

DIABETIC EMERGENCIES

DIABETIC KETOACIDOSIS (DKA) and HYPEROSMOLAR HYPERGLYCAEMIC STATE (HHS)



By

Dr Shamanth Soghal

JSD FY2- Medical Rotations

Queen Elizabeth Hospital Birmingham

OBJECTIVES

- ✓ To understand the brief pathophysiology and triggers of DKA
- ✓ To know the diagnostic criteria and step by step management protocol of DKA and HHS
- ✓ To be aware of the complications of DKA and HHS

THINGS NOT COVERED:

- Hypoglycemia
- Euglycemic DKA
- Mixed Picture: DKA and HHS
- Detailed Pathophysiology
- Controversial Issues



SURVEY



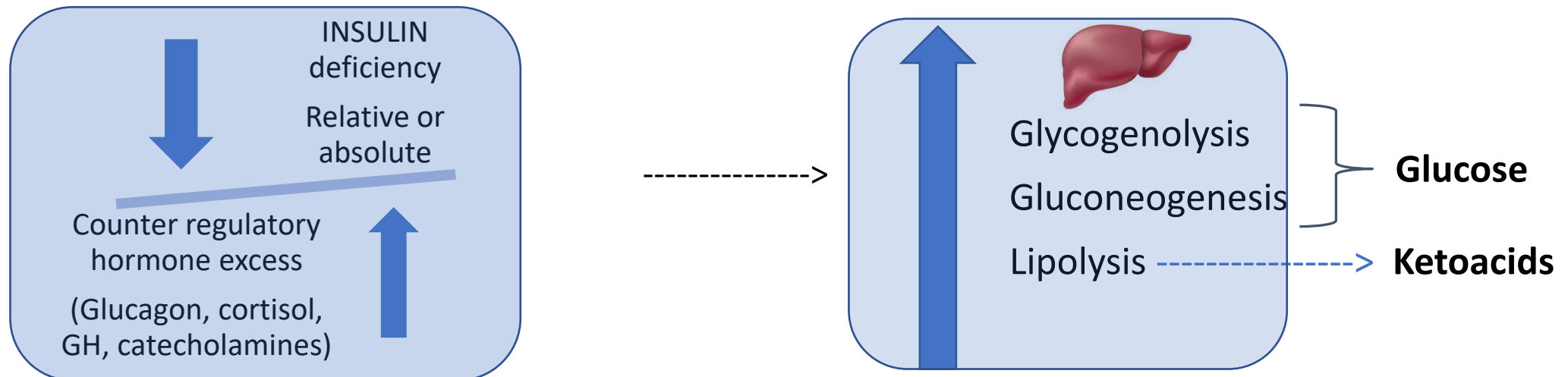
PRE -SESSION QUESTIONNAIRE

DIABETIC KETOACIDOSIS (DKA)

