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Integrated Management of Diabetes in Children (IMDC) Project

Guidelines for Diabetes Management in Children

2007
These Guidelines were developed as part of the Integrated Management of Diabetes in Children project (2007-2009), the project is a result of partnership between World Diabetes Foundation (WDF), Faculty of Medicine-University of Gezira (FMUG) and Ministry of Health (MOH). The project will take place in Gezira state, Sudan.

The guidelines were agreed upon in a workshop conducted in FMUG, January 2007. The Role of the partners in the development of the project and the role of the taskforce in the development of this Guidelines are highly appreciated and acknowledged for the best care of diabetic children in the Gezira state and the Sudan as a whole.

For any comments we do appreciate your contact through www.imdcsudan.org
1.0 Introduction:
These are guidelines and should be used in by considering the holistic needs of the child and the family and always consult with a more senior doctor on call as soon as you suspect DKA. Children with DKA can die from:
  1) **Cerebral Oedema:** see management of CO (5.0)
  2) **Hypokalaemia:** which is preventable with careful monitoring/ replacement
  3) **Aspiration pneumonia:** use NG tube in semi-conscious children
To optimise the effectiveness of the management of children with Type 1 Diabetes Mellitus (T1DM) care should be part of an integrated multidisciplinary paediatric diabetic team.
Young children with new onset TIDM are more likely to present in DKA and in children who have established diabetes, DKA may occur with episodes of infections or other illnesses or with insulin omission or malfunction of diabetes care equipment/insulin.

2.0 Aim:
To provide guidance for all medical and nursing staff in the care of children with T1DM.

3.0 Definition:
Biochemical criteria for diagnosis of DKA include hyperglycaemia, glucose >200 mg/dl (11 mmol/l) with a venous pH of < 7.3 and bicarbonate < 15 mmol/l associated with glucosuria, ketonuria and ketonaemia. Very rarely children may present with normal glucose with DKA.

- **Mild DKA:** pH <7.30. & Bicarbonate < 15.
- **Moderate DKA** pH < 7.20. & Bicarbonate < 10.
- **Severe DKA** pH < 7.10. & Bicarbonate < 5.

If no available facilities for bicarbonate measurement, the patient is considered ketoacidotic if he is: symptomatic, dehydrated, hyperglycaemic or has ketonuria.

4.0 DKA Guidelines:

4.1 for children who have:

- **Drowsiness**
- **Dehydration**
- **Vomiting**
- **Clinically acidotic**
- Hyperglycaemia (blood glucose > 200 mg/dl (11.1 mmol/l)
- Ph < 7.30
- Bicarbonate < 15 mmol/l
EMERGENCY MANAGEMENT IN A&E:

1) General Resuscitation: A, B, C.
   • **Airway**: ensure that the airway is patent. If comatose or has recurrent vomiting or if abdominal distension, secure the airway, insert NG Tube, aspirate and leave on open drainage.
   • **Breathing**: give 100% oxygen via facial mask (if required).
   • **Circulation**: insert iv cannula and take blood samples (see below). If shocked (poor peripheral pulses, capillary re-filling >2 seconds, with tachycardia and/or hypotension) give:-
     ✓ Bolus iv fluids of 10 – 20 ml/kg of 0.9 saline
     ✓ Repeat boluses up to maximum of 30 ml/kg

   Do NOT give iv bolus of saline in the absence of shock.

Think of DKA in a known diabetic child or any child who presents with either or a combination of the following:
   • Classical symptoms of diabetes
   • Acute abdomen
   • Dehydration
   • Acidotic breathing
   • Disturbed level of consciousness

2) Diagnosis and assessment:
   • **History**:
     ✓ Polydipsia
     ✓ Polyuria
     ✓ Abdominal pain/ vomiting
     ✓ Loss of wt.
     ✓ Precipitating factors ( omitting an Insulin dose, infection)

   • **Clinical**:
     ✓ Conscious level
     ✓ Acidotic breathing
     ✓ Degree of dehydration (usually around 10% in DKA)
     ✓ Look particularly for evidence of 1) cerebral oedema 2) infections 3) ileus (see page….)
     ✓ Abdominal pain/vomiting

   • **Biochemical**:
     ✓ blood glucose (finger-prick test)=usually >300mg/dl
     ✓ blood ketones ( finger-prick test )=1.5mmol/L (if available)
     ✓ Glucose & ketones in urine
     ✓ Lab glucose > 300 mg/dl (17 mmol/l)

3) additional investigation:
   • urine general
   • Urea & electrolytes
   • Capillary/venous blood gas
   • Full blood count
• If indicated, ESR, urine analysis, CXR & blood culture, BF for malaria, blood culture (if available & indicated)

4) Observations & Follow Up: (flow chart)
• Weigh the child on admission or as soon as possible
• Strict fluid balance (input & output chart)
• Test of every urine sample for glucose & ketones
• Hourly BP & pulse
• Hourly or more neuro-observations initially
• Symptoms of headaches, or any changes in conscious level or behaviour (these should be reported to medical staff immediately even at night)
• Nil by mouth
• ECG monitor (if available, look especially for T wave changes)

