



COLLEGE OF INTENSIVE CARE MEDICINE OF AUSTRALIA AND NEW ZEALAND

SECOND PART PAEDIATRIC EXAMINATION REPORT

AUGUST / NOVEMBER 2016

This report is prepared to provide candidates, tutors and their Supervisors of Training with information about the way in which the examiners assessed the performance of candidates in the Examination. Candidates should discuss the report with their tutors so that they may prepare appropriately for future examinations.

The Examination included two 2.5 hour written papers, each composed of 15 ten-minute short answer questions. Candidates were required to score at least 50% in the written paper to be eligible to sit the oral component of the Examination. The oral component comprised 8 interactive vivas and two clinical hot cases.

The tables below provide an overall summary, as well as information regarding performance in the individual sections. A comparison with the previous four examinations is also provided.

The written section of the Examination was held in Auckland, Brisbane, Melbourne and Sydney. The clinical section of the examination was held in Melbourne at the Royal Children's Hospital, and the vivas were held at the Etihad Stadium.

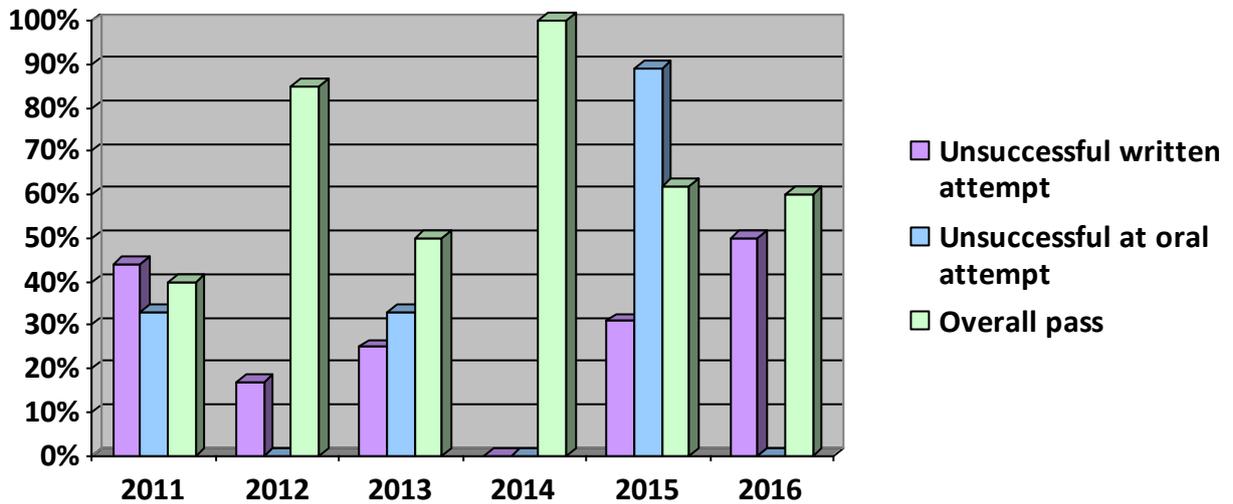
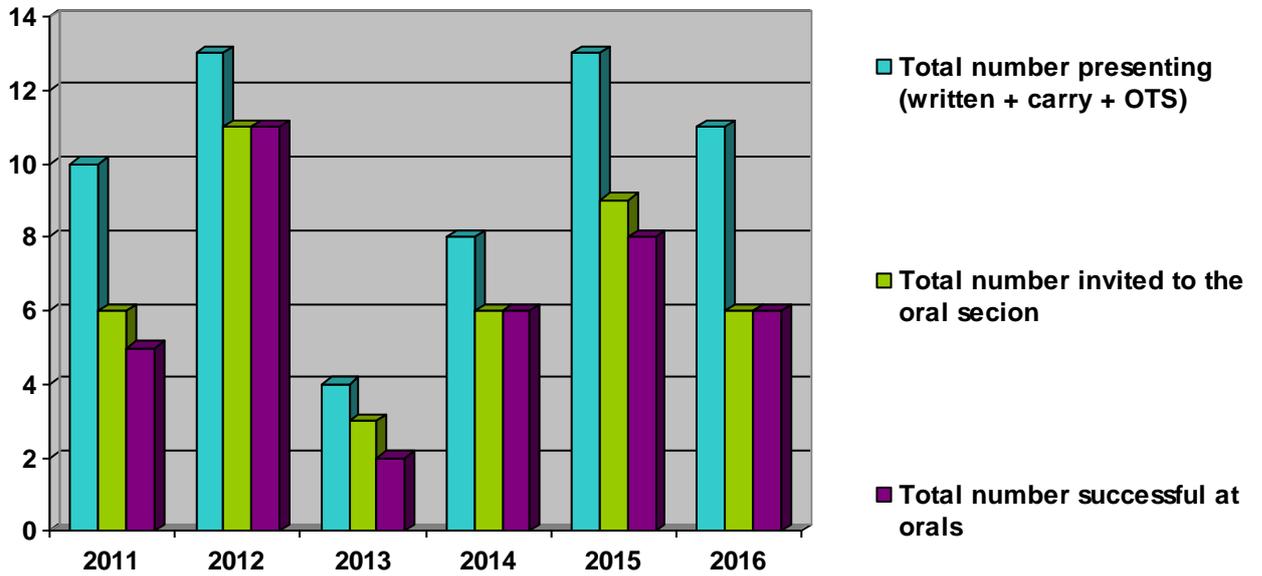
STATISTICAL REPORT

Overall pass rates	2011	2012	2013	2014	2015	2016
Total number presenting (written + carry + OTS)	10	13	4	8	13	11
Total number invited to the oral section	6	11	3	6	9	6
Total number successful at orals	5	11	2	6	8	6
	83%	100%	67%	100%	89%	100%
Overall pass rate	5/10	11/13	2/4	6/8	2/4	6/11
	50%	85%	50%	75%	62%	55%

Clinical Pass Rates	2011		2012		2013		2014		2015		2016	
	Pass rate	Highest individual mark										
Hot Case 1	83%	90%	100%	83%	67%	63%	83%	90%	78%	80%	100%	80%
Hot Case 2	50%	67%	100%	87%	67%	67%	83%	80%	56%	85%	100%	95%
Total number successful in the Hot Case section	5/6		11/11		2/3		5/6		8/9		6/6	
Overall Hot Case pass rate	83%		100%		67%		83%		89%		100%	

