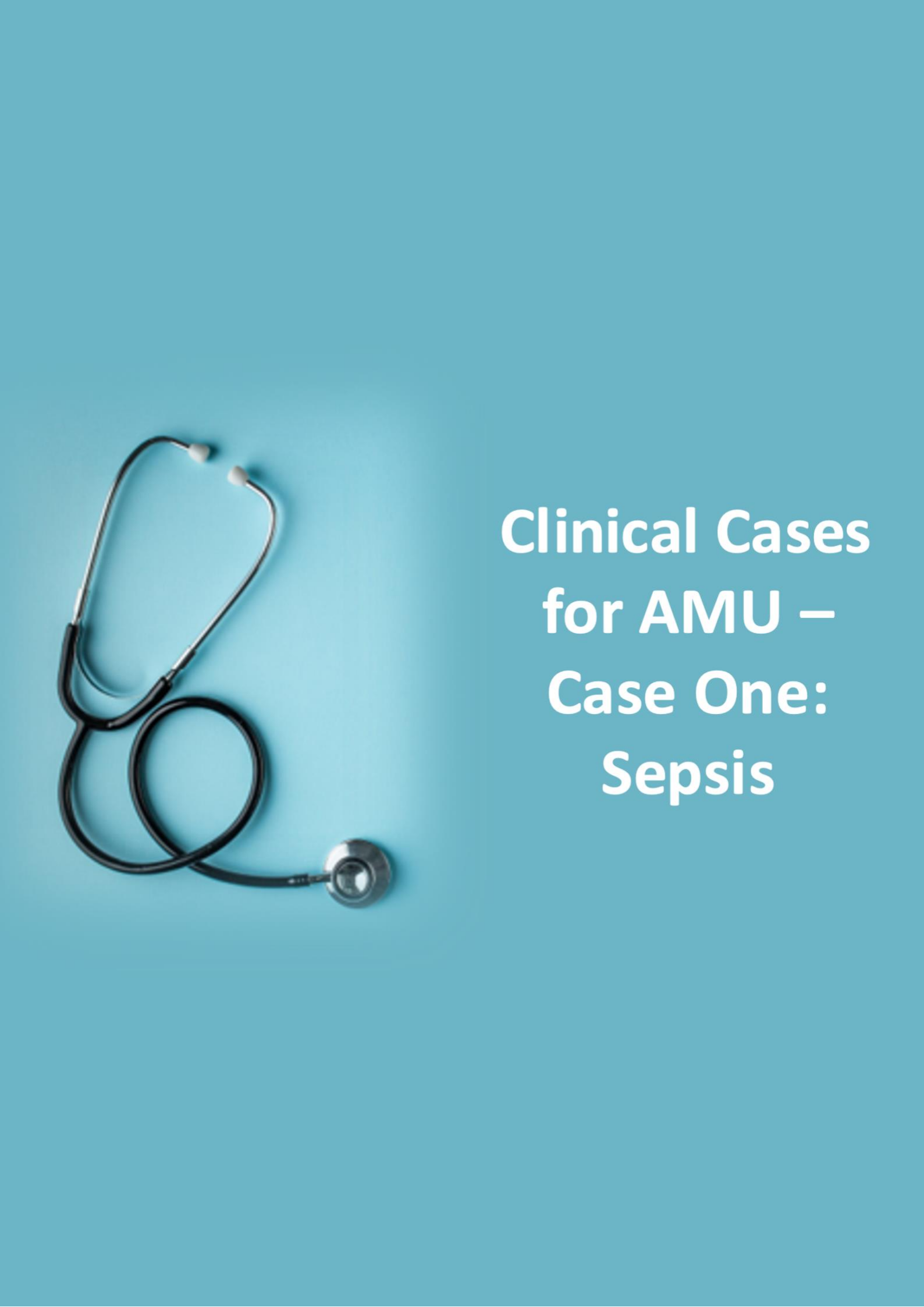


Clinical Cases for AMU – Case One: Sepsis

Introduction

These cases are designed to support your learning during your time in Acute and General Medicine. You can use them when you have free time on the ward. They can be done either alone, or in a small group. They use fictional scenarios to demonstrate learning points from common presentations to the Acute Medical Unit (AMU) and on the General Medical wards. As you work through the cases, you will find a mixture of case discussions, practical activities, and practice questions to assess your learning.