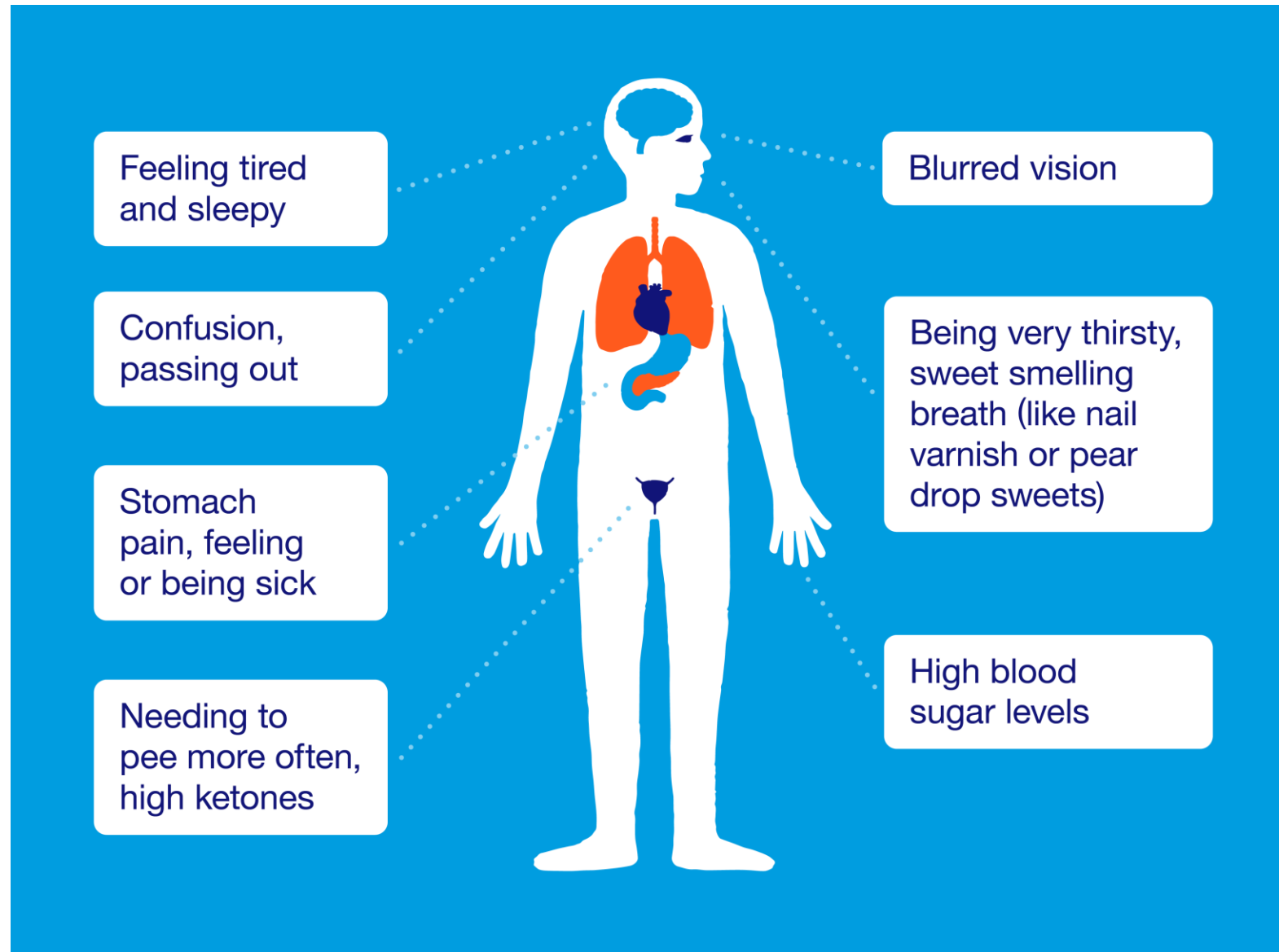
- It is an abnormal metabolic state and a **life-threatening emergency** - **hyperglycaemia**, **ketonaemia**, and **acidosis**
- Common in type 1, but about 1/3rd of cases in type 2.
- Epidemiology: UK Incidence : 8.0-51.3 cases/1000 patient years in T1 DM
- UK mortality rate: remains <1% , but still is the leading cause of death in people <58 years with T1DM)

PRECIPITATING FACTORS:

- Missed/wrong insulin dose, poor compliance, Failure of insulin pumps
- Intercurrent illness: Infection, MI, Pancreatitis
- Surgery, Trauma, Pregnancy
- Recreational drugs, Antipsychotics, Chemotherapy



SIGNS AND SYMPTOMS



DIAGNOSIS

all three of the following must be present:

D • blood glucose above **11** mmol/L or known diabetic (*Exception: Euglycemic DKA*)

K • blood ketones ≥ 3 mmol/L or urine ketones $\geq 2+$

A • venous pH < 7.3 and/or bicarbonate < 15 mmol/L

Differential Diagnosis:

- HHS
- HHS/DKA mixed picture
 - Euglycemic DKA
 - Alcoholic Ketoacidosis
- Starvational Ketoacidosis

