



Contact Details Name:

Hospital

Telephone:

This protocol has 4 pages

GLUT 1 DEFICIENCY (standard version)

- **Please read carefully. Meticulous treatment is important as there is a high risk of complications.**
- **If the instructions do not make sense or a problem is not addressed, discuss your concerns with the consultant on call.**
- **Important note: The management of illness in GLUT1 deficiency is quite different from most other metabolic disorders.**

1. Background

Children with GLUT1 deficiency have an impaired glucose transport into the brain and glucose levels in CSF are low (hypoglychorrhachia). As a result, seizures and secondary microcephaly are common.

The main aim of treatment is to provide an alternative fuel for the brain. Ketone bodies can cross the blood brain barrier and provide an alternative energy source so the children are treated with a ketogenic diet. On this diet the aim should be to maintain blood ketone bodies above 2.0mmol/l, with urinary ketone levels around 4-8 mmol/l.

In the standard emergency regime glucose is given but this will suppress the ketones and the patient therefore the patient might get worse. The aim of the emergency regimen is to maintain the ketosis together with fluid and electrolyte balance but this may not always be possible.

2. Admission

Almost all patients who present to hospital will require admission. Only allow the child home if you and the family are entirely happy and you have discussed the problems with the consultant on call. The family must have a clear management plan and be prepared to return if the child does not improve.

- **If there is any doubt at all, the child must be admitted, even if only necessary for a short period of observation.**

3. Initial plan and management in hospital

⇒ If fitting, treat with anticonvulsants carbamazepine or phenytoin. Avoid using phenobarbital, valproate, chloral hydrate and diazepam as they inhibit GLUT1. Recently introduced anticonvulsants have not been assessed and may be used in an emergency.

⇒ If admitted to metabolic/general ward make a careful clinical assessment including blood pressure and a [Glasgow coma score \(for details click here\)](#).

The following blood tests should be done:

- pH and blood gases
- Glucose (laboratory and bedside strip)
- Blood/plasma 3 –hydroxybutyrate *
- Urea & electrolytes
- Full blood count, blood culture

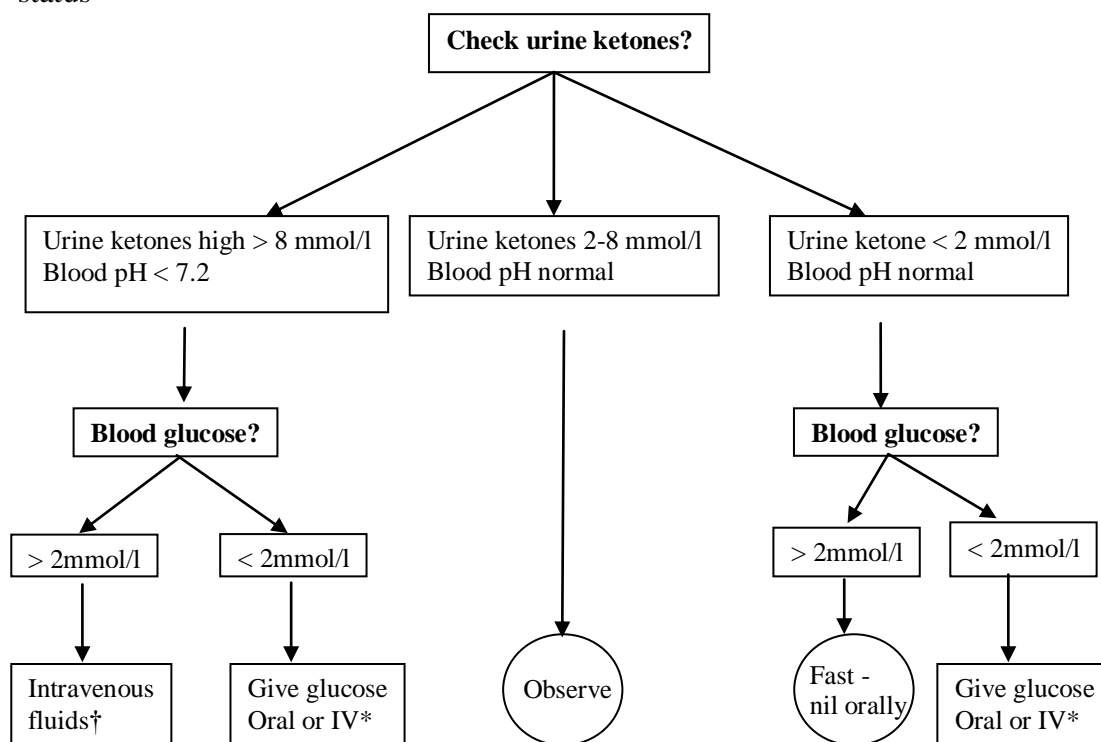
Urine ketones

* A bedside ketone meter may be used if a laboratory test is not readily available. Blood acetoacetate may be measured if available but it is not essential.

