Royal Berkshire NHS
NHS Foundation Trust

Diabetes – Hyperemesis and diabetic ketoacidosis guideline (GL824)

Approval

Approval Group	Job Title, Chair of Committee	Date
Maternity & Childrens Services Clinical Governance Committee	Chair, Maternity Clinical Governance Committee	3rd october 2014

Change History

Version	Date	Author, job title	Reason
12.1	May 2012	Deirdre Graham, Diabetes Specialist midwife	Revised to include new Trustwide insulin sliding scale
13.0	June 2014	Deirdre Graham, Diabetes Specialist midwife	Re-write in consultation with Diabetes Consultant

Overview: *DKA results from a shortage of insulin; in response the body switches to burning fatty acids and ketone bodies are produced, which are toxic and can cause the body to become acidic. DKA in adults with type 1 diabetes is associated with a mortality rate of 5-10%. In pregnancy, it is associated with a fetal mortality rate of 9-27%. Surviving children, exposed as fetuses to maternal DKA have been shown to have lower IQ levels than their peers. DKA needs to be avoided or, if present, treated as an emergency. DKA can present in pregnancy with normal blood glucose levels.*

- The abbreviation **VRIII**** (**Variable Rate Intravenous Insulin Infusion) will be used throughout this document in place of the term Insulin Sliding Scale.
- The abbreviation DKA will be used in place of diabetic ketoacidosis.
- The abbreviation CSII will be used in place of continuous subcutaneous insulin infusion

On admission, the presence of DKA, or impending DKA needs to be excluded at once. Crucial to diagnosis is the **venous** blood gas and the blood ketone level.

Diabetic ketoacidosis is defined as:

Blood ketone level	Venous pH	Bicarbonate	Blood glucose
≥3.0 mmol/L	± <7.3	± <15.0 mmol/L	± >11.0 mmol/L *

***In pregnancy DKA can occur with a normal blood glucose level**

For the purposes of this document, impending DKA will be defined as,

Blood ketone level	Venous pH
≥0.6 & <3.0 mmol/L	>7.3

No diabetic ketoacidosis is defined as,

Blood ketone level	Venous pH
<0.6 mmol/L	>7.3

This guidance is divided into 5 further sections,

1. Initial Management of all diabetic pregnant women contacting us with hyperemesis (pg 4)
2. Management of hyperemesis without DKA and without impending DKA (pg 6)
3. Management of hyperemesis with full DKA or impending DKA (pg 8)
4. VRIII** set up (pg 11)
5. Transfer from VRIII** back to subcutaneous insulin (pg 13)

Follow the ‘Think Glucose’ referral procedures on admission

On admission check that the patient has her own insulin pens and blood glucose meter with her. If not, send a relative to get them

Click here for printable version of Maternity Blood Glucose monitoring chart
Maternity Blood Glucose chart v2

Maternity Blood Glucose Chart V2 July

The blood glucose meters also measure ketones, and, in the maternity unit, ketone test strips are only kept on Delivery Suite. A quality control test *must* be done prior to patient testing and daily until blood ketone testing is no longer required.

Appendix 1 summarises the steps taken antenatally to prevent admission with DKA

Section 1. Initial management of *all* diabetic women with hyperemesis

Diabetic women are advised to call the Delivery Suite at any gestation if they have intractable vomiting. The midwife taking the call should;

- advise to attend DAU/Delivery Suite immediately, by ambulance if necessary
- check that the woman knows where to come to
- do not refer anywhere else
- order a syringe pump and collect equipment for VRIII** before arrival
- obtain the maternity notes

The presentation of hyperemesis can vary widely.

The initial action and investigations will determine the diagnosis and further treatment.

Implement management urgently on arrival.

Admit to Day Assessment Unit/Delivery Suite Admissions. **If the woman is seen to be extremely unwell on arrival, admit directly to a Delivery Room**.

Initial assessment in the first 0 – 60 minutes

- Assess airway, breathing, circulation, level of consciousness
- Assess temperature, blood pressure, pulse, O2 sats
- MOWS score
- Large bore cannula (grey) for fluid replacement
- Full clinical examination by medical staff

Investigations

- Blood ketones on ward meter; **quality control prior to patient testing**
- Capillary blood glucose on ward meter
- Urinalysis
- Bloods: venous blood gas; venous plasma glucose; full blood count; urea and electrolytes; amylase if pancreatitis suspected; group and save, if appropriate; consider blood cultures
- MSU for culture
- Consider chest X-Ray, ECG, if appropriate
- As soon as practically possible CTG fetal monitoring should commence
- Assess risk for VTE (see VTE prophylaxis guideline)

VTE_Prophylaxis_in_ Pregnant_Women_V5

IV insertion; fluid replacement; transfer from DAU/Delivery Suite Admissions

- Insert cannulae to allow free flow of fluid. Avoid a cannula ending at/crossing the wrist
- Site IV cannula 1 and start fluid replacement urgently and before siting cannula 2. The fluid replacement regimens follow, according to diagnosis, in Sections 3 or 4
- If needed, cannula 2 should be inserted for the use of a VRIII**

After the initial assessment, transfer to an appropriate room for ongoing care.