MANAGEMENT



**ABCDE Approach,
2 large bore iv cannulas**



Tests: VBG for pH, bicarbonate;
bedside and lab glucose and ketones; U&ES, FBC, CRP;
CXR, ECG



Consider ITU referral if any of the following:

- 1.** Young or elderly or pregnant
- 2.** Heart or liver or kidney failure
- 3.** Severe DKA judged by: blood ketones $>6\text{mmol/L}$ or bicarbonate $<5\text{mmol/L}$ or pH <7.1 or potassium $<3.5\text{ mmol/L}$ or GCS <12 or persistent hypoxia or persistent brady/ tachycardia or anion gap >16

Time since diagnosis of DKA

0 min
to
60
min

Restore circulatory volume

- Give 500ml of 0.9% sodium chloride stat doses until systolic BP > 90 mmHg
- Then give 1000ml 0.9% sodium chloride over 1 hr

Start insulin therapy

- Start fixed rate insulin infusion at 0.1ml/kg/hr
- Continue patient's long-acting insulin

60
min
to
6 hrs

Continue fluid replacement

- 1 litre of 0.9% sodium chloride with potassium*, over 2 hr
- Then, 1 litre of 0.9% sodium chloride with potassium*, over 2 hr
- Then, 1 litre of 0.9% sodium chloride with potassium*, over 4 hr

* Potassium replacement

- <3.5- senior review
- 3.5-5.5- 40 mmol/l
- >5.5- no replacement

6 hrs
to
12
hrs

Continue fluid replacement

- 1 litre of 0.9% sodium chloride with potassium*, over 4 hr
- Then, 1 litre of 0.9% sodium chloride with potassium*, over 6 hr
- **Senior review if DKA persists beyond 12 hours**

Monitor for hypoglycaemia

- Start 500ml 10% glucose at 125ml/hr and reduce insulin infusion rate by 50% (0.05ml/kg/hr) **when glucose ≤ 14 mmol/L**

ADDITIONAL MEASURES

Monitoring

- Hourly glucose and **hourly ketones**
- Bicarbonate & potassium at 1 hr & 2 hr after diagnosis & 2 hourly thereafter
- **Check infusion rate if:**
 - Ketones not reducing by 0.5mmol/hr
 - Bicarbonate not increasing by 3mmol/hr
 - Glucose not reducing by 3mmol/hr
- **If glucose ≤ 4 mmol/L, follow hypoglycaemia guidelines and ensure fixed rate insulin infusion is running at 0.05ml/kg/hr if DKA still persists**

- Consider catheter if not passed urine by 1h, aim for urine output 0.5mL/kg/h.
- Consider NG tube if vomiting or drowsy
- Start all patients on LMWH
 - *Find and treat infection/cause for DKA*

Bicarbonate may increase risk of cerebral oedema and is not recommended.

RESOLUTION OF DKA= Ketones < 0.6 mmol/L and venous pH > 7.3

- Diabetes referral for further management and until then VRll
- Expectation: Patient should be eating and drinking and back on normal insulin
- **Transfer to s.c insulin:** Give insulin infusion until 30 minutes after s.c short acting insulin has been given



COMPLICATIONS

- Cerebral Edema (monitor GCS, any suspicion warrants urgent imaging and antiedema measures)
- Hyperkalemia and Hypokalemia
- Hypoglycemia
- Aspiration pneumonia
- Hypomagnesaemia, Hypophosphatemia
- Venous thromboembolism
- Other: pulmonary edema, cardiomyopathy, rhabdomyolysis

HYPEROSMOLAR HYPERGLYCAEMIC STATE (HHS)

- HHS is a medical emergency which is different from DKA (Previously known as HONK)
- Typically occurring in T2 DM and elderly
- **Presentation** : over many days (unlike hours in DKA), and consequently the dehydration and metabolic disturbances are more extreme.
- HHS carries **higher mortality risk** than DKA and may be complicated by **vascular events**

PRECIPITATING CAUSES

Intercurrent or co-existing illness

- MI/Intestinal ischaemia/PE
- Infection/Sepsis/Burns/Acute abdomen/GI bleed
- Stroke/TIA/ICH
- Hyperthermia/Hypothermia.
- AKI / Decompensated CKD
- Hyperthyroidism/Cushing's syndrome/ACTH-secreting tumour.