MANAGEMENT:

a) Fluids:
• Initial fluid bolus resuscitation, if the patient is shocked =10 – 20 ml/kg of 0.9% saline over 30 min up to 30 ml/kg (discuss with consultant if the child needs more than 30 ml/kg)

Once circulating blood volume has been restored, calculate fluid requirement as follows:
If the pt. is shocked.

\[
\text{Requirement} = \text{maintenance} + \text{deficit (over 48hr)}
\]

\[
\text{Deficit (mls)} = \text{wt. (kg)} \times \text{deficit ()} \times 10
\]

Maintenance values:
- First 10 kg \(100\) ml/kg/24h
- Second 10 kg \(50\) ml/kg/24h
- Subsequent kgs \(20\) ml/kg/24h

e.g. if the child weighs 17 kg and the dehydration is 10%, the deficit in mls would be:

17 kg \(x\) 10% \(x\) 10 = 1700 mls

Add maintenance x 2 to deficit and give over 48 hours
Do not subtract the bolus from the calculations

e.g. 20 kg boy who is 10% dehydrated
24 hr maintenance = 1500 ml
48 hr maintenance = 3000 ml
Deficit = 10% \(x\) 20 kg \(x\) 10 = 2000 ml
Total = 5000 ml over 48 hr = 100 mls/hr

Notes:
(Never use more than 10% dehydration in fluid calculations, as this may be a risk factor for cerebral oedema).

Urine loss should not be added to calculations of replacement
NG loss/ vomiting should be replaced ml for ml with normal saline

• Initially use 0.9% saline.
• Once blood glucose has fallen to (250- 300 mg/dl), 14- 16 mmol/l change the fluids to 0.45% saline / 5% dextrose
• Check urea & electrolytes 2 – 4 hrs after resuscitation then 6 hourly (if possible)
• It has been suggested that cerebral oedema may be related to plasma sodium (if plasma sodium falls or does not rise, you must consult a senior colleague)
• Oral fluids should only be offered after substantial clinical improvement and no vomiting
• If clinically improved before 48, start oral fluid intake and stop iv infusion gradually.

b) Potassium:
Serum potassium at presentation may be normal, increased or decreased. Potassium should be started with the IV fluids once the child has passed urine. Administration of insulin and correction of acidosis will drive potassium back into the cells

Add 20 mmol of KCL to every 500 ml bag of fluid once urine has been passed.

Potassium should be withheld if:
• Serum potassium level is high (above normal levels)
• Peaked T waves on the ECG (if available
• If not passing urine or the bladder is not palpable

d) Insulin:
If no pump is available give 0.2 U/kg of regular insulin (1/2 im and 1/2 iv) followed by an hourly 0.1 U/kg im until recovery from DKA.
Criteria for recovery from DKA:
• Clinically well (conscious, well hydrated, not acidic, drinking & eating well) + urine containing one cross or no acetone
• pH >7.3, Hco3 >18 mmol/l, no ketonaemia

Blood glucose can be reduced by rehydration but insulin therapy is essential to normalise the blood glucose and to switch off lipolysis and ketogenesis and reverse acidosis. A continuous low dose IV insulin infusion is the preferred method. There is no need for an initial loading dose.

How to prepare the insulin infusion:
• Make a solution of 1 unit/ml of Human soluble insulin (Actrapid)
• Add 50 units (0.5 mls) of Actrapid insulin to 50 mls of 0.9% saline in a syringe pump.
• DO NOT add insulin directly to the fluid bag
• Commence the infusion at 0.1 units/kg/hr (1ml/kg/hr)
• If the blood glucose drops too quickly then reduce the insulin infusion rate to (0.05ml/kg/hr)
• If the blood glucose fallen < 250 mg/dl, (14 mmol), change the IV fluids to 0.45% saline with 5% dextrose
• If the blood glucose starts to rise DO NOT change the IV fluids back to saline. Instead increase the amount of the infused insulin
• Insulin must not be stopped whilst dextrose is being infused, even if blood glucose falls below 72 mg/dl, (4mmol/l) (insulin is required to switch off ketone production)
• If blood glucose continues to fall, then further reduction of insulin may be required, increase the dextrose infusion and check the fluid & insulin calculations.
• Continue IV fluids and insulin infusion until the child is out of DKA
• Do not expect ketones to disappear completely before changing to subcutaneous insulin.
• never stop the IV insulin or im insulin until the patient recovers from DKA
• Once the child is clinically well, rehydration is completed, and the pH is within normal, start s/c insulin, immediately start the daily s/c insulin requirement
  ✓ If the child is child is **under 3 years old** start s/c *Insulatard* (NPH), twice daily 0.25 units/kg
  ✓ If the child is **over 3 years old** start s/c *Mixtard 30*, 0.5 -0.75 units/kg/day (2/3 am & 1/3 pm)
  ✓ Then keep adjusting the dose according the blood glucose readings.

