Care of Sick Women with DKA/Hypoglycaemia Study Day

Ann Going & Chris Hall 2020

Ketones

- DKA IS A DANGEROUS AND POTENTIALLY LIFE THREATENING CONDITION WITH EARLY APPROPRIATE MEDICAL INTERVENTION ESSENTIAL.
- What are Ketones
- Metabolism of fats can provide the body with energy when glucose is not available to the cells Ketones are the by-product of fat metabolism
- In diabetes, if there is a lack of insulin, glucose may not be available for energy.
- As insulin is responsible for transporting glucose into cells, the bodies cells will be starved of glucose for energy. So fats are metabolised for energy resulting in ketones.

Ketosis and Ketoacidosis

- When Ketone levels rise Ketones can be very dangerous as they can cause a profound change in blood acidity level
- Two terms: Ketosis and Ketoacidosis
- Ketosis describes an elevated level of ketones in the blood
- Ketoacidosis relates to the pH of the blood dropping dangerously, below 7.35 (more acidic) as a result of the presence of ketone bodies

Blood Ketone Levels

Blood Ketone Level	State
<0.6 mmol/L	Normal
>0.6 mmol/L	Ketosis
>1.5 mmol/L	Risk of DKA
>3.0 mmol/L	DKA

DKA in Pregnancy

- DKA in pregnancy occurs more frequently, more rapidly, and at lower blood glucose levels
- This is due to the baby's demands, taking glucose from the mother, and pregnancy hormones that inhibit insulin.
- DKA occurs in 9% of diabetic pregnancies and is the major cause of fetal loss, with a mortality rate of 30-90%, when it occurs

Management of DKA

- Clinical assessment : Consider diagnosis of DKA in any patient with a history of diabetes that presents acutely and is unwell; perform capillary glucose, capillary ketones and venous blood gas.
- PH < 7.3
- Blood glucose >11 or history of diabetes
- Base Excess > 2
- Blood Ketones >3mmols/L
- Follow the DKA pathway in pink folder

Maternal deaths related to diabetes 2009-2018

Total- 322 (215 indirect, 107 direct)

6 mums died of causes related to diabetes

- 2 died of DKA during pregnancy
- 2 of DKA after delivery
- 1 of complications of pancreatitis
- 1 of hypoglycaemia in bath (advise not to bath alone!)
- 1 "Diabetic death in bed" syndrome (several theories about cause-? Nocturnal hypoglycaemia causing arrhythmias, ? abnormal nerve signals to heart)

NM

- T1Dm for 8 years (Levemir 24 am and 60 pm, Novorapid tds)
- Asthma
- BMI-39
- G2, P1, 26/40
- Emergency admission to obstetrics ward directly (8 hour waiting time in ED) on Sunday 23:45
- 2/7 vomiting, streaks of blood in vomit, no melena
- Husband D&V 1/52 ago- resolved
- Asthmatic- breathless, but not wheezy

On arrival

- RR-26/min
- Pulse 130/mil
- BP 118/70
- ECG- sinus tachycardia ("leads difficult to stick")
- Some chest pain worse on inspiration
- Urine ketones- 3+
- Glucose-10.7 mmol/l
- WBC-21.7
- CRP-100

Differential diagnosis on admission:

- 1. Vomiting secondary to gastroenteritis
- 2. Dehydration due to vomiting
- 3. Not obviously DKA
- 4. Possibly PE
- 5. ? Cardiac cause of chest pain? (T1DM and 个 BMI)

DKA

Hyperventilating and cough- PE and chest infection suspected

• Throat swab- influenza- started on Tamiflu

DKA



Issues

- Normal glucose level at presentation, therefore DKA not thought of and insulin not prescribed → delay in diagnosis and treatment
- Provision of home ketone monitoring essential in pregnant T1 patients
- No explanation for the cause of metabolic acidosis
- Medical and anaesthetic opinion sought 2x- DKA was not considered

Diagnostic problems in pregnancy

- DKA can occur at normal glucose levels
- Occurs very rapidly
- Hyperventilation from DKA mistaken for respiratory pathology
- DKA can present in T2DM and GDM in pregnancy
- Can be a new presentation of T1DM

Precipitants

- Acute illness (infection)- peripheral utilisation of glucose reduced by 50%
- Use of steroids (fetal lung maturation)
- Omission of insulin
- Severe emotional stress
- Hyperthyroidism
- Hyperemesis gravidarum
- New diagnosis of T1DM in pregnancy (30%)

How does DKA present in pregnancy?