Vivas Pass Rates	2011		2012		2013		2014		2015		2016	
	Pass rate	Highest individual mark										
Viva 1	83%	75%	100%	90%	67%	63%	100%	80%	44%	60%	67%	80%
Viva 2	100%	68%	82%	80%	100%	70%	67%	88%	44%	70%	100%	85%
Viva 3	100%	95%	82%	80%	33%	70%	100%	85%	33%	85%	0%	49%
Viva 4	33%	65%	100%	90%	67%	85%	50%	54%	67%	83%	67%	90%
Viva 5	33%	88%	82%	100%	100%	85%	67%	70%	67%	80%	100%	88%
Viva 6	67%	72%	91%	90%	33%	68%	83%	73%	89%	80%	100%	83%
Viva 7	17%	50%	100%	90%	33%	80%	100%	90%	89%	95%	83%	80%
Viva 8	33%	80%	64%	63%	67%	53%	100%	85%	100%	95%	83%	95%
Total number successful in the Viva section	5/6		11/11		2/3		6/6		8/9		6/6	
Overall Viva pass rate	83%		100%		67%		100%		89%		100%	

Overall Performance



EXAMINERS' COMMENTS

Written Paper

Ten of the thirty short answer questions had a pass rate of less than 50%. Topics covered by questions with a pass rate of less than 30% related to resistant infectious organisms, family-centred care, post-operative arrhythmia, thyroid hormone treatment after cardiac surgery, respiratory failure following haematopoietic stem cell transplant and statistical comparison of two methods of measurement.

The most common reasons for candidates to fail questions were:

- Insufficient knowledge of the topic
- Insufficient detail or incomplete answer
- Failure to answer the question asked
- Answer not at consultant level

It is crucially important to write legibly; examiners need to be able to read written answers.

Candidates are reminded to read the questions carefully and thoroughly and to include in their answer only information that is relevant to the question. The allocation of marks in multipart questions is shown to allow candidates to organise their answers appropriately. The glossary of terms is provided to help candidates to understand the type of information and structure required in the answer.

Hot Cases

Hot cases run for twenty minutes, with an additional two minutes at the start of each case for the candidate to read a written introduction. The written introduction is to allow candidates greater opportunity to plan a focused approach to the case.

The following comments are a guide to the expected standard for performance in the hot cases:

- Candidates should address and answer the question asked in the introduction.
- Candidates should interpret and synthesise information, rather than just describing the clinical findings.
- Candidates need to seek information relevant to the case in question.
- Candidates should be able to provide a sensible differential diagnosis and appropriate management plan. A definitive diagnosis is not always expected, and in some cases may yet to be determined.
- Candidates should not rely on a template answer or key phrases, but answer questions in the specific context of the case in question.
- Candidates must be able to describe, with justification, their own practice for specific management issues.

Candidates who performed well in the hot cases were able to demonstrate the following:

- A professional approach, showing respect and consideration for the patient and family.
- Competent, efficient and structured examination technique and an ability to appropriately adapt the examination to suit the case.
- Pursuit of information relevant to the case.
- An ability to interpret and synthesise their findings appropriately.
- Presentation of conclusions in a concise, targeted and systematic fashion.
- Listing of a differential diagnosis that is relevant to the clinical case.
- Discussion of management issues in a mature fashion, displaying confident and competent decision-making.
- Overall performance at the expected level (competent senior registrar / junior consultant).

Candidates who did not perform at the acceptable standard did so for the following reasons:

- Missing or misinterpreting key clinical signs on examination.
- Asking a large number of questions at the start of the case, many of which were not relevant or necessary.
- Incomplete or poor technique for examination of a system.
- Poor synthesis of findings with limited differential diagnosis.
- Poor interpretation of imaging and data.
- Inability to construct an appropriate management plan for the case in question.
- Limited time for discussion as a consequence of taking too long to present the clinical findings or to interpret basic data.
- Inability to convey the impression that he/she could safely take charge of the unit.

Some candidates were able to elicit and describe the clinical signs and data, but were unable to synthesise all the information and to formulate an appropriate management plan.

The overall pass rate was comparable to previous examinations. Comments noted by the examiners when candidates failed cases included:

- Too slow with initial assessment.
- Spent too long at bedside.
- Missed clinical signs / important abnormalities.
- Unfocussed / hesitant examination.
- Lack of clarity and depth in discussion.

Candidates are advised that they should not sit the Fellowship Examination until they can confidently examine patients, present the relevant clinical findings and discuss management issues at the appropriate level (senior fellow/junior consultant). This aspect of the examination requires specific and frequent practice.

Vivas

Candidates should be able to demonstrate a systematic approach to the assessment and management of commonly encountered clinical problems. Candidates should also be prepared to provide a reasonable strategy for management of conditions that they may not be familiar with.

WRITTEN EXAMINATION REPORT

Instructions to Candidates

- a) Write your answers in the blue books provided.
- b) Start each answer on a new page and indicate the question number. It is not necessary to rewrite the question in your answer book.
- c) You should aim to answer each question in ten minutes.
- d) The questions are worth equal marks.
- e) Record your candidate number and each question number on the cover of each book and hand in all books.

Glossary of Terms

Critically evaluate:	Evaluate the evidence available to support the hypothesis.
Outline:	Provide a summary of the important points.
List:	Provide a list.
Compare and contrast:	Provide a description of similarities and differences (E.g. Table form).
Management:	Generic term that implies overall plan. Where appropriate, may include diagnosis as well as treatment.
Discuss:	Explain the underlying key principles. Where appropriate, this may include controversies and/or pros and cons.

Notes

Where laboratory values are provided, abnormal values are marked with an asterisk (*).

Images from the SAQ papers are not shown in this report.

Question 1

A 9-month-old infant with respiratory syncytial virus (RSV) positive bronchiolitis, who was initially stable on high flow nasal cannula oxygen at a peripheral hospital, has deteriorated following intubation for transport.

Observations in transit are as follows:

SpO₂ 84% in FiO₂ 1.0
Heart rate 180 beats/min
Blood pressure 89/45 mmHg

On arrival in PICU the patient is being hand-bagged by the transport fellow, with a 3.5 mm cuffed endotracheal tube in situ. End-tidal CO₂ is 80 mmHg.

Chest X-ray on arrival is shown below:

(Image removed.)

