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ADULT DIABETIC KETOACIDOSIS TREATMENT AND MONITORING CHART

GIG CYMRU NHS WALES
Bwrdd Iechyd Prifysgol Bae Abertawe
Swansea Bay University Health Board

HOSPITAL: _____

WARD: _____

CONSULTANT: _____

HOSPITAL NO: _____

SURNAME: _____

FIRST NAMES: _____

ADDRESS: _____ ADDRESSOGRAPH

_____

_____

DATE OF BIRTH: _____

Weight: _____ Kg Estimated ☐

- This chart is for treatment of **ADULT DIABETIC KETOACIDOSIS** only
- Please refer to guidelines on page 4 as required
- This chart is NOT to be used to initiate variable rate insulin infusion (VRII)
- **All patients with DKA must be referred to diabetes team**

ADULT DIABETIC KETOACIDOSIS – DIAGNOSIS (All three of following)

- **Glucose ≥11.0 mmol/L**
- **Capillary Ketones ≥3.0 mmol/L**
- **Venous pH ≤7.3 and/or Bicarbonate ≤15 mmol/L**

→ ***Start fixed rate insulin infusion (see below)***

FIXED RATE INSULIN INFUSION REGIME (FRII)

- **Start if ketotic (blood ketones ≥3.0mmol/L) and acidotic (bicarbonate ≤15mmol/L; pH ≤7.3)**
- **Weigh/estimate weight in Kg; if pregnant, use current pregnant weight**
- **Start FRII at 0.1 units/Kg per hour (e.g. for 80 Kg man, give 8 units per hour)**
- **If patient takes long acting insulin, ALWAYS continue at usual dose & time [e.g. isophane (Insulatard®, Humulin I®, Insuman Basal®), glargine (Lantus®, Toujeo®, Abasaglar®), detemir (Levemir®) or degludec (Tresiba®)]**
- **Aim to reduce blood ketones by at least 0.5mmol/L/hr and glucose by at least 3mmol/L/hr; if targets NOT achieved, increase rate of insulin infusion by 1unit/hr each hour, until targets achieved**
- **Caution: If K^+ <3.5mmol/L - follow potassium guidance (page 2) AND WITHHOLD insulin until K^+ >3.5mmol/L**

FIXED RATE INSULIN INFUSION REGIME (FRII) PRESCRIPTION

DATE	INSULIN	DOSE	FLUID	VOLUME	ROUTE	START RATE (0.1 units/Kg/hr)	PRESCRIBER SIGNATURE	PHARMACY
	Actrapid	50 Units	0.9% Sodium chloride	Up to 50 mL	IV	..... units/hr	bleep No.	

DATE	TIME GIVEN	GIVEN BY	CHECKED BY	DATE	TIME GIVEN	GIVEN BY	CHECKED BY	DATE	TIME GIVEN	GIVEN BY	CHECKED BY

SEVERE DIABETIC KETOACIDOSIS (One or more of following)

- **Blood ketones ≥6mmol/L**
- **Bicarbonate ≤5mmol/L**
- **Venous/arterial pH ≤7.1**
- **GCS ≤12**
- **Pulse ≥100 or ≤60 bpm**
- **Systolic BP ≤90 mmHg**
- **Anion gap ≥16 (Anion gap = $(Na^+ + K^+) – (Cl^- + HCO3^-)$**
- **Oxygen saturation ≤92% on air (assuming normal baseline respiratory function)**

→ ***Seek senior / ITU review***

RESOLUTION OF DKA (Both of following)

- **Capillary ketones ≤0.6mmol/L (on two consecutive readings)**
- **Venous pH ≥7.3 and venous bicarbonate ≥15mmol/L**

Assess oral intake

→ **If eating and drinking** → ***Switch to subcutaneous insulin (see guidance page***

→ **If not eating and drinking well** → ***Switch to Variable Rate Insulin Infusion (VRII) chart***

ADULT DIABETIC KETOACIDOSIS TREATMENT AND MONITORING RECORD

PATIENT'S NAME…… **HEALTH RECORD NUMBER**……

POTASSIUM REPLACEMENT (KCl)	
OVER 5.5mmol/L	NIL
3.5mmol/L to 5.5mmol/L	40mmol/L
BELOW 3.5mmol/L	Senior Review (see opposite box)

