QUICK REFERENCE FOR HEALTHCARE PROVIDERS

MANAGEMENT OF TYPE 1 DIABETES MELLITUS IN CHILDREN & ADOLESCENTS

Ministry of Health Malaysia

Malaysian Paediatric Association

30th Anniversary 1981-2011
MEMS
Established 1981
Malaysian Endocrine & Metabolic Society

Academy of Medicine Malaysia

KEY MESSAGES

1. Type 1 diabetes mellitus (T1DM) children & adolescents classically present with polyuria, polydipsia & weight loss over 2 - 6 weeks.
2. Patients with diabetic ketoacidosis (DKA) should be managed in hospitals with specialists experienced in the management of the condition.
3. Patients with severe DKA & at risk of cerebral oedema should ideally be monitored in an intensive care unit. Risk of cerebral oedema can be reduced by:
   - not giving large volumes of fluid after initial volume expansion
   - not administering insulin in the first hour of fluid treatment
   - not using bicarbonate to correct acidosis
4. Intensive insulin therapy is the preferred regimen in patients with T1DM.
   - Basal insulin constitutes about 40 - 60% of the total daily insulin dose (TDD); the remainder is pre-prandial rapid-acting/short-acting insulin.
   - Those using night-time intermediate-acting insulin, the basal insulin constitutes between 30% (if on short-acting insulin) & 50% (if on rapid-acting insulin) of TDD; the remainder is pre-prandial rapid-acting/short-acting insulin.
5. The goal of hypoglycaemia treatment is to restore blood glucose (BG) to normal level (5.6 mmol/L). Severe hypoglycaemia warrants urgent treatment.
   - In hospital, this can be treated by intravenous (IV) dextrose 10% (2 - 4 ml/kg).
   - If there is no IV access, subcutaneous/intramuscular glucagon can be given (0.5 mg for patients <12 years old & 1.0 mg for those >12 years old).
6. Carbohydrate (carb) counting should be a part of T1DM management.
7. Ideally, diabetes team should consist of paediatrician, diabetes educator, dietitian, pharmacist, psychiatrist/clinical psychologist/counsellor & medical social officer.
8. Physical activities should be performed regularly & in a safe manner in T1DM.
9. Self-monitoring of blood glucose (SMBG) should be performed 4 to 6 times a day & more frequent in certain conditions such as sick day or exercise.
10. Screening of thyroid function & measurement of antithyroid peroxidase antibody should be done at diagnosis of T1DM.

This Quick Reference provides key messages & a summary of the main recommendations in the Clinical Practice Guidelines (CPG) on Management of Type 1 Diabetes Mellitus in Children & Adolescents.

Details of the evidence supporting these recommendations can be found in the above CPG, available on the following websites:
Ministry of Health Malaysia: www.moh.gov.my
Academy of Medicine Malaysia: www.acadmed.org.my
Also available as a mobile app for Android & IOS platform: MyMaHTAS

CLINICAL PRACTICE GUIDELINES SECRETARIAT
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DIAGNOSIS

Diagnostic criteria of diabetes mellitus (DM):

- classic symptoms of diabetes or hyperglycaemic crisis, with plasma glucose concentration ≥11.1 mmol/L

OR

- fasting plasma glucose (no caloric intake for at least 8 hours) ≥7.0 mmol/L

OR

- 2 hour post-load glucose ≥11.1 mmol/L in oral glucose tolerance test

OR

- HbA1c >6.5% (HbA1c alone in the diagnosis of DM remains unclear & cannot exclude DM when the value is <6.5%)

- The diagnosis must be confirmed by repeat BG testing in the absence of unequivocal hyperglycaemia.
- Biochemical features to support for the diagnosis of T1DM includes:
  - low or undetectable C-peptide levels
  - presence of diabetes-associated autoantibodies (GAD/IAA/ICA512/IA2/ZnT8)

T1DM can be misdiagnosed as:

