

FExNet 2026

Collated SAQs: Radiology — USS and CT

ANSWER BOOKLET

Model answers for the 20 radiology SAQs. References cited at the foot of each question. Items marked [core] are required for full marks. POCUS findings reflect ACEM/ASUM emergency ultrasound curriculum; contrast and radiation guidance per RANZCR (current).

20 questions • 212 marks

ACEM-aligned format. Sub-questions labelled a) b) c). Mark allocations indicative; references cited in the Answer Booklet. Question and answer indexes are clickable.

Answer Index

Click any entry to jump to its answer. Marks shown right.

Q1. POCUS in Adult Cardiac Arrest	12	Q11. Cervical Spine Clearance — NEXUS / CCR	10
Q2. FAST in Blunt Abdominal Trauma	14	Q12. Imaging in Suspected Pulmonary Embolism	12
Q3. POCUS for Ruptured AAA	11	Q13. Imaging in Suspected Appendicitis	10
Q4. Lung Ultrasound — Pneumothorax	10	Q14. CT KUB for Renal Colic	10
Q5. Lung Ultrasound — B-Line Patterns	11	Q15. CT in Small Bowel Obstruction	10
Q6. POCUS for Lower-Limb DVT	10	Q16. Acute Mesenteric Ischaemia	10
Q7. POCUS in First-Trimester Bleeding	12	Q17. Plain CXR — Interpretation of PTX and Effusion	10
Q8. POCUS for Acute Cholecystitis	10	Q18. Imaging in Pregnancy	10
Q9. USS-Guided Fascia Iliaca Block — #NOF	10	Q19. Iodinated Contrast — Risk and Mitigation	10
Q10. CT Head — Indications in Adult Head Injury	10	Q20. Paediatric Head Injury — PECARN	10

Question 1 | POCUS in Adult Cardiac Arrest (12 marks)

A 58-year-old man is brought to your ED in cardiac arrest after a witnessed collapse at home. Bystander CPR was commenced. On arrival he is in PEA. ALS is in progress. Your registrar asks how POCUS should be incorporated into the resuscitation.

a) List 3 recognised general uses of POCUS in adult cardiac arrest. (3 marks)

- Identifying reversible causes (tamponade, tension PTX, massive PE, hypovolaemia) [core]
- Distinguishing true PEA from pseudo-PEA (cardiac standstill vs organised contraction) [core]
- Confirming cardiac standstill / asystole during pulse check
- Confirming endotracheal tube placement (lung sliding bilat)
- Guiding vascular access (central line / large-bore IV)
- Prognostication — absent cardiac activity on TTE associated with extremely poor ROSC outcome

b) List 5 reversible causes of cardiac arrest with the SPECIFIC sonographic finding for each. (5 marks)

- Cardiac tamponade — pericardial effusion with RV diastolic collapse [core]
- Tension pneumothorax — absent lung sliding, absent B-lines, lung point [core]
- Massive PE — dilated RV (RV:LV >1), McConnell sign, septal D-shape, IVC plethora [core]
- Hypovolaemia — collapsed IVC, hyperdynamic LV, small kissing chambers [core]
- Haemoperitoneum / haemothorax — free fluid on FAST
- Aortic catastrophe — dilated abdominal aorta (>3 cm), intraperitoneal/retroperitoneal blood
- Cardiac standstill — no wall motion, no valve motion (poor prognosis but does not mandate cessation alone)

c) State 4 principles for integrating POCUS into ALS without compromising CPR quality. (4 marks)

- Image acquisition timed to pulse-check pause (<10 s); record clip and review afterwards [core]
- Operator must be a credentialled clinician, not the team leader, and not the compressor
- Subxiphoid / sub-costal view preferred — avoids interrupting compressor positioning
- Pre-place probe at chest before pause; capture clip immediately on pause; resume CPR within 10 s
- Findings communicated as closed-loop to team leader; do not delay shock or compressions for further imaging

References: ACEP / ASUM Emergency Ultrasound Guidelines (current); ACEM ED Ultrasound Curriculum • ACEM clinical policies and statements • ANZCOR Guidelines (current) • Tintinalli's Emergency Medicine 9e Ch 24

Question 2 | FAST in Blunt Abdominal Trauma (14 marks)

A 32-year-old female restrained driver is brought to your trauma bay after a high-speed MVC. HR 118, BP 92/56, GCS 14, abdomen tender in the left upper quadrant. You decide to perform a FAST scan.

a) Name the 4 standard windows of the FAST examination. (4 marks)

- Right upper quadrant — Morison's pouch (hepatorenal recess) + right paracolic gutter + right pleural space **[core]**
- Left upper quadrant — splenorenal recess + left subphrenic space + left pleural space **[core]**
- Pelvis — pouch of Douglas / rectovesical pouch **[core]**
- Subxiphoid / pericardial — long-axis four-chamber view **[core]**

b) List 4 advantages of FAST over CT in initial assessment of haemodynamically unstable blunt trauma. (4 marks)

- Bedside / does not require transport from resuscitation area **[core]**
- Rapid (<5 min) — accelerates decision to theatre **[core]**
- Repeatable — can be re-scanned as physiology changes
- No ionising radiation, no contrast
- Available 24/7, operator-dependent but inexpensive
- Detects haemoperitoneum, haemopericardium, haemothorax in single examination

c) List 3 important limitations of FAST. (3 marks)