The woman with either impending DKA or full DKA **must** be admitted to a Delivery Room and treated as a High Dependency patient, with one-to-one midwifery care and an HDU chart used. The use of room 12 is not appropriate.

Please turn to the appropriate section for further guidance,
Page 6 The management of hyperemesis *without* DKA
Page 8 The management of hyperemesis *with* Impending DKA or full DKA
Page 11 Variable rate intravenous insulin infusion
Page 13 Transfer from VRIII to subcutaneous insulin**

Section 2: Management of hyperemesis *without* diabetic ketoacidosis
(To be read in conjunction with the initial management detailed on page 4)

Immediate action: in the first 0 – 60 mins.

The aim of management will be to:

- rehydrate
- stop the vomiting
- prevent DKA developing
- clear urinary ketones
- monitor fetal well-being

Rehydration should be with 0.9% sodium chloride, via Cannula 1, as follows,

  - 1 litre given over the first hour
  - 1 litre may be given over the next 2 hours, if necessary

- If a CSII is in use, this should not be stopped unless the woman is too unwell to fully manage it herself. The CSII may be left running in conjunction with a VRIII**, if used
- Bolus doses via the CSII should be withheld until diet is resumed
- **U+Es should be taken regularly and the fluid replacement titrated according to the blood results. The need for potassium replacement can be assessed accordingly**
- Antiemetics should be prescribed and given regularly
- Precipitating factors should be investigated and treated
- Acid reflux should be treated with regular Ranitidine or Omeprazole
- Monitor:
  - 1 hourly: O_2 sats, pulse, blood pressure; blood glucose; MOWS
  - 4 hourly: respirations; temperature
  - Ongoing: strict fluid balance charting

Intravenous insulin

- Insulin dependent women admitted with hyperemesis usually need a VRIII**
- Metformin and diet controlled diabetics may need a VRIII**, depending on the clinical findings on admission. It should be noted that they can, rarely, develop DKA
- If a VRIII** is needed, a second, wide bore cannula should be used
- The VRIII** regimen includes potassium replacement. If a VRIII** is not needed, potassium replacement is unlikely to be required

60 mins to 6 hours

- Check urine ketones 4 hourly in those admitted with ketonaemia <0.6 mmol/L
- If urine ketones increasing repeat the blood ketones. If ketonaemia rises above 0.6 mmol/L, the obstetric registrar should be informed and advice sought from and the on-call diabetes medical team
- consider increasing the fluid replacement regimen as per section 3
- Monitor:
  - 1 hourly: O2 sats, pulse, blood pressure; blood glucose; MOWS
  - 4 hourly: respirations; temperature
  - Ongoing: strict fluid balance charting
- Continue this monitoring until the vomiting stops and the woman's condition improves when the monitoring frequency can be reduced
- When vomiting stopped, a light diet may be tried while the VRIII** is running.
- Subcutaneous insulin and/or Metformin may be recommenced and the VRIII** discontinued when the urine ketones have cleared and it is certain that the vomiting has stopped

Section 3: Management of hyperemesis *with* DKA or with Impending DKA (To be read in conjunction with the initial assessment on page 4)

Immediate action: In the first 0 – 60 mins.
The general hospital DKA treatment summary can be found on the intranet: Polices and Protocols > Clinical Documents > Acute Medicine > Diabetic Ketoacidosis Management in Adults v1 – GL696. This document is designed for use with patients managed on ITU/HDU and uses a fixed rate intravenous insulin infusion (FRIII), using an ITU/HDU drug chart not available in maternity. Therefore, this maternity protocol uses the VRIII** as documented on the Trustwide drug chart.

Assessment of severity: the presence of 1 or more of the following may indicate severe DKA and should prompt review by a senior diabetes physician and or the Outreach Team with consideration given to transfer to HDU or Intensive care.