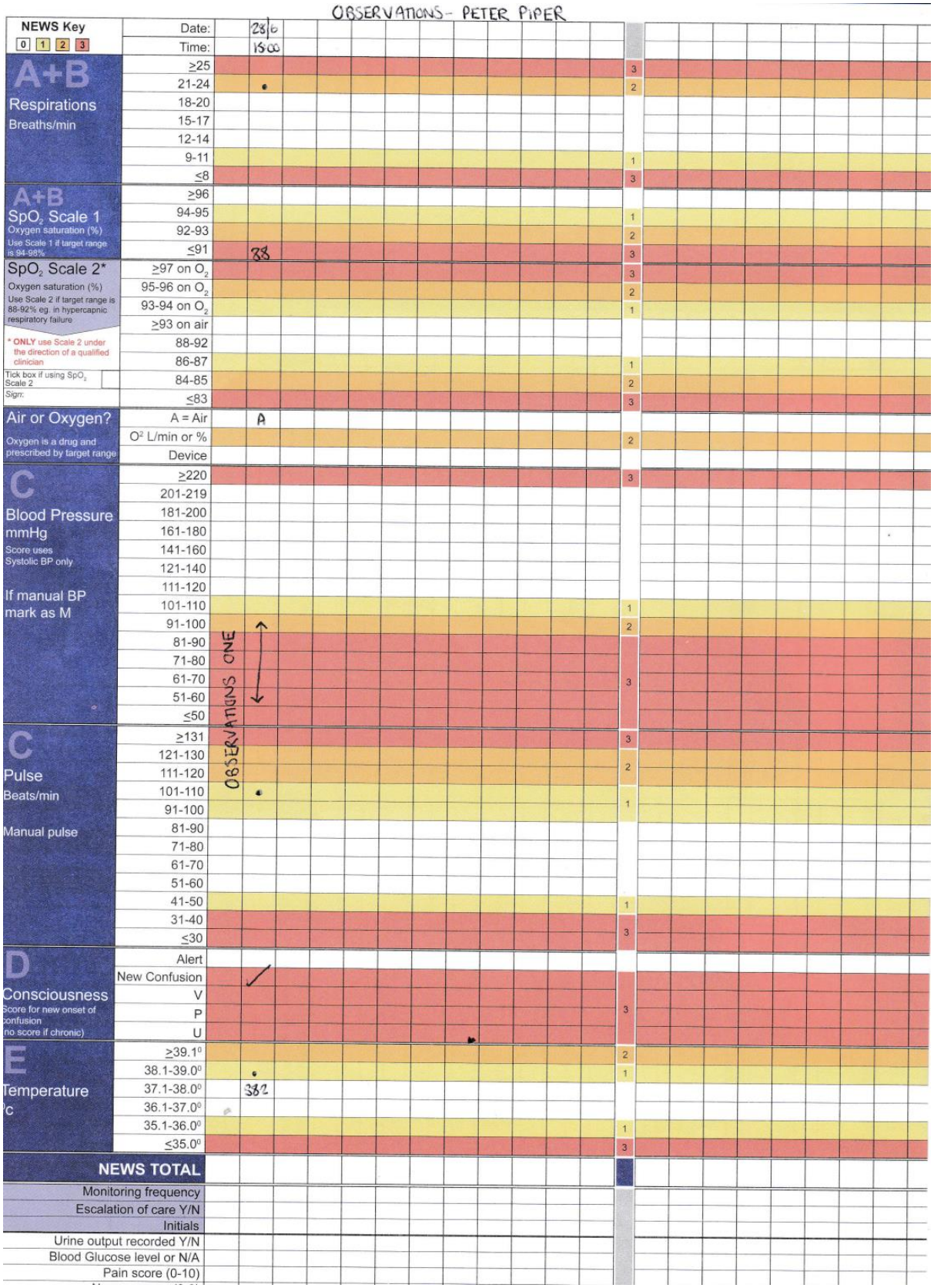
If there is a knowledge check or interpretation exercise, the answer can be found on the back of the same page that the question is on.