- Operator-dependent — sensitivity 60-85% for free fluid **[core]**
- Poor sensitivity for solid-organ injury without haemoperitoneum (occult liver/splenic lac) **[core]**
- Poor sensitivity for retroperitoneal injury (kidney, duodenum, pancreas)
- Cannot grade injury or guide non-operative management
- Limited views in obese / subcutaneous emphysema / bowel gas
- Pelvic free fluid in females may be physiological (small amount)

d) State the management decision for each scenario: (3 marks)

- Unstable + positive FAST → theatre for laparotomy **[core]**
- Unstable + negative FAST → seek other source (pelvic, long-bone, thoracic) ± repeat FAST **[core]**
- Stable + positive FAST → CT to characterise and guide management (operative vs angio vs non-operative) **[core]**
- Stable + negative FAST → clinical reassessment, serial examination, low threshold for CT if mechanism / signs suggest injury

References: ATLS 10th edition (current) • ACEP / ASUM Emergency Ultrasound Guidelines (current); ACEM ED Ultrasound Curriculum • Tintinalli's Emergency Medicine 9e Ch 264 • Cameron's Textbook of Adult Emergency Medicine 5e

Question 3 | POCUS for Ruptured AAA (11 marks)

A 72-year-old male is brought in by ambulance with severe central back and abdominal pain, pale, sweaty. HR 130, BP 78/42 (palpable brachial only). You suspect a ruptured abdominal aortic aneurysm and your registrar performs a bedside ultrasound.

a) State the threshold aortic diameter on POCUS that defines an abdominal aortic aneurysm, AND state the diameter above which surgical repair is generally indicated. (2 marks)

- AAA defined as outer-to-outer aortic diameter ≥ 3.0 cm at any infrarenal level [core]
- Elective repair generally indicated at ≥ 5.5 cm (men) or ≥ 5.0 cm (women) or rapid expansion >0.5 cm in 6 months [core]

b) List 3 sonographic features supporting AAA on bedside ultrasound. (3 marks)

- Outer-to-outer aortic diameter ≥ 3 cm (transverse and longitudinal views) [core]
- Mural thrombus — concentric / eccentric echogenic material within the lumen
- Free intraperitoneal fluid (rupture into peritoneum — uncommon; rupture is usually retroperitoneal)
- Periaortic / retroperitoneal haematoma (often poorly seen on POCUS)

c) List 3 limitations of POCUS in suspected ruptured AAA. (3 marks)

- POCUS cannot reliably detect retroperitoneal rupture (negative POCUS does NOT exclude rupture) [core]
- Bowel gas frequently obscures aorta, particularly in obese patients
- Operator-dependent, requires credentialed clinician
- Cannot assess for branch involvement / candidacy for endovascular repair (EVAR)

d) State 3 immediate resuscitation priorities BEFORE theatre for a haemodynamically unstable patient with confirmed AAA on POCUS. (3 marks)

- Permissive hypotension — target SBP 70-90 mmHg (maintain mentation) until aortic control [core]
- Activate massive transfusion protocol — 1:1:1 balanced resuscitation, group O blood until crossmatched [core]
- Immediate vascular surgical and anaesthetic review — transfer direct to theatre or hybrid suite [core]
- Two large-bore IV access (16G or larger) $\pm$ central line
- Avoid crystalloid bolus, large-volume resuscitation (worsens dilutional coagulopathy)
- Notify blood bank, radiology, theatre simultaneously

References: ACEP / ASUM Emergency Ultrasound Guidelines (current); ACEM ED Ultrasound Curriculum • Cameron's Textbook of Adult Emergency Medicine 5e Ch on Vascular Emergencies • Tintinalli's Emergency Medicine 9e Ch 60

Question 4 | Lung Ultrasound — Pneumothorax (10 marks)

A 24-year-old male sustains penetrating chest trauma. He is tachypnoeic, hypoxic on supplemental oxygen, and your registrar performs bedside lung ultrasound.

a) Name 4 sonographic findings used to assess for pneumothorax. (4 marks)

- Lung sliding (present / absent) — shimmering movement of pleural line with respiration **[core]**
- B-lines — absence of B-lines in pneumothorax (PTX abolishes pleural-line artefacts) **[core]**
- Lung point — pathognomonic — transition between PTX (no sliding) and aerated lung (sliding) **[core]**
- M-mode — 'barcode / stratosphere sign' replaces normal 'seashore sign'
- Lung pulse — cardiac pulsation transmitted at pleural line; ABSENCE in PTX

b) List 3 advantages of lung ultrasound over supine CXR for pneumothorax detection. (3 marks)

- Higher sensitivity than supine CXR (88-95% vs 30-50%) **[core]**
- Bedside, faster than CXR, no transport required
- No ionising radiation
- Repeatable — can monitor response to decompression
- Detects occult / small anterior pneumothoraces missed on supine film

c) List 3 conditions OTHER than pneumothorax that abolish lung sliding (false-positive findings). (3 marks)

- Mainstem intubation — affected side has no ventilation, no sliding **[core]**
- Pleural adhesions / pleurodesis — sliding absent, lung still aerated
- Apnoea / breath-hold — no respiratory motion
- Severe pulmonary fibrosis / ARDS — diminished sliding
- Bullae / blebs — focal absence of sliding