Blood ketones >6mmol/L
Bicarbonate <5 mmol/L
Venous/arterial pH below 7.0
Hypokalaemic on admission – below 3.5mmol/L
Abnormal AVPU
0_2 sats <92%
Systolic BP <90 mmHg
Pulse >100 or <60
Anion gap >16 [Anion gap =$(Na^+ + K^+)-(Cl+HCO_3)$

0 – 60 minutes: Immediate action upon diagnosis

- Consultant obstetrician to be informed
- Medical diabetes specialist review as soon as available
- Review by anaesthetist on duty
- Commence 0.9% sodium chloride in cannula 1
- Site second cannula and commence VRIII** in cannula 2
- Monitor - with the use of a maternity HDU chart:
  - Continuous: O2 sats; CTG
  - ¼ hourly: pulse, blood pressure
  - 1 hourly: MOWS; blood glucose; blood ketones; urine volume; respirations
  - 2 hourly: potassium; bicarbonate
  - 4 hourly: temperature

Fluid replacement
Aims: Restore circulating volume; normalise blood ketones; correct electrolyte imbalance
Typical deficits are:

Water	100ml/kg	Sodium	7-10 mmol/kg
Chloride	3 – 5 mmol/kg	Potassium	3 - 5 mmol/kg

Fluid	Volume	Duration	Potassium
0.9% sodium chloride	1 litre	1 hour	None
0.9% sodium chloride	1 litre	1 hour	Replace as below
0.9% sodium chloride	1 litre	2 hours	Replace as below
0.9% sodium chloride	1 litre	4 hours	Replace as below
0.9% sodium chloride	1 litre	6-8 hours	Replace as below

NB: Cautious fluid replacement in young adults and pregnant women

Potassium replacement: Serum potassium may be high on admission and fall rapidly with insulin treatment. Regular monitoring is mandatory

Potassium level	KCl per litre of NaCl	Comment
<3.5 mmol/L	40 mmol	Refer to Snr diabetes physician/Outreach
3.5 – 5.5 mmol/L	20 mmol	-
>5.5 mmol/L	No potassium	-

Resolution of DKA is defined as,
Blood ketone level <0.6 mmol/L; venous pH >7.3

Metabolic treatment target
Blood ketone reduction of 0.5 mmol/hour;
Increase venous bicarbonate by 3.0 ml/hour
Reduce raised capillary glucose by 3.0 mmol/L/hour
Maintain Potassium between 4.0 – 5.5 mmol/L

60 mins to 6 hours
Continue hourly capillary ketone and glucose testing
Venous blood gas for pH, bicarbonate and potassium and 2 hourly thereafter
Laboratory potassium if not available on blood gas analyser in DS or ITU
Consider urinary catheterisation if oliguria
Arterial blood gas if O_2 sats not maintained
Treat precipitating factors

6 to 12 hours
Ensure improvement
If no improvement seek specialist/Out Reach advice
Check venous pH, potassium, bicarbonate
Check capillary ketones and glucose
Continue fluid and insulin therapy
Assess for fluid overload

12 to 24 hours
Ensure improvement
Check venous pH, potassium, bicarbonate
Check capillary ketones and glucose
May start light diet if able to eat
Continue IV fluids if not eating/drinking
Assess for fluid overload

- DKA should resolve by 24 hours. If it has not, diabetes specialist help should be sought
- When the DKA has resolved (pH >7.3; blood ketones <0.6mmol/L) and the woman is allowed and able to eat, she can transfer to subcutaneous insulin with the next main meal.

Precipitating causes of hyperemesis leading to DKA should be identified and treated, such as, hyperemesis gravidarum, infection, inadequate insulin, neglect of diabetes care, corticosteroid therapy, faulty insulin injecting equipment, faulty blood glucose meter.

Section 4: Variable Rate Intravenous Insulin Infusion (VRIII**) in Cannula 2

Caution! The infusion in Cannula 2, which runs together with the IV insulin needs to be set up, with or without potassium, according to whether the woman is receiving potassium in Cannula 1.

Patient is *not* receiving potassium via Cannula 1
If blood glucose ≥14.0 mmol/L - 1 Litre 0.9% sodium chloride and 20 mmol potassium
If blood glucose <14.0 mmol/L - 1 Litre 10% glucose and 20 mmol potassium

OR

Patient is receiving potassium via Cannula 1
If blood glucose ≥14.0 mmol/L - 1 Litre 0.9% sodium chloride
If blood glucose <14.0 mmol/L - 1 Litre 10% glucose

Through same cannula,
Intravenous insulin, 50 units soluble insulin in 49.5 ml 0.9% sodium chloride.
This is now available on Delivery Suite in pre-filled syringes.
Check the expiry date carefully as the shelf-life is short.

In case of non-availability of a pre-filled syringe, 50 units of Actrapid or Humilin S (soluble insulin) may be drawn up in an insulin syringe and added to 49.5 ml of 0.9% sodium chloride in a 50 ml Luer lock syringe. This should be well mixed before use and labelled appropriately.