Medication-induced

- Metformin during intercurrent illness.
- Diuretics
- Beta-blockers, Calcium-channel blockers.
- H₂-receptor antagonists.
- Dialysis/TPN/glucose-containing fluids.
- anti-psychotics
- Glucocorticoids, Phenytoin and other anticonvulsants.
- Substance misuse: Alcohol, Cocaine, Amphetamines, MDMA

Diabetes-related

- First presentation of diabetes mellitus:
- Poor diabetic control/non-compliance:

POLYDIPSIA
HEADACHE



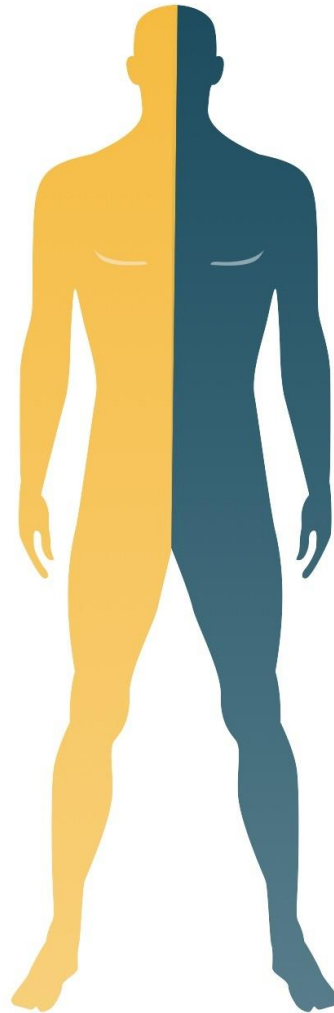
NAUSEA
VOMITING
ABDO PAIN



POLYURIA
MUSCLE CRAMPS



SYMPTOMS



LOW GCS/COMA
CONFUSION
SEIZURES



TACHYCARDIA
HYPOTENSION
DEHYDRATION



OLIGURIA/
ANURIA

SIGNS



DIAGNOSTIC CRITERIA

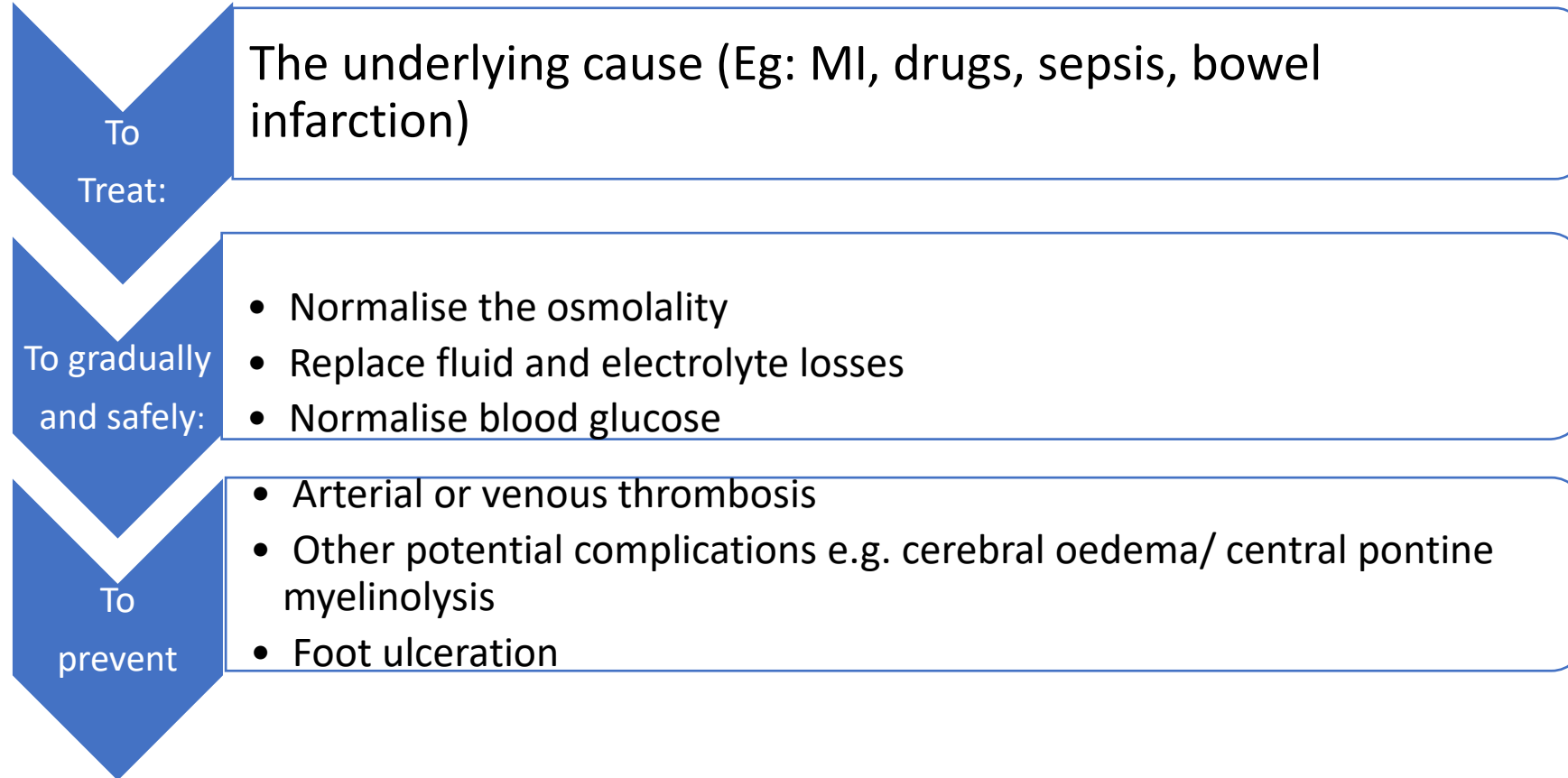
- **Hypovolaemia**
- Marked hyperglycaemia (Glucose ≥ 30 mmol/L)
without significant hyperketonaemia (ketones < 3 mmol/L) or
without acidosis (pH > 7.3 , bicarbonate > 15 mmol/L)
- Osmolality ≥ 320 m osmol/kg

Differential Diagnosis:

- DKA
- HHS/DKA mixed picture
 - Euglycemic DKA
- Alcoholic Ketoacidosis
- Starvational ketoacidosis

MANAGEMENT

Principles and Goals:



MANAGEMENT



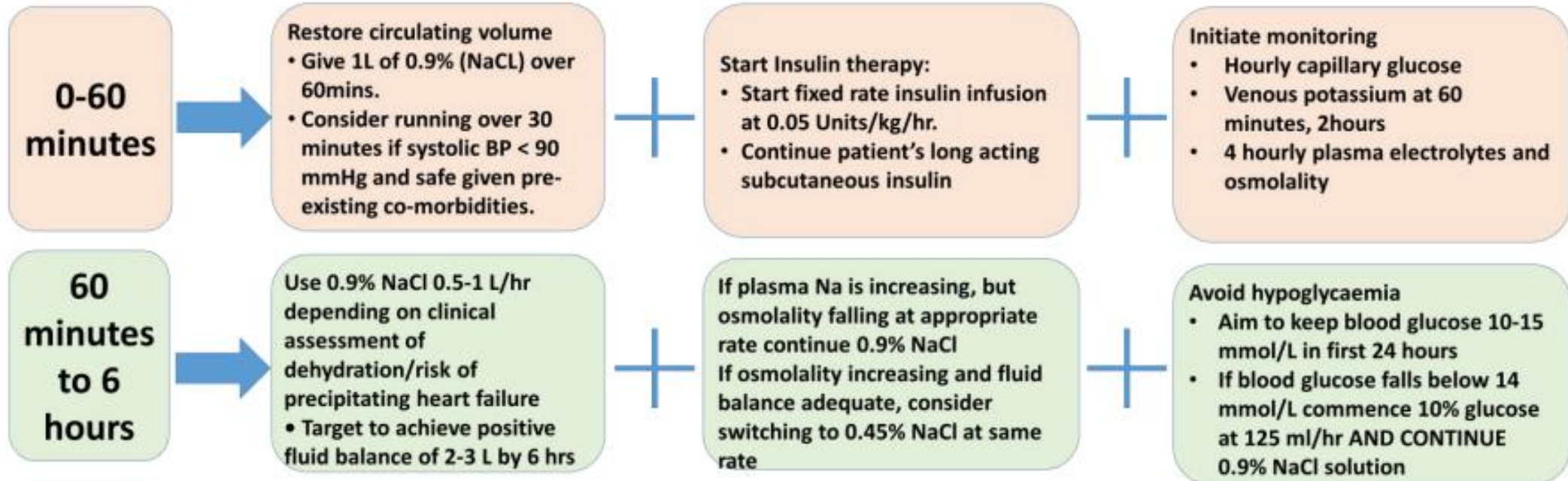
**ABCDE Approach,
2 large bore iv cannulas**

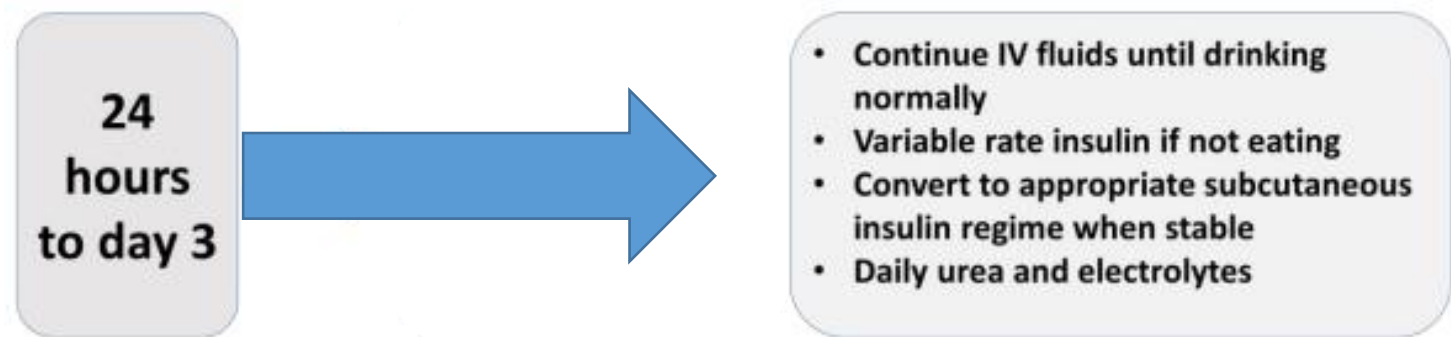
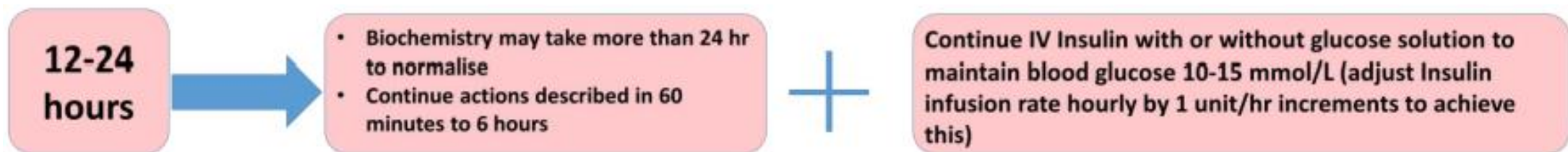
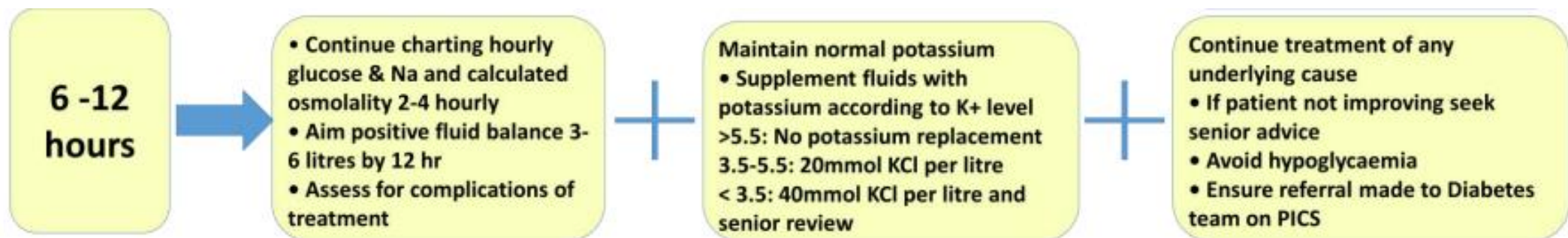
Tests: Capillary BG, plasma BG, U&E, FBC, Measured or calculated osmolality ($2\text{Na}^+ \text{ glucose} + \text{urea}$), VBG, Blood ketones, lactate, Blood cultures, ECG, CXR, Urinalysis and culture, CRP