POTASSIUM REPLACEMENT REGIME

- **If potassium <3.5mmol/L on admission bloods, WITHHOLD insulin and replace potassium: give 1L 0.9% Sodium chloride containing 40 mmol/L potassium over 2hr via a peripheral line (with cardiac monitoring).**
- **Maintain potassium between 4.0 & 5.5 mmol/L.**
- **Venous blood gas for pH, bicarbonate and potassium on admission, at 60 minutes, 2 hours & 2 hourly thereafter.**

FLUID RESUSCITATION

- **A standard infusion regime for fluid resuscitation in DKA is prescribed below**
- **A SLOWER RATE & REDUCED VOLUME of infusion should be considered if:**
  - **Patient <25 years or >70 years of age**
  - **Pregnant**
  - **Heart failure / Cardiac disease**
  - **Chronic kidney disease (eGFR <30mL/min and dialysis patients refer to nephrologist on call)**
- **Give both 0.9% sodium chloride & 10% dextrose together if ketones ≥1.0mmol/L & glucose ≤14mmol/L**

INTRAVENOUS NORMAL SALINE

DATE	FLUID	**POTASSIUM** (CIRCLE AS APPROPRIATE)	RATE (mL/hr) (CIRCLE AS APPROPRIATE)	PRESCRIBER SIGNATURE	DATE	TIME GIVEN	GIVEN BY	CHECK BY
	0.9% Sodium chloride 1 litre	Nil / 20mmol	1000 / other…….	bleep No.				
	0.9% Sodium chloride 1 litre	Nil / 20mmol / 40mmol	500 / other…….	bleep No.				
	0.9% Sodium chloride 1 litre	Nil / 20mmol / 40mmol	500 / other…….	bleep No.				
	0.9% Sodium chloride 1 litre	Nil / 20mmol / 40mmol	250 / other…….	bleep No.				
	0.9% Sodium chloride 1 litre	Nil / 20mmol / 40mmol	250 / other…….	bleep No.				
	0.9% Sodium chloride 1 litre	Nil / 20mmol / 40mmol	166 / other…….	bleep No.				
	0.9% Sodium chloride 1 litre	Nil / 20mmol / 40mmol	166 / other…….	bleep No.				
By 24 hours ketonaemia & acidosis should be resolved (ketones ≤ 0.6mmol/L and pH ≥7.3 or bicarb ≥15mmol) Continue IV fluids & *switch to variable rate insulin infusion (VRII chart)* if patient not eating & drinking as per clinical judgment								
	0.9% Sodium chloride 1 litre	Nil / 20mmol / 40mmol	125 / other…….	bleep No.				
	0.9% Sodium chloride 1 litre	Nil / 20mmol / 40mmol	125 / other…….	bleep No.				
	0.9% Sodium chloride 1 litre	Nil / 20mmol / 40mmol	125 / other…….	bleep No.				
	0.9% Sodium chloride 1 litre	Nil / 20mmol / 40mmol	125 / other…….	bleep No.				

INTRAVENOUS DEXTROSE (RUN ALONGSIDE NORMAL SALINE with FRII if BG < 14mmol/L (via GREEN VENFLON)

DATE	FLUID	INSTRUCTION	RATE (mL/hr) CIRCLE AS APPROPRIATE	PRESCRIBER SIGNATURE	DATE	TIME GIVEN	GIVEN BY	CHECK BY
	10% Dextrose 1 Litre **For Use with FRII**	If CBG <14mmol/L run **alongside** Normal Saline	125 / other…….	bleep No.				
	10% Dextrose 1 Litre **For Use with FRII**	If CBG <14mmol/L run **alongside** Normal Saline	125 / other…….	bleep No.				
	10% Dextrose 1 Litre **For Use with FRII**	If CBG <14mmol/L run **alongside** Normal Saline	125 / other…….	bleep No.				
	10% Dextrose 1 Litre **For Use with FRII**	If CBG <14mmol/L run **alongside** Normal Saline	125 / other…….	bleep No.				