Case History

Peter, a 66-year-old male with a background of recently diagnosed lung adenocarcinoma is brought to hospital by ambulance. His partner describes a 1–2 week history of illness characterised by increased shortness of breath, cough and chest pain, decreased oral intake, fluctuating confusion, lethargy and weakness. Peter has also been complaining of feeling hot and shivery. He had refused for his partner to contact a doctor, but when he started becoming drowsier, she thought "enough was enough" and called an ambulance.

<u>Activity One</u>
You wish to check the patient's vital signs, but unfortunately the chart has been misplaced and/or not yet completed.
Check a patient on the ward's vital signs and complete a NEWS assessment.

Peter's NEWS chart has now been found and is enclosed with this pack. Initial observations are marked 'observations one'.



<u>Interpretation One</u>

Calculate Peter's NEWS score.

How would this affect your ongoing management?

Interpretation One - Answer

Peter has a NEWS score of 12 systems indicating a high severity of illness.
The patient requires continuous observations and urgent medical review by a senior doctor.

You bleep the medical registrar that you are working alongside and inform her of the patient using an SBAR handover. She thanks you for the referral, states that she will be along to review the patient as soon as possible, within the next 15 minutes, and asks if you would kindly proceed to perform an initial basic assessment. Peter is unable to give you any history. You perform an A to E assessment.

A	Maintaining own airway, nil added sounds
B	RR 22 during time of assessment Bedside Sats 88% OA Coarse crackles auscultated over the right mid zone. Chest otherwise clear, no wheeze. Finger clubbing Tar staining noted on fingers and in moustache No new redness, swelling, or pain to calves
C	Peripherally cold to mid forearms Central CRT 5 secs JVP not elevated HS pure Radial pulse 100-110 regular Hypotensive – repeat BP 94/65 mmHg Dry oral mucosae Poor skin turgor
D	GCS 11 E3, V2, M6 PEARL – no discomfort observed on shining light into patient's eyes Poor compliance with neurological examination No obvious cranial nerve deficit Power 4/5 all 4 limbs. Light touch sensation grossly intact Normal tone all 4 limbs Kernig's sign negative Bedside BM 5.6
E	Abdomen soft and non-tender. Bowel sounds positive No jaundice/scleral icterus No new rashes Febrile 38.2 Weight 80kg

You are concerned that Peter may have sepsis.

Knowledge Check One

1. Define sepsis.
2. Which tests should be carried out within the first hour of initial assessment?

You send away all of the relevant initial blood tests. As Peter is hypoxic and has a background of COPD you additionally perform an ABG.

The ABG results are as follows.

Test	Result	Normal Range
pH	7.29	7.35 – 7.45
pO_2 (kPa)	6.8	11.1 – 14.4
pCO_2 (kPa)	4.92	4.7 – 6.4
HCO_3^- (mmol/L)	16	22 - 28
Base Excess (mmol/L)	-6	-2 - 3
Oxygen saturations	84%	>94%
Lactate (mmol/L)	5.2	<2

Interpretation Two

Interpret the ABG.

Knowledge Check One - Answer

1. Sepsis is defined as life-threatening organ dysfunction caused by a dysregulated host response to an infection.
   Sepsis represents severe, life-threatening infection. The key to improving outcome is early recognition and prompt treatment. By the time deranged organ function becomes apparent mortality is high.