Arterial blood gas results on arrival are shown below:

Parameter	Patient Value	Normal Range
pH	6.92*	7.34 – 7.43
PCO ₂	142 mmHg (18.9 kPa)*	31 – 42 (4.1 – 5.6)
PO ₂	127 mmHg (16.9 kPa)*	80 – 105 (10.7 – 14)
Bicarbonate	29 mmol/L*	20 – 26
Base Excess	- 7 mmol/L*	5 – 5
Haemoglobin	122 g/L	105 – 135
Oxygen saturation	95.3%	
Sodium	142 mmol/L	135 – 145
Potassium	4.8 mmol/L	3.5 – 5.0
Ionised Calcium	1.31 mmol/L*	1.19 – 1.29
Chloride	109 mmol/L	98 – 110
Glucose	8.0 mmol/L*	3.6 – 5.4
Lactate	0.4 mmol/L*	1.0 – 1.8

Outline your management of this situation.

Comments

30% of patients passed this question.

The reproduction quality of the Chest X-ray image was less than ideal. This was reflected in the marking, with no candidate being penalized for erroneous interpretation of the image.

The question required candidates to recognize a problem with differential inflation of the lungs of an intubated patient and inadequate CO₂ removal in the face of adequate oxygenation. The response to this involved ensuring that the patient was safe (access, sedation) and an approach to ventilation that would reinflate the bad lung, while protecting the overinflated lung. A discussion of the use of mucolytics, suction and bronchoscopy was expected, as was a plan for escalation of support in the face of further deterioration.

Question 2

Discuss delirium in Paediatric ICU, including the following:

- a) Definition
- b) Incidence
- c) Clinical features
- d) Assessment
- e) Management strategy

Comments

80% of candidates passed this question.

This was a fairly predictable question addressing a hot topic in PICU, and major features to be covered were supplied in the question. Many candidates did well, but there were some answers that belied an ignorance of the nature of the problem and how to assess and treat it. The management strategy part was poorly answered, with several candidates ignoring non-pharmacological methods of treatment completely.

Question 3

- a) What is *extended spectrum beta lactamase* (ESBL)? (30% marks)
- b) How does an organism gain the capacity to produce ESBL? (10% marks)
- c) Which organisms are likely to produce ESBL in ICU? (20% marks)
- d) What infection control precautions should be taken for a patient with ESBL? (20% marks)
- e) Justify your antibiotic choice for ESBL bacteraemia in a PICU patient. (20% marks)

Comments

20% of candidates passed this question.

This question was designed to test the knowledge underlying the candidate's responses to a specific type of resistant organism. Many candidates did not describe the nature and effects of ESBL, the types of organisms that may acquire the capacity to produce the enzyme and how to treat it. Overall, there was a disappointing lack of knowledge about an important clinical problem.

Question 4

In table form, compare and contrast the following aspects of management of diastolic and systolic cardiac failure: preload, contractility, vascular tone, heart rate, rhythm, cardiopulmonary interactions and drug therapy.

Comments

60% of candidates passed this question.

The table format is used to isolate specific pieces of information that are expected from the candidate; it is important to produce a table-based answer when asked to do so. Most candidates gave a list of suggestions for drug therapies for these heart failure types, but knowledge of manipulation of heart rate, vascular tone and cardiopulmonary interactions was not manifest.

Question 5

A 3-year-old boy, 100 days following a bone marrow transplant for Hunter syndrome (mucopolysaccharidosis II), is admitted with worsening respiratory failure. He has engrafted, but is still requiring platelet transfusions once a week. He is receiving broad and appropriate antimicrobials and antirejection therapy. Pulse oximetry is 89% on mask BIPAP (20/8) in FiO_2 0.9. He has been deteriorating steadily over the last 6 hours and you have decided to intubate him. Previous intubations (last 6 months ago) were described as difficult, with a grade 3 – 4 view.

- a) Outline your approach to intubation. (40% marks)

Following intubation he is placed on pressure-controlled ventilation:

Peak pressure 30 mmHg; PEEP 10 mmHg
Rate 30 breaths/min
Inspiratory time 1.1 sec
 FiO_2 0.9

Oxygen saturation is 90%

A chest X-ray is taken and is shown below:

(Image removed.)

- b) Describe the important features on the X-ray. (20% marks)

Despite high frequency oscillatory ventilation, a FiO_2 of 1.0 and inhaled nitric oxide, the patient continues to deteriorate, with hypoxaemia and hypercarbia.

- c) Is this patient a candidate for extracorporeal membrane oxygenation (ECMO)? Justify your answer. (40% marks)

Comments

60% of candidates passed this question.

The expected response here was a detailed description of an approach to a difficult intubation in a critically unwell patient, with appropriate back-up plans. This part was done quite well by most candidates. Part C required consideration of whether or not ECMO should be offered to such a patient, and an ideal answer would have discussed the potential risks and benefits in this specific case. This was poorly handled by many, with opinion or institutional practice being offered as justification for the decision.

Question 6

What are the key principles of family-centered care?

Discuss how these can be incorporated into PICU practice.

Comments

20% of candidates passed this question.

This required candidates to articulate what family-centered care actually means in a PICU environment. A good answer would have included listening, communicating and collaborating with patients and families, ensuring flexibility of healthcare practice and adequate family support, with examples of how this can be done in PICU. Many candidates struggled to articulate anything more meaningful than family meetings and social work involvement.

Reference

*Meert, *Pediatr Clin North Am* 2013;60(3):761-772*

Question 7

A 15-year-old girl, weighing 70 kg, is brought to the emergency department because of drowsiness over the last 12 hours. She has a 1-month history of increasing headaches (occasionally waking her from sleep), nausea, vomiting and visual symptoms.

On arrival, she is drowsy, with a Glasgow Coma Score of 12/15 (E3, V4, M5). Routine observations are as follows:

Blood pressure 200/110 mmHg
Heart rate 82 beats/min
Respiratory rate 16 breaths/min

Her initial biochemistry is shown below:

Parameter	Patient Value	Normal Range
Sodium	135 mmol/L	135 – 145
Potassium	3.5 mmol/L	3.4 – 4.5
Glucose	6 mmol/L*	3.6 – 5.4
Urea	6.6 mmol/L*	2.1 – 6.5
Creatinine	106 µmol/L*	30 – 80

You are asked to advise on initial management and to admit her to PICU for further treatment.

- a) What preliminary investigations will you order? (20% marks)
- b) What is your differential diagnosis? (20% marks)
- c) Describe the principles of initial blood pressure management. (20% marks)
- d) In table form, compare and contrast the following features of intravenous sodium nitroprusside, esmolol and hydralazine: dose, onset, and half-life. (40% marks)

Comments

40% of candidates passed this question.

Candidates needed to demonstrate knowledge of the wide variety of pathologies that might present with hypertension in an adolescent female, recognize the urgency and describe treatment of a hypertensive emergency. There was a disappointingly narrow consideration of differential diagnoses, with consequently limited investigation suggested.

