

## MARKING SHEET Q 11

1.

Moderately severe acidaemia – pH decreased 7.18

Metabolic acidosis – reduced  $\text{HCO}_3$  and BE

High anion gap 34 – Diabetic ketoacidosis, other possible causes renal failure, lactic acidosis

Appropriate respiratory compensation –  $\text{pCO}_2$  reduced

Na corrected for glucose is approx. 151 – elevated suggesting total body water loss / dehydration

K is elevated but when corrected for pH is likely to be approx. 4.7 which is in normal range

Cl reduced to maintain electrical neutrality in face of excess anions

Glucose elevated in DKA

Pass 6 of 8

2.

Diabetic ketoacidosis exacerbated by pneumonia

Pass 2 of 2

3.

**Insulin infusion 0.1U/kg/hr**

**IV fluid** – initial bolus 20ml/kg N/S, then replace deficit plus maintenance over 24hrs

**IV antibiotics** – benzylpenicillin 60mg/kg and roxithromycin 4mg/kg

K replacement – add 20-40mmol/L to fluids when K below 4.5 -5.0

Dextrose – add 5% dextrose to N/S when glucose below 12-15

(must have

Pass 3 of 5

Total Pass 11/15 corrects to **7/10**

## SAQ 8 Answers

1.

High anion gap metabolic acidosis

- AG 29
- Due to DKA (high BSL) with contributions from renal failure and lactic acidosis

Concomitant metabolic alkalosis due to vomiting

= resultant normal pH

Hyperkalaemia due to renal failure

High lactate – likely type A from shock, but component type B from renal failure

High creat – renal failure (pre-renal with illness, CRF from DM)

Na low, but when corrected for BSL is upper normal – 144-145

2.

Insulin infusion Actrapid 5U/hr – end-point resolution of ketosis

IV fluids – N/S (bolus acceptable 1000mL stat) initially 1 litre over 1 hour then replace losses plus maintenance over 24-48hrs, add 5% dextrose when BSL falls to 12-15, maintain BP >100mmHg and cerebral perfusion

K replacement – will fall with insulin – add 40mmol/L to infusion when K falls to 4.5 – 5.0 only if passing urine (care with chronic renal failure)

Treat cause (eg sepsis, abdominal pathology)

## QUESTION 20 (10 marks)

A 20 year old male presents with a 3 day history of lethargy and generalised malaise. He is confused and looks unwell. The following venous blood tests are obtained.

|                  |      |            |           |
|------------------|------|------------|-----------|
| pH               | 7.08 |            |           |
| pCO <sub>2</sub> | 20   | mmHg       | (35-45)   |
| HCO <sub>3</sub> | 16   | mmol/L     | (22-28)   |
| BE               | -22  | mmol/L     | (-3-3)    |
| Lactate          | 9    | mmol/L     | (<2.2)    |
| Glucose          | 44   | mmol/L     | (3.9-5.8) |
| K                | 2.7  | mmol/L     | (3.5-4.2) |
| Na               | 160  | mmol/L     | (135-145) |
| Cl               | 124  | mmol/L     | (95-110)  |
| Creatinine       | 70   | micromol/L | (60-110)  |
| Urea             | 5.3  | mmol/L     | (3-8)     |

i. Interpret the above results, and show any relevant calculations (5 marks)

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- Severe metabolic acidosis with adequate respiratory compensation
- High anion gap metabolic acidosis. Likely secondary to DKA given the high glucose
- Na is high – 160 and even higher when corrected –  $160 + (44-10/3) = 171$ . Likely secondary to water loss – glycosuria. Potassium is low – acidaemia usually drive K up, so corrected will be even lower.
- Delta AG/HCO<sub>3</sub> – 1
- Hyperosmolality –  $(2 \times 160) + 44/18 + 5.3/2.8 = 324$

ii. Outline your immediate management priorities (5 marks)

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- Move to resus – needs monitoring in view of hypokalaemia and hypernatraemia. Needs x2 IVC, may need central access if K drops when resuscitation starts
- Needs 1 litre NS immediately
- Start insulin infusion at rate of 0.1 unit per kg/hr. Aim to drop BSL 2-4 per hour
- K replacement – may need central line. 10mmol/hour
- Need to monitor K and Na – at risk of seizures with large drops of Na level

#### Q4 (10/15)

1.

