

FExNet 2026

Collated SAQs: Neonatal Emergencies

ANSWER BOOKLET

Model answers for the 20 neonatal SAQs. References cited at the foot of each question. Items marked [core] are required for full marks. Drug doses and protocols confirmed with current ANZCOR Neonatal Life Support, RCH/SCH clinical practice guidelines, NETS retrieval guidelines, and ANZNN standards.

20 questions • 215 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.

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

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Question 1 | Term Newborn Resuscitation in the Emergency Department (14 marks)

A 32-year-old woman in active labour presents to your small urban emergency department with no antenatal care. She is at an estimated 38 weeks gestation by fundal height. Within minutes of arrival she delivers a female infant on the resuscitation cubicle trolley. Immediately after the cord is clamped and cut, the baby is placed on the resuscitaire in front of you. The infant is floppy, has no spontaneous respiratory effort, is centrally cyanosed, with a heart rate of 50 beats per minute (auscultated at the umbilicus). Copious meconium-stained liquor is noted on the baby's skin.

a) List 4 immediate actions in the first 30 seconds before addressing the airway. (4 marks)

- **Place under the radiant warmer**; dry and stimulate the baby; remove wet linen (maintain temperature 36.5-37.5 degrees Celsius) **[core]**
- **Position the head in neutral position** (slight extension); use a shoulder roll if needed; clear the airway only if obstructed (routine suctioning of the airway in the presence of meconium is no longer recommended in non-vigorous neonates per current ANZCOR guidelines) **[core]**
- **Reassess heart rate, breathing, tone, colour at 30 seconds** **[core]**
- **Apply pulse oximeter to the right hand** (pre-ductal saturation), apply ECG monitoring; document time of birth on the Apgar timer **[core]**
- Maintain ambient temperature in the resuscitation cubicle 23-25 degrees Celsius
- Call for additional help — paediatrician, neonatal nurse, anaesthetist

b) Explain why peripheral oxygen saturation is measured on the right hand (rather than the left hand) of a newborn, AND state the target saturations at 5 minutes. (3 marks)

- **The right hand is supplied by the right subclavian artery, which arises proximal to the ductus arteriosus**; saturation here reflects PRE-DUCTAL oxygenation **[core]**
- **The left hand and lower limbs are POST-DUCTAL** — supplied beyond the ductus arteriosus where right-to-left ductal shunting (in persistent fetal circulation) would dilute saturation, falsely lowering the reading **[core]**
- **Target SpO₂ at 5 minutes is 85-95 percent** (per ANZCOR neonatal resuscitation algorithm); >90 percent at 10 minutes; do not initially aim for 100 percent (oxygen toxicity / oxidative stress) **[core]**

c) State the initial T-piece resuscitator settings for this term infant (4 components). (4 marks)

- **Fraction of inspired oxygen — 0.21 (room air) initially for term, 0.30 for preterm <32 weeks**; titrate up by 10 percent every 30 seconds if SpO₂ not rising appropriately **[core]**
- **Rate 40-60 breaths per minute** **[core]**
- **Positive end-expiratory pressure (PEEP) 5 centimetres of water** (alveolar recruitment, prevents derecruitment) **[core]**
- **Peak inspiratory pressure 20-25 centimetres of water** (titrate to adequate chest rise; lower in preterm; higher (30 cm H₂O) may be required for first few breaths) **[core]**
- Tidal volume target ~6-8 mL/kg
- Reassess every 30 seconds — heart rate, chest rise, SpO₂

d) Describe how to identify the umbilical vein for catheter insertion AND state when umbilical venous catheterisation is indicated. (3 marks)

- **The umbilical vein is single, larger, thinner-walled, and at the 12 o'clock position** on the cut surface; the two umbilical arteries are smaller, thicker-walled, often constricted, and at approximately the 4 and 8 o'clock positions **[core]**

- **Indications:** failure to obtain peripheral intravenous access in a newborn requiring resuscitation; rapid drug / fluid administration **[core]**
- Insert sterile 5-French catheter to depth of 2-3 cm in emergency (low position to avoid hepatic / portal vein injury); ideal position confirmed by free flow of blood **[core]**
- Adrenaline (1:10,000 dose 10-30 µg/kg = 0.1-0.3 mL/kg of 1:10,000 solution) IV via UVC if heart rate <60 despite adequate ventilation

References: ANZCOR Guideline 13 — Neonatal Life Support (current) • APLS Australia/NZ — Advanced Paediatric Life Support • Royal Children's Hospital Melbourne — Clinical Practice Guideline • Newborn and Paediatric Emergency Transport Service guidelines • Tintinalli's Emergency Medicine 9e Ch 109

Question 2 | Persistent Cyanosis in the Newborn — Hyperoxia Test (11 marks)

A 12-hour-old male neonate is brought to your emergency department from a peripheral midwife-led birthing unit because his peripheral oxygen saturation is persistently around 75 percent on room air. He was born at term by uncomplicated normal vaginal delivery with appropriate growth (birth weight 3.4 kilograms). He has a respiratory rate of 60 breaths per minute (mildly increased), no work of breathing, no grunting, but appears centrally cyanosed. Auscultation reveals normal heart sounds and clear lung fields. The infant is well perfused with normal pulses in all four limbs.

a) List 4 differential diagnoses for persistent central cyanosis in a newborn. (4 marks)

- **Cyanotic congenital heart disease** — tetralogy of Fallot, transposition of the great arteries, total anomalous pulmonary venous return, tricuspid atresia, truncus arteriosus, hypoplastic left heart [core]
- **Persistent pulmonary hypertension of the newborn** — failure of decline in pulmonary vascular resistance after birth [core]
- **Pulmonary disease** — meconium aspiration, transient tachypnoea of the newborn, neonatal pneumonia, pneumothorax, respiratory distress syndrome (preterm), diaphragmatic hernia [core]
- **Sepsis** — septic shock with metabolic acidosis [core]
- Methaemoglobinaemia (rare; suggested by SpO₂ reading not improving with oxygen)
- Polycythaemia (haematocrit >65 percent)
- Central nervous system pathology — hypoventilation from CNS depression

b) Describe the hyperoxia test AND interpret the results. (4 marks)

- **Method:** measure right radial arterial blood gas (pre-ductal) in room air (or current oxygen) at baseline, then administer 100 percent oxygen via head-box or face mask for 10 minutes, repeat right radial arterial blood gas [core]
- **Pulmonary disease:** PaO₂ rises significantly to greater than 150-300 millimetres of mercury (oxygen diffusion improves with high FiO₂) [core]
- **Cyanotic congenital heart disease:** PaO₂ rises only modestly, often remaining less than 100-150 millimetres of mercury (right-to-left shunt is fixed; additional alveolar oxygen does not improve arterial saturation) [core]
- **Persistent pulmonary hypertension:** intermediate response or labile; pre-ductal PaO₂ rises but post-ductal remains low (>20 mmHg gradient is diagnostic) [core]
- Limitations: oxygen administration may close ductus arteriosus (worsens duct-dependent lesions); should not delay echocardiography

c) State 3 immediate management priorities while awaiting paediatric cardiology / NETS retrieval. (3 marks)

- **Prostaglandin E1 (alprostadil) intravenous infusion 5-10 nanograms/kg/min** — maintain patency of the ductus arteriosus pending definitive diagnosis (most cyanotic congenital heart disease is duct-dependent) [core]
- **Anticipate apnoea** from prostaglandin — prepare for intubation; cautious use of oxygen (excessive FiO₂ may close the ductus arteriosus) [core]
- **NETS / paediatric cardiology consultation** for echocardiography and definitive diagnosis; transfer to paediatric cardiac centre [core]
- Establish reliable intravenous access (umbilical venous catheter or peripheral); 4-limb blood pressures; arterial blood gas monitoring
- Maintain temperature, normoglycaemia, and adequate perfusion

References: ANZCOR Guideline 13 — Neonatal Life Support (current) • Royal Children's Hospital Melbourne — Clinical Practice Guideline • eTG (Therapeutic Guidelines, current) • Newborn and Paediatric Emergency Transport Service guidelines • Tintinalli's Emergency Medicine 9e Ch 109