Reference

*www.uptodate.com
Hypertensive emergencies and urgencies in children.*

Question 8

A 3-month-old boy is admitted to PICU following uncomplicated repair of an atrioventricular septal defect (AVSD). Six hours after admission, he has been tachycardic for the last 30 minutes. He is afebrile and is receiving dobutamine 5mcg/kg/minute by infusion. His blood pressure is 62/36 mmHg, and his right atrial pressure is 10 mmHg. His arterial lactate is 2.9 mmol/l (reference range < 2 mmol/L) and central venous saturation is 63%.

The atrial electrocardiogram (Figure 1), shown on page 8, is taken (atrial pacing wires attached to left and right upper limb ECG leads).

- a) What rhythm is shown? (10% marks)
- b) What is the mechanism of this tachycardia? (10% marks)
- c) Describe in detail two specific non-pharmacologic options to terminate this tachycardia. (80% marks)

(Image removed.)

Comments

10% of candidates passed this question.

Candidates were expected to recognise atrial flutter and to describe rapid atrial pacing and cardioversion. Almost all candidates incorrectly interpreted the atrial ECG as junctional ectopic tachycardia.

Question 9

A 14-year-old girl is admitted to PICU 5 days following a bone marrow transplant for transfusion-dependent beta thalassemia. She is conscious but hypotensive, with fever and back pain. Routine echocardiogram prior to her transplant showed a moderate pericardial effusion.

The following laboratory results are obtained:

Parameter	Patient Value	Normal Range
Haemoglobin	78 g/L*	115 – 155
Platelet count	< 10 x10 ⁹ /L*	150 – 400
White Cell Count	< 0.10 x10 ⁹ /L *	4.00 – 11.00
Activated partial thromboplastin time	44 sec*	25 – 37
International normalised ratio	1.3*	0.8 – 1.2
Fibrinogen	5.2 g/L*	1.5 – 4.0
pH	7.43	7.36 – 7.44
PCO ₂	37.5 mmHg (5.0 kPa)	35.0 – 45.0 (4.6 – 6.0)
PO ₂	41 mmHg (5.5 kPa)*	80 – 100 (10.6 – 13.3)
Oxygen saturation	74%*	95 – 100
Lactate	4.0 mmol/L*	0.5 – 2.2
Creatinine	203 µmol/L*	45 – 90
Phosphate	2.64 mmol/L*	0.70 – 1.50
Magnesium	0.75 mmol/L	0.70 – 1.00
Albumin	19 g/L*	32 – 48

- a) Summarise the abnormalities in the laboratory results. (10% marks)
- b) In table form, list potential causes for this girl's clinical presentation with investigations and management for each cause. (90% marks)

Comments

80% of candidates passed this question.

Candidates were expected to suggest plausible causes for this clinical scenario, with a list of investigations and treatment to address each. Marking was weighted towards likely causes, such as neutropaenic sepsis, typhlitis, intra-abdominal bleed or enlarging pericardial effusion.

Question 10

Critically evaluate the use of thyroid hormone replacement therapy following neonatal and Paediatric cardiac surgery.

Comments

10% of candidates passed this question.

Few candidates were able to answer this question with anything more than very basic knowledge and a statement of institutional practice. There were few attempts to describe the rationale for T3 use following cardiac surgery, and very limited knowledge of the small body of literature that does exist.

References

*Mackie AS, et al, JTCVS 2005; 130(3): 810–816
Plumpton KR, et al, Intensive Care Medicine, 2010.
Portman MA, et al Circulation. 2010; 122[suppl 1]:S224–S233*

Question 11

In table form, compare and contrast the following characteristics of frusemide, acetazolamide, and spironolactone: indications, mechanism of action, dose, metabolism and adverse effects.

Comments

50% of candidates passed this question.

This was a simple question about a frequently used category of drugs in PICU. Answers varied widely in detail and accuracy, with some scoring highly. However, there were some disappointing answers, which did not convey a good knowledge of mechanisms of action, metabolism or adverse effects of Frusemide and Spironolactone, the two most commonly used of the drugs listed.

Question 12

Briefly outline the physiologic rationale underlying, and the evidence to support, the use of glucocorticoid steroid therapy in PICU management of the following conditions:

- a) Refractory hypotension (25% marks)
- b) Support of the brain dead potential organ donor (25% marks)
- c) Post-extubation stridor (25% marks)
- d) Acute respiratory distress syndrome (ARDS) requiring ongoing ventilation at 10 days (25% marks)

Comments

80% of candidates passed this question.

Candidates who scored well here gave good descriptions of the physiology of each condition and conveyed some knowledge of the current understanding of how useful steroids might be in each condition and in different patient groups. Candidates were not penalised for being unable to cite individual studies in each case.

References

*Dupuis Br. J. Anaesth. (2014) 113 (3): 346-359.
Corticosteroids for the prevention and treatment of post-extubation stridor in neonates, children and adults. Cochrane Database of Systematic Reviews 2009.*

Steinberg *N Engl J Med.* 2006;354(16):1671.

Corticosteroids for treating hypotension in preterm infants *Cochrane Database of Systematic Reviews* 2011.

Pinsard *Critical Care* 2014; 18:R158.

Question 13

A 4-year-old boy is referred for admission to PICU. He has been brought to the emergency department by his maternal grandmother, who is concerned that he may have taken some of his stepfather's drugs (reported as "ecstasy"). This happened at home approximately 2 hours ago.

He is hallucinating, has a temperature of 39.5°C, a heart rate of 170 beats/min and a blood pressure of 160/80 mmHg.

Discuss your immediate management.

Comments

60% of candidates passed this question.

Candidates were expected to know the signs and symptoms of MDMA intoxication, anticipating problems such as seizures, hypertension and rhabdomyolysis, while describing acute management of the case described, where the drug(s) and dose involved are unknown. Basic acute overdose management was expected, with discussion of specific therapies for MDMA and appropriate involvement of other agencies.

Question 14

Discuss the key features to be addressed when appraising the validity of a systematic review with meta-analysis of randomised, controlled trials.

Comments

20% of candidates passed this question.

The ability to read and appraise meta-analyses is an important one, and this topic has been examined before. This question specifically asked about appraising the validity of such a paper, requiring an understanding of the methodology of meta-analyses, rather than simple interpretation of results. Answers here were generally disappointing. Candidates were expected to address search strategy, study selection, study quality assessment, reporting of results, heterogeneity and publication bias.

Question 15

- a) Define acute respiratory distress syndrome (ARDS) in children. (20% marks)
- b) Discuss the principles of respiratory support in children with ARDS. (80% marks)

Comments

90% of Candidates passed this question.