2. Within 1 hour the following steps should be followed:
   a. Blood cultures:
      Take 2 sets of blood cultures. Prioritise first filling the aerobic bottle. Send to the lab as soon as possible to improve yield. It is important that blood cultures are taken as soon as possible for two reasons: a) they may take up to 48 – 72hrs to come back with sensitivities of causative organisms and b) cultures are far less likely to be positive if delayed until after giving antimicrobials.
   b. Measure serum lactate
      Measure serum lactate, on a blood gas, to determine the severity of sepsis and monitor the patient's response to treatment. It is sufficient to measure the serum lactate on a *venous* blood gas. Raised serum lactate suggests possible tissue hypoperfusion. Repeat lactate can be used to assess response to treatment, specifically fluid resuscitation. Do not be falsely reassured by a normal lactate, this does not mean that the patient is not acutely unwell.
   c. Measure hourly urine output
      A low urine output (<0.5mL/kg/hr) may suggest intravascular volume depletion or renal failure. Ask the patient and/or carer etc. about urine output over the previous 12 – 24 hours. Consider catheterising the patient on. Urine output should be monitored closely every hour. In practice this often falls to the nursing team, so it is important to clearly (and politely) communicate your wishes and the rationale with the nursing team. An accurate fluid balance chart should be kept and closely monitored.

Interpretation Two Answer

This ABG show type 1 respiratory failure with a metabolic (lactic) acidosis

Further history

Whilst you are performing these initial investigations you are able to complete your comprehensive history taking. Peter's partner Bethany gives you the following information:

History of presenting complaint

Peter was diagnosed with Stage 2 lung cancer in June of this year (3 months ago). He did not wish to have surgery, so he has been treated with radical combined chemoradiotherapy with curative intent. He finished his last course of treatment 3-4 weeks ago. She believed that he had a good response to treatment.

After the treatment he was initially well but has deteriorated quite significantly over the past 7- 10 days. Initially he had increased breathlessness on mild exertion e.g., walking up the stairs at home. He has also been complaining of a cough, but feels he is struggling to bring up sputum. He described right sided chest pain that is worse when he takes a big breath in, "catching and stabbing" on deep inspiration. He has not recently coughed up any blood (haemoptysis) but did so before the lung cancer was diagnosed.

Peter's weight has fallen by 2-3 stone over the last year and Beth states that he has generally not been eating as much, but over the past 1 week he has "barely eaten or drunk anything".

Peter has been "burning up" at home but saying that he's been feeling "freezing" and asking for more duvets to cover him. He has seemed weak and fatigued. Over the past 2-3 days Beth has noticed that his conversation has not been making sense and he has kept repeating things that they had already discussed. Yesterday he was much more drowsy and even more confused, which was why she decided to call the ambulance.

Peter had not specifically complained of any trouble passing urine, but Beth states that Peter has largely just been lying on the couch for the last week and does not think he has got up to pass urine much at all. Beth has not noticed any new rashes/wounds/breaks to skin. She does not think he has had any stomach upset.

There is no history of recent foreign travel, no infective contacts and no recent courses of antibiotic.

Past Medical History

COPD
Lung cancer
Hypertension

Drug History

ALLERGIES - Penicillin
Amlodipine 10mg OD
Inhalers - Peter is prescribed inhalers, but Bethany is not sure of their name and Peter very rarely takes them
No other prescribed nor over the counter medications

Social History

Smoker 40-50 pack year history since he was 15.
Minimal alcohol.
Recreational drug use in 30s, nil since.
Lives alone in a two storey house in Midlothian.
Independent all ADLs

Knowledge Check Two

After completing a thorough but focussed history and examination, further investigations should be considered.

Early and adequate source identification and targeted management is essential.

To further investigate the source for *any patient* presenting with sepsis, what investigations should be considered?