Question 3 | Heart Failure in the Newborn — Coarctation (11 marks)

A 14-day-old male neonate is brought to your emergency department by his mother who has noticed increased breathlessness during feeding, sweating with feeds, and difficulty taking the breast over the past 48 hours. The baby was born at term by normal vaginal delivery and appeared well at discharge from hospital on day 1. On examination he is tachypnoeic (respiratory rate 70 breaths per minute) with mild intercostal recession, peripheral oxygen saturation 92 percent on room air (right hand) and 88 percent (foot), heart rate 180 beats per minute. Blood pressure differs between upper limbs (110/65 millimetres of mercury) and lower limbs (75 millimetres of mercury systolic). Femoral pulses are weak compared with brachial pulses.

a) State the most likely diagnosis AND list 3 supportive features. (3 marks)

- **Coarctation of the aorta with closing ductus arteriosus [core]**
- **Differential blood pressure / saturation** between upper and lower limbs (pre-ductal upper limb higher than post-ductal lower limb — when the ductus arteriosus closes, the post-ductal circulation is dependent on a coarcted aorta) [core]
- **Weak / absent femoral pulses** compared to upper limbs; brachio-femoral delay (palpate radial and femoral pulses simultaneously) [core]
- **Presentation around days 7-14** (timing of ductal closure post-discharge)
- **Heart failure features** — tachypnoea, sweating with feeds, hepatomegaly, gallop rhythm, cardiomegaly on chest radiograph

b) List 4 immediate management priorities. (4 marks)

- **Prostaglandin E1 (alprostadil) intravenous infusion 10-50 nanograms/kg/min** — reopens the ductus arteriosus, restoring lower-body perfusion; ICU / NICU admission [core]
- **Cautious fluid management** — small boluses (10 mL/kg of 0.9 percent saline) if shocked but avoid overload (cardiogenic shock is the underlying problem); inotropic support (dobutamine, dopamine) may be required [core]
- **Diuretic therapy** if pulmonary oedema — furosemide 0.5-1 mg/kg intravenous [core]
- **Urgent paediatric cardiology consultation** and NETS retrieval to a paediatric cardiac surgical centre — definitive treatment is surgical or interventional repair of coarctation [core]
- Investigate for differential diagnosis (sepsis, metabolic) — bloods (FBC, CRP, blood culture, lactate, U&E; glucose, ammonia, organic acids, very-long-chain fatty acids); chest radiograph; echocardiogram
- Maintain temperature and normoglycaemia

c) List 4 acyanotic congenital cardiac causes of neonatal heart failure. (4 marks)

- **Coarctation of the aorta** (this case) [core]
- **Critical aortic stenosis** [core]
- **Hypoplastic left heart syndrome** (typically presents earlier — first week — with shock) [core]
- **Large ventricular septal defect or patent ductus arteriosus** (typically later — 4-8 weeks — when pulmonary vascular resistance falls) [core]
- Atrioventricular septal defect (often associated with Down syndrome)
- Anomalous origin of the left coronary artery from the pulmonary artery (ALCAPA)
- Truncus arteriosus, total anomalous pulmonary venous return

References: ANZCOR Guideline 13 — Neonatal Life Support (current) • Royal Children's Hospital Melbourne — Clinical Practice Guideline • eTG (Therapeutic Guidelines, current) • Tintinalli's Emergency Medicine 9e Ch 109

Question 4 | Bilious Vomiting — Malrotation and Midgut Volvulus (12 marks)

A 5-day-old male neonate is brought urgently to your emergency department because of green vomiting that started 6 hours ago. The baby is otherwise well at rest but became distressed with each vomit. He was born at term by uneventful normal vaginal delivery and discharged on day 1 in good condition. On examination, he appears unsettled but is haemodynamically stable: heart rate 150 beats per minute, blood pressure 70 millimetres of mercury systolic, capillary refill 2 seconds, peripheral oxygen saturation 99 percent. The abdomen is mildly distended but without obvious tenderness or palpable mass. The baby has not passed any stool today.

a) State the most concerning diagnosis AND explain why bilious vomiting is a surgical emergency in the neonate. (3 marks)

- **Malrotation with midgut volvulus [core]**
- **Midgut volvulus** — congenital malrotation results in narrow mesenteric base, allowing the small bowel to twist on the superior mesenteric artery pedicle, occluding both venous and arterial supply [core]
- **Window for irreversible bowel ischaemia is very short (hours)** — entire midgut (jejunum to mid-transverse colon) at risk of necrosis; loss may be incompatible with life or result in short-gut syndrome [core]
- Bilious (green) vomit in a neonate is malrotation until proven otherwise (sensitivity ~90 percent for obstructive aetiology)

b) List 4 immediate management priorities. (4 marks)

- **Urgent paediatric surgical consultation** — do NOT delay; immediate transfer to a paediatric surgical centre (NETS retrieval if remote) [core]
- **Nasogastric tube on free drainage** (decompresses obstructed proximal bowel; prevents aspiration); make nil by mouth [core]
- **Intravenous access and resuscitation** — 0.9 percent saline 20 mL/kg bolus if any signs of shock; bloods for FBC, U&E, lactate, group and crossmatch, blood culture [core]
- **Broad-spectrum intravenous antibiotics** if septic / advanced ischaemia — ampicillin 50 mg/kg + gentamicin 5 mg/kg + metronidazole 7.5 mg/kg [core]
- Maintain temperature, normoglycaemia
- Communicate with parents — emergency surgery imminent

c) Name 3 differential diagnoses for neonatal obstruction at this age. (3 marks)

- **Duodenal atresia** (often presents earlier — within first 24-48 hours; associated with Down syndrome; double-bubble sign on plain abdominal radiograph) [core]
- **Jejunal / ileal atresia [core]**
- **Hirschsprung's disease** (typically presents with delayed passage of meconium >48 h; chronic constipation; bilious vomiting with toxic megacolon if advanced) [core]
- Meconium ileus (cystic fibrosis association)
- Anorectal malformation (imperforate anus — observe perineum)
- Necrotising enterocolitis (more common in preterm)

d) Name the imaging investigation of choice AND describe the diagnostic finding. (2 marks)

- **Upper gastrointestinal contrast study (meal)** — gold standard for malrotation diagnosis (sensitivity ~95 percent) [core]
- **Findings: malposition of the duodenojejunal junction (ligament of Treitz)** to the right of midline; corkscrew or 'Z' appearance of duodenum; whirlpool sign on ultrasound (twisting of mesenteric vessels)

[core]

- Abdominal ultrasound is rapid bedside alternative (may show whirlpool sign — twisted mesenteric vessels)
- Plain abdominal radiograph is often non-specific or normal — does NOT exclude malrotation

References: Royal Children's Hospital Melbourne — Clinical Practice Guideline • eTG (Therapeutic Guidelines, current) • Tintinalli's Emergency Medicine 9e Ch 109 • APLS Australia/NZ — Advanced Paediatric Life Support

Question 5 | Failure to Pass Meconium — Hirschsprung's Disease (11 marks)

A 36-hour-old male neonate is brought to your emergency department by a community midwife because of failure to pass meconium since birth, with associated mucous-like vomiting. The baby is otherwise alert and well-perfused, with heart rate 140 beats per minute, blood pressure 65 millimetres of mercury systolic, respiratory rate 35 breaths per minute, peripheral oxygen saturation 99 percent on room air, normal core temperature. The abdomen is moderately distended but soft.

a) Complete each statement. (4 marks)

- **(a) A normal digital rectal examination** (with stool gush) **helps EXCLUDE Hirschsprung's disease** (in Hirschsprung the rectum is empty of stool; finger withdrawal often produces explosive release of stool from the proximal dilated segment) **[core]**
- **(b) Successful passage of a nasogastric tube** excludes **oesophageal atresia / tracheo-oesophageal fistula** **[core]**
- **(c) Characteristic abdominal radiograph appearance of duodenal atresia** = 'double-bubble' sign (gas in the stomach and proximal duodenum, with no distal bowel gas) **[core]**
- **(d) Congenital condition associated with neonatal bowel obstruction = Down syndrome (trisomy 21)** — increased incidence of duodenal atresia and Hirschsprung's disease **[core]**
- Cystic fibrosis is associated with meconium ileus

b) List 5 essential actions in the emergency department prior to transport to a specialist paediatric surgical centre. (5 marks)