References: ACEP / ASUM Emergency Ultrasound Guidelines (current); ACEM ED Ultrasound Curriculum • Tintinalli's Emergency Medicine 9e Ch 65 • BLUE protocol (Lichtenstein)

Question 5 | Lung Ultrasound — B-Line Patterns (11 marks)

A 76-year-old man presents with acute dyspnoea. He has a history of hypertension, ischaemic heart disease, and was discharged from hospital 2 weeks ago after a 'chest infection'. You are uncertain whether he has acute pulmonary oedema or pneumonia.

a) State 3 sonographic features that distinguish cardiogenic pulmonary oedema from pneumonia / ARDS on lung ultrasound. (3 marks)

- Distribution: cardiogenic oedema = bilateral, symmetric, gravity-dependent (worse at bases). Pneumonia / ARDS = patchy, non-dependent, often unilateral **[core]**
- Pleural line: smooth and regular in cardiogenic oedema; thickened, irregular, fragmented in pneumonia / ARDS **[core]**
- Spared areas: present in ARDS (heterogeneity); absent in cardiogenic oedema **[core]**
- Consolidation / dynamic air bronchograms: pneumonia
- Sub-pleural consolidations: pneumonia / pulmonary infarct
- Effusion: more common with pneumonia (parapneumonic) but also with cardiogenic oedema

b) Name 4 components of an undifferentiated dyspnoea POCUS protocol (e.g. BLUE / RUSH). (4 marks)

- Anterior lung — bilateral B-lines (cardiogenic oedema, ARDS), A-lines (asthma/COPD/PTX) **[core]**
- Pleural line + lung sliding — pneumothorax **[core]**
- Postero-lateral / PLAPS point — consolidation, pleural effusion **[core]**
- Cardiac (parasternal long, apical 4-chamber) — LV function, RV strain, pericardial effusion **[core]**
- IVC — volume status (collapsed = volume-responsive; plethoric = fluid overload / RV failure)
- DVT (femoral / popliteal compression) — supports PE

c) List 4 management priorities for confirmed acute cardiogenic pulmonary oedema. (4 marks)

- Sit upright; high-flow oxygen to $\text{SpO}_2 \geq 94\%$ **[core]**
- Non-invasive ventilation (CPAP 8-10 cm H_2O or BiPAP) — reduces intubation, mortality **[core]**
- GTN — sublingual 400 μg or IV infusion 5-200 $\mu\text{g}/\text{min}$ titrated to SBP >110 **[core]**
- Treat underlying cause — STEMI (PCI), AF rate control, valvular pathology **[core]**
- IV furosemide 40-80 mg if volume-overloaded (use cautiously — many APO patients are euvoelaemic)
- Avoid morphine routinely (associated with worse outcomes in observational data)
- Intubate / mechanical ventilation if NIV failure or exhaustion

References: ACEP / ASUM Emergency Ultrasound Guidelines (current); ACEM ED Ultrasound Curriculum • eTG (Therapeutic Guidelines, current) • NHF/CSANZ ACS Guidelines 2016 (updated) • Tintinalli's Emergency Medicine 9e Ch 53

Question 6 | POCUS for Lower-Limb DVT (10 marks)

A 56-year-old woman returns from a 12-hour flight with a swollen, tender right calf. Wells DVT score 3. You decide to perform a 2-point compression ultrasound at the bedside.

a) Name the 2 anatomical sites compressed in 2-point compression ultrasound, and state the single key finding that defines a positive scan. (3 marks)

- Common femoral vein at the saphenofemoral junction (inguinal crease) and at the bifurcation **[core]**
- Popliteal vein in the popliteal fossa (extends to trifurcation) **[core]**
- Positive scan = inability to fully compress the vein with probe pressure (vein wall apposition); presence of echogenic intraluminal material is supportive but not required **[core]**

b) List 3 limitations of 2-point compression ultrasound for DVT. (3 marks)

- Misses isolated calf-vein DVT (5-10% of clinically relevant DVT) **[core]**
- Operator-dependent — requires credentialed clinician
- May miss isolated SFA, profunda, or pelvic DVT (proximal to femoral)
- Limited in obese, oedematous, or post-surgical limbs
- Requires repeat scan at 5-7 days if Wells high-probability and initial negative

c) State 4 elements of management once DVT is confirmed. (4 marks)

- Anticoagulation — DOAC first-line (rivaroxaban 15 mg BD x 21 d then 20 mg OD; or apixaban 10 mg BD x 7 d then 5 mg BD) **[core]**
- Assess bleeding risk and contraindications (active bleeding, recent surgery, severe thrombocytopenia, severe renal impairment for DOACs) **[core]**
- Provoked vs unprovoked — duration of anticoagulation (3 mo for provoked, ≥3 mo / indefinite for unprovoked)
- Investigate for underlying malignancy if unprovoked and age >40 (history, exam, age-appropriate screening)
- Compression stockings — class 2 graduated, 30-40 mmHg
- Outpatient management if low-risk (no concurrent PE, no severe symptoms, social support, follow-up arranged)

References: Wells score for PE / DVT (validated) • eTG (Therapeutic Guidelines, current) • Tintinalli's Emergency Medicine 9e Ch 60 • ACEP / ASUM Emergency Ultrasound Guidelines (current); ACEM ED Ultrasound Curriculum

Question 7 | POCUS in First-Trimester Bleeding (12 marks)