- Often as abdominal pain
- Rapid and deep respiration
- Nausea
- Lethargy
- Mental clouding
- Polyuria, polydipsia
- Muscle cramps (loss of electrolytes)
- Acetone breath odour

Treatment- fast and vigorous

Longer fetus exposed to adverse metabolic environment to higher chance of damage

- Iv fluids
- Iv insulin (but also sc long acting insulin to continue)
- Iv potassium
- Iv glucose if BG < 15 mmol/l and still acidotic
- Thromboprophylaxis
- Continuous CTG monitoring

Correction of fetal hypoxia:

- Correction of maternal academia and dehydration
- Maternal oxygenation
- Left maternal decubitus position

Fetal outcomes

- DKA in 11/888 pregnant women on insulin (4-GDM, 7- Pre-existing diabetes)
- 3 fetal deaths (27% fetal mortality)

Schneider MB. Pregnancy complicated by Diabetic ketoacidosis Maternal and fetal outcomes, Diabetic Care 2003, 26

ALGORITHM FOR THE MANAGEMENT OF DIABETIC KETOACIDOSIS Name Portsmouth Hospitals NHS NHS Trust Date of Birth Diabetic Ketoacidosis Treatment Record (treatment algorithm overleaf) Hosp Number pH < 7.3 with: IV INSULIN PRESCRIPTION Date Base Excess > 2, Affix patient label here ACTRAPID INSULIN 50units in 50mls Pre-Loaded Syringe Key: < Less than Blood Ketones > 3mmol/L

Patient weight =

kg → Insulin Infusion Rate =

units/hr

Pre	scribe fluids	separately on	trust fluid pr	escription, but	record hrly v	olumes here	Pre	escribers Sig	nature / Bleep
		-	INFUSIONS	6	FINGERS	FICK TESTS	BLOOD	TESTS	URINE
Hour of	Clock Time	0.9%Saline (mls/hr ± K+)	Insulin (units/hr)	10% Glucose (mls/hr)	Plasma Glucose (mmol/L)	Plasma Ketones (mmol/L)	Venous pH	Venous K+ (mmol/L)	Urine Volume (<u>mls</u>)
Therapy	Record hour and minute of chart completion, 1 line to be fully completed for each hour of treatment	confirm volume by circling printed protocol figure or delete and record actual volume used and any additional K+	Set at 0.1unit/kg/hr Do not change till cure is declared	Run as well as saline once BG<15mmol/L Initially run at 125ml/ <u>b.or</u> adjust per guideline over*	Measure every hour until "cure"	Check for diagnosis and then hourly once pH > 7.3 Once ketones <0.5 STOP & declare CURE	Measure alternate hours till >7.3 Then stop measuring	Measure K+ alongside pH to determine need for additional KCL in Saline infusion	Dip and Send 1 st specimen for MSU Record volume hourly (or when voided) if acutic >Ahr or incontinent ⇒ catheterise
0	Diagnosis time	1000							
1		500							
2		500							
3		500							
4		500							
5		250							
6		250							
7		250							
8		250							
9		250							
10		250							
11		250							
12		250							
13		170							
14		170							

If cure (pH >7.3 AND blood ketones <0.5mmol/L) not declared by 12hrs contact senior medical opinion Draw a hard black line across the chart representing the time cure is declared, record ongoing plan beneath* CLINICAL ASSESSMENT: Consider diagnosis of Ketoacidosis in any patient with a history of diabetes that presents acutely and is unwell: perform capillary glucose, capillary Ketones and venous blood gas.



COMMENCE FLUID, INSULIN, DEXTROSE AND POTASSIUM REPLACEMENT AS BELOW:

1 a	nd	2 a	nd	3	and	4
Resuscitation Fluid	5	Insulin Infusion Fluid] [Insulin Infusion		<u>Potassium</u>
USE		 If BG >15mmol/Luse 	H	Estimate weight**		(to be added to
the following rate:	ar	 If BG < 15 mmol/l 		 <u>Fixed</u> rate insulin infusion at 0.1unit/kg 		use pre-mixed bags)
 1000mls over 1hr 		use both Resus fluids*	Ш	Hourly BG monitoring		 If K+ >5.5mmol/l,
 1000mis±KCl over 2 	h	dextrose at 125mls/hr as	Ш	Continue normal dose		use same only
 1000mis±KCl over 2 	h	a separate infusion	Ш	and timing of lantus of levemining up if used	r	 If K+ 3.5-5.5mmol/l use saline with
 1000mls±KCl over 4 	h	 Adjust Dextrose Infusion Rates if BG is 	Ш	 If weight upsysilable 		40mmol/L KCI
 1000mls±KCl over 4 	h	excessively raised or too	Ш	use nomogram to		 If K+ < 3.5mmol/l
 1000mls±KCl over 6 	h	low as per guide below	Ш	estimate		use saline with
Add K+ to bags as po column 4 directions	er	See Resuscitation fluids on the Left.		**see appendix on-line at diabetes web-site for a nornogram to estimate wt		40mmol/L KCL AND seek senior advice*

