

# Diabetic Ketoacidosis in Adults Management Guideline



Advisory, not mandatory

DEPARTMENT OF MEDICINE



- ▶ Diabetic Ketoacidosis (DKA) is an acute, major, life-threatening complication of diabetes.
- ▶ DKA mainly occurs in patients with Type 1 diabetes, but may occur also in some patients with Type 2 diabetes.
- ▶ DKA is defined clinically as an acute state of severe uncontrolled diabetes that requires emergency treatment with insulin and intravenous fluids.

## DIAGNOSIS

- ▶ Metabolic acidosis ( $\text{pH} < 7.3$ ;  $\text{HCO}_3^- < 18 \text{ mmol/L}$ )
- ▶ Ketonuria
- ▶ Hyperglycaemia usually  $> 14.0 \text{ mmol/L}$

*Individually, all of these values may vary considerably, but taken together they help make the diagnosis of DKA. (See also Normoglycaemic DKA in 'Pitfalls' below).*

## SYMPTOMS & SIGNS

SYMPTOMS:	SIGNS:
<ul style="list-style-type: none"> <li>▶ Thirst</li> <li>▶ Polyuria, nocturia</li> <li>▶ Nausea/Vomiting</li> <li>▶ Abdominal pain (rule out surgical problem)</li> <li>▶ Lethargy</li> <li>▶ Rapid weight loss</li> <li>▶ Fever</li> <li>▶ Dysuria</li> <li>▶ Shortness of breath</li> </ul>	<ul style="list-style-type: none"> <li>▶ Looks ill</li> <li>▶ Tachypnoea/Kussmaul breathing</li> <li>▶ Tachycardia</li> <li>▶ Hypotension</li> <li>▶ Dehydration</li> <li>▶ Altered consciousness or Coma</li> <li>▶ Acetone breath</li> <li>▶ Intercurrent illness:                             <ul style="list-style-type: none"> <li>– Sepsis (Check Oral or Rectal Temperature)</li> <li>– Myocardial Infarction</li> <li>– Signs of Addison's/Thyroid disease</li> </ul> </li> <li>▶ Abdominal tenderness (rule out surgical problem)</li> </ul>

**One must enquire about omission of insulin dose in patients suspected to be suffering from DKA.**

This is a clinical practice guideline and clinical discretion may be used in its implementation



## INVESTIGATIONS AT A&E

<b>Bedside blood glucose testing (BGM)</b>	<b>Arterial blood gases (ABG)</b> – (Venous blood gases is an option in difficult cases if GC improving)	<b>Cultures:</b> Blood / MSU (boric acid bottle) / Body fluid c/s	<b>Anion gap</b> (Normal <17) ( $\text{Na}^+ + \text{K}^+ - (\text{Cl}^- + \text{HCO}_3^-)$ )	<b>Pregnancy test</b> (in females of reproductive age)
<b>CBC, RBG, U+E/Creatinine, Phosphate</b>	<b>CK/amylase</b> – if abdo/chest pain	<b>Osmolality:</b> (Normal 285-300) $2(\text{Na}^+ + \text{K}^+) + \text{glucose} + \text{urea}$ .	<b>Urinalysis</b> (especially for ketones)	<b>ECG &amp; CXR</b>

## IMMEDIATE MANAGEMENT

1. Admit to a Diabetes ward where the patient will be cared for by a designated nurse. Outside regular working hours the House Officer on-call will take the necessary investigations, review the results and chart them, and help identify any problems. The Senior House Officer on-call will review the patient as necessary.
2. It is important that Emergency Lab personnel are alerted to give priority to the blood investigations.
3. If no Diabetologist on-call, admit under admitting Consultant (to Diabetes ward). Consultation with Diabetologist ASAP
4. Consider HDU/ITU if comatose/ BP not responding to IV fluids/ renal or heart failure
5. Data should be entered in “DKA monitoring charts A and B” (Form MED/I027/v01.0). Download from the intranet: @ <http://cpg.mdh.gov.mt>

## FLUIDS: (VIA VOLUMETRIC PUMP)

Normal Saline (0.9%) INTRAVENOUSLY	
1L over 30 mins	Start immediately – chase U/E/Creat
1L over 1 hour	Start potassium supplementation only after $\text{K}^+$ levels known (with care at this stage) – Maximal rate should not exceed 20mmol (7.7 ml of 20%) KCl over an hour
1L over 2 hours	See Potassium supplementation below
1L over 2 hours	
1L over 4 hours	
1L over 4 hours	
1L over 8 hours	

- ▶ If  $\text{Na}^+ > 150$  mmol/L or osmolality  $> 350$  mosm/kg use 0.45% saline.
- ▶ When **BGM (Blood Glucose Monitoring)**  $< 11$  mmol/L change to 5% dextrose in N Saline.
- ▶ If BGM reaches  $< 5$  mmol/L change to 10% dextrose at the same rate.
- ▶ If patient is old or has heart or renal failure, titrate IV fluids with caution. (Consider inserting a central line).