A 28-year-old woman presents at 7 weeks gestation by LMP with PV bleeding and right iliac fossa pain. Vitals: HR 110, BP 95/60. β -hCG 4500 IU/L. You perform a transabdominal POCUS.

a) List the 3 sonographic findings that confirm an intrauterine pregnancy (IUP). (3 marks)

- Gestational sac WITHIN endometrial cavity [core]
- Yolk sac visible within the gestational sac [core]
- Embryo / fetal pole $\pm$ cardiac activity [core]
- (Pseudosac is a false positive — central, lacks yolk sac and double-decidual sign)

b) List 3 sonographic findings concerning for ectopic pregnancy. (3 marks)

- Empty uterus with β -hCG above the discriminatory zone (>1500 - 2000 IU/L for TVS, >6500 for TAS) [core]
- Adnexal mass separate from the ovary (tubal ring, complex adnexal mass)
- Free fluid in the pouch of Douglas (suggests rupture)
- Echogenic ring around adnexal mass ('ring of fire' on colour Doppler)
- Live extrauterine pregnancy (cardiac activity outside uterus — diagnostic)

c) State 3 management priorities for this haemodynamically unstable patient with concern for ruptured ectopic. (3 marks)

- Activate massive transfusion / call for blood; give O-negative initially [core]
- Urgent O&G; consult — direct to theatre for laparoscopy / laparotomy [core]
- Two large-bore IV; FBC, group & crossmatch (4+ units), coagulation, β -hCG [core]
- Anti-D 250 IU IM if Rh-negative
- Avoid large-volume crystalloid; balanced resuscitation

d) List 3 limitations of transabdominal POCUS in early pregnancy assessment. (3 marks)

- Lower sensitivity than transvaginal — TVS visualises IUP from ~5 weeks; TAS from ~6 weeks [core]
- Body habitus (obesity), bowel gas, retroverted uterus all limit views
- Cannot reliably exclude ectopic — formal TVS by US department often required
- Heterotopic pregnancy possible (1:30,000 spontaneous; up to 1:100 in IVF) — ectopic NOT excluded by visualised IUP if ART

References: ACEP / ASUM Emergency Ultrasound Guidelines (current); ACEM ED Ultrasound Curriculum • Tintinalli's Emergency Medicine 9e Ch 100 • Cameron's Textbook of Adult Emergency Medicine 5e

Question 8 | POCUS for Acute Cholecystitis (10 marks)

A 48-year-old female presents with 12 hours of right upper quadrant pain, fever, vomiting. WCC 16, CRP 120. You perform a bedside biliary ultrasound.

a) Name 4 sonographic findings supporting acute cholecystitis. (4 marks)

- Gallstones (echogenic foci with posterior acoustic shadowing, mobile) **[core]**
- Gallbladder wall thickening >3 mm **[core]**
- Pericholecystic fluid **[core]**
- Sonographic Murphy sign — maximal tenderness directly over gallbladder **[core]**
- Distended gallbladder (>4 cm transverse / >10 cm long)
- Gallstone impacted in neck / Hartmann's pouch

b) List 3 differential diagnoses for thickened gallbladder wall on ultrasound. (3 marks)

- Hepatitis (any cause)
- CCF / right heart failure (gallbladder wall oedema)
- Hypoalbuminaemia / nephrotic syndrome / cirrhosis ascites
- Adenomyomatosis / gallbladder polyps
- Acalculous cholecystitis (critical illness, sepsis)
- Post-prandial gallbladder (always scan fasted if possible)

c) State 3 management priorities for confirmed acute cholecystitis. (3 marks)

- IV broad-spectrum antibiotics (e.g. amoxicillin/clavulanate 1.2 g IV q6h, or piperacillin-tazobactam if septic) per local antibiogram **[core]**
- Surgical referral — early laparoscopic cholecystectomy within 7 days **[core]**
- IV fluids, analgesia, anti-emetics; NBM **[core]**
- Investigate for choledocholithiasis (LFTs, MRCP) if deranged LFTs / bile-duct dilatation

References: eTG (Therapeutic Guidelines, current) • Tintinalli's Emergency Medicine 9e Ch 79 • Tokyo Guidelines TG18

Question 9 | USS-Guided Fascia Iliaca Block — #NOF (10 marks)

An 84-year-old woman presents with a left subcapital fractured neck of femur after a fall. Pain score 9/10. You plan an ultrasound-guided fascia iliaca compartment block.

a) Name 3 nerves blocked by a fascia iliaca compartment block. (3 marks)

- Femoral nerve (L2-L4) **[core]**
- Lateral femoral cutaneous nerve (L2-L3) **[core]**
- Obturator nerve (L2-L4) — variable, less reliably blocked

b) State 3 anatomical landmarks / structures identified on ultrasound when performing this block. (3 marks)

- Femoral artery (lateral to vein, medial to nerve) **[core]**
- Femoral nerve — hyperechoic, lateral to artery, deep to fascia iliaca **[core]**
- Fascia iliaca — hyperechoic line above iliacus muscle, deep to fascia lata **[core]**
- Iliacus muscle — deep to fascia iliaca
- Sartorius muscle — superficial landmark

c) List 4 specific safety steps to minimise risk of local anaesthetic systemic toxicity (LAST) in this elderly patient. (4 marks)

