

Appendix 4 Recognition, management and prevention of diabetic ketoacidosis in children

- 1. Definition:** DKA results from absolute or relative deficiency of circulating insulin and the combined effects increased level of the counter regulatory hormones. Both results an accelerated catabolic state. The counter regulatory hormones increased response to stress (sepsis, GI illness, vomiting, psychological trauma & others).
- 2. Biochemical criteria:**
 - Hyperglycaemia (BG \geq 200 mg/dl)
 - Venous pH < 7.3 or bicarbonate <15 mmol/l
 - Ketonaemia and ketonuriaPartially treated children and children who have consumed little or no CHO, may have modestly increased BG (euglycaemic ketoacidosis)
- 3. Classification of DKA:**
 - Mild; venous PH < 7.3 or HCO_3^- < 15 mmol/l
 - Moderate; venous PH < 7.2 or HCO_3^- < 10 mmol/l
 - Severe; venous PH < 7.1 or HCO_3^- < 5 mmol/l
- 4. The High Risk of DKA:**
 - Poor metabolic controlled patient
 - Peri pubertal and adolescent girls
 - Child with psychiatric disorders
 - Unstable family
 - Children who omit insulin
 - Insulin pump therapy
- 5. Indications for ICU admission:**
 - Impaired consciousness level
 - Those who increased risk for cerebral oedema (e.g. < 5 years of age, severe acidosis, low pCO_2 & high urea)
- 6. Fluid and Salt Replacement:**
 - The objective of fluid & electrolyte replacement therapy are:
 - Restoration of circulating volume
 - Replacement of Na in ECF & ICF
 - Improved glomerular filtration
 - Reduction of risk cerebral oedema.
 - The rate of fluid (IV and oral) should be calculated over 48 hours (full maintenance + half of deficits – shock therapy over 24 hours)
 - Should not excess of 1.5 -2 times of usual daily maintenance requirement
 - Normal saline is the fluid of choice
 - Use of [0.18 % saline + 10-12.5 % dextrose] once BG <100-150 mg/dl with insulin.

7. Potassium Replacement:

- In hypokalaemia give potassium before insulin
- Give it usually after passed urine
- Start with 20 mmol/l, may increased up 40 mmol/l
- Use potassium chloride.

8. Treatment of Acidosis:

- Consider use of HCO_3 if arterial pH <6.9 -7.0 at start, 7.1 after 4 hours of treatment where decreased cardiac contractility and peripheral vasodilatation are present
- Give HCO_3 (8.4%) 1-2 mmol/kg over 60 minutes
- Beware of inducing hypokalaemia.

9. Insulin therapy:

- Start insulin infusion 1 -2 hours after starting fluid replacement therapy.
- Dose 0.1 U/kg/h (50 units of regular insulin in 50 ml of normal saline)
- May give half dose 0.05 U/kg/h or less to insulin sensitive patients
- Continue IV insulin infusion to corrected acidosis
- During treatment BG decreases typically by 36 to 72 mg/dl/h.
- If continuous IV insulin can not be given, give hourly or 2 hourly SC or IM rapid- or short-acting insulin
- Initial dose SC 0.3 U/kg followed by SC insulin lispro or aspart at 0.1 U/kg/h 0.15 -0.2 U/kg/2-h.

10. Introduction of oral fluid and transition to SC insulin

- Start oral fluid when patient clinical improvement has occurred, even when patient still has mild acidosis.
- When ketoacidosis resolved & tolerated oral fluid:
 - > change to SC insulin just before a mealtime.
 - > stop IV insulin after 1-2 hour after regular insulin or after 15-30 minutes after rapid acting insulin.
 - > give basal insulin and start reduce IV insulin rate before stop IV insulin.

11. Complications of therapy

- Inadequate rehydration.
- Hypoglycaemia.
- Hyperglycaemia.
- Hyperchloraemic acidosis.
- Cerebral oedema.

12. Cerebral oedema:

Increased risk of cerebral oedema in:-

- Younger age.
- New onset diabetes.
- Severe acidosis.
- Use of half-normal saline, dextrose/saline or bicarbonate.
- High serum urea & low Na.

- Administration of insulin in the first hour of fluid treatment or and use of greater volumes of fluid.

Warning signs & symptoms:

- Headache & slowing of heart rate.
- Specific neurological signs like cranial nerve palsies.
- BP and decreased O₂ saturation.
- Change neurological status.

Treatment of cerebral oedema:

- Initiate treatment as soon as condition is suspected after exclusion of hypoglycaemia.
- Reduce the rate of fluid infusion by one third.
- Give mannitol 0.5 -1 g/kg over 20 minutes, repeat every 30-120 minutes.
- Hypertonic saline 3% 5-10ml/kg over 30 minutes.
- Elevate the head of bed and intubate.
- CT scan.

13. Prevention of recurrent DKA:

- Educated the patient & family about the risk of insulin omission & how deal during sick days properly (avoiding insulin dose reduction when unwell).
- Educate to take extra insulin during ketonuria and/or hyperglycaemia.
- Home measurement of ketones and BG.
- Psychosocial support.
- Should recognize DKA at early stage by family & give short or rapid acting insulin then come to hospital immediately.