Evaluation:

- Does the history suggest sepsis/vascular event or a recent change in medication?
- Assess the degree of dehydration
- Examine for a source of sepsis or evidence of vascular event
- Mental state assessment





CONSIDER HDU/ITU REFERRAL

- osmolality >350 mosmol/kg
- sodium > 160 mmol/L
- venous / arterial pH < 7.1
- hypokalaemia (K<3.5 mmol/L) or hyperkalaemia (K>6 mmol/L) on admission
- GCS <12
- oxygen saturation < 92% on air (assuming normal baseline respiratory function)
- SBP < 90 mmHg
- pulse > 100 or < 60 bpm
- urine output <0.5 ml/kg/hr
- serum creatinine >200 µmol/L
- hypothermia
- macrovascular event such as MI or stroke
- other serious co-morbidity.

ADDITIONAL MEASURES IN MANAGEMENT:

- Assess for: - signs of fluid overload or cerebral oedema
- evidence of continuing sepsis
- Foot (daily)
- Regular monitoring : - Observations
- Plasma Osmolality
- Fluid balance (Minimum U.O 0.5 ml/kg/hr)
- Consider urinary catheterisation
- Measure lab glucose if bedside measurement >33mmol/L
- Aim gradual decline of Plasma osmolality (3-8 mosml/kg/hour)
- Diabetes team referral
- Continue LMWH until day of discharge (consider extended treatment in very high risk patients)



COMPLICATIONS

- Ischaemia or infarction affecting any organ, particularly MI and CVA
- Thromboembolic disease (DVT and PE)
- ARDS
- DIC
- Multi-organ failure.
- Rhabdomyolysis.
- Cerebral oedema.
- Central pontine myelinolysis.
- Iatrogenic complications:
 - due to inexpert rehydration and electrolyte management;
 - over-administration of insulin
 - fluid overload leading to cardiac failure.

RESOLUTION of HHS

- ✓ Improvement of mental status
- ✓ Blood glucose **<16** mmol/L
- ✓ S. Osmolality **<320** mOsm/kg

AFTER CARE

Most patients should go home on subcutaneous insulin (the regime being determined by their circumstances).

For patients with previously undiagnosed DM or well controlled on oral agents, switching from insulin to the appropriate oral hypoglycaemic agent should be considered after a period of stability (weeks or months).