- Calculate maximum dose by lean body weight — ropivacaine max 3 mg/kg, lidocaine 4 mg/kg (without adrenaline) **[core]**
- Aspirate before AND during injection to detect intravascular placement **[core]**
- Inject in 5 mL aliquots while observing the patient and ECG **[core]**
- Have intralipid 20% available (1.5 mL/kg bolus, then 0.25 mL/kg/min infusion if LAST) **[core]**
- Continuous monitoring throughout block and 30 min after (pulse oximetry, ECG, BP)
- Maintain verbal contact with patient; stop if signs of CNS toxicity (perioral tingling, tinnitus, agitation)
- Resuscitation equipment immediately available

References: ANZCA / AAGBI LAST guideline • ACEP / ASUM Emergency Ultrasound Guidelines (current); ACEM ED Ultrasound Curriculum • Tintinalli's Emergency Medicine 9e Ch 36

Question 10 | CT Head — Indications in Adult Head Injury (10 marks)

A 38-year-old male presents 2 hours after a witnessed assault to the head. GCS 14 on arrival, vomited once in triage, no focal neurology. Anticoagulated on warfarin for AF (INR 2.5). You apply the Canadian CT Head Rule (CCHR).

a) List 5 high-risk criteria from the Canadian CT Head Rule that mandate CT. (5 marks)

- GCS <15 at 2 hours post-injury [core]
- Suspected open or depressed skull fracture [core]
- Any sign of basal skull fracture (haemotympanum, raccoon eyes, Battle sign, CSF oto/rhinorrhoea) [core]
- Vomiting ≥ 2 episodes [core]
- Age ≥ 65 years [core]

b) List 2 medium-risk criteria from CCHR. (2 marks)

- Amnesia before impact >30 minutes [core]
- Dangerous mechanism (pedestrian struck by vehicle, ejection from vehicle, fall >3 ft / 5 stairs) [core]

c) State 3 patient-specific factors that should mandate CT in this patient regardless of CCHR. (3 marks)

- Anticoagulation with warfarin — significant increased risk of intracranial haemorrhage [core]
- Antiplatelet therapy or DOAC use
- Coagulopathy — chronic liver disease, haemophilia, thrombocytopaenia
- Age >65 with mechanism (already CCHR criterion)
- Persistent altered mental status / GCS not returning to 15
- Focal neurological deficit / seizure

References: Canadian CT Head Rule (Stiell 2001) • ACEM clinical policies and statements • Tintinalli's Emergency Medicine 9e Ch 254

Question 11 | Cervical Spine Clearance — NEXUS / CCR (10 marks)

A 28-year-old woman presents after a low-speed rear-end MVC. She is alert, GCS 15, complaining of mild neck stiffness. No neurological deficit. You consider clinical clearance of the cervical spine.

a) List the 5 NEXUS low-risk criteria that, if ALL absent, permit clinical clearance. (5 marks)

- No posterior midline cervical tenderness [core]
- No focal neurological deficit [core]
- Normal level of alertness (GCS 15, no clouding) [core]
- No evidence of intoxication [core]
- No painful distracting injury [core]

b) State 3 high-risk Canadian C-Spine Rule criteria that mandate radiological clearance. (3 marks)

- Age ≥ 65 years [core]
- Dangerous mechanism (fall >1 m / 5 stairs, axial load, MVC >100 km/h or rollover, ejection, motor vehicle vs pedestrian, bicycle collision) [core]
- Paraesthesias in extremities [core]

c) Name 2 advantages of CT over plain XR for cervical spine clearance in trauma. (2 marks)

- Far higher sensitivity (98-100% vs 50-70% for plain films) for fracture detection [core]
- Better visualisation of C7-T1 junction (often obscured on plain XR) [core]
- Faster — single acquisition with sagittal / coronal reconstructions
- Can be combined with brain CT in same session
- Higher radiation and cost are trade-offs

References: NEXUS / Canadian C-Spine Rule • ATLS 10th edition (current) • Tintinalli's Emergency Medicine 9e Ch 257

Question 12 | Imaging in Suspected Pulmonary Embolism (12 marks)

A 64-year-old woman presents with 2 days of pleuritic chest pain and dyspnoea. She had a knee replacement 3 weeks ago. HR 105, BP 130/80, SpO₂ 94% on room air. Wells score 6 (high risk).

a) State 3 advantages of CTPA over V/Q scan in this patient. (3 marks)

- Higher diagnostic accuracy in patients with abnormal CXR / underlying lung disease [core]
- Provides alternative diagnoses (aortic dissection, pneumonia, malignancy, pneumothorax) [core]
- Faster acquisition; available 24/7 in most centres
- Single examination, no need for follow-up imaging
- Better visualisation of large central PE for clot burden

b) State 3 contraindications or cautions to CTPA. (3 marks)

- Iodinated contrast allergy [core]
- Severe renal impairment (eGFR <30) — risk of contrast-induced nephropathy [core]
- Pregnancy — though radiation dose is low (<1 mGy to fetus); V/Q preferred if CXR normal
- Severe thyrotoxicosis (relative)
- Metformin — generally continue but consider hold if AKI risk
- Inability to lie supine / breath-hold

c) Name 3 sonographic features of right ventricular strain on echocardiography in massive PE. (3 marks)