This straightforward question was generally well answered. Clear knowledge of a current ARDS definition was necessary for full marks in the first part. The second part of the question should have elicited brief discussion of mechanical ventilation in ARDS, including management of PEEP, tidal volume, oxygenation, CO₂ and ventilator mode, as well as other supports (iNO, ECMO, prone positioning).

Question 16

A three-month-old infant is admitted to your unit following repair of tetralogy of Fallot. Operative findings included a hypertrophic right ventricle, and dysplastic and stenotic pulmonary valve. Surgical repair consisted of: patch closure of the VSD (via a ventriculotomy), infundibular muscle resection, pulmonary valvotomy and transannular patch augmentation of the right ventricular outflow tract. Atrial and ventricular pacing wires, a mediastinal and intercostal drain, and arterial line and triple-lumen central line are in situ.

Six hours following admission, the patient is cool and pale peripherally. The liver edge is palpable 4 cm below the right costal margin, and his abdomen is distended. The heart rate is 195 beats/min, with a narrow QRS complex. P-waves are not discernible on the monitor ECG. Central venous pressure is 14 mmHg and arterial blood pressure is 55/39 (45) mmHg.

Ventilator settings are as follows:

Pressure-regulated/volume-controlled mode
Peak inspiratory pressure 20 cmH₂O
PEEP 6 cmH₂O
Respiratory rate 25 breaths/min
FiO₂ 0.5

An arterial blood gas is performed:

Parameter	Patient Value	Normal Range
pH	7.32*	7.34 – 7.43
PaCO ₂	47 mmHg (6.3 kPa)*	32 – 45 (4.3 – 6.0)
PaO ₂	86 mmHg (11.5 kPa)	80 – 100 (10.7 – 13.3)
Bicarbonate	18 mmol/L	18 – 24
Base excess	- 6.2 mmol/L*	- 4.0 – 3.0
Lactate	4.6 mmol/L*	0.7 – 2.0

Current medications include milrinone at 0.5 µg/kg/min, dopamine at 7.5 µg/kg/minute and morphine at 20 µg/kg/hour. There has been no urine from the urinary catheter for the past two hours.

- List four plausible causes for low cardiac output syndrome in this infant. (10% marks)
- Describe how you would confirm or refute your suspicion of junctional ectopic tachycardia (JET). (40% marks)
- You have confirmed JET. Outline your management plan for this infant over the next 12 hours. (50% marks)

Comments

100% of candidates passed this question.

This simple question was well answered.

Question 17

List the features of the ideal paediatric transport ventilator.

For example:

- Ability to provide CPAP/PEEP and a range of inflation pressures
- Adjustable rate and inspiratory time
- Appropriate alarms (disconnection, high pressure, etc.)

Comments

100% of candidates passed this question.

Candidates were expected to articulate features that would make a transport ventilator practical, safe, robust and flexible in application.

Question 18

- a) Name one sedative/analgesic withdrawal scoring tool that is validated in PICU patients. List its components and how it is administered. (20% marks)
- b) What factors make sedative/analgesic drug withdrawal more likely? (30% marks)
- c) What are the principles of managing drug withdrawal? (50% marks)

Comments

100% of candidates passed this question.

Many candidates betrayed a lack of familiarity with what tools such as the WAT-1 actually measured and how it was administered. The remainder of the question was answered better by all candidates.

Question 19

A 12-year-old boy is referred to PICU for management of worsening respiratory failure 14 days following a haematopoietic stem cell transplant.

Outline what you will tell his family about the following:

- a) Your approach to respiratory support
- b) Prognosis

Comments

40% of candidates passed this question.

Candidates are reminded to read the glossary of terms to understand what is expected in an answer. Outline requires more than an undifferentiated or unexplained list. In the first part of this answer, candidates were expected to outline a plan of escalating respiratory support with attendant benefits and problems. The second part of the answer should have described a discussion about prognosis in the context of the underlying disease and therapy, with comments on how progress and complications may influence this.

References

Invasive mechanical ventilation and mortality in pediatric hematopoietic stem cell transplantation: a multicenter study. Rowan, PCCM 2016;17: 294-30.
Epidemiology of Acute Respiratory Distress Syndrome Following Hematopoietic Stem Cell Transplantation. Yadav, Crit Care Med 2016 Jun;44(6):1082-90.

Question 20

Studies comparing two methods of measurement are common in the ICU literature. These are correctly reported using the Bland-Altman plot.

Below is a Bland-Altman plot comparing two methods of measuring mean arterial blood pressure – Arterial line (Art) and a novel method (New).

(Image removed.)

- a) Roughly redraw and label the axes and lines on the graph. (30% marks)
- b) Comment on the pattern displayed on the graph. (20% marks)
- c) What are the important points to consider in deciding whether the novel method may be used clinically? (30% marks)
- d) Why is this a more appropriate method to compare two measurement methods than correlation? (20% marks)

Comments

10% of candidates passed this question.

This is a commonly used method to compare new methods of measurement to a gold standard in the ICU literature. Most candidates were unable to label the graph, comment on it and infer information from it. There was poor understanding of the difference between agreement and correlation.

Question 21

A 7-year-old boy is admitted to PICU following a collapse at school. He has been complaining of nausea, headache and double vision. The transfer doctor describes a fluctuating conscious state with drowsiness – Glasgow Coma Scale 14 (E4 V4 M6).

Several images from his CT brain scan are shown below:

(Images removed.)

- a) Describe the abnormalities identified. (10% mark)
- b) List your differential diagnosis. (10% mark)
- c) Describe the components of an intracerebral pressure monitoring system with cerebrospinal fluid drainage capacity. (40% marks)
- d) Outline the complications of the use of such a device. (40% marks)

Comments

80% of candidates passed this question.

The majority of marks in this question were for demonstrating an understanding the principles and appropriate use of a ventricular drain and pressure monitor. Whilst most candidates did this very well, some candidates omitted important components of the system or failed to describe complications beyond blockage of the drain.

Question 22

Discuss autoregulation of cerebral blood flow and alterations in vascular tone following traumatic brain injury.

Comments

40% of candidates passed this question.

The answer should have described normal cerebral autoregulation, with comments about how this might be changed in traumatic brain injury. Many candidates did not discuss how autoregulation occurs, even in simple terms. A discussion of changes in vascular tone in TBI and how this might be managed was omitted by most candidates.

Reference

O'Brien NF et al. The epidemiology of vasospasm in children with moderate to severe traumatic brain injury. Crit Care Med 2015; 43: 674-85.

