration</u> : 6-8hours	
Withhold dose while NBM, normal dose the night before surgery. Check BSL 2 hourly while NBM.			
Premixed insulin	Humulin 30/70® Penmix 30® Mixtard 30® Penmix 50®	<u>Onset</u> : 30 minutes <u>Peak</u> : 2-8 hours <u>Duration</u> : Up to 24 hours	
Rapid Acting Premixed Insulin	Humalog Mix 25® Novomix 30®	<u>Onset</u> :0-15 minutes <u>Peak</u> : 30-70 minutes <u>Duration</u> :16-18 hours	
	Humalog Mix 50®	<u>Onset</u> :0-15 minutes <u>Peak</u> : 30-70 minutes <u>Duration</u> :16-18 hours	
If AM surgery: give 50% of usual dose on admission to hospital with hourly CBG checks** If PM surgery: 50% of am dose with light breakfast			
Intermediate Acting	Humulin NPH® Protaphane®	<u>Onset</u> :1-2 hours <u>Peak</u> : 4-12 hours <u>Duration</u> : Up to 24 hours	
If AM surgery: give 80% of dose on admission to hospital with hourly CBG checks** If PM surgery: give 80% of AM dose with light breakfast at home and advice for hypoglycaemia management.			
Long Acting	Detemir (Levemir®) Glargine (Lantus®)	No pronounced peak Duration: Up to 24 hours	
Administer usual dose regardless of timing of surgery or starvation status.			

**If CBG < 4 mmol/L and ≥2 hours pre-operative give 200 mL clear apple juice/tropical just juice or hypo-fit gel, if less than 2 hours commence glucose 10% infusion at 80 mLs/hr if CBG 4 - 6 mmol/L and if < 4mmol/L at 120 mL/hour. Still administer basal insulin for Type 1 DM.

If CBG > 12 mmol/L, ensure if on long acting insulin to take usual dose or 80% of usual dose of intermediate acting insulin and start GIK, in addition check for ketones and if 3+ start DKA management.

Patients should have 80 mL/hr of glucose 10% whilst starvation ongoing once they are administered their usual insulin and CBG < 6mmo/L (fluid management is at the discretion of the procedural anaesthetist in theatre).

These, and international guidelines takes a pragmatic approach to the peri-operative management of the diabetic patient having surgery. The diversity of patients makes it a very difficult topic, clearly there will be individuals who do not fit a specific pathway. Most diabetic patients have vast experience in managing their own diabetes, and the aim is now to manipulate 'normal' insulin regimes, moving away from using the GIK or VRIL (variable rate insulin) and aiming for early return to self-management. Admission on day of surgery, having been assessed and optimised in the pre-assessment clinic. All patients should have a written plan*, and ideally listed first to minimise disruption to glycaemic control and minimise starvation time.

Other considerations...

If Dexamethasone is used as post-operative nausea and vomiting prophylaxis blood glucose level should be checked hourly for four hours. If possible use alternative anti-emetic.

ERAS (Enhanced recovery after surgery) – this group of patients are likely ideal ERAS however use of carbohydrate drink should not be used for Type 1 DM with a is short starvation time, it can be used for Type 2 DM and for all types DM if GIK or VRIL used. Evidence in this population scant and gastric emptying may be delayed^{vi}.

Controversies...

Contrary to previous understanding the risk of lactic acidosis with metformin is low. However it should still be withheld in the patient with renal impairment or if contrast used intra-operatively^{vii}. It was found that those who continued with metformin, often inadvertently, had improved outcomes compared with those patients who omitted metformin as instructed^{viii}.

Safety...

Insulin was listed as one of the top five 'high risk' medications in a National Audit in the UK (NaDIA). Half of patients treated with insulin had a medication error on their drug chart^{ix}. The VRIL is still overused and patients are at risk of DKA (diabetic ketoacidosis) during transition from intravenous to sub-cutaneous insulin management.

There is also risk of hyponatremia associated with the GIK.

*Advice pamphlets

Advice for diabetic patients who use insulin to manage their diabetes before surgery

Please bring all your usual medication, tablets and Insulin to hospital on the day of surgery.

If you use **Insulin** to manage your diabetes please discuss this with your **anaesthetist** or pharmacist.

If you use Lantus (Glargine) or Detemir (Levemir) Insulin you may continue to administer your usual dose.