- **Insert a nasogastric tube on free drainage** to decompress the obstructed stomach and bowel and reduce risk of aspiration **[core]**
- **Establish intravenous access** and commence maintenance fluids (10 percent dextrose with 0.45 percent saline at 60 mL/kg/day for first 24 hours of life, increasing to 100 mL/kg/day by day 3-7); bolus 10-20 mL/kg 0.9 percent saline if shocked **[core]**
- **Make the infant nil by mouth** **[core]**
- **Maintain temperature** — radiant warmer or skin-to-skin contact with mother; warm transport incubator **[core]**
- **Send blood investigations** — full blood count, urea and electrolytes, glucose, blood culture, group and save; plain abdominal radiograph (supine and lateral decubitus / cross-table) **[core]**
- Communicate with NETS / receiving paediatric surgical centre
- Begin broad-spectrum intravenous antibiotics if concerns regarding sepsis or perforation
- Document carefully and discuss with parents

c) State the maintenance intravenous fluid choice and rate for a term neonate (day 1) of weight 3.0 kilograms. (2 marks)

- **10 percent dextrose with 0.225 percent saline** (or 0.45 percent saline) — no potassium until urine output established **[core]**
- **Day 1 maintenance: 60 mL/kg/day = 180 mL/day = 7.5 mL/h** for a 3 kg neonate (increase to 80 mL/kg/day on day 2, 100 mL/kg/day from day 3 if no fluid restriction needed) **[core]**
- Add potassium 1-2 mmol/kg/day from day 2-3 (once renal function established)

References: Royal Children's Hospital Melbourne — Clinical Practice Guideline • Newborn and Paediatric Emergency Transport Service guidelines • Australian and New Zealand Neonatal Network standards • eTG (Therapeutic Guidelines, current)

Question 6 | Necrotising Enterocolitis (11 marks)

A 28-day-old former preterm neonate (born at 32 weeks gestation, now corrected age 36 weeks; discharged home 1 week ago after uncomplicated neonatal course) is brought to your emergency department with a 12-hour history of feeding intolerance, increasing abdominal distension, and blood-stained stool. He is mildly lethargic. Examination reveals: heart rate 175 beats per minute, blood pressure 60 millimetres of mercury systolic, capillary refill 4 seconds, peripheral oxygen saturation 94 percent on room air, temperature 36.0 degrees Celsius. The abdomen is distended, tense, and tender with visible bowel loops.

a) List 4 plain abdominal radiograph findings of necrotising enterocolitis. (4 marks)

- **Pneumatosis intestinalis** — gas in the bowel wall (pathognomonic linear or bubble-like lucencies in bowel wall) **[core]**
- **Portal venous gas** — branching lucencies over the liver shadow (advanced disease) **[core]**
- **Pneumoperitoneum** (Rigler's sign — double bowel wall, football sign on supine film) indicating perforation **[core]**
- **Persistent dilated bowel loop** on serial films (sentinel loop, suggests ischaemia / impending perforation) **[core]**
- Generalised bowel-wall thickening; asymmetric / abnormal gas distribution
- Loss of normal small-bowel pattern (gas-filled or fluid-filled)

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

- **Bowel rest** — make nil by mouth, nasogastric tube on free drainage; decompress and remove enteric content **[core]**
- **Aggressive intravenous resuscitation** — 0.9 percent saline 20 mL/kg boluses, blood products as needed; vasopressor support if shock persists **[core]**
- **Broad-spectrum intravenous antibiotics** — ampicillin (or vancomycin) + gentamicin + metronidazole; cover gram-negative, gram-positive, and anaerobic organisms **[core]**
- **Urgent paediatric surgical consultation** — operative intervention for perforation, peritonitis, or progressive deterioration **[core]**
- Serial abdominal radiographs every 6 hours
- Investigations — FBC, U&E, lactate, blood culture, CRP, coagulation
- Intensive care unit / NICU admission; ventilatory support if needed

c) List 3 risk factors for necrotising enterocolitis. (3 marks)

- **Prematurity** (especially <32 weeks or birth weight <1500 g) **[core]**
- **Formula feeding** (breastfeeding is protective); rapid advancement of enteral feeds **[core]**
- **Hypoxic / ischaemic events** — perinatal asphyxia, congenital heart disease with diastolic runoff, sepsis, hypothermia, polycythaemia **[core]**
- Patent ductus arteriosus with diastolic runoff (reduced mesenteric perfusion)
- Prior gastrointestinal infection
- Maternal cocaine use

References: Royal Children's Hospital Melbourne — Clinical Practice Guideline • eTG (Therapeutic Guidelines, current) • Australian and New Zealand Neonatal Network standards • Tintinalli's Emergency Medicine 9e Ch 109

Question 7 | Hypertrophic Pyloric Stenosis (10 marks)

A 4-week-old preterm female neonate (4 weeks corrected age to term) is brought to your emergency department by her mother with 12 hours of vomiting. The vomiting is described as projectile and non-bilious. The baby is hungry to feed shortly after vomiting. On examination, the baby has sunken eyes, is irritable, with temperature 37.5 degrees Celsius, capillary refill 4 seconds, heart rate 172 beats per minute, respiratory rate 40 breaths per minute, peripheral oxygen saturation 98 percent on room air. Visible peristalsis is observed traversing the upper abdomen during feeding.

a) List 3 obstructive AND 3 non-obstructive causes of vomiting in this age group (3 of each). (4 marks)

- **OBSTRUCTIVE: hypertrophic pyloric stenosis** (most likely given age, projectile non-bilious vomiting, hungry infant) **[core]**
- **OBSTRUCTIVE: malrotation with midgut volvulus** (bilious vomiting); intussusception (3-9 months); incarcerated inguinal hernia **[core]**
- **OBSTRUCTIVE: intestinal atresia, duplication cyst, antral web** **[core]**
- **NON-OBSTRUCTIVE: gastroenteritis** (viral or bacterial) **[core]**
- **NON-OBSTRUCTIVE: sepsis** (occult source — urinary tract infection, meningitis, pneumonia) **[core]**
- **NON-OBSTRUCTIVE: gastro-oesophageal reflux, overfeeding**; metabolic — inborn errors of metabolism, congenital adrenal hyperplasia, hypercalcaemia **[core]**
- Raised intracranial pressure
- Drug toxicity, milk protein allergy

b) Describe the classic biochemical abnormality of pyloric stenosis AND state the imaging investigation of choice. (3 marks)

- **Hypochloraemic, hypokalaemic metabolic alkalosis** with paradoxical aciduria — loss of hydrochloric acid in vomitus → alkalosis; potassium and chloride loss; kidney conserves sodium with hydrogen exchange (paradoxical aciduria) preserving alkalosis **[core]**
- **Pyloric ultrasound** — gold standard; diagnostic criteria: pyloric muscle thickness ≥ 3 mm AND pyloric channel length ≥ 15 mm; failure of pyloric relaxation post-feed **[core]**
- Plain abdominal radiograph generally not helpful (may show distended stomach with little distal gas)

c) State 3 management priorities — emphasise the ORDER of priority. (3 marks)

- **FLUID AND ELECTROLYTE CORRECTION FIRST** (before any surgical intervention) — 0.9 percent saline 10-20 mL/kg bolus if shocked, then 0.45 percent saline + 5 percent dextrose with potassium supplementation; correct alkalosis (target chloride >100 , bicarbonate <28) and electrolyte abnormalities **[core]**
- **Surgical pyloromyotomy (Ramstedt's procedure)** — definitive treatment, performed AFTER biochemistry corrected (uncorrected alkalosis predisposes to post-anaesthetic apnoea / arrhythmias) **[core]**
- **Nasogastric tube on free drainage** if ongoing vomiting; nil by mouth; paediatric surgical referral **[core]**
- Avoid empirical antibiotics — not infective
- Monitor for hypoglycaemia; serial fluid balance