4. Management

The management of this disorder is distinct from that of most other inborn errors of metabolism. The aim is to maintain ketosis and to do this it is recommended that oral therapy is continued as long as possible.

If the patient is still fitting review the anticonvulsants (see above) and the metabolic status



† go to section B on intravenous therapy

* Give glucose 200mg/kg

- If the child is not vomiting, not systemically unwell or dehydrated, may usually be treated orally
- If the child is vomiting, dehydrated or systemically unwell and/or cannot tolerate oral fluids, must be treated with intravenous fluids

A. ORAL.

If possible, the ketogenic diet should be continued. Carbohydrate-free medication may be given orally.

If, for any reason, the ketogenic diet is not possible, give drinks using a standard rehydration mixture following manufacturer's instructions in the volumes listed below. (The small quantity of glucose in these mixtures does not matter). This may be given as regular frequent drinks but if the patient is at risk of vomiting or is nauseated fluid should be given either continuously or as small boluses more frequently. The routine emergency regimen (high carbohydrate content) should **not** be used.

Age (years)	Total daily volume*
0-1	150-200 ml/kg
1-2	100 ml/kg
2-6	1200-1500 ml
6-10	1500-2000 ml
>10	2000 ml

*For each drink the volume will generally be this figure divided by 12 and given 2 hourly but if the patient is nauseated or refuses try frequent smaller drinks or a continuous naso-gastric infusion.

- Treat any infection

Note: To maintain ketosis, do not use oral suspension (liquid) antibiotics unless they are carbohydrate free. Drops or tablets are usually suitable.

B. INTRAVENOUS.

Note: If ketosis is present, do not use intravenous fluids that contain glucose.

- Give normal saline 10 ml/kg as a bolus immediately unless the peripheral circulation is poor or the patient is frankly shocked, give 20 ml/kg normal saline instead of the 10 ml/kg. Repeat the saline bolus if the poor circulation persists as for a shocked non-metabolic patient.
- Continue with normal saline 10 ml/kg/h Quickly calculate the deficit and maintenance and prepare the intravenous fluids
 - Deficit: estimate from clinical signs if no recent weight available
 - Maintenance: Formula for calculating daily maintenance fluid volume (BNF for children) 100ml/kg for 1st 10kg then 50 ml/kg for next 10kg then 20ml/kg thereafter, using calculated rehydrated weight. Deduct the fluid already given from the total for the first 24 hours.
 - Give as normal saline unless there is hypernatraemia (plasma sodium >148 mmol/l) when 0.45% saline should be substituted

- Having calculated the deficit and the maintenance, give 1/3 of the total for 24 hours over the next 6 hours and the remainder in 18 hours. If intravenous fluids are still needed, continue with the same solution.
- Recheck the electrolytes in 4-6 hours and then every 24 hours if still on intravenous fluids.
- Regrade onto normal diet as soon as possible to avoid hypernatraemia and maintain ketosis.

- Potassium can be added, if appropriate, once urine flow is normal and the plasma potassium concentration is known.

- Keto-acidosis. If blood pH is less than 7.2 after correction of peripheral circulation this may indicate excessive ketosis. Start with Saline 0.45%/glucose 2.5% ([for instructions to make this solution click here](#)). If after 3-4 hours still keto-acidosis change to saline 0.45%/glucose 5% ([for instructions to make this solution click here](#)) at the rate as above.

- Fits should be treated with conventional anticonvulsants carbamazepine or phenytoin. Recently introduced anticonvulsants have not been assessed and may be used in an emergency. Phenobarbital, valproate, benzodiazepines including diazepam inhibit GLUT1 and should not be given.

- Other medicines to avoid are chloral hydrate and methylxanthines (caffeine, theophylline, etc).

5. Progress:

Monitoring: Reassess after 4-6 hours or earlier if there is any deterioration or no improvement
Clinical assessment should include [Glasgow coma score \(for details click here\)](#) and blood pressure.

Blood tests: Blood pH and gases
Glucose (laboratory)
Urea & electrolytes,
Urine ketones

⇒ If improving, continue and for intravenous fluids after 6 hours, please refer to the previous section.

⇒ If deteriorating, seek specialist help without delay.

6. Re-introduction of oral feeds: Restart the ketogenic diet as soon as possible; once the child is alert and has stopped vomiting. If necessary, seek specialist advice.

7. Going Home: Only allow the child home if you and the family are entirely happy and you have discussed the problems with the consultant on call. The family must have a clear management plan and be prepared to return if the child deteriorates.

For further information please refer to:

Saudubray J-M, van den Berghe G, Walter JH. (editors) Inborn Metabolic Diseases. Diagnosis and treatment. 5th Edition. Springer 2012

Last reviewed in Jan 2013