Question 23

You are caring for a 6-year-old girl with known oesophageal varices secondary to liver cirrhosis, who has presented with acute haematemesis and hypovolaemic shock. She has been intubated in the Emergency Department, but has ongoing bleeding.

Outline your approach to haemorrhage control in this patient.

Comments

80% of candidates passed this question.

This was a relatively straightforward question, with the expected answer covering resuscitation and transfusion, along with a practical description of pharmacologic, balloon tamponade, and endoscopic and surgical approaches to control of variceal bleeding.

References

Management of Portal Hypertension in Children with Portal Vein Thrombosis. J Pediatr 2013;57(4):419–425.

Rogers Textbook of Pediatric Intensive Care. Chapter 99

Question 24

- a) List the features of presentation with pertussis infection that are associated with poor prognosis. (20% marks)
- b) List the stages of pertussis infection. (10% mark)
- c) What are the most significant virulence factors associated with *Bordetella pertussis*, and what role do they play in the development of disease? (30% marks)
- d) What advantage does maternal vaccination in the last stages of pregnancy confer to neonates? (20% marks)
- e) What is the role of extracorporeal life support (ECLS) in the management of *Bordetella pertussis* pneumonia? (20% marks)

Comments

70% of candidates passed this question.

Candidates who scored well displayed a detailed knowledge of Pertussis toxins and their actions, and a mature and informed approach to the question of ECMO in Pertussis disease.

Question 25

A 6-year-old girl is 7 days post-liver transplantation for biliary atresia. After an initially difficult course requiring 3 days of ventilation and vasopressors, she has recovered and been discharged to the ward on her immunosuppression and analgesic regimen.

On the morning following discharge, she has a generalised tonic/clonic convulsion, terminated with a single dose of intravenous midazolam. Following this, she has a pulse rate of 120 beats/min, blood pressure of 160/100 mmHg, a respiratory rate of 10 breaths/min and shallow respirations. She is unable to protect her airway and is intubated, ventilated and brought to PICU. Her admission biochemistry is unremarkable. Her tacrolimus level 48 hours ago was at the upper level of normal.

A representative image of her MRI brain scan is presented below:

(Images removed.)

- a) What are the significant features in this image? (20% marks)
- b) What is the differential diagnosis, and which is the most likely diagnosis? (30% marks)
- c) List your aims of management over the next 48 hours. (30% marks)
- d) List the important points that you will tell her parents about prognosis. (20% marks)

Comments

60% of candidates passed this question.

Reproduction of the MRI images was poor on the printed paper. No marks were allocated for questionable or subtle changes on MRI.

Candidates who identified posterior reversible encephalopathy syndrome (PRES) as the most likely diagnosis scored well in this question. Good answers described a rational approach to supportive management and modification of cytotoxic drugs, with an understanding of the natural history of PRES.

References

*Bartynski, W, American Journal of Neuroradiology 2008 29 1036-1042.
Raj, S., Overby, P., Erdfara, A., Pediatric Neurology 2013 49(5) 335-339.*

Question 26

- a) Outline the pathophysiology of pulmonary hypertension in neonates. (50% marks)
- b) Outline medical management of such patients. (50% marks)

Comments

50% of candidates passed this question.

Many candidates wrote only about the transitional circulation in the newborn, rather than pulmonary hypertension. A description of causes and mechanisms of pulmonary hypertension was expected in the first part of the answer. The section on management was better dealt with, and a rational approach to diagnosis and clinical management was generally provided. However, some candidates did not discuss important aspects of treatment, for example management of the ductus arteriosus or pharmacological options beyond inhaled nitric oxide.

Question 27

A two-year-old child is admitted to PICU following an uncomplicated fenestrated Fontan procedure. She is extubated two hours after return from theatre, but rapidly develops a marked increase in work of breathing with saturations in the low 60s.

- a) List likely causes for this girl's desaturation. (20% marks)
- b) Outline your immediate management plan. (30% marks)
- c) Briefly outline the haemodynamic advantages and disadvantages of early extubation following cavopulmonary shunts. (30% marks)
- d) List risk factors for prolonged pleural effusions after the Fontan procedure. (20% marks)

Comments

70% of candidates passed this question.

Many candidates offered a limited list of potential causes, often omitting respiratory reasons for systemic desaturation. The question asked for an outline of a management plan and not just a list of therapies. Answers to the latter parts of the question were better organized.

Question 28

You are asked to consult on a 3-day-old patient in the neonatal ICU with a diagnosis of refractory sepsis. He is 36 weeks gestation, weighs 3 kg and was born by normal vaginal delivery. He received vitamin K after birth. He has shock and coagulopathy. He is easy to ventilate on 30% oxygen. He is on 1.4 µg/kg/min noradrenaline and 1.8 µg/kg/min adrenaline, via a peripherally-inserted central venous catheter, to maintain his mean blood pressure > 40 mmHg. An echocardiogram shows a structurally normal heart with good left ventricular function and no shunts. The neonatologists are considering gestational alloimmune liver disease (GALD, previously neonatal haemochromatosis) as the diagnosis.

Laboratory values are shown below:

Parameter	Patient Value	Normal Range
pH	7.29*	7.32 – 7.46
CO ₂	32 mmHg (4.3 kPa)	27 – 40 (3.6 – 5.3)
O ₂	88 mmHg (11.7 kPa)	80 – 90 (10.7 – 12.0)
Bicarbonate	14.9 mmol/L*	18 – 26
Sodium	124 mmol/L*	131 – 143
Potassium	4.8 mmol/L	3.2 – 6.0
Chloride	94 mmol/L*	101 – 112
Lactate	5.1 mmol/L*	0 – 3
Glucose	2.8 mmol/L*	3.6 – 7.0
Creatinine	236 µmol/L*	27 – 78
Urea	7.4 mmol/L*	1.0 – 6.0
Alanine aminotransferase	17 U/L	0 – 35
γ-Glutamyl transferase	5 U/L	0 – 140
Lactate dehydrogenase	412 U/L	125 – 765
Alkaline phosphatase	113 U/L	100 – 400
C-reactive protein	1 mg/L	0 – 5
Haemoglobin	97 g/L*	168 – 228
White Cell Count	16.3 x 10 ⁹ /L	> 8.0
Neutrophils	10.6 x 10 ⁹ /L	5.1 – 23.2
Platelets	157 x 10 ⁹ /L	150 – 400
International normalised ratio	8.9*	0.8 – 1.5
Activated partial thromboplastin time	69 sec*	27 – 65
Fibrinogen	0.5 g/L	1.5 – 4.0
Ferritin	2527 ng/ml*	10 – 200

- List your differential diagnosis. (25% marks)
- Outline your management plan. (30% marks)
- Outline the pathophysiology of GALD. (20% marks)
- How would you confirm a diagnosis of GALD? (15% marks)
- What would you tell the parents regarding prognosis? (10% marks)

Comments

60% of candidates passed this question.