References: Royal Children's Hospital Melbourne — Clinical Practice Guideline • eTG (Therapeutic Guidelines, current) • Tintinalli's Emergency Medicine 9e Ch 109

Question 8 | Early-Onset Neonatal Sepsis (12 marks)

A 4-day-old male neonate is brought to your emergency department by his parents who report he is lethargic and feeding poorly. He was born at term by uncomplicated normal vaginal delivery and went home on day 2. On examination, he is mottled, cool peripherally, with heart rate 190 beats per minute, blood pressure unrecordable, capillary refill 5 seconds centrally, respiratory rate 60 breaths per minute (with grunting and chest recession), temperature 35.5 degrees Celsius, peripheral oxygen saturation 88 percent on room air. He responds to painful stimulus but is not consoling.

a) List 3 antenatal and perinatal risk factors for early-onset neonatal sepsis. (3 marks)

- **Prolonged rupture of membranes >18 hours** before delivery [core]
- **Maternal Group B streptococcus colonisation** (positive screening or previous infant with GBS) without adequate intrapartum antibiotic prophylaxis [core]
- **Maternal chorioamnionitis** (fever, leucocytosis, abdominal tenderness, foul-smelling discharge) [core]
- Premature delivery (especially <37 weeks)
- Maternal urinary tract infection during pregnancy
- Difficult or instrumental delivery

b) List 4 differential diagnoses for collapsed neonate other than sepsis. (4 marks)

- **Duct-dependent congenital heart disease** (critical aortic stenosis, hypoplastic left heart, coarctation, transposition) [core]
- **Inborn errors of metabolism** — organic acidaemia, urea cycle defect, fatty acid oxidation disorder, galactosaemia [core]
- **Congenital adrenal hyperplasia (salt-wasting crisis)** [core]
- **Hypovolaemia / haemorrhage** — intraventricular haemorrhage, abdominal haemorrhage, vitamin K-deficiency bleeding (if not given) [core]
- Trauma — non-accidental injury, accidental TBI
- Toxin / drug exposure — maternal medications, deliberate poisoning
- Severe hypoglycaemia
- Severe respiratory disease — pneumothorax, pneumonia, RDS

c) State the empirical antibiotic regimen for neonatal sepsis at this age AND list 4 essential investigations. (5 marks)

- **Empirical antibiotics: ampicillin (or benzylpenicillin) 50 mg/kg intravenous every 6 hours + gentamicin 5 mg/kg intravenous every 24 hours** — covers Group B streptococcus, Listeria, E. coli (early-onset sepsis pathogens) [core]
- **Add cefotaxime 50 mg/kg every 6 hours** if meningitis suspected (gentamicin has poor cerebrospinal fluid penetration); **add aciclovir 20 mg/kg every 8 hours** if HSV encephalitis suspected (vesicles, seizure, hepatic involvement) [core]
- **Investigations: blood culture** (before antibiotics if no delay), **full blood count + C-reactive protein, urinalysis with culture** (suprapubic aspirate or catheter sample), **chest radiograph, lumbar puncture** (after stabilisation), bedside glucose, blood gas, lactate, electrolytes, ammonia, organic acids [core]
- **Resuscitation:** 0.9 percent saline 10 mL/kg boluses (×3 if needed); inotrope (adrenaline or dopamine) if persistent shock [core]
- **Notify NETS / paediatric retrieval** for transfer to NICU; intensive supportive care [core]
- Treat hypoglycaemia: 10 percent dextrose 2 mL/kg intravenous bolus
- Active warming — radiant warmer, warm fluids

References: eTG (Therapeutic Guidelines, current) • Royal Children's Hospital Melbourne — Clinical Practice Guideline • ANZCOR Guideline 13 — Neonatal Life Support (current) • Australian and New Zealand Neonatal Network standards • Newborn and Paediatric Emergency Transport Service guidelines

Question 9 | Neonatal Hyperbilirubinaemia (12 marks)

A first-time mother brings her 5-day-old male neonate to your emergency department with concerns about jaundice. He was born at term by normal vaginal delivery (birth weight 3.6 kilograms) and discharged on day 2 in good condition. He is exclusively breastfed but the mother reports he has been less keen to feed for the past 24 hours. On examination he is alert but lethargic, with yellowish discolouration of skin extending to the abdomen and proximal lower limbs. His weight today is 3.3 kilograms (8 percent loss). Vital signs: heart rate 160 beats per minute, peripheral oxygen saturation 99 percent, alert on the AVPU scale.

a) List 5 likely causes for his jaundice. (5 marks)

- **Physiological jaundice** (peaks days 3-5; resolves by 1-2 weeks; bilirubin $<250 \mu\text{mol/L}$) **[core]**
- **Breastfeeding (suboptimal feeding) jaundice** — weight loss >7 percent (this baby), poor intake, dehydration **[core]**
- **Breast-milk jaundice** (later — weeks 2-4; well-fed baby; persists) **[core]**
- **Haemolysis** — ABO/Rh incompatibility (direct Coombs test positive); G6PD deficiency; hereditary spherocytosis **[core]**
- **Sepsis / urinary tract infection** — infection-driven haemolysis or hepatic dysfunction **[core]**
- Cephalohaematoma or extensive bruising (haemolysed blood release)
- **Conjugated hyperbilirubinaemia** (always pathological): biliary atresia (urgent — surgical intervention by 8 weeks), neonatal hepatitis, metabolic disease, total parenteral nutrition
- Hypothyroidism (congenital), Crigler-Najjar syndrome

b) List 4 'red-flag' findings that warrant admission and urgent investigation. (4 marks)

- **Jaundice within first 24 hours of life** (suggests haemolysis) **[core]**
- **Conjugated (direct) bilirubin >20 percent of total OR $>25 \mu\text{mol/L}$** — always pathological; consider biliary atresia, neonatal hepatitis **[core]**
- **Pale stools and dark urine** — obstructive picture; biliary atresia **[core]**
- **Total bilirubin above the phototherapy or exchange-transfusion threshold** on Bhutani / NICE nomogram (gestation- and age-specific) **[core]**
- Signs of acute bilirubin encephalopathy — lethargy, poor feeding, hypertonia, opisthotonos, high-pitched cry, retrocollis, seizures
- Persistent jaundice >14 days (term) or 21 days (preterm) — needs investigation
- Weight loss >10 percent or signs of dehydration
- Maternal blood group O Rh-negative

c) List 3 investigations with rationale. (3 marks)

- **Total and conjugated (direct) bilirubin** — plot on Bhutani / NICE age-specific nomogram; differentiates conjugated (always pathological) from unconjugated **[core]**
- **Full blood count + film + reticulocytes + blood group/Rh + Direct antiglobulin (Coombs) test** — assesses for haemolysis and alloimmune disease **[core]**
- **Urea and electrolytes, urinalysis with culture, blood culture if febrile or unwell** — sepsis / dehydration assessment **[core]**
- G6PD screen if appropriate ethnicity (Mediterranean, Asian, African)
- Liver function tests, alpha-1 antitrypsin, ammonia, thyroid function tests if conjugated
- Newborn screening (Guthrie card) review if not performed

References: Royal Children's Hospital Melbourne — Clinical Practice Guideline • NICE NG98 Neonatal jaundice • eTG (Therapeutic Guidelines, current) • ANZCOR Guideline 13 — Neonatal Life Support (current) • Tintinalli's Emergency Medicine 9e Ch 109

Question 10 | Severe Neonatal Hyperbilirubinaemia — Treatment (9 marks)

A 4-day-old male neonate (born at 38 weeks gestation, blood group O-positive, mother A-negative with positive antibody screen) is brought to your emergency department with rapidly progressive jaundice. He is feeding poorly and has noticeable lethargy. His total serum bilirubin is 480 micromoles per litre (above the exchange-transfusion threshold on the Bhutani nomogram for his age). Direct Coombs test is positive. Haemoglobin is 110 grams per litre (low for age).

a) Describe the principles of intensive phototherapy. (3 marks)