HCO<sub>3</sub> – high anion gap metabolic acidosis due to renal failure, probably also lactate and ketones

Formula: anion gap = Na – (HCO<sub>3</sub> + Cl)

Glucose – due to HHS, as a result of poor glycaemic control in the context of sepsis

Na – dilutional due to hyperglycaemia, corrects to 139 – normal

Formula: corrected Na = Na + (glucose-5)/3

K – elevated due to intracellular shift from likely acidaemia, and also renal failure

Urea, creat – renal failure, intrinsic as ratio <100, probably due to ATN and maybe pyelonephritis

2.

Ca gluconate 30ml 10%

HCO<sub>3</sub> 50mmol (to treat hyper K)

fluid bolus – 500-1000mL N/S aiming for BP >100mmHg and good perfusion

insulin infusion – start at 5U/hr

IV abs – eg ceftriaxone 1g

Also accept other hyperK Rx – salbutamol 5mg neb, resonium 30g po

DVT prophylaxis – any standard regime is fine eg heparin / dalteparin

### Q5 (8 /12)

1.

Tachycardia

AF

Hyper-reflexia

Thin habitus

Tremor

fever

2.

|                                |          |           |
|--------------------------------|----------|-----------|
| <b>Primary hyperthyroidism</b> | elevated | depressed |
|--------------------------------|----------|-----------|

|                                  |          |          |
|----------------------------------|----------|----------|
| <b>Secondary hyperthyroidism</b> | elevated | elevated |
|----------------------------------|----------|----------|

3.

- Graves disease – eye signs eg exophthalmos
- thyroiditis – diffusely tender enlarged thyroid gland
- TMNG – large thyroid, irregular, lots of nodules
- toxic adenoma – unilateral lump in thyroid

**Question 18 (11 marks)**

Provide 4 differential diagnoses for this patient apart from Myxoedema coma (4 marks)

- Neuro – Seizure, ICH
- Endocrine – Adrenal insufficiency
- Infective – sepsis, Meningo-encephalitis
- Environmental Hypothermia
- Toxicological – Opioids, Barbituates, Valproate overdose

Excluding medication non-compliance, list 4 possible triggers for this presentation (2 marks)

- Hypothermia - Increased incidence in winter months
- Infection - Pneumonia > UTI > Cellulitis
- Cerebrovascular Events
- Acute Myocardial Ischemic Events
- Trauma
- Medications - Amiodarone, Lithium, Anaesthetic agents, Lithium, Diuretics
- Cessation of Hypothyroid Replacement

Outline your treatment of this patient in the ED (5 marks)

Replace Thyroid Hormones (T4 + T3)

1. Levothyroxine (T4) 200 to 400 mcg IV loading – 1 mark  
(daily doses of 50 to 100 mcg)
2. Triiodothyronine (T3) 5 to 20 mcg IV – 1 mark  
(2.5 to 10 mcg every eight hours)

Hydrocortisone 50-100mg QID – 1 mark

Supportive Care – Max 2 marks

- IV Fluid replacement
- Vasopressors and Inotropes - accept sensible regime of either Adrenaline, NA or Dobutamine with MAP 65mmHg target
- Electrolyte management
  - Hypocalcaemia IV replacement IV Ca gluconate 10mls 10%

QUESTION 20 (14 marks)

A 42-year-old man is brought to your ED by ambulance with acute confusion. His health has been deteriorating for three months, with tiredness & 10kg weight loss despite an enormous appetite. He is on no medications.

Observations on arrival are:

HR 140 BP 180/100 RR 40 SaO<sub>2</sub> 100% GCS 13 Temp 38.5 BSL 10

- i. List the most likely diagnosis (1 mark)

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- Thyroid storm

- ii. List 4 differential diagnoses (4 marks)

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- Heat related illness
- Intracranial SOL/haemorrhage
- Sepsis – meningoencephalitis, other
- Toxidrome – sympathomimetic, anticholinergic
- Withdrawal syndromes – ethanol, benzodiazepines

- iii. List 4 problems that may precipitate the most likely diagnosis (4 marks)

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- Sepsis
- Acute MI
- DKA
- Trauma
- IV iodinated contrast
- Unrecognised or poorly treated hyperthyroidism
- Ingestion thyroid hormone
- Withdrawal of thyroid medication

iv. List 5 treatment priorities in ED (5 marks)

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- Some knowledge/description of anti thyroid medications essential
- Supportive care – ABC
- Sedation – benzodiazepines
- Seek and treat precipitant
- Block peripheral effects – IV B Blocker (Propanolol, esmolol)
- Decrease synthesis – PTU, carbimazole
- Prevent release of hormone – iodine (after synthetic pathway blocked)
- Corticosteroids
- Consult endocrinology