- RV dilatation — RV:LV ratio >1 in apical 4-chamber [core]
- McConnell sign — akinesia of mid-RV free wall with preserved apical contraction [core]
- Septal flattening / D-shape of LV in short-axis view
- Plethoric IVC with reduced respiratory variation
- TAPSE <1.7 cm (reduced RV systolic function)
- Tricuspid regurgitation jet (estimated PASP elevated)

d) List 3 indications for systemic thrombolysis in confirmed PE. (3 marks)

- Haemodynamic instability (SBP <90 or vasopressor requirement) [core]
- Cardiac arrest with confirmed / high-suspicion massive PE
- Submassive PE with severe RV dysfunction AND clinical deterioration despite anticoagulation (case-by-case; consider catheter-directed lysis)

References: Wells score for PE / DVT (validated) • PERC rule (Kline) • Tintinalli's Emergency Medicine 9e Ch 56 • eTG (Therapeutic Guidelines, current)

Question 13 | Imaging in Suspected Appendicitis (10 marks)

A 22-year-old female presents with 18 hours of right iliac fossa pain, anorexia, and a low-grade fever. β -hCG negative. Alvarado score 7. Local protocol favours USS first-line.

a) List 3 sonographic findings supporting acute appendicitis. (3 marks)

- Non-compressible blind-ending tubular structure >6 mm in maximal diameter [core]
- Appendicolith — echogenic intraluminal focus with shadowing
- Hyperaemia on colour Doppler (early); reduced flow if perforation/necrosis
- Periappendiceal fluid / phlegmon / abscess
- Echogenic surrounding fat (inflammation)
- Sonographic McBurney tenderness with probe

b) State 3 advantages and 3 disadvantages of CT vs USS in this patient (3 of each). (3 marks)

- ADVANTAGES of CT:
- Higher sensitivity (94-98% vs 70-80% for USS); operator-independent [core]
- Better visualisation in obese patients / retrocaecal appendix [core]
- Identifies alternative diagnoses (diverticulitis, ovarian pathology, IBD)
- DISADVANTAGES of CT:
- Ionising radiation (5-10 mSv) — significant in young women / repeated exposure [core]
- Iodinated contrast — renal, allergic risks [core]
- Cost, availability, time delay

c) State 4 management priorities once appendicitis is confirmed. (4 marks)

- IV access, fluids, analgesia, anti-emetics; NBM [core]
- Surgical referral — laparoscopic appendicectomy [core]
- IV antibiotics — cefazolin + metronidazole (or per local protocol) [core]
- Consent, anaesthetic review, group & save
- Consider non-operative management with antibiotics in selected uncomplicated cases per local pathway

References: Alvarado / RIPASA scores for appendicitis • eTG (Therapeutic Guidelines, current) • Tintinalli's Emergency Medicine 9e Ch 79

Question 14 | CT KUB for Renal Colic (10 marks)

A 38-year-old man presents with 3 hours of left loin-to-groin colicky pain, microscopic haematuria, vomiting. Vitals stable. Local protocol allows non-contrast CT KUB or POCUS as first imaging.

a) Name 3 sonographic features of obstructive uropathy on POCUS. (3 marks)

- Hydronephrosis — anechoic dilatation of renal calyces / pelvis **[core]**
- Echogenic stone with posterior shadowing (most often at VUJ or PUJ)
- Twinkle artefact on colour Doppler over stone
- Asymmetric ureteric jets at bladder (absent on affected side)
- Perinephric fluid (severe / forniceal rupture)

b) State 3 advantages of low-dose non-contrast CT KUB over IVP and over USS in renal colic. (3 marks)

- Sensitivity ~98% for any-size stone, including <5 mm; higher than USS (45-85%) **[core]**
- Identifies alternative diagnoses (AAA, diverticulitis, ovarian pathology) **[core]**
- No contrast required → safe in renal impairment
- Provides stone size, location, density (HU), measurements guide management
- Modern low-dose protocols 1-2 mSv (similar to plain KUB series)

c) List 4 indications for urgent urological consultation. (4 marks)

- Obstructed, infected system (fever, sepsis with hydronephrosis) **[core]**
- Single / transplanted kidney with obstruction **[core]**
- Bilateral obstruction or AKI **[core]**
- Stone >6-7 mm (unlikely to pass spontaneously) **[core]**
- Intractable pain or vomiting despite analgesia
- Pregnancy with obstruction

References: eTG (Therapeutic Guidelines, current) • Tintinalli's Emergency Medicine 9e Ch 95 • EAU Urolithiasis Guidelines

Question 15 | CT in Small Bowel Obstruction (10 marks)

A 67-year-old male with previous open appendicectomy 30 years ago presents with 24 hours of central crampy abdominal pain, vomiting, and absolute constipation. Abdomen distended with tinkling bowel sounds.

a) List 4 CT findings of small bowel obstruction. (4 marks)

- Dilated small bowel loops (>3 cm) **[core]**
- Transition point — dilated proximal bowel, collapsed distal bowel **[core]**
- Air-fluid levels **[core]**
- String-of-pearls sign — small gas bubbles in dilated fluid-filled loops
- Mesenteric oedema, mesenteric vessel engorgement
- Faeculisation in dilated loop (longstanding obstruction)

b) List 3 CT features suggestive of strangulation / ischaemic bowel that mandate urgent surgical review. (3 marks)