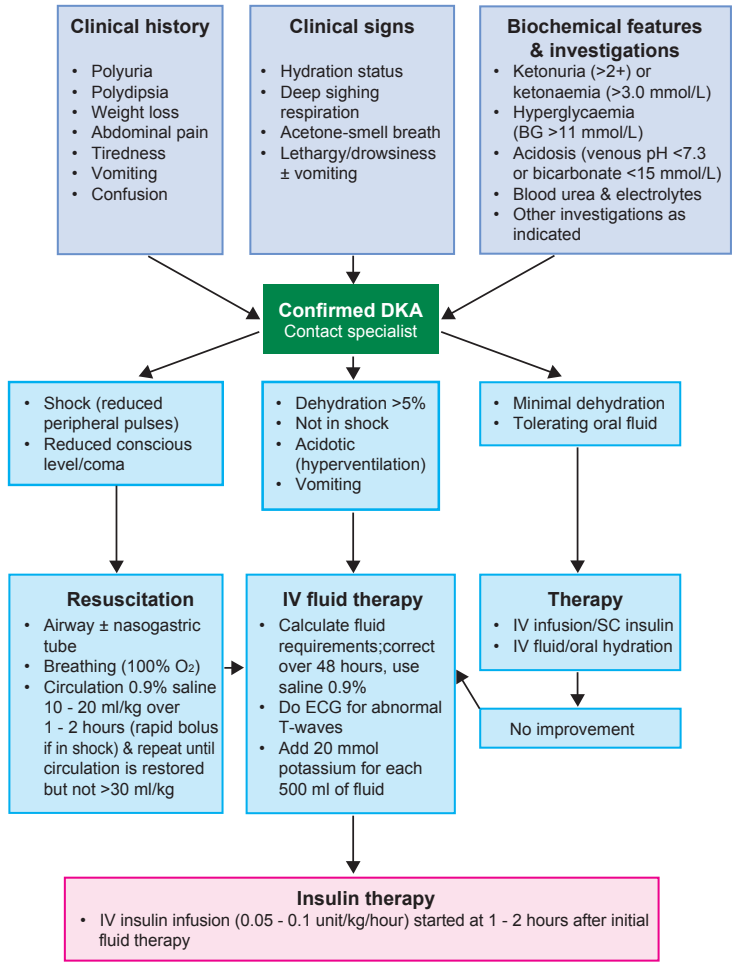
- pneumonia or asthma
- urinary tract infection
- gastroenteritis or sepsis
- acute abdomen
- psychogenic polydipsia
- meningitis/encephalitis

TARGET INDICATORS OF GLYCAEMIC CONTROL

Assessment	Level of control			
	Ideal (non-diabetic)	Optimal	Sub-optimal (action suggested)	High risk (action required)
Clinical assessment				
Symptoms of hyperglycaemia	No symptom	No symptom	Polyuria, polydipsia, enuresis	Blurred vision, poor weight gain, poor growth, delayed puberty, poor school attendance, skin or genital infections, and signs of vascular complications
Symptoms of hypoglycaemia	No symptom	No severe hypoglycaemia	Episodes of severe hypoglycaemia	Episodes of severe hypoglycaemia
Biochemical assessment				
SMBG values in mmol/L				
AM fasting or pre-prandial	3.6 - 5.6	4 - 8	>8	>9
Post-prandial	4.5 - 7.0	5 - 10	10 - 14	>14
Bedtime	4.0 - 5.6	6.7 - 10	<4.2 or >9	<4.4 or >11
Nocturnal	3.6 - 5.6	4.5 - 9	<4.2 or >9	<4.0 or >11
HbA1c DCCT (%)	<6.5	<7.5	7.5 - 9.0	>9.0
HbA1c IFCC (mmol/mol)	<48	<58	58 - 75	>75