**QUESTION 7 (16 marks)**

A 32 year old man is brought to your ED by ambulance with acute confusion, recent tiredness, 10 kg weight loss and heat intolerance. He appears to have bulging eyes. Vital signs are:

HR 146 bpm  
BP 180/110 mmHg  
RR 40 bpm  
SaO<sub>2</sub> 100 % RA  
GCS 13  
Temp 38.5 deg C

- i. State the most likely diagnosis and give 4 differential diagnoses for this presentation (5 marks)

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- Thyroid storm
- Meningoencephalitis
- Sepsis – any source
- Toxidromes (anticholinergic/sympathomimetic/serotonin syndrome/NMS)
- Salicylate poisoning
- Withdrawal of EtOH– DT's
- Withdrawal of BDZ/opiates
- Heat stroke
- Hypothalamic stroke

- ii. Provide details of 3 specific pharmacological treatments for this condition and the role of each treatment (6 marks)

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- Beta blockers – eg Propranolol 1mg IV q 5mins up to 10mg, then 40 – 120mg q 6h regularly: block peripheral effects & inhibits peripheral conversion T4 to T3, aim pulse <100
- PTU: 900 – 1200mg loading (PO/NG) then 200mg q4-6h: blocks de novo synthesis (or Carbimazole)
- Iodine – Lugols iodine 8 -10 drops PO q 6h (or Na Iodine 1g IV bd): Prevents release stored hormones (NB must wait approx. 4 hours after PTU to ensure synthetic pathway blocked (or lithium carbonate if allergic to iodine)
- Steroids – hydrocortisone 100mg q6h: tx steroid concomitant deficiency & inhibits peripheral conversion T4 to active T3

- iii. List 5 other management and disposition priorities (5 marks)

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- Cooling eg cooling blankets, cold fluids, antipyretics
- Fluid resuscitation /ABCs
- Seek and treat complications eg CV collapse
- Seek and treat precipitants eg ECG for ACS, Abx for sepsis
- Cultures/IV antibiotics if indicated
- Urgent Endocrine review /admission
- HDU review

**Question 8 (12 marks)**

A 36-year-old lady is brought in by her husband who is concerned that she is 'not herself'. Her GP has been investigating her for irritability, weight loss, palpitations and fatigue. The following tests are available:

TSH 0.2mIU/L (0.4-5mIU/L)  
T4 20mcg/dL (5-11mcg/dL)

a). Provide a diagnosis and list four (4 ) possible causes . (5 marks)

|                                                                                      |
|--------------------------------------------------------------------------------------|
| Blood results consistent with hyperthyroidism and clinical picture of thyrotoxicosis |
| Primary- Grave's disease, toxic multinodular goitre, toxic adenoma                   |
| Thyroiditis- radiation, post-partum                                                  |
| Drug induced- Lithium, amiodarone                                                    |
| Central hyperthyroidism- pituitary adenoma, ectopic thyroid tissue                   |

On assessment she appears restless and anxious. A set of vital signs are performed; her heart rate is 160 bpm, BP 91/57 mmHg, temperature 38 degrees Celsius.

b). List six (6) differential diagnoses that must be considered. ( 3 marks)

|                           |
|---------------------------|
| Thyroid storm             |
| Sepsis                    |
| Heat stroke               |
| Drug withdrawal           |
| Neuroleptic syndrome      |
| Sympathomimetic ingestion |
| Malignant hyperthermia    |

You conclude that her current symptomatology is caused by her thyroid disorder.

c). List and prioritise the medical treatments required, with a justification (4 marks)

| Treatment                                                                               | Justification                                                                                                                                                            |
|-----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| b-blocker<br>- IV propranolol 0.5mg to 10mg, then 40-120mg qid po                       | decreases morbidity and mortality, inhibits peripheral conversion T4 to T3, antagonises the effects of thyroid hormones and decreases the sensitivities to catecholamine |
| Thyroid blocking drugs<br>propylthiouracil 900-1200mg po, then 200mg q4h                | - prevents hormone synthesis by blocking iodination of tyrosine and inhibits peripheral conversion T4 to T3                                                              |
| Iodine (Iugols iodine) 60 drops daily in divided doses<br>Lithium if allergic to iodine | - prevents hormone synthesis by blocking iodination of tyrosine and inhibits peripheral conversion T4 to T3                                                              |
| Corticosteroids- Hydrocortisone 100mg IV qid                                            | inhibit peripheral conversion T4 to T3                                                                                                                                   |
| correct fluid loss, electrolyte abnormalities, cool hyperthermia                        | Supportive measures-                                                                                                                                                     |
| Avoid NSAIDS (displace T4 from binding proteins), treat precipitating cause             |                                                                                                                                                                          |

**SAQ 14: (6 minutes)**  
**(Total marks 12)**

**Candidate Names:**

Passmark: 8

A 30 year old male is referred by his GP for an enlarging anterior neck mass suggestive of a goitre. He is tremulous and tachycardic.