## INSULIN:

Insulin dose to be given according to BGM	
BGM	Actrapid Insulin
> 15	6U/hr
10 - 15	4U/hr
5 - 9.9	2U/hr
< 5	Keep IV insulin at 1Unit/hr; change fluids to 10% dextrose

If no improvement in blood glucose or ketosis, double insulin dose every 2 hours but check pump and cannula first.

## POTASSIUM SUPPLEMENTATION: (VIA VOLUMETRIC PUMP)

**NOTE: Recommendations and doses are different from those advised in the Hypokalemia management guideline (MED/1/GUIDE/2005/v01.0)**

Amount KCl in INTRAVENOUS FLUID INFUSION (IVI)	
Se K <sup>+</sup> level (mmol)	Amount in ml of 20% KCl per litre of Intravenous fluid
> 6	Nil
5 – 6	4 ml of 20% KCl per litre of Intravenous fluid ( <b>10.4 mmol</b> )
4 – 4.9	11 ml of 20% KCl per litre of Intravenous fluid ( <b>28.6 mmol</b> )
2.3 – 3.9	15 ml of 20% KCl per litre of Intravenous fluid ( <b>39 mmol</b> )
< 2.3	Inform direct Senior; Consider CCU/HDU/ITU; Administer <b>15 ml</b> of 20% KCl in 100 ml IV over 1 hour via central vein ( <b>39 mmol</b> )

If patient is anuric, CAUTION before giving potassium supplements

Table of Equivalence of INTRAVENOUS KCl		
ml of 20% KCl	mmol of KCl	Minimum volume of IVI to be diluted in 0.9% Sodium chloride or 5% Dextrose
5	13	333 ml (use 500 ml bag)
7.5	19.5	500 ml bag
10	26	1000 ml bag
15	39	1000 ml bag

**NOTE: Maximum dose of 20% KCL per 1000 ml IVI is 40 mmol (15.4 ml) and maximum infusion rate is 20 mmol/hour (7.7 ml/hour) unless patient is in HDU/ITU.**

## BICARBONATE: (RARELY IF EVER NECESSARY IN DKA (NICE RECOMMENDATION))

- ▶ If after adequate initial IV fluid replacement (2-3 litres of fluid) the pH is still < 7.0 and not improving, **consider** giving 100 mmol sodium bicarbonate (VIA SEPARATE IV LINE)
- ▶ **Add 100ml of 8.4% sodium bicarbonate to 400 ml N saline at 200 ml/hour**
- ▶ Check pH 30 minutes later



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## OTHER MEASURES:

- ▶ **ANTIBIOTICS:** If sepsis suspected or invasive procedures used. One should have a low threshold to starting antibiotics.
- ▶ **COLLOIDS:** If systolic at A&E < 80mmHg.
- ▶ **CATHETER + URINOMETER:** If comatose; If anuric after 4 hours of IVI; If clinically severely dehydrated.
- ▶ **LOW PHOSPHATE:** consider replacement if weakness is present, or platelets are low

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## FURTHER MANAGEMENT IN WARD

1. BGM - 1 hourly
2. Oral Temp, P, BP - 4 hourly
3. Urinalysis - 4 hourly (most importantly for ketones)
4. Input/Output charting, by urinometer if needed.
5. RBG, U+E, Creatinine, ABG - at 2 hours, 4 hours, 8 hours, 12 hours.
6. ABGs to be taken until normalization achieved - Venous blood gases an option in difficult cases if general condition improving
7. Urinalysis and microscopy, MSU for culture and sensitivity
8. Start s/c Actrapid insulin when pH and bicarbonate normal, patient normoglycaemic and eating normally, and urine free of ketones.
9. One should give subcutaneous (s/c) insulin 30 minutes before eating and insulin pump should be stopped one hour after s/c insulin is given.

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## COMPLICATIONS

- ▶ If there are high insulin requirements, look for a precipitating cause (sepsis, MI etc)
- ▶ Hypo/hyperkalaemia, hypoglycaemia, recurrent ketoacidosis
- ▶ If clinical condition has not shown a satisfactory response despite metabolic improvement, consider underlying precipitating cause, Addison's disease and cerebral oedema
- ▶ Adult Respiratory Distress Syndrome (ARDS)
- ▶ Disseminated Intravascular coagulation(DIC)/Arterial thrombosis
- ▶ Opportunistic infections esp. Mucormycosis

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## PITFALLS IN DKA

1. DKA can be relatively Normoglycaemic, usually in patients with diminished glycogen stores (eg starvation, persistent vomiting), but look for other causes of metabolic acidosis with a raised anion gap – Salicylate o/d; Tricyclic o/d; Lactic acidosis
2. Look thoroughly for a precipitating factor especially: Sepsis (don't forget the feet), Acute Coronary syndrome/Myocardial Infarction, Acute Abdomen particularly acute pancreatitis
3. Patient may be afebrile despite sepsis
4. Amylase can be raised despite absence of pancreatitis
5. Increased white cell count does not always denote sepsis

Further information may be found on the Intranet Annexes at <http://cpg.mdh.gov.mt>