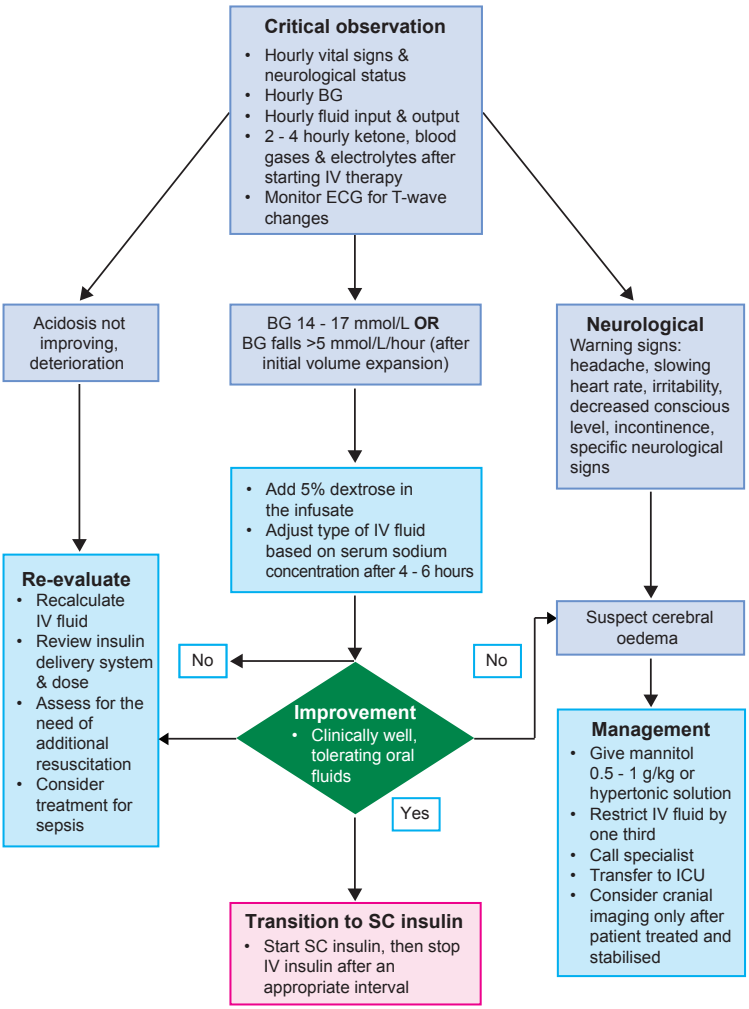
DCCT= Diabetes Control and Complications Trial
IFCC=International Federation of Clinical Chemistry and Laboratory Medicine

Algorithm 1. Immediate Assessment in DKA



DKA is categorised by the severity of acidosis:
- mild (venous pH <7.3, bicarbonate <15 mmol/L)
- moderate (venous pH <7.2, bicarbonate <10 mmol/L)
- severe (venous pH <7.1, bicarbonate <5 mmol/L)

Algorithm 2. Critical Observation in DKA



CEREBRAL OEDEMA

- Risks of cerebral oedema include:
  - younger age, new onset diabetes
  - longer duration of symptoms, greater hypocapnia at presentation after adjusting for degree of acidosis
  - increased serum urea nitrogen, severe acidosis at presentation
  - bicarbonate treatment for correction of acidosis
  - marked early decrease in serum effective osmolality
  - an attenuated rise in serum sodium concentration or an early fall in glucose-corrected sodium during therapy
  - administration of insulin in the first hour of fluid treatment
  - large volumes of fluid given in the first 4 hours

- Warning signs & symptoms of cerebral oedema:
  - headache (variable severity)
  - change in neurological status (restlessness, irritability, increased drowsiness, incontinence)
  - specific neurological signs (e.g. cranial nerve palsies)
  - slowing of heart rate
  - rising blood pressure
  - decreased oxygen saturation

INSULIN DOSE

- The guidelines on TDD are as follows:
  - partial remission phase: <0.5 IU/kg/day
  - pre-pubertal period: 0.7 - 1.0 IU/kg/day
  - pubertal period: 1.2 - 2 IU/kg/day

- Insulin dose adjustment may be done based on insulin to carbohydrate ratio (ICR) & insulin sensitivity factor (ISF) in patients with T1DM on basal bolus therapy.