- **Light source** — high-intensity blue light (wavelength 460-490 nm) at 30 microwatts/cm²/nm or higher (intensive phototherapy threshold) **[core]**
- **Maximum surface area exposure** — expose entire skin (cover eyes with patches; nappy may be reduced); above and below sources for high-intensity therapy **[core]**
- **Mechanism: photoisomerisation of bilirubin** in skin to water-soluble isomers (lumirubin and configurational isomers) excreted in bile and urine without conjugation **[core]**
- Maintain hydration (insensible water loss increases ~40 percent under intensive phototherapy)

b) List 3 indications for exchange transfusion. (3 marks)

- Total serum bilirubin above the exchange threshold on Bhutani / NICE nomogram (varies by gestational age and risk factors) **[core]**
- **Acute bilirubin encephalopathy** — lethargy, poor feeding, hypertonia, opisthotonos, retrocollis, high-pitched cry, seizures (irrespective of bilirubin level) **[core]**
- Failure to respond to intensive phototherapy (rising bilirubin despite optimal phototherapy); rapid rate of rise (>8.5 µmol/L/h) **[core]**
- Severe haemolysis with anaemia (Hb <100 g/L)
- Hydrops fetalis

c) State 3 complications of exchange transfusion. (3 marks)

- **Cardiac arrhythmias / arrest** from rapid volume shifts, hypocalcaemia (citrate binding), hyperkalaemia (from stored blood) **[core]**
- **Infection / transfusion-transmitted disease** — bacterial sepsis, viral (despite screening); umbilical line-related complications **[core]**
- **Necrotising enterocolitis** — risk increased post-exchange transfusion **[core]**
- Thromboembolic complications (umbilical vessel trauma, portal vein thrombosis)
- Hypoglycaemia (rebound after citrated blood ceases)
- Coagulopathy from washout of platelets and clotting factors

References: Royal Children's Hospital Melbourne — Clinical Practice Guideline • NICE NG98 • eTG (Therapeutic Guidelines, current) • Australian and New Zealand Neonatal Network standards

Question 11 | Neonatal Hypoglycaemia and Inborn Errors of Metabolism (11 marks)

A 6-day-old male neonate is brought to your emergency department by his mother who reports increasing lethargy, poor feeding, and unusual breathing pattern over the past 24 hours. He was born at term by uncomplicated normal vaginal delivery to a non-consanguineous mother. His newborn screening (Guthrie card) result is not yet available. On examination he is hypotonic, with tachypnoea (respiratory rate 60 breaths per minute), intermittent twitching of the limbs, capillary refill 4 seconds. Bedside glucose is 1.8 millimoles per litre. Venous blood gas: pH 7.18, bicarbonate 9 millimoles per litre, anion gap 22, ammonia 250 micromoles per litre (normal <100).

a) List 4 differential diagnoses suggested by the metabolic profile. (4 marks)

- **Organic acidaemia** (e.g. methylmalonic, propionic acidaemia) — high anion gap metabolic acidosis with hyperammonaemia **[core]**
- **Urea cycle defect** (e.g. ornithine transcarbamylase deficiency) — markedly raised ammonia (often >500), respiratory alkalosis early then metabolic acidosis **[core]**
- **Fatty-acid oxidation disorder** (MCAD) — hypoglycaemia without ketosis, hyperammonaemia **[core]**
- **Galactosaemia** — hepatic dysfunction, hypoglycaemia, sepsis (E. coli predisposition) **[core]**
- Sepsis (mimics IEM)
- Congenital hyperinsulinism — recurrent hypoglycaemia without ketones
- Mitochondrial disease
- Maple syrup urine disease — sweet-smelling urine

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

- **Treat hypoglycaemia: 10 percent dextrose 2 mL/kg intravenous bolus** = approximately 6-8 mL for this neonate; then infusion at 6-8 mg/kg/min (approximately 80 mL/kg/day of 10 percent dextrose) **[core]**
- **STOP all enteral feeds** — protein and carbohydrate-containing feeds may worsen metabolic crisis until specific diagnosis **[core]**
- **Save samples** — paired blood and urine BEFORE intervention: blood gas, ammonia, lactate, glucose, ketones, amino acids, acylcarnitine profile; urine for organic acids, ketones, amino acids; newborn screening Guthrie **[core]**
- **Liaise with metabolic specialist / NETS retrieval**; consider intravenous carnitine, biotin, hydroxocobalamin, haemodialysis for severe hyperammonaemia **[core]**
- Treat acidosis cautiously — sodium bicarbonate only for pH <7.0 with appropriate metabolic specialist input
- Resuscitate per APLS principles for shock; broad-spectrum antibiotics if sepsis cannot be excluded

c) State 3 reasons inborn errors of metabolism are often missed initially. (3 marks)

- Non-specific clinical presentation mimicking sepsis — lethargy, poor feeding, vomiting, irritability, seizures, coma — overlaps with common conditions **[core]**
- Early presentation may follow asymptomatic newborn period — symptoms emerge only when exposed to nutrients (protein loading, weaning), or after intercurrent illness **[core]**
- Specific testing not part of standard screen — must be requested specifically; results often take 24-72 hours; newborn screening result may not be available at presentation **[core]**
- No family history in autosomal recessive disorders (70 percent of IEM)
- Diversity of disorders and biochemical patterns

References: Royal Children's Hospital Melbourne — Clinical Practice Guideline • eTG (Therapeutic Guidelines, current) • AusEMet metabolic emergency guideline • Tintinalli's Emergency Medicine 9e Ch 109

Question 12 | Neonatal Seizure (11 marks)

A 3-day-old male neonate is brought to your emergency department by his parents who witnessed him having repetitive jerky movements of the right arm and leg lasting approximately 2 minutes. He was born at term following a difficult forceps delivery with shoulder dystocia, with Apgar scores of 4 at 1 minute and 7 at 5 minutes. He has been mildly lethargic since birth. On examination, he has a cephalohaematoma over the right parietal area, subtle eye deviation to the left, and lip-smacking movements. His vital signs are: heart rate 160 beats per minute, peripheral oxygen saturation 96 percent on room air, capillary refill 3 seconds, bedside glucose 4.5 millimoles per litre.

a) List 4 causes of neonatal seizure relevant to this case. (4 marks)

- **Hypoxic-ischaemic encephalopathy (HIE)** — from perinatal asphyxia (Apgar 4 at 1 min); typically presents within 24-48 hours **[core]**
- **Intracranial haemorrhage** — subdural, subarachnoid, or intraventricular bleed; associated with traumatic delivery **[core]**
- **Cerebral infarction (perinatal stroke)** — focal seizures suggest focal lesion **[core]**
- **Neonatal sepsis / meningitis** (Group B strep, E. coli, Listeria) **[core]**
- Inborn errors of metabolism — hypoglycaemia, hyponatraemia, hypocalcaemia, hypomagnesaemia, organic / amino acidopathies
- Drug withdrawal — neonatal abstinence syndrome
- Pyridoxine-dependent epilepsy (rare)
- Congenital brain abnormalities

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

- **ABC and bedside glucose** — exclude hypoglycaemia (treat with 10 percent dextrose 2 mL/kg if <2.6 mmol/L); ABC support, oxygen, intravenous access **[core]**
- **Treat seizure: phenobarbitone 20 mg/kg intravenous loading dose** over 20 minutes (first-line in neonates); if ongoing, repeat 10 mg/kg up to total 40 mg/kg; second-line phenytoin / fosphenytoin 20 mg/kg or levetiracetam 40 mg/kg **[core]**
- **Investigate cause:** full blood count, C-reactive protein, urea and electrolytes, calcium, magnesium, glucose, blood culture, blood gas, lactate, ammonia; cranial ultrasound; consider lumbar puncture, computed tomography or magnetic resonance imaging **[core]**
- **Empirical broad-spectrum antibiotics** (ampicillin + gentamicin ± cefotaxime + aciclovir 20 mg/kg every 8 hours) if infection cannot be excluded **[core]**
- Continuous monitoring; intubation if airway compromise or recurrent seizures
- Liaise with NETS / paediatric neurology and NICU transfer

c) State 3 indications for therapeutic hypothermia in this case. (3 marks)