The rate of insulin infused is dependent on the blood glucose results, as per the table below

Blood glucose	Metered IV Insulin (units/hr)
4.0 or below	Stop insulin, measure blood glucose in 30 min
4.1 – 7.0	1.5
7.1 – 9.0	2.5
9.1 – 11.0	4
>11.0	6

NB: If the woman normally takes Lantus (Insulin Glargine) or Levemir (Insulin Detemir), long-acting insulin, this should continue at the normal administration times while the VRIII** is in progress, **unless the need for delivery is imminent, when it should be withheld**. This will avoid hypoglycaemia in a newly delivered woman, who will have significantly decreased postnatal insulin needs. In this case, after delivery a postnatal dose of long-acting insulin may be taken.

Other types of intermediate-acting insulin, such as 'Insulatard' or 'Humulin I' should *not* be continued while the VRIII** is in progress.

If the woman is normally on a CSII (commonly called and insulin pump), this can be left in situ and running while the VRIII** is in progress. There will be a very small dose of basal insulin per hour infusing subcutaneously (typically 0.1 – 0.8 units per hour). The woman should be advised not to give her bolus doses (normally given at meal times) until she is eating normally and this should be resumed in agreement with the medical team.

If there is uncertainty about the woman's ability to fully self-manage her insulin pump, it should be removed.

Section 5: Transfer back to subcutaneous insulin

Important points to consider

1. If the long acting insulin, Lantus or Levemir, has been continued, transfer to subcutaneous insulin can take place at the next mealtime
2. If the long acting insulin has been stopped and a dose is not due at the time of transfer to subcutaneous insulin, please refer to the diabetes midwives or the on-call diabetes medical team for advice. The woman may need a reduced dose of long acting insulin to cover her until her regular long acting dose is due
3. If the patient was on a twice daily insulin regimen the transfer to subcutaneous insulin must only take place at breakfast or evening meal
4. If the woman is on a CSII that has been left running, transfer to mealtime boluses can take place with the next main meal
5. If the woman discontinued her CSII this should be recommenced at the normal basal rate and allowed to run in combination with the VRIII** until the next meal time when the bolus dose can be given (see additional notes below)
6. Women who have had DKA should not be transferred off a VRIII** after evening meal time. Transfer should take place at breakfast time the next day

Procedure for antenatal women to transfer to subcutaneous insulin injections:

- Follow the Self-administration of Insulin procedures
- A carbohydrate-rich meal should be given
- Wait a short time to ensure the meal is tolerated
- The woman on individual insulin injections may give an appropriate subcutaneous dose of short/rapid acting insulin and basal insulin if this is due (see notes above). Antenatal women should resume their pre-admission doses, unless these have been adjusted during the admission, in which case the new doses should be used
- If the CSII has been continued with the VRIII**, they should run together for 30 minutes following the mealtime bolus dose of subcutaneous insulin before the VRIII** is removed

- If the CSII has been discontinued during the use of the VRIII**, when it is resumed, the CSII should run together with the VRIII** for a minimum of one hour before the VRIII** is removed

Procedure for postnatal women to transfer to subcutaneous insulin:
If a woman has been delivered during this episode of hyperemesis/DKA the appropriate Diabetes delivery guideline, i.e., Labour, Elective LSCS, Emergency LSCS should be used to guide the transfer back to subcutaneous insulin injections or CSII

References:

1. Joint British Diabetes Societies Inpatient Care Group (2013) The Management of Diabetic Ketoacidosis in Adults 2nd edition available at www.diabetologists-abcd.org.uk/JBDS/JBDS.htm

Reviewed: Deirdre Graham (Diabetes Specialist Midwife) June 2014

Review due: October 2016

Appendix 1

Antenatal education to prevent admission with diabetic ketoacidosis

Antenatally on referral:

- Patient contacted by Diabetes Specialist Midwife (DSM), or her deputy, by phone
- Medical history taken
- Notes prepared and Diabetes Care Record started
- **Discussion regarding**:
    - Previous experience and ability to cope with illness; review of 'sick day rules'
    - Previous experience with DKA
    - Increased risk of DKA due to morning sickness and increasing insulin requirement in pregnancy; reassured that increasing insulin requirement does not mean worsening diabetes; the insulin requirement will return to pre-pregnancy levels after delivery
    - High fetal mortality rate with DKA
    - DKA also associated with adult mortality
    - DKA can occur with normal to near-normal blood glucose in pregnancy

Advice to patient:

1. Target blood glucose level in pregnancy (3.5-6 mmol/L)
2. Patient given phone numbers of:
    - DSM: 0118 322 7245
    - Triage: 0118 322 7304
3. Seek help early particularly to avoid hyperemesis developing into DKA and causing risks to pregnancy
4. Delivery Suite will manage at any stage in the pregnancy.
5. Ring the Delivery Suite on number above
6. Tell Delivery Suite that she is diabetic on insulin and vomiting