  - The 500 rule for rapid-acting insulin:

$$\text{ICR} = \frac{500^*}{\text{TDD insulin}}$$

  *450 for short-acting insulin

  - The 100 rule for rapid-acting insulin:

$$\text{ISF} = \frac{100^*}{\text{TDD insulin}}$$

  *83 for short-acting insulin

GUIDELINES FOR INSULIN ADJUSTMENT DURING SICK DAYS

Ketones		Blood Glucose				
Blood ketones mmol/L	Urine ketones	<5.5 mmol/L	5.5 to 10 mmol/L	>10 to 14 mmol/L	>14 to 22 mmol/L	>22 mmol/L
<0.6	Negative or trace	• Do not give extra insulin • Recheck BG & ketones in 2 hours	No insulin adjustment needed	Add correction dose of insulin according to ISF	Give extra 5% of TDD or 0.05 IU/kg	• Give extra 10% of TDD or 0.1 IU/kg • Repeat if needed
0.6 - 1.4	Trace, small to moderate	• Starvation ketones • Extra carb & fluid are needed	• Starvation ketones • Extra carb & fluid are needed • No insulin adjustment needed	• Extra carb & fluid may be needed • Give 5 - 10% of TDD or 0.05 - 0.1 IU/kg	Give extra 5 - 10% of TDD or 0.05 - 0.1 IU/kg	• Give extra 10% of TDD or 0.1 IU/kg • Repeat if needed
1.5 - 2.9	Moderate to large	• High levels of starvation ketones • Check BG meter • Recheck BG & ketones • Extra carb & fluid are needed	• High levels of starvation ketones • Extra carb & fluid are needed • Give 5% of TDD or 0.05 IU/kg; repeat insulin dose when BG has risen	• Extra carb & fluid are needed • Give 10% of TDD or 0.1 IU/kg	Give extra 10 - 20% of TDD or 0.1 IU/kg; repeat insulin dose after 2 hours if ketones do not decrease	
>3.0	Large	• Very high levels of starvation ketones • Check BG meter • Recheck BG & ketones • Extra carb & fluid are needed	• Very high levels of starvation ketones • Extra carb & fluid are needed. • Give 5% of TDD or 0.05 IU/kg; repeat insulin dose when BG has risen	• Extra carb & fluid are needed • Give 10% of TDD or 0.1 IU/kg	Give extra 10 - 20% of TDD or 0.1 IU/kg; repeat insulin dose after 2 hours if ketones do not decrease	

There is an immediate risk of ketoacidosis if the blood ketone level is ≥3.0 mmol/L.

SCREENING, RISK FACTORS & INTERVENTIONS FOR VASCULAR COMPLICATIONS IN T1DM

Complications	Screening schedule	Screening methods	Risk factors	Potential interventions
Retinopathy	• Start at age 10 or at onset of puberty if this is earlier, after 2 - 5 years' diabetes duration • Annually thereafter	• Fundal photography or • Mydriatic ophthalmo-scopy (less sensitive)	• Hyperglycaemia • High blood pressure (BP) • Lipid abnormalities • Higher body mass index (BMI)	• Improved glycaemic control • Laser therapy
Nephropathy	• Start at age 10 or at onset of puberty if this is earlier, after 2 - 5 years' diabetes duration • Annually thereafter	• Urinary albumin: creatinine ratio or • First morning urinary albumin concentration or • Timed urine collections for albumin excretion rates	• Hyperglycaemia • High BP • Lipid abnormalities • Smoking	• Improved glycaemic control • Angiotensin converting enzyme inhibitor or angiotensin receptor blocker • BP control
Neuropathy	Unclear	History & physical examination	• Hyperglycaemia • Higher BMI	Improved glycaemic control
Macrovascular disease	After age 10 years	• Lipid profile every 5 years • BP annually	• Hyperglycaemia • High BP • Lipid abnormalities • Higher BMI • Smoking	• Improved glycaemic control • BP control • Statins