- Gestation ≥ 36 weeks **[core]**
- Apgar score ≤ 5 at 10 min OR ongoing resuscitation at 10 min OR umbilical arterial pH < 7.0 OR base deficit ≥ 16 mmol/L on cord or first-hour blood gas **[core]**
- Moderate to severe encephalopathy (Sarnat stage 2-3) — abnormal consciousness, abnormal tone, abnormal reflexes, seizures **[core]**
- Must commence within 6 hours of birth; cooled to 33-34°C for 72 hours; performed in NICU; transfer urgently to tertiary centre

References: Royal Children's Hospital Melbourne — Clinical Practice Guideline • eTG (Therapeutic Guidelines, current) • ANZCOR Guideline 13 — Neonatal Life Support (current) • Australian and New Zealand Neonatal Network standards •

Tintinalli's Emergency Medicine 9e Ch 109

Question 13 | Hypoxic-Ischaemic Encephalopathy (10 marks)

A term male neonate (gestation 39 weeks; birth weight 3.5 kilograms) was born by emergency Caesarean section in your peripheral hospital after prolonged second stage and foetal bradycardia (detected on cardiotocography). He required extensive resuscitation including 5 minutes of positive pressure ventilation and brief chest compressions. Apgar scores were 1 at 1 minute, 4 at 5 minutes, and 6 at 10 minutes. Cord arterial pH was 6.95 with base deficit -18 millimoles per litre. He is now 30 minutes old and remains lethargic with abnormal tone (initially flaccid, now intermittent stiffness). He has had one focal seizure of the right arm.

a) Describe the Sarnat staging of hypoxic-ischaemic encephalopathy. (4 marks)

- **Stage 1 (mild):** hyperalert, normal tone, hyper-reflexia, no seizures; resolves in 24 hours; usually no long-term sequelae **[core]**
- **Stage 2 (moderate):** lethargy, hypotonia, weak suck, depressed reflexes, seizures common (about 70 percent); moderate risk of long-term neurological deficit **[core]**
- **Stage 3 (severe):** stupor / coma, flaccid, absent reflexes, prolonged seizures, brainstem dysfunction (apnoea, bradycardia, fixed pupils); high mortality and severe long-term sequelae **[core]**
- **This baby = Sarnat stage 2 (moderate)** given lethargy, abnormal tone, seizure **[core]**

b) State the eligibility criteria for therapeutic hypothermia AND describe the protocol. (4 marks)

- **Eligibility:** gestation ≥ 36 weeks; evidence of perinatal hypoxic insult (cord pH < 7.0 OR base deficit ≥ 16 OR Apgar ≤ 5 at 10 minutes OR ongoing resuscitation at 10 minutes); moderate to severe encephalopathy (Sarnat stage 2-3) **[core]**
- **Cool to core (rectal) temperature 33-34 degrees Celsius** within 6 hours of birth **[core]**
- **Maintain cooling for 72 hours**, then rewarm slowly (0.5 degrees Celsius per hour over 6-12 hours) **[core]**
- **Method:** whole-body cooling with specific cooling mat / device (preferred) OR selective head cooling; bedside amplitude-integrated EEG monitoring; magnetic resonance imaging at day 5-7 **[core]**
- Avoid passive hypothermia in transit (overcooling risk); active temperature regulation
- Manage complications: coagulopathy, thrombocytopenia, persistent pulmonary hypertension, hypotension, electrolyte derangement

c) List 2 contraindications to therapeutic hypothermia. (2 marks)

- Gestation < 36 weeks (insufficient evidence of benefit) **[core]**
- Age greater than 6 hours from birth at presentation **[core]**
- Major congenital abnormality incompatible with life
- Severe trauma or active life-threatening bleeding
- Persistently low blood pressure unresponsive to treatment

References: Royal Children's Hospital Melbourne — Clinical Practice Guideline • ANZCOR Guideline 13 — Neonatal Life Support (current) • Australian and New Zealand Neonatal Network standards • TOBY/CoolCap trial evidence • Tintinalli's Emergency Medicine 9e Ch 109

Question 14 | Failure to Thrive (10 marks)

A 3-week-old male neonate is brought to your emergency department by his mother because he is feeding poorly and has not gained weight since birth. He weighs 2.95 kilograms today (birth weight 3.0 kilograms). The mother reports he was born at term by uncomplicated normal vaginal delivery, exclusively breastfed (mother of three previous children, no feeding difficulties), but he tires during feeding and now takes 30 minutes per feed. She has noticed sweating during feeds and his breathing seems faster than her older children's did. On examination he is alert but pale, with a respiratory rate of 65 breaths per minute (mildly increased), heart rate 170 beats per minute, peripheral oxygen saturation 95 percent (right hand) and 92 percent (foot).

a) List 5 features on examination AND state the relevance of each. (5 marks)

- **Plot weight, length, head circumference on growth chart** — quantify failure to thrive (typically <3rd percentile or crossing 2 percentile lines downward) **[core]**
- **Cardiovascular examination** — heart sounds, murmurs, peripheral pulses (brachial vs femoral comparison for coarctation), differential pulse oximetry pre-/post-ductal **[core]**
- **Respiratory examination** — work of breathing, recession, grunting; chest signs of consolidation **[core]**
- **Hydration assessment** — capillary refill, fontanelle, mucous membranes, skin turgor, urine output **[core]**
- **Hepatomegaly, jaundice, dysmorphism, anal patency** — assess for liver dysfunction, congenital anomalies **[core]**
- Tone, primitive reflexes, feeding observation (direct observation of breast or bottle feed; cyanosis, grunting, fatigue)
- Weighing feed (pre- and post-feed weight to estimate intake)

b) List 5 investigations with rationale tailored to this presentation. (5 marks)

- **Echocardiography** — features suggest duct-dependent or evolving congenital heart disease (sweating with feeds, tachypnoea, differential saturation) **[core]**
- **Chest radiograph** — cardiomegaly, pulmonary congestion, heart silhouette, rib notching (older children with coarctation) **[core]**
- **Full blood count, U&E, glucose, creatinine, lactate** — anaemia, electrolyte derangement, metabolic compensation **[core]**
- **Urinalysis with culture, blood culture** — exclude infection (urinary tract infection, sepsis as cause of poor feeding) **[core]**
- **Newborn screening (Guthrie) result** — metabolic, endocrine, cystic fibrosis, haemoglobinopathies **[core]**
- Thyroid function tests (congenital hypothyroidism)
- Liver function tests, ammonia, organic acids if metabolic disease suspected
- Pyloric ultrasound if vomiting

References: Royal Children's Hospital Melbourne — Clinical Practice Guideline • eTG (Therapeutic Guidelines, current) • ANZCOR Guideline 13 — Neonatal Life Support (current) • Tintinalli's Emergency Medicine 9e Ch 109

Question 15 | Neonatal Pneumonia and Respiratory Distress (10 marks)

A 9-day-old female neonate is brought to your emergency department by her parents with a 24-hour history of increased work of breathing, irritability, and reduced feeding. She was born at 38 weeks gestation by uncomplicated normal vaginal delivery. Her mother had positive Group B streptococcus screening but received only 1 dose of intrapartum penicillin (incomplete prophylaxis as labour was rapid). On examination, the baby has a respiratory rate of 70 breaths per minute, with grunting, intercostal recession, and nasal flaring. Peripheral oxygen saturation is 88 percent on room air, rising to 95 percent on 4 litres oxygen via low-flow nasal cannulae. Heart rate 180 beats per minute, temperature 38.2 degrees Celsius.

a) List 4 differential diagnoses for neonatal respiratory distress. (4 marks)

- **Neonatal pneumonia** (early-onset — Group B streptococcus, E. coli, Listeria; late-onset — Staphylococcus, respiratory syncytial virus) **[core]**
- **Sepsis with respiratory involvement** **[core]**
- **Bronchiolitis (RSV)** in older neonates; pertussis (apnoeic spells) **[core]**
- **Congenital heart disease** with pulmonary congestion / heart failure (coarctation, large left-to-right shunt) **[core]**
- Pneumothorax / pneumomediastinum
- Aspiration pneumonia (gastro-oesophageal reflux, tracheo-oesophageal fistula)
- Inborn error of metabolism (e.g. urea cycle defect with respiratory alkalosis)
- Airway obstruction (laryngomalacia, vascular ring)

b) State the empirical antibiotic regimen AND identify 3 essential investigations. (3 marks)