If your surgery is in the morning: administer your own insulin when you get to hospital. But if you use long acting insulin Detemir (Levemir) or Lantus (Glargine), you can administer it at home.

If your surgery is in the afternoon: administer your own insulin at home after having a light breakfast.

Advice for low blood sugar management (blood sugar level < 4 mmol/L) or if you having symptoms of low blood sugar on the morning of surgery:

If your blood sugar level is < 4 mmol/L two hours before surgery you can have 200mls clear apple juice, tropical just juice or hypo-fit gel. Recheck your blood sugar level and proceed to hospital accompanied.

If it is less than two hours before your surgery and you are at hospital the staff should start a glucose infusion.

If your blood sugar level is > 12 mmol/L please advise staff at the hospital and they will start treatment and check for ketones in your urine or blood as soon as you arrive.

Other instructions:

If you unsure what to do, do not take anything BUT bring all your medication to hospital.

For more information contact:

Instructions for your type of Insulin

	Types of Insulin Available	Lilly Brand Name	Novo Brand Name	Day of surgery	Calculated dose for day of surgery
<input type="checkbox"/>	*Rapid Acting/Short Acting	Humalog*/ Humulin R	Novorapid /Actrapid	Do not have a dose	
<input type="checkbox"/>	Intermediate Acting	Humulin NPH	Protaphane	Have 80% of your normal dose (ask the pharmacist or anaesthetist to work out the correct dose) and check your blood sugar every hour for first two hours. For morning surgery only administer Insulin once you've arrived at hospital. For afternoon surgery administer insulin after light breakfast at home.	
<input type="checkbox"/>	Long Acting		Detemir (Levemir)	Have your usual dose regardless of time of surgery, and check your blood sugar as usual.	
<input type="checkbox"/>	Long acting	Glargine	Lantus	Have your usual dose regardless of time of surgery, and check your blood sugar as usual.	
<input type="checkbox"/>	*Premixed Insulin/ Rapid Acting Insulin	Humulin 30/70 Humalog Mix 25 Humalog Mix 50	Penmix 30 Mixtard 30 Penmix 50 Novomix 30	If morning surgery : half of usual dose on admission to hospital with hourly blood sugar checks. If afternoon surgery : half of morning dose with light breakfast and check blood sugar levels hourly for two hours then as usual.	

*Do not confuse Humalog (rapid acting) with Humalog Mix 25 and Humalog Mix 50 (premixed preparations)

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Advice for diabetic patients who take oral medication and are undergoing surgery.

Please bring all your usual medication, tablets and Insulin to hospital on the day of surgery.

Please do not take **any** of your usual diabetic medication unless told by the Anaesthetist or Pharmacist to do so. **If you are unsure what to do, take nothing and bring all your medication to hospital.**

Instructions for your oral diabetic medication have been ticked, highlighted or circled below:

	Tablet	Having surgery in the morning:	Having surgery in the afternoon:
<input type="checkbox"/>	Acarbose	Do not take usual morning dose if not having breakfast.	Take your usual morning dose if having light breakfast.
<input type="checkbox"/>	Metformin	Take your usual morning dose, But do not take dose if: <ul style="list-style-type: none"> <input type="checkbox"/> You won't be eating for more than six hours after surgery, for example having bowel surgery. <input type="checkbox"/> Having contrast studies (Radiology). <input type="checkbox"/> Having heart or lung surgery. 	Take your usual <u>morning and afternoon</u> dose, But do not take afternoon dose if: <ul style="list-style-type: none"> <input type="checkbox"/> You won't be eating for more than six hours after surgery, for example having bowel surgery. <input type="checkbox"/> Having contrast studies (Radiology). <input type="checkbox"/> Having heart or lung surgery.
<input type="checkbox"/>	Pioglitazone	Take as normal. Except do not take if having heart or lung surgery.	Take as normal. Except do not take if having heart or lung surgery.
<input type="checkbox"/>	Suphonylurea (Glibenclamide, Glipizide, Gliclazide)	Do not take. Only start taking again when eating normally.	Do not take. Only start taking again when eating normally.
<input type="checkbox"/>	DPP4 inhibitor (Saxagliptin, Sitagliptin)	Do not take.	Do not take.
<input type="checkbox"/>	GLP-1 analogue (Exenatide)	Do not take.	Do not take.

Other instructions:

If you have any questions or enquiries please contact:

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Aiming for better care for the Surgical diabetic patient.

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