1. What is Pemberton's sign? (2 marks)

Triad of facial congestion, cyanosis and respiratory distress after lifting both arms above the head. Usually caused by SVC obstruction from tumour/mass/substernal goitre.

2. List 5 possible precipitants of thyroid storm (5 marks)

- Infection
- PE
- MI
- Trauma
- DKA
- Other acceptable answers – Iodine administration, withdrawal thyroid medication, CVA, general surgery or any major physical/physiological insult

3. What are the 5 main aims of thyroid storm treatment? Give an example for each (5 marks)

0.5 Marks for each box

| Aims                                        | Example                                           |
|---------------------------------------------|---------------------------------------------------|
| Supportive care                             | Fluids – saline + 5%/10% dextrose<br>Thiamine     |
| Inhibition of thyroid hormone release       | Thionamides - Propylthiouracil /<br>Methimazole   |
| Inhibition of new thyroid hormone synthesis | Iodine (Iugol solution)                           |
| Preventing peripheral conversion<br>T4 → T3 | Glucocorticoids –<br>hydrocortisone/dexamethasone |
| B-adrenergic blockade                       | Propranolol                                       |

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### **Question 16 :**

A 48 year old woman with a history of thyrotoxicosis and presents with fever and confusion.

You are concerned she may have thyroid storm.

**What are three diagnostic criteria for thyroid storm ( 3 marks)**

Fever

Tachycardia disproportionate to fever

CNS disturbance

**What factors may have precipitated this episode ( give six examples, 3 marks)?**

Inadequate treatment or non compliance with treatment

Acute illness- sepsis, AMI, DKA

Surgery- thyroid, other surgery

Iodine- radioactive or iodine contrast

**Describe four specific treatments for thyroid storm and their mechanism of action (4 marks)**

PTU- Inhibition of thyroid hormone synthesis, decrease peripheral conversion of T4 to T3

Iodine- inhibition of thyroid hormone synthesis, needs to be given after PTU to prevent uptake of iodine to form more thyroid hormone

Propanolol- blocks cardiac and peripheral effects, blocks sympathetics, slows conversion of T4 to T3

Corticosteroids decrease peripheral conversion of T4 to T3, decreases metabolic demands

**SAQ 17: (6 Minutes)**  
**(Total Marks 12)**

**Candidate Name:**

Passmark 8/12

A 28 year old office worker presents by ambulance following a conscious collapse at work. She had been unwell at work that day.

On arrival, her vital signs are:

HR 160 -190

BP 190/110

Temp 39.5

RR 30

Sats 92% on RA

GCS 14/15

BSL 11.6

She is confused, tremulous and anxious.

There is mild pitting oedema

**I. List five (5) differential diagnoses other than Thyroid storm?**

**(2.5 Marks)**

- CNS infection
- Heat stroke
- Sympathomimetic overdose
- Serotonin syndrome
- Neuroleptic malignant syndrome
- Pheochromocytoma

**II. The husband arrives and reports a recent history of a neck lump which is due to be investigated. Closer examination reveals a diffuse multinodular goitre. What five (5) underlying conditions can cause thyrotoxicosis?**

**(2.5 Marks)**

- Graves' disease
- Toxic multinodular goitre
- Toxic adenoma

- Thyroiditis
- Drug induced e.g. amiodarone, lithium iodine
- Postpartum

**III. What are three (3) clinical findings with thyrotoxicosis? (3 Marks)**

- Temperature >37.8
- Tachycardia out of proportion to fever
- CNS disturbance

**IV. List four (4) immediate treatment priorities with drug names and doses?**

**(4 Marks)**

- Supportive including sedation and active cooling
- Management of cardiac complications with nonselective beta-blocker – propranolol
  - o 1mg Q5min to max 10mg
- Prevention of peripheral conversion of T4-T3 with corticosteroids
- Decreased production with propylthiouracil (900-1200mg)
- Referral for definitive management of underlying disease