Several candidates did not know sufficient detail about gestational alloimmune liver disease to pass this question, and the section on pathophysiology was very poorly dealt with.

References

Roumintsev S. Case 20-2015: A Newborn Girl with Hypotension, Coagulopathy, Anemia, and Hyperbilirubinemia. *N Engl J Med* 2015; 372:2542-2553.
 Treatment of Neonatal Hemochromatosis with Exchange Transfusion and Intravenous Immunoglobulin *Journal of Pediatrics* volume 155, Issue 4, October 2009, Pages 566–571.e1.

Question 29

Discuss the important ethical principles and considerations underlying research in children in PICU.

Comments

50% of candidates passed this question.

Candidates were expected to be able to describe the ethical issues facing research in critically ill patients, with a focus on particular considerations in children. Vital parts of an answer included the process and difficulties of consent of a minor, including the right to withdraw consent, and vulnerability of the critically ill child.

References

Informed consent in paediatric critical care research – a South African perspective. Morrow et al. BMC Medical Ethics (2015) 16:62, DOI 10.1186/s12910-015-0052-6.

Question 30

A previously well 6-year-old child is receiving conventional mechanical ventilation for severe pneumonia due to *Staphylococcus aureus* (culture positive from blood and endo-tracheal tube). Chest X-ray shows bilateral extensive airspace opacities, several pneumatoceles, small pleural effusions (< 1cm depth) and no pneumothorax. The circulation is well maintained following 60ml/kg fluid boluses, and a combination of dobutamine 10 µg/kg/min and noradrenaline 0.05 µg/kg/min. An echocardiogram shows good ventricular function.

The ventilator settings are:

Rate	25 breaths/min
PEEP	12 cmH ₂ O
Tidal volume	7 ml/kg
Inspiratory time	1 sec
FiO ₂	0.8

The arterial blood gas reveals:

Parameter	Patient Value	Normal Range
pH	7.09*	7.35 – 7.45
PaCO ₂	77 mmHg (10.27 kPa)*	35 – 45 (4.7 – 6)
PaO ₂	48 mmHg (6.4 kPa)*	80 – 100 (10.7 – 13.3)
Bicarbonate	21 mmol/L	20 – 26
Base Excess	- 2.2	- 5.0 – +5.0
Lactate	1.7 mmol/L	1 – 2
Oxygen saturation	84%	

- List adjustments to his current management (**not** ventilator changes) that may optimize his gas exchange. (20% marks)
- You have decided to use high frequency oscillatory ventilation (HFOV). Describe the settings you would choose, and how you would evaluate the efficacy of each setting over the first 30 minutes. (50% marks)

After 30 minutes on HFOV, an arterial blood gas reveals:

Parameter	Patient Value	Normal Range
pH	6.98	7.35 – 7.45
PaCO ₂	106 mmHg (14.1 kPa)*	35 – 45 (4.7 – 6.0)
PaO ₂	69 mmHg (9.2 kPa)*	80 – 100 (10.7 – 13.3)
Bicarbonate	20 mmol/L	20 – 26
Base Excess	- 2.4	- 5.0 – +5.0
Lactate	1.6 mmol/L	1 – 2
Oxygen saturation	91%	

- c) List ventilation changes and other adjustments to management that may improve CO₂ removal. (30% marks)

Comments

80% of candidates passed this question.

Most candidates answered this question well, supplying the required details about how to manage a patient with respiratory failure on a ventilator, rather than how to manage ventilation. The section on the use of HFOV was answered well.

ORAL SECTION

The Clinical Section

The Clinical Section (2 clinical cases – 20 minutes per case) was conducted in the Paediatric Intensive Care Unit at the Royal Children's Hospital, Melbourne.

Candidates who approach the clinical examination of the patient and presentation of findings in an organized manner will impress the examiners. 30% of the overall marks are allocated to the two clinical cases. Candidates should bear this in mind when preparing for the examination.

This year candidates were given a written introduction to the hot cases which they could study for 2 minutes. This allowed candidates time to think about how best to approach the case, what information to seek and how to structure the examination. These two minutes are in addition to the 20 minutes taken to perform the hot case.

Cases are usually presented as problem solving exercises. For maximum marks, candidates should demonstrate a systematic approach to examination, clinical signs should be demonstrated, and a reasonable discussion regarding their findings should follow.

Some candidates waste valuable time at the start of the case by spending more than a couple of minutes around the bedside before actually examining the patient. Exposing the patient should be limited to those areas that are necessary for that component of the examination. Candidates must show appropriate courtesy and respect to patients and their families if present during the examination.

The twenty minutes available for each case provides ample opportunity to discuss investigations and plans of management. Candidates are reminded that a large proportion of the marks are allocated to coherent presentation and synthesis, discussion and reasoning. Candidates should approach the case discussion in a consultant-like manner.

Cases encountered in the clinical component of the examination included:

- A 3 week old infant on VA ECMO following a cardiac arrest due to coronary ischaemia one week after repair of truncus arteriosus.
- A 15 year old girl still ventilated 2 weeks after multitrauma.
- A 2 week old girl second day post repair of transposition of the great arteries.
- A 13 year old boy with persistently elevated intracranial pressure following a traumatic brain injury.

Viva Section

There are 8 stations of ten minutes each for structured vivas. Two minutes are provided to read an introductory scenario (which includes the initial question) outside each viva room. This same information is also provided inside the viva room.

The following are the introductory scenarios and questions provided to the candidates:

Viva 1

A 1-year-old boy has been transferred to your PICU from another hospital with a provisional diagnosis of sepsis. He was born at 38 weeks and has been fully immunized. He had previously been well, apart from having severe mouth ulcers at the age of 9 months. These lasted 1 week and resolved with topical treatment.

Three weeks ago he developed fever, a macular rash, and lethargy. His parents were also sick with a similar illness, but rapidly recovered. He has been febrile and slightly lethargic since that time, but over the past 2 days has become increasingly febrile and confused.

The patient had a sibling who died at the age of 2 years, after a similar illness. Cause of death was recorded as septic shock. He had been healthy up until that illness.