Knowledge Check Two - Answer

- Urinalysis
    - Send for MC&S if positive and suspicion of urinary source. Always interpret urine analysis in the context of the wider clinical assessment. Urinalysis may show evidence of infection (nitrates; leucocytes; blood/protein).
- CXR
- Cultures from any potential sources
    - Sputum
    - Stool
    - Ascitic fluid
    - Pleural fluid
    - Joint fluid
    - Abscess aspirate
    - Swabs from open wounds or ulcers.
- Lumbar puncture
    - Perform a lumbar puncture if you suspect meningitis or encephalitis. If there is any concern of raised ICP a CT head scan must be performed prior to LP.
- Imaging
    - CT abdo/pelvis
        i. If you suspect intra-abdominal or pelvic infection, involve the surgical or gynaecological teams early. They may request a CT abdo/pelvis
    - Ultrasound
        i. Ultrasound can be useful in further investigation of abscesses, pyelonephritis, cholangitis etc.
- Viral swabs
    - Viral throat swabs can be useful for further investigating respiratory infection including Influenza, RSV, parainfluenza, human metapneumovirus, adenovirus, as well as COVID-19.
- Urine antigen testing
    - Carry out legionella and pneumococcal urinary antigen testing for patients with suspected or confirmed CAP.
- HIV screen
    - Consider HIV testing in patients with recurrent or atypical infections, and in high-risk groups e.g. IVDUs, unprotected sexual intercourse etc.
- Echocardiogram
    - Echo can be used to detect endocarditis. Note a TTE (transthoracic echo) is not sufficient to exclude infective endocarditis. For this you would require a TOE (transoesophageal echocardiogram)