- Bowel wall thickening / oedema with abnormal enhancement (target sign) **[core]**
- Pneumatosis intestinalis (gas in bowel wall) **[core]**
- Portal venous gas
- Free intraperitoneal fluid / haemoperitoneum
- Mesenteric stranding, closed-loop appearance, whirl sign (volvulus)
- Pneumoperitoneum (perforation)

c) State 3 immediate management priorities. (3 marks)

- NGT decompression on free drainage; NBM; anti-emetics **[core]**
- IV fluid resuscitation (correct hypovolaemia and electrolyte derangement; replace NG losses) **[core]**
- Surgical referral — early operative management if strangulation features or failed conservative trial **[core]**
- Analgesia — opioid titration
- Monitor urine output, lactate, electrolytes; anticipate AKI and hypokalaemia

References: Tintinalli's Emergency Medicine 9e Ch 80 • Cameron's Textbook of Adult Emergency Medicine 5e • eTG (Therapeutic Guidelines, current)

Question 16 | Acute Mesenteric Ischaemia (10 marks)

A 78-year-old male with permanent atrial fibrillation (non-anticoagulated due to recent fall) presents with 6 hours of severe central abdominal pain that is disproportionate to the soft, minimally tender abdomen. Lactate 4.8.

a) List 3 CT findings of acute mesenteric ischaemia. (3 marks)

- Filling defect / thrombus in SMA, SMV, or coeliac trunk on CT angiogram **[core]**
- Bowel wall thickening or thinning ('paper thin' if infarcted)
- Pneumatosis intestinalis
- Mesenteric / portal venous gas
- Lack of bowel-wall enhancement after contrast
- Free intraperitoneal fluid

b) State 3 predisposing conditions for acute mesenteric ischaemia. (3 marks)

- Atrial fibrillation (embolic — most common, ~50%) **[core]**
- Atherosclerosis (thrombotic, often with chronic intestinal angina history) **[core]**
- Recent MI / ventricular thrombus
- Hypercoagulable state / malignancy
- Low-flow state (cardiogenic shock — non-occlusive mesenteric ischaemia, NOMI)
- Mesenteric venous thrombosis (cirrhosis, PV thrombosis)

c) State 4 immediate management priorities. (4 marks)

- Early CT angiogram — do not delay imaging for creatinine; benefits outweigh contrast risk **[core]**
- Vascular surgery / interventional radiology referral — endovascular thrombectomy / open revascularisation **[core]**
- Therapeutic anticoagulation — IV heparin (5000 IU bolus then infusion) once decision made **[core]**
- Aggressive resuscitation — IV fluid, correct lactic acidosis, MTP if bleeding
- Broad-spectrum IV antibiotics (translocation risk)
- ICU referral — high mortality (50-70% even with optimal care)

References: Tintinalli's Emergency Medicine 9e Ch 80 • Cameron's Textbook of Adult Emergency Medicine 5e • ESVS Guidelines AMI 2017

Question 17 | Plain CXR — Interpretation of PTX and Effusion (10 marks)

Two patients present to your ED: Patient A: 19-year-old tall thin male with sudden-onset right-sided pleuritic chest pain after coughing. Patient B: 68-year-old female with 2 weeks of progressive dyspnoea, dull right chest, tracheal shift to LEFT.

a) List 3 plain-CXR findings of a simple (non-tension) pneumothorax. (3 marks)

- Visceral pleural line with absent lung markings lateral to it **[core]**
- Deep sulcus sign (supine film) — abnormally deep, lucent costophrenic angle
- Subcutaneous emphysema
- Increased lucency of the affected hemithorax (relative lack of overlying lung)

b) List 3 CLINICAL features of a tension pneumothorax that mandate immediate decompression BEFORE confirmatory imaging. (3 marks)

- Severe respiratory distress / hypoxia **[core]**
- Hypotension / shock **[core]**
- Tracheal deviation AWAY from the affected side (late sign) **[core]**
- Distended neck veins (in non-hypovolaemic patient)
- Hyper-resonance and absent breath sounds on the affected side
- Cardiac arrest with rising airway pressures in ventilated patient

c) Name 4 plain-CXR findings of a large pleural effusion. (4 marks)

- Blunting of the costophrenic angle (>200 mL needed on PA, >50 mL on lateral) **[core]**
- Meniscus sign — concave upper border of fluid **[core]**
- Mediastinal shift AWAY from the effusion (large effusion)
- Loss of hemidiaphragm silhouette
- Tracheal deviation away from affected side
- Subpulmonic effusion — apparent elevation of hemidiaphragm with peak shift laterally

References: Tintinalli's Emergency Medicine 9e Ch 65 • Cameron's Textbook of Adult Emergency Medicine 5e

Question 18 | Imaging in Pregnancy (10 marks)

A 32-year-old woman at 22 weeks gestation presents with right iliac fossa pain. Possible appendicitis. You are deciding between USS, MRI, and CT.

a) State the threshold fetal radiation dose at which deterministic effects (e.g. malformation) become a concern, AND state the typical fetal dose for: (i) CT abdo/pelvis, (ii) CXR. (3 marks)

- Threshold for deterministic effects ~100 mGy (risk increases substantially >150 mGy); below 50 mGy no demonstrated increase in malformation **[core]**
- CT abdo/pelvis: 25-50 mGy (single phase) — under the deterministic threshold but cumulative dose matters **[core]**
- CXR: <0.01 mGy (negligible) **[core]**

b) List 4 considerations when ordering imaging in a pregnant patient. (4 marks)