PATIENT'S NAME……**HEALTH RECORD NUMBER**……

SUBCUTANEOUS INSULIN PRESCRIPTION GUIDANCE

- **KEY MESSAGE: Long acting (basal) insulin should be continued while on FRII but rapid acting insulin has to be withheld**
- **If patient takes long acting (basal) insulin, ALWAYS continue at usual dose & time [isophane (Insulatard®, Humulin I®, Insuman Basal®), glargine (Lantus®, Toujeo®, Abasaglar®), detemir (Levemir®) or degludec (Tresiba®)]**
- **If long acting (basal insulin) was omitted by patient on the day before admission and next dose of basal insulin is due in <12 hours, give full dose of basal insulin immediately**
- **If long acting (basal insulin) was omitted by patient on day before admission, and next dose of basal insulin is due in ≥12 hours give 1/3rd of usual dose of basal insulin immediately and remaining 2/3rds of the dose at the usual injection time.**
- **For INSULIN NAÏVE PATIENTS administer Lantus® - dose calculated by multiplying patient's weight (in kg) by 0.25 units example: 60kg person would require approximately 60 x 0.25 units or 15 units of Lantus daily**
- **When SWITCHING to subcutaneous insulin from insulin infusion, wait till meal time and ensure patient will be able to eat and drink; there MUST be a 30min overlap between giving first injection of fast acting insulin or premixed insulin and stopping insulin infusion**

ENTER DOSE AGAINST TIME REQUIRED WRITE THE INSULIN DOSE WITHOUT THE WORD 'UNITS'				MONTH:				YEAR:		
				DATE:						
DATE ⇨				INSULIN & STRENGTH		SPECIAL INSTRUCTIONS		PRESCRIBER'S SIGNATURE		PHARMACY
ROUTE ⇨		S/C	S/C							
INITIALS ⇨								BLEEP		SUPPLY
SPECIFY TIME IF REQUIRED ⇩		bleep	bleep							
		Units	Units							
Breakfast		Units	Units							
Lunch		Units	Units							
Supper		Units	Units							
Bedtime		Units	Units							
		Units	Units							

ENTER DOSE AGAINST TIME REQUIRED WRITE THE INSULIN DOSE WITHOUT THE WORD 'UNITS'				MONTH:				YEAR:		
				DATE:						
DATE ⇨				INSULIN & STRENGTH		SPECIAL INSTRUCTIONS		PRESCRIBER'S SIGNATURE		PHARMACY
ROUTE ⇨		S/C	S/C							
INITIALS ⇨								BLEEP		SUPPLY
SPECIFY TIME IF REQUIRED ⇩		bleep	bleep							
		Units	Units							
Breakfast		Units	Units							
Lunch		Units	Units							
Supper		Units	Units							
Bedtime		Units	Units							
		Units	Units							

ENTER DOSE AGAINST TIME REQUIRED WRITE THE INSULIN DOSE WITHOUT THE WORD 'UNITS'				MONTH:				YEAR:		
				DATE:						
DATE ⇨				INSULIN & STRENGTH		SPECIAL INSTRUCTIONS		PRESCRIBER'S SIGNATURE		PHARMACY
ROUTE ⇨		S/C	S/C							
INITIALS ⇨								BLEEP		SUPPLY
SPECIFY TIME IF REQUIRED ⇩		bleep	bleep							
		Units	Units							
Breakfast		Units	Units							
Lunch		Units	Units							
Supper		Units	Units							

Bedtime		Units	Units							
		Units	Units							

HYPOGLYCAEMIA PREVENTION AND MANAGEMENT (while on FRII)