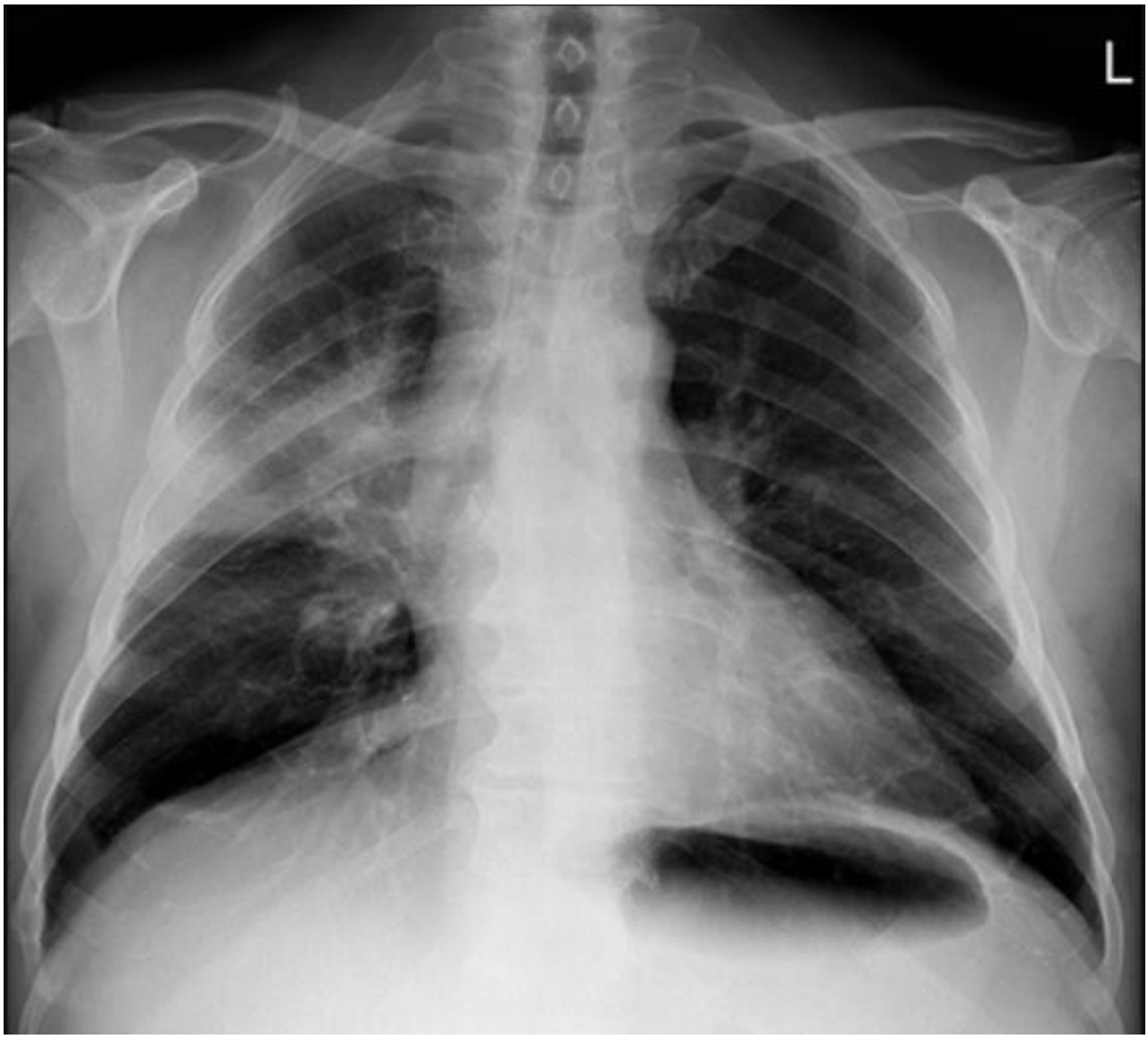
Knowledge Check Three

What other diagnoses may you consider in your differential diagnosis for Peter?

Interpretation Three

For Peter the most likely diagnosis is sepsis. Respiratory symptoms of increased breathlessness, cough, and pleuritic chest pain, as well as focal crackles on auscultation suggest a respiratory source of infection. You go ahead and order a CXR.

Interpret the chest radiograph below.



Knowledge Check Three – Answer

These are multiple and it is important to always consider alternative diagnoses. Two have been considered two in more detail below.

- You may also consider pulmonary embolism. PE typically presents with dyspnoea and pleuritic chest pain. Fever, pre-syncope, and reduced GCS may be present. In massive pulmonary embolism haemodynamic compromise (hypotension) may be present. Risk factors for thromboembolic disease including malignancy and reduced mobility are present.
- Non-infectious causes of systemic inflammatory response syndrome (SIRS). Identification of a specific infectious agent is definitive in differentiating sepsis from SIRS.