- **Empirical antibiotics:** amoxicillin (or benzylpenicillin) 50 mg/kg every 6 hours + gentamicin 5 mg/kg every 24 hours (covers Group B streptococcus, E. coli, Listeria); add cefotaxime if meningitis suspected **[core]**
- **Investigations:** blood culture, full blood count + C-reactive protein, respiratory viral PCR (NPA — RSV, influenza, parainfluenza, adenovirus, rhinovirus), urinalysis with culture, lumbar puncture if signs of meningitis (after stabilisation) **[core]**
- **Chest radiograph** — interstitial or consolidation pattern; rule out pneumothorax, congenital diaphragmatic hernia, cardiomegaly **[core]**
- Blood gas; bedside glucose; electrolytes
- Echocardiography if congenital heart disease suspected

c) List 3 indications for intubation in a neonate with respiratory distress. (3 marks)

- **Apnoea or inadequate spontaneous ventilation** with hypercapnia **[core]**
- **Persistent hypoxaemia** despite high-flow oxygen / continuous positive airway pressure (CPAP at $\text{FiO}_2 > 0.6$ with peripheral oxygen saturation $< 90\%$) **[core]**
- **Severe respiratory distress with exhaustion / haemodynamic instability** **[core]**
- Need for surfactant administration in preterm RDS
- Airway protection — depressed mental state, seizures, profound shock

References: Royal Children's Hospital Melbourne — Clinical Practice Guideline • eTG (Therapeutic Guidelines, current) • ANZCOR Guideline 13 — Neonatal Life Support (current) • Australian and New Zealand Neonatal Network standards • Tintinalli's Emergency Medicine 9e Ch 109

Question 16 | Apnoea in the Neonate (10 marks)

A 4-week-old male former preterm neonate (born at 34 weeks gestation, now corrected age 38 weeks) is brought urgently to your emergency department by ambulance after his mother witnessed him become limp, pale, and stop breathing for approximately 30 seconds. She gave him gentle stimulation and he began breathing again and now appears well. He does not have a history of any similar episodes. He had been mildly snuffly with rhinorrhoea for the past 2 days. On arrival, he is alert, haemodynamically stable, with normal saturations and vital signs.

a) List 4 specific differential diagnoses to consider in this clinical context. (4 marks)

- **Pertussis** — apnoea is the dominant presentation in young infants with *Bordetella pertussis* (whooping cough); screen with nasopharyngeal swab [core]
- **Respiratory syncytial virus / bronchiolitis** — apnoea common in <6 weeks corrected age; less prominent with viral symptoms [core]
- **Apnoea of prematurity** — common in infants <36 weeks corrected age; resolves as the infant matures (typically by 36-40 weeks corrected) [core]
- **Sepsis / urinary tract infection** [core]
- Seizure
- Gastro-oesophageal reflux with apnoea (controversial)
- Inborn errors of metabolism, hypoglycaemia
- Non-accidental injury — abusive head trauma, smothering

b) Apply the AAP BRUE criteria — state whether this is HIGHER- or LOWER-risk AND why. (4 marks)

- **BRUE (Brief Resolved Unexplained Event)** requires: age <1 year; brief (<1 min); resolved with patient back to baseline at evaluation; unexplained after history and examination; with at least 1 of cyanosis/pallor, irregular/decreased breathing, marked tone change, altered responsiveness [core]
- **This patient is HIGHER-risk BRUE** because: (a) ex-preterm 34/40, (b) post-conceptual age <45 weeks, (c) duration ~30 seconds (lower-risk requires <1 min, qualifies), (d) viral prodrome — DOES NOT meet lower-risk criteria [core]
- **Lower-risk criteria:** age >60 days, gestational age ≥32 weeks AND post-conceptual age ≥45 weeks, first event <1 min, no CPR by trained provider, no concerning features [core]
- **Higher-risk = admit for monitoring; investigate (consider pertussis swab, respiratory viral PCR, electrocardiogram, urinalysis) [core]**

c) List 2 essential discharge criteria if this patient were lower-risk. (2 marks)

- Resolution of episode at evaluation; clinically well throughout observation; normal cardiopulmonary examination [core]
- Reliable carer with clear instructions, infant cardiopulmonary resuscitation training offered, return-to-emergency criteria explicit; safe environment (no concern for non-accidental injury); follow-up arranged with general practitioner / paediatrician within 24 hours [core]

References: Royal Children's Hospital Melbourne — Clinical Practice Guideline • AAP BRUE guideline 2016 • eTG (Therapeutic Guidelines, current)

Question 17 | Neonatal Abstinence Syndrome (11 marks)

A 3-day-old male term neonate is brought to your emergency department by his mother who is concerned that he is irritable, crying inconsolably, sweating, and feeding poorly with vomiting. He was born by uncomplicated vaginal delivery and discharged on day 1. The mother has a history of opioid dependence (maintained on methadone 60 milligrams daily during pregnancy, last dose this morning). On examination, the baby has tremulousness, hyperalert state, increased tone, frequent yawning, sneezing, mild diarrhoea, and a high-pitched cry. He is afebrile with normal vital signs.

a) List 4 features of neonatal abstinence syndrome (by system). (4 marks)

- **Central nervous system:** high-pitched cry, irritability, tremor, increased tone, hyperreflexia, sleeplessness, seizures (in severe cases) **[core]**
- **Autonomic / vasomotor:** sweating, fever, sneezing, yawning, mottled skin, nasal stuffiness, hypertension **[core]**
- **Gastrointestinal:** poor feeding, frantic sucking, vomiting, diarrhoea, weight loss, dehydration **[core]**
- **Respiratory:** tachypnoea, sneezing, hyperventilation; respiratory alkalosis **[core]**
- Excoriation from rubbing

b) State 4 management priorities. (4 marks)

- **Non-pharmacological measures first** — swaddling, low-stimulation environment, frequent small feeds (encourage breastfeeding even with maternal methadone, as it reduces NAS severity), skin-to-skin contact, rooming-in **[core]**
- **Finnegan or modified Finnegan score** every 4 hours — guides initiation and titration of pharmacotherapy **[core]**
- **Pharmacological treatment** if score consistently ≥ 8 — **oral morphine** (0.05-0.1 mg/kg every 4 hours, titrated to score) is first-line for opioid withdrawal; phenobarbitone for non-opioid withdrawal; clonidine adjunct **[core]**
- **Multidisciplinary support** — drug and alcohol service, social work, child protection (mandatory consideration with drug-using mother in Australia), lactation, psychiatric support **[core]**
- Investigate other causes — sepsis, hypoglycaemia, hypocalcaemia, hyperthyroidism, intracranial haemorrhage
- Maternal drug screen and history of all substances

c) List 3 considerations for safe discharge of an NAS infant. (3 marks)

- **Stable feeding and weight gain;** Finnegan score consistently < 8 for 24-48 hours off pharmacotherapy **[core]**
- **Social work and child protection assessment** — safety of home environment, support network, ongoing maternal treatment **[core]**
- **Multidisciplinary follow-up** — general practitioner, paediatrician, drug and alcohol team, child and family health nurse; clear handover and contact information **[core]**
- Education and resources for parent / carer on ongoing care
- Mandatory child protection notification per state legislation

References: Royal Children's Hospital Melbourne — Clinical Practice Guideline • eTG (Therapeutic Guidelines, current) • ACEM clinical policies and statements • Finnegan Neonatal Abstinence Scoring System

Question 18 | Oesophageal Atresia / Tracheo-Oesophageal Fistula (9 marks)

A term male neonate (gestation 39 weeks) is brought to your emergency department from a birthing centre 1 hour after birth because of excessive frothing of saliva from the mouth and choking with attempted feeds. The pregnancy was complicated by polyhydramnios. He has been unable to take any feeds. On attempted nasogastric tube insertion, the tube could not be advanced beyond approximately 10 centimetres.