- **Ideally no patient on FRII should get hypoglycaemia as 10% dextrose infusion must be commenced at rate of 125mL/hr alongside 0.9% saline infusion as soon as the capillary glucose <14 mmol/L.**
- **If despite 10% dextrose infusion at rate of 125 mL/hr, capillary glucose drops by more than 2.0 mmol/L on 2 consecutive readings, reduce rate of insulin infusion by 1 unit/hr (to reduce the risk of developing hypoglycaemia)**
- **If despite 10% dextrose infusion at the rate of 125 mL/hr, capillary glucose rapidly falls to <4mmol/L without resolution of ketoacidosis, recheck venflon patency, exclude pump malfunction and double rate of dextrose infusion if there's no issue with venflon or infusion pump. Send venous glucose to lab for check.**
- **It would be very unlikely for a patient to develop severe hypoglycaemia while on FRII along with 10% dextrose going through a patent cannula. However, if symptoms of severe hypoglycaemia develop (unconsciousness, seizures or very aggressive behavior) stop insulin infusion and treat as severe hypoglycaemia (100mL of 20% dextrose IV over 15 minutes, check capillary glucose every 15 minutes and repeat 100mL of 20% dextrose IV over 15 minute until capillary glucose ≥4mmol/L).**
- **If still ketoacidotic despite severe hypoglycaemia, seek ITU help because alternative causes of acid base balance disturbance would need to be taken into account.**
- **Restart FRII at half the initial rate along with 10% dextrose infusion when blood glucose >10mmol/L.**

ADULT DIABETIC KETOACIDOSIS – GUIDELINE BY TIME BLOCKS

DIAGNOSIS: - Capillary Glucose >11.0 mmol/L and Capillary Ketones >3.0 mmol/L and Venous pH <7.3 or Bicarbonate <15 mmol/L

BOX 1: Immediate management upon diagnosis: 0 - 60 min.

(T = 0 at time intravenous fluids commenced)

Action 1: Commence 0.9% sodium chloride infusion (use large bore cannula) via infusion pump

When systolic BP (SBP) on admission is <90mmHg:

Hypotension is likely to be due to low circulating volume, but consider other causes such as heart failure, sepsis, etc.

- Give 500mL 0.9% sodium chloride solution over 10 -15 min.
- If SBP remains <90mmHg this may be repeated **whilst awaiting senior input**
- In practice, most patients require between 500 -1000mL given rapidly
- If no clinical improvement, reconsider other causes of hypotension & seek **immediate senior assessment**
- Consider involving ITU/critical care team
- Once SBP above 90mmHg, follow fluid replacement as per page 2

Action 2: Insulin – commence fixed rate intravenous insulin infusion (FRII)

- 0.1 unit/kg/hr based on actual or estimated weight
- 50units human soluble insulin (Actrapid®) added to 49.5mL sodium chloride 0.9%
- If patient takes long acting insulin, ALWAYS continue usual dose & time [isophane (Insulatard®, Humulin I®, Insuman Basal®), glargine (Lantus®, Toujeo®, Abasaglar®), detemir (Levemir®) or degludec (Tresiba®)]

Action 3: Assess patient clinically for severe DKA requiring HDU/ITU input

Action 4: Further investigations:

[capillary & lab glucose, venous blood gases, U&E, capillary ketones, FBC, CXR, blood cultures, urinalysis & culture, ECG & MI screen (in high risk group), pregnancy test in women of child bearing age

Action 5: Establish monitoring regimen - see pages 5 & 6

- Capillary glucose & ketones; venous bicarbonate, potassium, U&E, etc (continuous cardiac monitoring and/or pulse oximetry if required)

Action 6: Consider precipitating causes & treat appropriately; consider thromboprophylaxis.

Caution: If Potassium <3.5mmol/L - follow potassium & fluid resuscitation guidance (page 2) and withhold insulin until K^+ ≥ 3.5mmol/L

BOX 2: 60 minutes to 6 hours and beyond

Aims of treatment:

- Rate of fall of ketones of at least 0.5mmol/L/hr OR bicarbonate rise 3 mmol/L/hr & capillary glucose fall 3mmol/L/hr.
- Maintain serum potassium in range 4 - 5.5 mmol/L
- Aim for capillary glucose of 6 - 12mmol/L

Action 1: Re-assess patient (vital signs) – continue to monitor:

- Capillary glucose & ketones - hourly
- Venous blood gas for pH, bicarbonate and potassium at 60minutes, 2 hours and 2 hourly thereafter
- **For potassium replacement follow table on Page 2** (Venous potassium should be maintained between 4 and 5.5 mmol/L). Complete DKA monitoring form on Pages 5 & 6 for all monitoring parameters