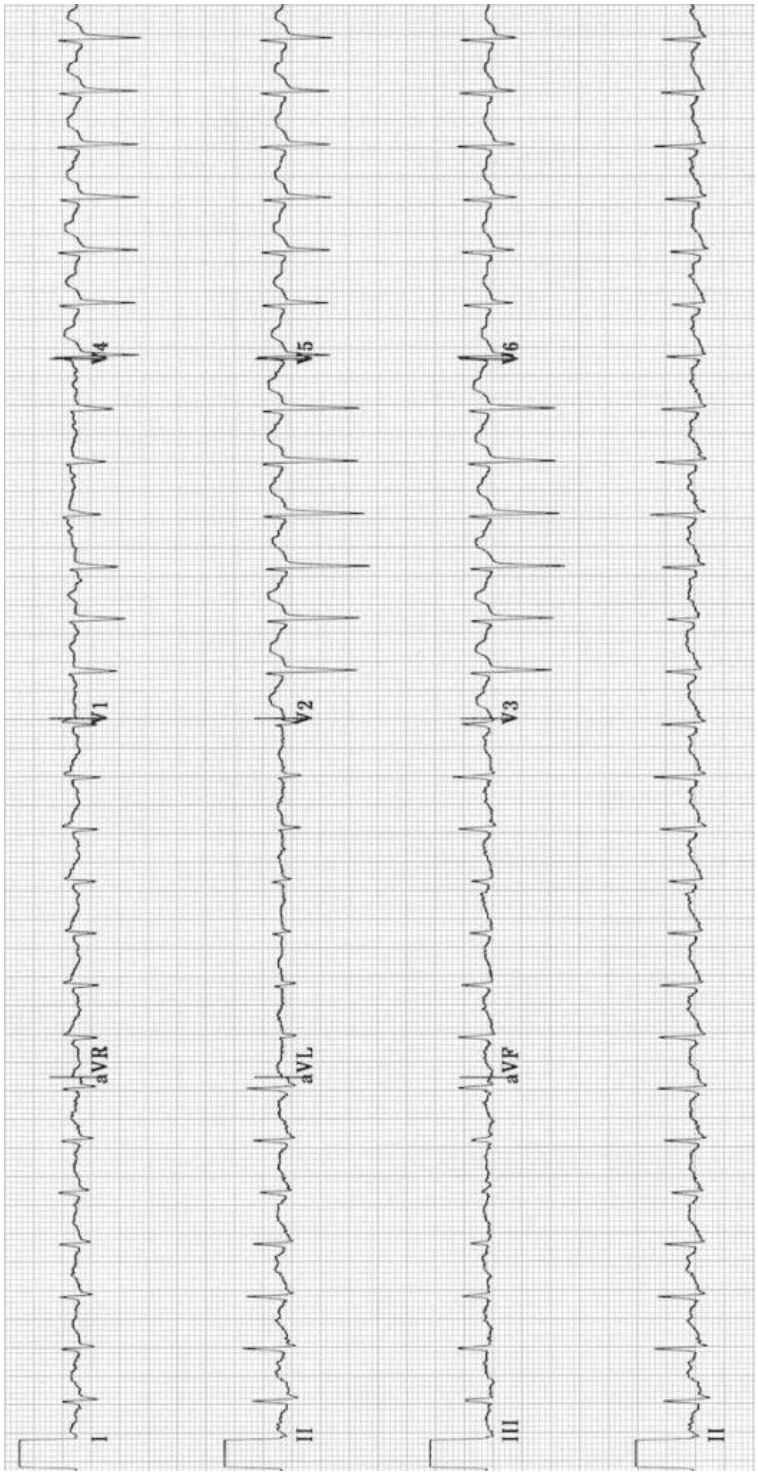
Interpretation Three – Answer

This X-ray shows an area of air-space shadowing (consolidation) in the right upper lobe. This appearance could be consistent with infection or malignancy.

Interpretation Four

You request a baseline ECG, as you would for all acutely ill presentations.

What does the ECG show? How would you manage this?



Knowledge Check Four

Which 3 urgent treatments should be carried out within the first hour of initial assessment?

Interpretation Three - Answer

The ECG shows a sinus tachycardia with a heart rate of 150bpm.

Sinus tachycardia is usually a secondary condition, and, in this case, treatment involves managing the underlying cause e.g., a chest infection with appropriate antibiotics and IV fluids.

Knowledge Check Four– Answer

Treatment should be started immediately if a senior clinician suspects sepsis. In practice treatment is started whilst further investigation e.g., CXR, ECG are being requested.

1. Give intravenous broad-spectrum antibiotics if you suspect bacterial infection
    - Follow local policy. Initially give broad spectrum antibiotics and then focus, when more details are known, e.g., source of infection and organism. Target the presumed source of infection if known.
2. Give IV fluids if there is evidence of haemodynamic compromise
    - Start with a fluid challenge of 250ml – 500ml balanced crystalloid given over 10-15 mins. Repeat if indicated. Do not exceed 30ml/kg – 2L is a good benchmark.
3. Given oxygen if indicated
    - Give oxygen as needed to maintain target oxygen sats >94% . Target saturation of 88% to 92% in people at risk of hypercapnic respiratory failure (e.g., those with COPD)

Activity Two

Look up Sepsis Six online and consider that the key early investigations and treatment that you have initiated together comprise Sepsis Six.

Activity Three

Download NHS Lothian's antimicrobial app and refer to our local guidelines – you may need a junior doctor/ANP/PA to help you find this.

What antibiotics would you start for Peter? You will need to work out Peter's CURB65 score to determine this. Guidance on how to calculate this can be found within the app. The urea on his formal blood tests is 10.4mmol/L

Increased drowsiness

The nurse looking after Peter calls you as she is worried that Peter has deteriorated since treatment was started. He is now drowsier than before and only responding to pain.

You attend Peter and do a rapid assessment. His observations can be seen in the NEWS chart, marked observations 2.