a) State the most likely diagnosis AND describe the most common anatomical variant. (3 marks)

- **Oesophageal atresia with distal tracheo-oesophageal fistula** (approximately 85 percent of cases) **[core]**
- **The proximal oesophagus ends in a blind pouch**, and the distal oesophagus communicates with the trachea via a fistula **[core]**
- **VACTERL association** in 25-50 percent (Vertebral, Anal, Cardiac, Tracheo-oesophageal, Renal, Limb) — investigate for all components **[core]**

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

- **Replegle (double-lumen) tube** placed in the upper oesophageal pouch on continuous low suction — prevents aspiration of pooling secretions **[core]**
- **Position 30-40 degrees head-up** in prone or right lateral position — minimises reflux of gastric contents through the fistula into the trachea **[core]**
- **Make nil by mouth**; intravenous fluids (10 percent dextrose with electrolytes as appropriate); broad-spectrum antibiotics if any suspicion of aspiration pneumonitis **[core]**
- Avoid bag-mask ventilation if possible (gas may distend stomach via fistula and impair ventilation)
- Urgent paediatric surgical consultation; NETS transfer to surgical centre

c) List 3 investigations to confirm the diagnosis and assess for associated anomalies. (3 marks)

- **Plain chest and abdominal radiograph** with the radio-opaque tube in situ — coiled tube in upper pouch confirms atresia; distal bowel gas confirms tracheo-oesophageal fistula (no distal gas in isolated atresia) **[core]**
- **Echocardiogram** (high incidence of associated cardiac anomalies, including right-sided arch which alters surgical approach) **[core]**
- **Renal and spinal ultrasound** (VACTERL screening) **[core]**
- Anoscopy to assess anal patency

References: Royal Children's Hospital Melbourne — Clinical Practice Guideline • eTG (Therapeutic Guidelines, current) • Tintinalli's Emergency Medicine 9e Ch 109

Question 19 | Non-Accidental Injury — Neonate (11 marks)

A 14-day-old female neonate is brought to your emergency department by her father with a 4-hour history of progressive lethargy. The father reports the baby fell off the changing table earlier today. The father is on his own as the mother is at work; this is the first time he has cared for the baby alone. On examination, the baby is sleepy, with Glasgow Coma Score 12 (E3 V3 M6), heart rate 175 beats per minute, blood pressure 90/55 millimetres of mercury, respiratory rate 50 breaths per minute, peripheral oxygen saturation 96 percent, temperature 36.8 degrees Celsius. There are several small bruises on the cheeks and a swelling of the occipital scalp. Her anterior fontanelle is full. Computed tomography of the head shows a unilateral subdural haematoma and diffuse cerebral oedema.

a) List 4 features supporting non-accidental injury. (4 marks)

- **Mechanism inconsistent with injury** — fall from changing table is unusual for a 14-day-old neonate (poor head control); low-energy fall does not typically cause subdural haematoma in pre-walking child **[core]**
- **Bruising in pre-mobile infant** — neonates and infants <6 months should rarely bruise; facial bruising is particularly suspicious **[core]**
- **Sole carer with new caring responsibility** — increased risk in stressed first-time carers; non-accidental injury patterns **[core]**
- **Subdural haematoma with diffuse cerebral oedema** — pattern consistent with abusive head trauma (acceleration-deceleration shaking injury) **[core]**
- Retinal haemorrhages on dilated fundoscopy (pathognomonic of abusive head trauma in this context)
- Delayed presentation
- Other unexplained injuries — fractures of differing ages, metaphyseal corner fractures, posterior rib fractures

b) State 4 immediate medical management priorities. (4 marks)

- **Airway, breathing, circulation** — definitive airway with rapid sequence induction (ketamine 1-2 mg/kg, rocuronium 1.2 mg/kg) given decreasing GCS; neuroprotective principles (head-up 30°, PaCO₂ 35-40, normoxaemia) **[core]**
- **Treat raised intracranial pressure** — head-up 30°, hyperosmolar therapy (3 percent saline 5 mL/kg or mannitol 0.5 g/kg intravenous); urgent neurosurgical consultation **[core]**
- **Active warming** — radiant warmer, warm fluids; correct hypothermia, hypoglycaemia (10 percent dextrose 2 mL/kg if <2.6 mmol/L) **[core]**
- **Transfer to tertiary paediatric centre** with NETS retrieval; intensive care unit and neurosurgical involvement **[core]**
- Empirical antibiotics if any suspicion of sepsis (cefotaxime + ampicillin)

c) State 3 child protection management priorities. (3 marks)

- **Mandatory child protection notification** per state legislation (e.g. NSW Department of Communities and Justice, Victoria Department of Families); ALL clinicians are mandated reporters in Australia **[core]**
- **Detailed contemporaneous documentation** with diagrams / photographs (with consent), verbatim history; preserve forensic evidence (clothing, scene description) **[core]**
- **Skeletal survey + dilated retinal examination + magnetic resonance imaging of head** within 24 hours to identify occult injuries **[core]**
- Multidisciplinary team — paediatrician, social work, child protection, possibly police; safety planning before discharge

- Examine siblings (if any) for similar concerns

References: Royal Children's Hospital Melbourne — Clinical Practice Guideline • ACEM clinical policies and statements • RACP NAI guidelines • State child protection legislation

Question 20 | Congenital Diaphragmatic Hernia (9 marks)

A term male neonate is brought to your emergency department by his parents 2 hours after a precipitate home delivery. The pregnancy was unmonitored. He has increasing respiratory distress with grunting and central cyanosis. On examination he has a scaphoid abdomen, decreased breath sounds on the left chest, displaced apex beat to the right, with audible bowel sounds in the left chest. Vital signs: heart rate 180 beats per minute, blood pressure 65 millimetres of mercury systolic, peripheral oxygen saturation 75 percent on bag-valve-mask ventilation.

a) State the diagnosis AND list 3 supportive examination features. (3 marks)

- **Congenital diaphragmatic hernia** (typically left-sided posterolateral Bochdalek defect; abdominal contents herniate into thoracic cavity) **[core]**
- **Scaphoid (sunken) abdomen** — abdominal contents are in the chest **[core]**
- **Decreased breath sounds with bowel sounds in chest** on the affected side; mediastinal shift away from the side of hernia **[core]**
- Severe respiratory distress and cyanosis (persistent pulmonary hypertension and pulmonary hypoplasia)
- Apex beat displaced contralaterally

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

- **Immediate intubation and gentle ventilation** — AVOID bag-mask ventilation (distends bowel in chest, worsens compression); rapid sequence induction with neuroprotective principles **[core]**
- **Nasogastric tube on free drainage** — decompresses herniated bowel and stomach **[core]**
- **Positioning** — affected side down (left-side-down for left CDH) to allow non-affected lung expansion; high-frequency ventilation if available; gentle ventilation strategy with low peak inspiratory pressure (avoid barotrauma — pulmonary hypoplasia) **[core]**
- Treat persistent pulmonary hypertension — inhaled nitric oxide, sildenafil; optimise pre-ductal saturation 88-95 percent
- Urgent transfer to tertiary paediatric surgical centre with NICU and ECMO capability

c) State 3 prognostic factors. (3 marks)

- **Antenatal diagnosis (ultrasound) with lung-to-head ratio** — predicts outcome; <1.0 indicates poorer prognosis **[core]**
- **Side of defect** — left-sided more common (~85 percent); right-sided typically associated with liver herniation and worse outcomes **[core]**
- **Pulmonary hypoplasia severity** (measured by oxygenation index post-stabilisation); lung volumes on imaging **[core]**
- Need for ECMO support
- Associated congenital anomalies (chromosomal, cardiac)
- Mortality typically 30-50 percent in severe cases

References: Royal Children's Hospital Melbourne — Clinical Practice Guideline • eTG (Therapeutic Guidelines, current) • ANZCOR Guideline 13 — Neonatal Life Support (current) • Australian and New Zealand Neonatal Network standards • Tintinalli's Emergency Medicine 9e Ch 109