Monitoring

Glucose. -HOURLY capillary blood sugars (until IV insulin discontinued) pH. Venous blood gas @ 1hr, 2hrs then every 2hrs until pH 7.3 achieved then. Ketones, hourly capillary ketones (with glucose) once pH >7.3 until ketone level <0.5mmol/L Urine Output, Record all urine output, (Fluid balance charts) Urinary catheter if anuric > 4 hours or incontinent. Aim for 0.5ml/ko/Hour. First specimen must be multi-stick ward tested and sent for MSU. Serum K+. measure with venous gases to adjust KCI in resuscitation infusion fluids Conscious level, AVPU monitoring hourly, if other than A then use Glasgow Coma Scale Pulse, Blood Pressure, Temperature, Respiration and oxygen saturations 4hourly minimum

ADJUSTMENT OF GLUCOSE INFUSION RATE (IF REQUIRED) WHILST ON THIS PATHWAY

Once 10% Glucose Commenced at 125ml/hr, DO NOT STOP IT, but consider alteration in rate if:

Blood alucose areater than 15mmols/I and rising by more than:

blood glucose greater than tommoish and tising b	y note than.
4mmols/l per hr	Reduce glucose rate to 50ml / hr
2 - 4mmols/l per hr	Reduce glucose rate to 75ml / hr
0 - 2mmols/l per hr	Reduce glucose rate to 100ml / hr
Blood glucose less than 5mmols/I or less than 8mm	nols/I and falling by more than:
3mmols/l / hr	Increase glucose rate to 200ml / hr
If these adjustments do not result in effective BG co	ontrol seek senior advice*

Monitoring and treatment continues until biochemical DKA Cure can be declared.

DKA Cure

- pH >7.3 (or bicarbonate>18) AND blood ketones <0.5 = call DKA cure, mark on treatment chart &...
- Once Cure is declared then Reassess patient immediately, and move to one of 2 plans, either

(a) S/C Patient well, eating and drinking - reinstate usual insulin & take down IV insulin & infusions

NB always start S/C insulin BEFORE discontinuing the IV **10**.....

(b) IV Patient remains unwell - continue infusions using peri-operative insulin infusion guidelines

If "cure" not achieved by 12h → seek senior advice* (*Med Reg / ICU team / Diabetes Physician on call)

GIK Infusion Charts

GIK REGIMEN 2 (STANDARD DOSE)

Portsmouth Hospitals NHS Trust NHS Formulary & Medicines Group

Units

FOR INDIVIDUALS WEIGHING BETWEEN 50-90KG OR TDD INSULIN 30-70 UNITS

PHT Variable Glucose, Insulin and Potassium Infusion (Sliding Scale)

To Prep	pare Insulin Infusion	Patient Name:
1)	Ideally use a prefilled syringe of insulin 50units in 50ml	Fatent Name.
	sodium chloride 0.9%. OR:	Hospital Number:
2)	If a prefilled syringe is not available prepare as below:	riospital Number.
•	Measure 50 units soluble insulin (e.g. Actrapid) using an	Date of Birth:
	insulin syringe. Use a 50ml syringe and make up to 50ml with	Date of Birth.
	sodium chloride injection 0.9%. Mix thoroughly.	Word
•	This solution contains 1 unit soluble insulin in 1ml	waru.

Patient Weight

Prescribing Sliding Scale Insulin

....ka

- Prescription: Prescribe IV insulin on standard IV prescription chart 'Insulin as per sliding scale protocol'. A qualified nurse can then
 administer insulin according to these directions & Sign the prescription for variable rate adjustment below
- 2) Fluids: Prescribe fluids (e.g. 10% glucose + 40 mmols potassium chloride/L running at 1.5L/ 24 hours) ON IV FLUID CHART

Usual Total Daily Insulin Dose ..