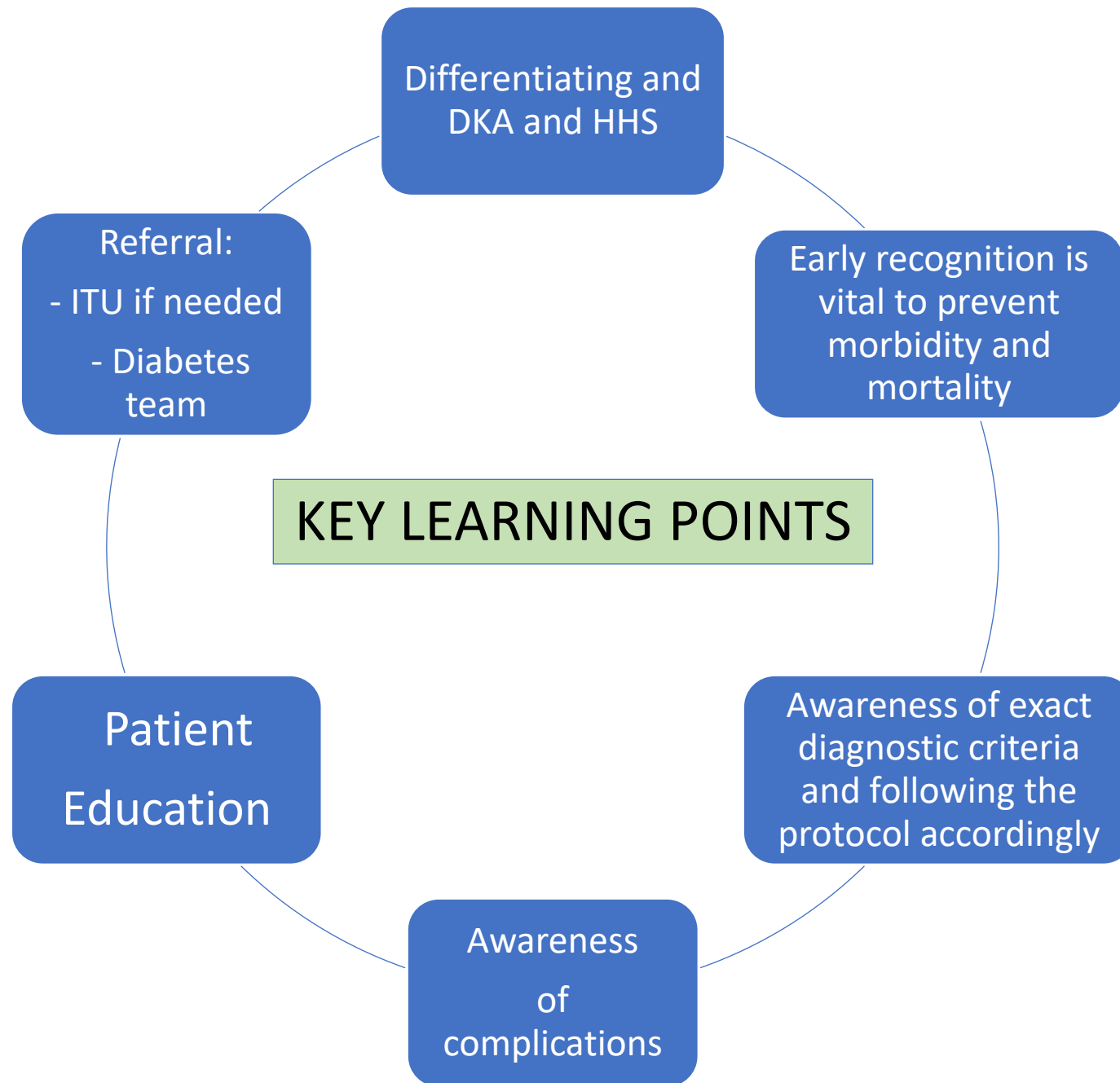
Ensure patient has appropriate diabetes education prior to discharge and arrange follow-up by diabetes team.



SURVEY



POST -SESSION QUESTIONNAIRE





REFERNCES AND FURTHER READING:



- Trust Guidelines
- Joint British Diabetes Societies
- Oxford Handbook of Clinical Medicine
- <https://spectrum.diabetesjournals.org>

THANK YOU

ANY QUESTIONS?