Action 2: Continue fluid replacement via infusion pump. Follow fluid replacement schedule on Page 2 - when capillary glucose is less than 14mmol/L ADD 10% dextrose to run alongside sodium chloride 0.9%

DO NOT STOP INSULIN INFUSION

Action 3: Assess response to treatment – Insulin infusion rate may need review if:

- Capillary ketones not falling by at least 0.5mmol/L/hr.
- Venous bicarbonate not rising by at least 3mmol/L/hr.
- Plasma glucose not falling by at least 3mmol/L/hr.
- Check for insulin infusion pump malfunction
- If pump working but response inadequate – **increase insulin infusion by 1 unit/hr increments until targets achieved**

Action 4: Identify and treat precipitating factors

Action 5: Type 1 diabetes patients taking long acting insulin should continue to receive it at usual dose and time
For insulin naive patients, administer Lantus® at a dose of 0.25 units/Kg subcutaneously once daily

Action 6: Ensure all DKA patients referred to diabetes team

Resolution of DKA:

Continue FRII until both of following achieved:

- Ketones <0.6mmol/L for 2 consecutive hours,
- Venous pH >7.3 and venous bicarbonate >15mmol/L

Once DKA resolved, start VRII if patient still not eating & drinking.

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PATIENT'S NAME……HEALTH RECORD NUMBER……PATIENT'S NAME……..HEALTH RECORD NUMBER……

FREQUENCY OF MONITORING (FOR ALL DKA PATIENTS)

- ***Hourly capillary glucose monitoring***
- ***Hourly capillary ketone monitoring until < 0.6mmol/L - 2 consecutive hrs***
- ***Venous HCO_3 & K^+ at time zero, 1 hour, 2 hours & 2 hourly shaded area***

DIABETIC KETOACIDOSIS MONITORING CHART

METABOLIC TARGETS

- ***Capillary ketones ≤0.6 mmol/L***
- ***venous pH ≥7.3 and/or venous bicarbonate ≥15mmol/L***
- ***Capillary glucose 6 - 12 mmol/L***

Date	**DAY 1**											**Date:**											
Hours from start	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
BLOOD GLUCOSE mmol per Litre (28 / 24 / 20 / 16 / 12 / 8 / 4 / 0)		*LIAISE*			*WITH*					*DOCTOR*			*TO*			*REVIEW*			*TREATMENT*				*REGIME*	
		LIAISE			*WITH*					*DOCTOR*			*TO*			*REVIEW*			*TREATMENT*				*REGIME*	
											TREAT			*HYPOGLYCAEMIA*										
Test Times																								
Capillary Glucose (mmol/L)																								
Capillary Ketones (mmol/L)																								
Insulin rate (mL/hr)																								
Volume left in syringe at the start of the hour																								
Volume infused last hr	0																							
Serum Potassium (mmol/L)																								
Serum Bicarbonate (mmol/L)																								
Doctor/Nurse's initial																								

Date	**DAY 2**											**Date:**											
Hours from start	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
BLOOD GLUCOSE mmol per Litre (28 / 24 / 20 / 16 / 12 / 8 / 4 / 0)		*LIAISE*			*WITH*					*DOCTOR*			*TO*			*REVIEW*			*TREATMENT*				*REGIME*	
		LIAISE			*WITH*					*DOCTOR*			*TO*			*REVIEW*			*TREATMENT*				*REGIME*	
											TREAT			*HYPOGLYCAEMIA*										
Test Times																								
Capillary Glucose (mmol/L)																								
Capillary Ketones (mmol/L)																								
Insulin rate (mL/hr)																								
Volume left in syringe at the start of the hour																								
Volume infused last hr																								
Serum Potassium (mmol/L)																								
Serum Bicarbonate (mmol/L)																								
Doctor/Nurse's initial																								

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Swansea Bay University Health Board

Authorisation Form for Publication onto COIN

PLEASE ENSURE THAT ALL QUESTIONS ARE ANSWERED – IF NOT APPLICABLE PLEASE PUT N/A

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