3) Pre-existing s/c insulin: Type 1 diabetes Glargine (Lantus), Detemir (Levemir) Continue usual dose of these insulins in

		conjunction with sliding scale
	Any 'other' insulin type	Stop these insulins whilst on iv insulin
Type 2 diabetes	Any insulin type	Stop these insulins whilst on iv insulin

Blood	Insulin In	fusion Rate (U	nits/Hour)		Fluids Must be Infused Commence IV fluids in addition t the insulin sliding scale infusion	
Glucose (mmol/L)	Standard	Individualised 1 Date	Individualised 2 Date	Additional action		
Less than or equal to 3.0	0.5			Re-check in 30mins. If two consecutive results are less than 3mmol/I - alert doctor	For most patients:	
3.1 - 6.0	1.0				potassium chloride/L running 1.5 Litres/ 24 hours.	
6.1 - 9.9	2.0				 Do NOT start using sodium chloride routinely except in initial stages of treating a hyperplycemic emergence 	
10.0 - 14.0	3.0				(eg.DKA). For the management of DKA there is a separate fixed dose	
14.1 - 22.0	4.0				Diabetic Ketoacidosis Guidelines).	
Greater than or equal to 22.1	6.0			Check pump & IV line for blockage. Alert doctor to write individualised prescription	 Rate: Infuse fluids at a rate prescribed according to patient's status. Factors such as fluid overload age, degree of dehydration, other sources of fluid loss (fistulas, etc) an 	
INITIAL PRESCRIPTION SIGN NAME & BLEEP	ATURE				cardiac history should be taken into account. If fluid overload is a problem clinically – use higher 96glucose at lower infused volume: (target 150g CHO /24hrs)	

4) Monitoring: Blood glucose and insulin dosage to be recorded hourly on the chart overleaf.

 Stopping sliding scale: If patient had pre-existing s/c insulin ensure it is administered approximately 15-30mins PRIOR to discontinuing the sliding scale infusion unless Giargine or <u>Deternit</u> have already been administered (see guideline for more details).

For more information on fluid requirements, fluid restricted patients and potassium requirements and individualized insulin prescription read the full 'Glucose, Insulin-Potassium Guideline' on the Trust intranet.

NB. This is NOT the IV insulin prescription chart for the treatment of DKA

Med Illustration Ref: 12/2982

BLOOD GLUCOSE RECORD (on IV insulin sliding scale infusion therapy)

HOSP NUMBER

NAME				
DAY 1	1	<i>l</i> .	/)
TIME		GLUCOSE (MMOL/L)	INSULIN (UNIT/HR)	SIGNATURE
00.				
01.				
02.				
03.				
04.				
05.				
06.				
07.				
08.				
09.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				
21.				
22.				
23.				

DAY 2 (/	/)	
TIME	GLUCOSE (MMOL/L)	INSULIN (UNIT/HR)	SIGNATURE
00.			
01.			
02.			
03.			
04.			
05.			
06.			
07.			
08.			
09.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
17.			
18.			
19.			
20.			
21.			
22.			
23.			

3 Versions

(make sure you use the correct one!)

<50kg (30units)

50-90kg (30-70units)

>90kg (70units)

Blood	Insulin In	fu
Glucose (mmol/L)	Standard	נ נ
Less than or equal to 3.0	0.2	
3.1 - 6.0	0.5	
6.1 - 9.9	1.0	
10.0 - 14.0	1.5	
14.1 - 22.0	2.0	
Greater than or equal to 22.1	4.0	
INITIAL PRESCRIPTION SIGN	ATURE	

Blood	Insulin In	fus
Glucose (mmol/L)	Standard	Ir
(D
Less than or equal to 3.0	0.5	
3.1 - 6.0	1.0	
6.1 - 9.9	2.0	
10.0 - 14.0	3.0	
14.1 - 22.0	4.0	
Greater than or equal to 22.1	6.0	
INITIAL PRESCRIPTION SIGN	ATURE	

Blood	Insulin In	fusio
Glucose (mmol/L)	Standard	Inc
		Dat
Less than or equal to 3.0	1.0	
3.1 - 6.0	2.0	
6.1 - 9.9	3.0	
10.0 - 14.0	4.0	
14.1 - 22.0	6.0	
Greater than		
or equal to 22.1	8.0	
INITIAL PRESCRIPTION SIGN	NATURE	

Low Dose

Standard Dose

High Dose

Insulin chart



Page 1 of the chart is for recording information that is required during admission in order to make safe adjustments to doses and to record the level of self-administration

This section records clinical information which will impact on inpatient insulin requirements and

This section records usual doses and device use to ensure appropriate supplies at discharge from hospital

For further information on assessment of selfadministration level – see appendix 5