Findings on Admission:

Weight 10.1 kg. Looks well nourished.
Macular rash over limbs with bullae on feet.
No dysmorphic features.
Vitals Heart Rate 180 beats per minute
Respiratory Rate 62 breaths/minute
Temperature 40°C
Blood Pressure 102/60 mmHg
SpO₂ 99% room air

Cap refill time < 2 seconds
Irritable and drowsy with GCS 13.
Marked hepatosplenomegaly.
Bleeding from nares.

What is your differential diagnosis?

Viva 2

A 1-year-old boy is taken to a small regional hospital by his mother because of irritability and difficulty breathing. The hospital is 2 hours away by fixed wing aircraft.

He has pulmonary atresia, VSD and has previously had a modified Blalock–Taussig (BT) shunt. He is more cyanosed than usual.

At triage his saturations are 45%, respiratory rate 38 breaths/minute, with mild to moderate recession, and a heart rate of 120 beats/minute.

The triage nurse can hear a murmur and places him in 10 L/minute face mask oxygen.

What is your provisional and differential diagnosis?

Viva 3

The Emergency Department (ED) has asked you to accept a patient for PICU admission.

She is a 15-year-old girl who had a self-resolving syncopal episode at school and was brought in by ambulance. Her mother reports she has been receiving care from a private psychiatric clinic for a diagnosis of anorexia nervosa for the past 8 months. She reported feeling dizzy in class, fell to the floor (wooden floor), and regained consciousness within minutes. When the ambulance arrived her GCS was 15.

Her vital signs and examination in the ED are:

Heart Rate: 44 beats/minute

Regular Rate: appears to be sinus rhythm on monitor
 Blood Pressure: 78/50 mmHg
 Peripheral pulses: palpable and normal strength.
 Central Capillary refill: 3 seconds. Hands and feet cool.
 Respiratory Rate: 12 breaths/minute
 No respiratory distress
 Chest clear on auscultation
 Pulse oximetry: 99% in room air
 Mucous membranes moist, not dry clinically.
 Temperature: 34.9°C (tympanic membrane)
 Glasgow Coma Scale: 15
 Neurological examination including pupil reactions is normal.

Apart from a 4 cm bruise on her left anterior forehead, she has no external signs of trauma head or signs of trauma elsewhere. Abdominal examination is normal. Her weight is 28 kg, height is 152 cm, BMI (Body Mass Index) is 12.1.

A non-contrast head CT scan was performed in the ED and was normal.

An arterial blood gas was performed in the ED as follows:

pH	↑	7.54		[7.350 – 7.450]			
pCO ₂		49	mmHg	[32.0 – 48.0]	6.5	kPa	[4.7 – 6.0]
pO ₂		102	mmHg	[83.0 – 108]	13.6	kPa	[10.6 – 13.3]
Base(B)c	↑	11.3	mmol/L				
HCO ₃ ⁻	↑	44.5	mmol/L				
Hb		116	g/L				
sO ₂		99.8	%	[94.0 – 100]			
Na ⁺	↓	129	mmol/L	[135 – 145]			
K ⁺	↓	1.9	mmol/L	[3.5 – 4.5]			
Cl ⁻	↓	81	mmol/L	[97 – 108]			
Ca ²⁺	↓	1.01	mmol/L	[1.15 – 1.32]			
Anion Gap		2.0	mmol/L				
Glucose		3.2	mmol/L				
Lactate		1.9	mmol/L	[0.5 – 2.2]			
Creatinine		26	μmol/L				
Bilirubin		42	μmol/L				

You have agreed to admit her to PICU.

Please interpret this blood gas and suggest likely reasons for any abnormalities.

Viva 4

You are called to assess the 5 year old girl (pictured below) who has a 3 day history of headache, periorbital swelling and fever following a minor wound to her nasal bridge. She has been treated on the ward for three days with intravenous flucloxacillin but has progressive swelling of both eyes. She is now unrouseable but maintaining her own airway.

(Image removed.)

What are your immediate concerns?

Viva 5

A 14-year-old boy has been struck by a car.

On arrival in your Emergency Department, the patient is complaining of difficulty breathing, and pain in his left leg, pelvis and abdomen. Primary survey reveals a patent airway; moderate tachypnoea with some chest abrasions but no obvious flail segment; heart rate 155 beats/minute, blood pressure 75/30 mmHg, abdominal distension and tenderness, pelvic tenderness, left thigh deformity; GCS 13, pupils equal and reactive. The trauma team identifies hypovolemic shock with moderate respiratory distress.

Initial management involved placing 2 large bore peripheral intravenous cannulae in the upper limb and giving 20 mls/kg of saline while activating your massive transfusion protocol. He has now received 2 units of packed red cells, 2 units FFP, and 2 units platelets. His left leg is placed in a splint. His pelvis is strapped.

In anticipation of the need for resuscitative surgery and CT scans, the patient is now intubated and ventilated.

His vital signs are:

Temperature 35°C
Heart rate 140 beats/minute
Mean arterial pressure 55 mmHg

Ventilating pressures 26/8 cm H₂O
Tidal volume 8 mls/kg
Respiratory rate 20 breaths/minute
FiO₂ 0.5

He is transported to radiology for CT scans. Theatre is being prepared to receive him from the scanner.

What are your concerns?

Viva 6 – Procedure viva

A 3-month-old girl has undergone a slide tracheoplasty for tracheal stenosis three days ago. Over the last 4 hours, mechanical ventilation has become more difficult, with a rising PaCO₂ and falling PaO₂ on conventional ventilation prompting a change to high frequency oscillatory ventilation.

In this viva, you will be asked to manage this situation, with an emphasis on equipment and technical aspects of care.

Viva 7 – Radiology Viva

Candidates were shown and asked to comment on a series of plain X-ray and CT images from unrelated cases, including a mediastinal mass, bronchiolitis, hypoxic ischaemic brain injury, extradural haematoma and dilated cardiomyopathy.

Viva 8 – Communication Viva

Mohammed is a 3-year-old boy admitted to your unit 3 days ago following an immersion in the family's backyard swimming pool. They were having the house renovated and the safety gate was propped open.

Mohammed was apnoeic and asystolic when the ambulance arrived, and return of spontaneous circulation only occurred in your hospital's Emergency Department after a total of approximately 40 minutes of CPR. The initial arterial pH was 6.8.

You took over 'first call' for the Department earlier this morning and have had clinical handover from your Intensivist colleague. They have already performed a set of brain death tests that were consistent with a diagnosis of brain death. You have just confirmed a clinical diagnosis of brain death.

You are now going to meet the child's parents to inform them of the results of your examination and what this means for their child.