c) Bicarbonate:
This is rarely if, ever, necessarily.
Continuing acidosis usually means insufficient resuscitation. It should only be considered in children who are profoundly acidic (pH < 6.9) and shocked with circulatory failure and potentially life threatening hyperkalaemia (its only purpose is to improve cardiac contractility in severe shock.)
5.0 GUIDELINES FOR MANAGEMENT OF NEWLY DIAGNOSED TIDM WHO ARE CLINICALLY WELL

If a newly diagnosed child is not dehydrated and clinically well, they can immediately be commenced on subcutaneous insulin. They **must** fulfil the following criteria:

- Clinically well
- PH is within normal
- Urea & electrolytes are within normal
- No clinical signs of dehydration

**These guidelines depend on:**

- Age
- Presence of ketones

**The golden principles are:**

- Minimum injections, maximum control
- Insulin fits around a child’s life, their life does not fit around the insulin
- Eat to the child’s appetite not to the insulin
- They need to be taught to give insulin and recognise when to call for help

**(i) Children under 3 years of age:**

1. If the child is under 3 years and has **no ketones**, start:
   
   INSULATARD (NPH)  0.25 units/kg  twice daily s/c injection

2. If the child is under 3 years and **has ketones**, start:
   
   ACTRAPID/NOVORAPID (Rapid acting)  0.25 units/kg  once
   And
   INSULATARD (NPH)  0.25 units/kg  twice daily

If the child needs to be admitted for education or for other reasons, this regime can be commenced or continued on the ward.

**(ii) Children aged 3 years or more:**

1. If the child is > 3 years and has **no ketones**, start:
   
   MIXTARD 30  0.5 units/kg/day  2/3 of the dose am and 1/3 pm

2. If the child is > 3 years and **has ketones**, start:
   
   ACTRAPID/NOVORAPID  0.25 units/kg  once
   And
   MIXTARD 0.5 units/kg/day  2/3 of the dose am and 1/3 pm

**NB:** the child who **has ketones** needs to be closely observed to ensure the ketones are subsiding.
If the ketones do not reduce, extra rapid acting insulin may need to be given.

6.0 CEREBRAL OEDEMA:

Cerebral oedema accounts for 57 – 87% of all DKA deaths. The incidence is between 0.5 – 1% is fairly constant.
Cerebral oedema typically occurs 4 – 12 hours after treatment is initiated but can present any time before or during treatment of DKA.

Signs and symptoms of cerebral oedema include:
- Headache
- Irritability
- Confusion
- Reduced conscious level
- Fits
- Small pupils
- Increasing BP
- Slow pulse
- Papilloedema (not always present acutely)
- Possible respiratory impairment

Risk factors:
- Little evidence to show association between sodium content of IV fluids or rate of change of serum glucose
- Failure of potassium to rise
- Severe acidosis
- Bicarbonate treatment for correction of acidosis
- High carbon dioxide at presentation
- Increased serum urea at presentation

Management:
- Exclude hypoglycaemia < 70 mg/dl
- If cerebral oedema is suspected, inform senior staff immediately
- Close observation
- Give mannitol 0.5 g/kg stat = 2.5 ml/kg mannitol 20% over 15 min (has to be started within 10 min to get good response)/
  - or 3% saline 2 ml/kg
- Restrict IV fluids to 2/3 maintenance and replace deficit over 72 rather 48 hrs
- Move the child to PICU (if available, otherwise need close observations)
- Repeat the dose of Mannitol (above dose every 6 hours) to control intracranial pressure.
- Intubate and hyperventilate to reduce blood pCO2 (if possible)
7.0 Appendix:

8.1 Appendix A: Glasgow Coma Scale:

Best Motor Response:
- 1 = none
- 2 = extensor response to pain
- 3 = abnormal flexion to pain
- 4 = withdraws from pain
- 5 = localises pain
- 6 = respond to command

Eye Opening:
- 1 = none
- 2 = to pain
- 3 = to speech
- 4 = spontaneous

Best Verbal Response:
- 1 = none
- 2 = incomprehensive sounds
- 3 = inappropriate words
- 4 = appropriate words but confused
- 5 = fully oriented

Maximum score = 15
Minimum score = 3

Modification of verbal response score for younger children:
2 – 5 years
- 1 = none
- 2 = grunts
- 3 = cries or screams
- 4 = monosyllables
- 5 = words of any sort

< 2 years
- 1 = none
- 2 = grunts
- 3 = inappropriate crying or unstimulated screaming
- 4 = cries only
- 5 = appropriate non-verbal responses (coos, smiles, cries)

Pupil reaction: + = reaction, - = no reaction, S = sluggish, C = close

8.2 Appendix B:
A = ALERT
V = response to VOICE
P = response to PAIN
U = UNRESPONSIVE
8.0 References:

- NICE 2004. TIDM: diagnosis and management of T1DM. National Institute of Clinical Excellence
- Pediatric Clinic of North America 2005. Pediatric Diabetic Ketoacidosis and Hyperglycaemia state management.