Insulin chart



Insulin chart



Hypoglycaemia

- Blood glucose level <4mmols
- Shakiness
- Nervousness or anxiety
- Sweating, chills and clamminess
- Irritability or impatience
- Confusion, including delirium
- Rapid/fast heartbeat
- Lightheadedness or dizziness
- Hunger and nausea
- Sleepiness
- Blurred/impaired vision
- Tingling or numbness in the lips or tongue
- Headaches
- Weakness or fatigue
- Anger, stubbornness, or sadness
- Lack of coordination
- Nightmares or crying out during sleep
- Seizures
- Unconsciousness

Hypoglycaemia

- Reduced hypo awareness in pregnancy
- Reduced hypo awareness with some drugs i.e.
 Labetalol
- Hyperemesis risk of hypoglycaemia
- Less insulin resistance postnatally
- Use of insulin in pregnancy (GDM and T2 DM)

<u>HYPO BOX</u>: For Treatment of Hypoglycaemia in Patients with Diabetes (Adult inpatient

care) Hypoglycaemia is a blood glucose of 4 mmol/l or less (if not less but symptomatic give small carbohydrate snack for symptom relief and monitor glucose levels)		
MILD Alert, conscious and able to swallow	MODERATE Drowsy or uncooperative and/or risk of choking	SEVERE - <u>Call 2222 and Fast Blp Doctor</u> Unconscious and potential for no gag reflex, and/or fitting, and/or NBM
STEP 1		
Initially administer 1x25g Glucose 40% oral gel from the hypoglycaemia kit inside the cheek . Massage outside of cheek allowing it to be absorbed or swallowed . If Glucose 40% oral gel unavailable use 10-20g fast acting glucose such as 2 tsp sugar in water or 200ml glass of fizzy drink or patients own remedy if appropriate	Initially administer ONE or TWO tube(s) of glucose 40% oral gel from the hypoglycaemia kit, inside the cheek . Massage outside of cheek allowing it to be absorbed	 Check ABC. Place in recovery position if required Administer IM injection of Glucagon 1mg using GlucaGen Kit stored in locked ward fridge. If no response from Glucagon within 5-10 minutes, doctor to administer IV injection of 50% dextrose, 50mls, administered slowly through a large vein and large gauge cannula
STEP 2		
Repeat at 5-15 min intervals as necessary depending on patient symptoms and glucose concentrations.		Once conscious, follow yellow step one and two
STEP 3		
To prevent glucose levels falling again ensure long-acting carbohydrates such as adequate amounts of bread/potato/rice is eaten with a meal or a snack such as 2-3 biscuits, fruit, current bun is eaten if it is not a meal time. Continue regular monitoring for 24 – 48 hours and reflect on cause of hypo event. Refer to diabetes specialist team if no obvious cause of hypo event		

INSULIN SHOULD NOT BE OMITTED FOLLOWING AN EPISODE OF HYPOGLYCAEMIA. If you are concerned, patients should be assessed for a smaller insulin dose rather than an omission

Hyperosmolar Non-Ketotic Diabetic State (HHS)

- The hyperglycaemic hyperosmolar state (HHS) is a medical emergency. HHS is different from diabetic ketoacidosis (DKA) and treatment requires a different approach.
- Although typically occurring in the elderly, HHS is presenting in ever younger adults and teenagers, often as the initial presentation of type 2 diabetes mellitus
- (T2DM). It has a higher mortality than DKA and may be complicated by vascular complications such as myocardial infarction, stroke or peripheral arterial thrombosis. Seizures and cerebral oedema
- Whilst DKA presents within hours of onset, HHS comes on over many days, and consequently the dehydration and metabolic disturbances are more extreme.

Hyperosmolar Non-Ketotic Diabetic State (HHS)

- Undiagnosed Type 2 DM or known cases of Type 2 DM
- Hyperglycaemia (blood glucose often > 28 mmol/l)
- Usually no ketones in the urine, although may be present in patient with
- vomiting (Particularly trace or 1+)
- No severe acidosis (pH >7.2 and HCO3- often normal)
- Hyperosmolality (serum osmolality >350 mosm/l)
- 50% of patients are hypernatraemic
- ± decreased conscious level and mental confusion

Hyperosmolar Non-Ketotic Diabetic State (HHS)

- The goals of treatment of HHS are to treat the underlying cause and to gradually and safely:
- Normalise the osmolality
- Replace fluid and electrolyte losses
- Normalise blood glucose

Prevent:

- Arterial or venous thrombosis
- Other potential complications e.g. cerebral oedema