- Use non-ionising imaging first-line where possible (USS, MRI without gadolinium) **[core]**
- Iodinated contrast crosses placenta — small risk of transient neonatal hypothyroidism; benefit usually outweighs risk **[core]**
- Gadolinium associated with stillbirth/rheumatologic outcomes — AVOID unless essential **[core]**
- Document indication, alternatives considered, and informed-consent discussion **[core]**
- Shield abdomen for non-abdominal CT where possible
- Consult radiologist for low-dose CT protocols if CT is needed

c) State 3 reasons MRI is preferred over CT in this patient if USS is non-diagnostic. (3 marks)

- No ionising radiation to fetus **[core]**
- Sensitivity for appendicitis comparable to CT (>95%) in pregnancy **[core]**
- Avoids iodinated contrast (gadolinium not required for appendicitis assessment)
- Better soft-tissue contrast for differentiating appendicitis vs gynaecological pathology

References: RANZCR Imaging Guidelines (current) • RANZCR Recommendations on Iodinated Contrast (current) • ACEM clinical policies and statements • ACOG Committee Opinion 723 (2017)

Question 19 | Iodinated Contrast — Risk and Mitigation (10 marks)

A 66-year-old male diabetic on metformin presents with abdominal pain. Creatinine 165 $\mu\text{mol/L}$ (eGFR 38). The radiologist asks for clarification before performing contrast-enhanced CT abdomen.

a) List 3 patient risk factors for contrast-induced nephropathy (CIN). (3 marks)

- Pre-existing renal impairment (eGFR <60, particularly <30) [core]
- Diabetes mellitus (especially with nephropathy) [core]
- Heart failure / haemodynamic instability
- Volume depletion / hypotension
- Concurrent nephrotoxins (NSAIDs, ACE-i / ARB, aminoglycosides)
- Age >75
- High contrast volume / repeated administration within 24 h

b) State 3 strategies to minimise risk of CIN in this patient. (3 marks)

- IV crystalloid hydration — 1 mL/kg/h normal saline for 6-12 hours pre and post contrast (RANZCR / ESUR) [core]
- Withhold NSAIDs, ACE-i / ARB, diuretics, aminoglycosides peri-procedure if possible [core]
- Use lowest volume of low- or iso-osmolar non-ionic contrast
- Consider alternative imaging (US, non-contrast MRI) if diagnostically adequate
- Avoid repeat contrast within 48-72 h
- Recheck creatinine 48-72 h post contrast

c) State the RANZCR recommendation regarding metformin and iodinated contrast in this patient. (2 marks)

- If eGFR ≥ 30 — continue metformin; recheck creatinine if AKI suspected [core]
- If eGFR <30 OR AKI — withhold metformin at the time of contrast and for 48 h, restart only after renal function confirmed stable [core]

d) List 2 features of severe (anaphylactic) contrast reaction. (2 marks)

- Airway compromise — stridor, angio-oedema, respiratory distress [core]
- Cardiovascular collapse — hypotension, tachycardia or bradycardia [core]
- Generalised urticaria with respiratory or circulatory involvement
- Loss of consciousness / cardiac arrest

References: RANZCR Recommendations on Iodinated Contrast (current) • eTG (Therapeutic Guidelines, current) • ACEM clinical policies and statements

Question 20 | Paediatric Head Injury — PECARN (10 marks)

A 3-year-old boy is brought in 1 hour after falling from a 1-metre changing table onto a tiled floor. Brief LOC, no vomiting, no seizure. GCS 15, no scalp haematoma, behaving normally with parents.

a) List 4 PECARN high-risk features in a child <2 years that mandate CT. (4 marks)

- GCS <14 OR signs of altered mental status **[core]**
- Palpable skull fracture **[core]**
- Acting abnormally per parent (specific PECARN criterion in <2 y) **[core]**
- Loss of consciousness ≥5 seconds **[core]**
- Severe mechanism (MVC with ejection / death of passenger / rollover; pedestrian / cyclist without helmet vs vehicle; fall >0.9 m / 3 ft for <2 y; head struck by high-impact object)
- Non-frontal scalp haematoma (parietal / temporal / occipital) in <2 y
- Not acting normally per parent

b) State 3 reasons paediatric CT head should be limited where possible. (3 marks)

- Cumulative lifetime cancer risk from radiation — children more radiosensitive, longer life expectancy to manifest malignancy **[core]**
- Often requires sedation in young children (its own risks) **[core]**
- Most clinically important TBI in children with intermediate risk can be excluded with observation period (4-6 hours)
- Limited yield from CT in low-risk children (PECARN low-risk = <0.05% risk of clinically important TBI)

c) State 3 management options for a child with intermediate PECARN risk. (3 marks)

- Period of observation (4-6 hours) in ED with serial neurological examination **[core]**
- Shared decision-making with family about CT vs observation **[core]**
- CT if deterioration, persistent symptoms, or parental preference after discussion **[core]**
- Discharge with head-injury advice and clear return-criteria if observation uneventful
- Consider MRI (if available) to avoid radiation in non-acute setting

References: Royal Children's Hospital Melbourne — Clinical Practice Guideline • PECARN (Kuppermann 2009) • ACEM clinical policies and statements • Tintinalli's Emergency Medicine 9e Ch 254