Given his extensive smoking history and background of COPD, you are worried that Peter has developed type 2 respiratory failure. You perform an arterial blood gas.

Interpretation Four

Test	Result	Normal Range
pH	7.20	7.35 – 7.45
pO_2 (kPa)	13.0	11.1 – 14.4
pCO_2 (kPa)	8.5	4.7 – 6.4
HCO_3^- (mmol/L)	17	22 - 28
Base Excess (mmol/L)	-6	-2 - 3
Oxygen saturations	94%	>94%
Lactate (mmol/L)	3.8	<2

Interpret the ABG results. How would you manage this?

Activity Three – Answer

Peter has a CURB65 score of 3 (confusion, urea >7mmol/L, age >65). He should be started on vancomycin and ciprofloxacin due to his penicillin allergy.

Interpretation Four – Answer

This shows Type 2 Respiratory failure with relative hypoxia and a mixed respiratory and metabolic acidosis.

The non-rebreather mask should be removed, and oxygen therapy titrated to saturations of 88-92%. You should immediately call for senior support as NIV (BiPAP) should be considered.

Case continued

Serial ABGs showed that Peter's ABG rapidly improved with appropriate supplementary oxygen therapy and NIV was ultimately not needed.

Later that evening he is moved round to the Acute Medical Unit for further care, whilst awaiting a bed on the respiratory ward. You go to do an evening review of the patient (2100), after first seeing him at midday. The outcome of your assessment can be seen below.

A	Maintaining own airway, nil added sounds
B	RR 20 Sats 91% OA Crackles R mid zone. You can hear that Peter is able to cough. Expectorating clear sputum.
C	Peripherally warmer than previous CRT 4 seconds JVPNE HR 110 BP 82/57 mmHg Oral mucosae more moist than previous Catheter in situ draining dark urine, total 600ml in bag. Fluid balance chart inspected. Totals over preceding 9hrs: INPUT 3L of balanced crystalloid resuscitation fluids OUTPUT Total 600ml since catheterised, the majority of which was drained immediately. Last 4 hours urine output 35ml, 20ml, 0ml, 0ml.
D	GCS 12 E3 V3 M6 No focal neurological deficit BM 4.6
E	Abdo SNT No new rashes/wounds T 38.1

You are worried that Peter remains severely unwell. You take a full set of repeat blood tests and cultures. You take a VBG to the point of care processor and notice that his repeat Lacate is still 4.

Knowledge Check Five

What would you do next and why?

Knowledge Check Five – Answer

Peter is demonstrating ongoing hypotension and signs of organ hypoperfusion despite a large volume (3L) of IV fluid resuscitation. He has a lactate of 4, oliguria (urine output <0.5ml/kg/hr) and reduced GCS reflecting tissue hypoperfusion and multiple organ dysfunction.
You call the Medical Registrar as you are concerned that this patient is failing to respond to treatment and may need to be considered for vasopressor support in critical care.

Peter may have septic shock, which has been redefined as a subset of sepsis, in which there is co-existence of: persistent hypotension requiring vasopressors to maintain mean arterial pressure ≥65 mmHg; and serum lactate >2 mmol/L (>18 mg/dL).
Septic shock indicates profound circulatory, cellular, and metabolic deterioration, and is associated with a greater risk of mortality than with sepsis alone.

Conclusion

Well done on completing this case. I hope that you have found it informative. If you have any questions, please contact …
Dr Sophie Horrocks, Sophie.horrocks@nhslothian.scot.nhs.uk
Dr Toby Merriman, Andrew.Merriman@nhs.scot

Thank you for completing this long case. As these cases are new intervention, we would really value your feedback.

We would be very grateful if you could complete the feedback form accessed from the QR code below.

References

1. Radiology Masterclass. *Chest X-ray – Lung cancer – Mass v Consolidation.* https://www.radiologymasterclass.co.uk/gallery/chest/lung_cancer/mass_consolidation#top_2nd_img
2. Life in the Fast Lane (2021). *Sinus tachycardia.* https://litfl.com/sinus-tachycardia-ecg-library/
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