



# COLLEGE OF INTENSIVE CARE MEDICINE OF AUSTRALIA AND NEW ZEALAND

## REPORT OF THE INTENSIVE CARE FIRST PART EXAMINATION

**MARCH / MAY 2019**

This report is prepared to provide candidates, tutors and their supervisors of training with information about the examination. Answers provided are not model answers but our guide as to what was expected.

Candidates should read and then discuss the report with their tutors to prepare appropriately for future examinations.

The exam included two 2.5 hour written papers, each comprised of ten short answer questions and fifty multi-choice questions. Candidates were required to perform at a satisfactory level in the written before being eligible to present for the oral part of the exam. The oral was comprised of eight ten-minute viva stations.

### **OVERALL STATISTICS**

Total number of candidates presenting for the written examination:	63
Number of candidates scoring > 50% in the written:	38
Number of candidates scoring 45 – 50% in the written:	2
Number of candidates carrying a written score:	1
Total number invited to the oral section based on written marks:	41
Total number of candidates successful at the CICM First Part Exam:	40

### **SUCCESSFUL CANDIDATES**

Dr Hesham Abdelwahed	Dr Lisa Mcdaid
Dr Rachel Baran	Dr Steve Mcelroy
Dr Sean Blackall	Dr Jonathan Messing
Dr Damian Bruce-Hickman	Dr Rashmi Mohan
Dr Laura Chudleigh	Dr Julia Moore
Dr Mark Collins	Dr Laura Noble
Dr Jessica Dean	Dr James Pearlman
Dr Eamonn Deverall	Dr Grace Pearson
Dr Neil Glassford	Dr Thomas Prichard
Dr Linda Guo	Dr Edmund Rose
Dr James Haslam	Dr Nicholas Ryan
Dr Matthew Hauser	Dr Jean Sandig
Dr Jessica Hillwood	Dr Jasdeep Singh
Dr Bianca Jodeikin	Dr Jitain Sivarajah
Dr Eun-Hye Grace Kang	Dr Hannah Smeele
Dr Albert Kim	Dr Dilip Sunder Raj
Dr Rahul Kumar	Dr Karthik Venkatesh
Dr Daniel Lane	Dr Shaun Williams
Dr Samuel Marshall	Dr Shaun Woodbridge
Dr Edwin McBride	Dr Krisoula Zahariou

## WRITTEN SECTION

### **EXAMINERS' COMMENTS**

Candidates are reminded that all questions are scored equally, hence time should be apportioned accordingly. On occasion some questions were not attempted, and this denies the candidate an opportunity to gain valuable marks. Candidates are encouraged to attempt all questions.

Questions from previous examinations are occasionally repeated and candidates are encouraged to review prior papers and examination reports.

Candidates are expected to have a detailed knowledge and depth of understanding of "level 1" topics – for example cardiovascular and respiratory physiology. Candidates are strongly encouraged to read widely to gain a high level of understanding. Candidates are reminded to ensure writing is legible.

### **SHORT ANSWER QUESTIONS – PAPERS 1 AND 2**

#### **1. Describe the pharmacology of lignocaine.**

16% of candidates passed this question.

Comprehensive answers included uses (including antiarrhythmic action and a role in analgesia), physical properties and preparations, pharmacodynamics and pharmacokinetics. Its mode of action should also have been described. Many candidates focussed on toxicity and its management but provided little information on pharmacodynamics and pharmacokinetics, commonly omitting factors which affect its systemic absorption. Other common omissions were the dose required for its local anaesthetic effect and for its antiarrhythmic effect.

#### **2. Outline the components required to measure blood pressure from an intra-arterial catheter (75% of marks). What information (other than blood pressure) may be gained from an arterial line trace (25% of marks)?**

44% of candidates passed this question.

Most of the marks were allocated to the components of the measuring system (as detailed in the question), hence a level of detail was required. An explanation of how the various components work was required; e.g. hydraulic coupling and transducers. Some candidates forgot to include heart rate as a piece of information derived from the trace.

#### **3. Compare and contrast fresh frozen plasma and prothrombin complex concentrate.**

10% of candidates passed this question.

Very few answers included details on prothrombin complex concentrate which meant it was difficult to score well. Useful headings included preparation and administration, dose, indications and adverse effects. Not many candidates knew the dose of FFP, and few were able to describe the preparation/production of the product. Few candidates knew the factors available from either product. Commonly missed was the need for ABO typing for FFP and that Prothrombin complex concentrate did not require this.

**4. Outline the functional anatomy of the kidney (40% of marks). Outline the regulation of renal blood flow (60% of marks).**

71% of candidates passed this question.

It was expected that answers include sections on the blood supply, the nephron (including the difference between the cortical and juxta-medullary nephrons) and innervation. A number of candidates failed to quantify renal blood flow and to define autoregulation. The concept that it's the flow that's regulated was not described by some. Tubuloglomerular feedback was generally described correctly but a reasonable number had the blood flow increasing when an increased sodium was sensed at the macula densa.

**5. Define volume of distribution (15% of marks). Outline the factors affecting volume of distribution (60% of marks) and explain how it may be measured (25% of marks).**

51% of candidates passed this question.

The first two parts of the question were reasonably done. Most candidates had well-structured answers which included drug factors and patient factors. In addition to listing the factors it was expected candidates state how these factors affect volume of distribution. Explaining how volume of distribution is determined was not so well done.

**6. Outline the physiology of the adrenal gland (70% of marks). Describe the actions of aldosterone (30% of marks).**

43% of candidates passed this question.

Lack of breadth and detail were in many of the answers. Physiology of the adrenal gland includes an outline of the adrenal medulla, the types of chromaffin cells, hormones secreted and how secretion is stimulated. The three zones of the adrenal cortex should have been outlined including substances secreted, their function and again how their secretion is stimulated. The actions of aldosterone should have been described; a comment on sodium and water excretion was insufficient to attain many marks for this section. The extra-renal actions of aldosterone were missing from most answers.

**7. Compare and contrast the pharmacokinetics and pharmacodynamics of midazolam and dexmedetomidine.**

27% of candidates passed this question.

Most candidates used the effective tabular format presenting pharmacokinetics and pharmacodynamics of each drug side by side. Many answers demonstrated a lack of correct detail with respect to the pharmacokinetics and pharmacodynamics of these two level 1 drugs. Many included pharmaceuticals which attracted no marks as it was not asked.

**8. Compare and contrast the measurement (40% of marks) and interpretation (60% of marks) of both central venous and mixed venous oxygen saturations.**

8% of candidates passed this question.

Many candidates did not appreciate that ScvO<sub>2</sub> refers to SVC / RA junction venous oximetry and not femoral or peripheral venous oximetry. Methods of measurement such as co-oximetry

and reflectance spectrophotometry needed to be explained. Marks were awarded for the normal values. Discussion of the relationship between ScvO<sub>2</sub> and SmvO<sub>2</sub> and changes during shock attracted marks. Better answers quoted the modified Fick equation and related this to cardiac output and factors affecting oxygen consumption versus delivery.

**9. Classify antibiotics with respect to their mechanism of action (50% of marks). Outline the mechanisms of antimicrobial resistance (50% of marks). Give specific examples of each.**

70% of candidates passed this question.

This question was well answered. Marks were awarded for correct pairing of mechanism of action and resistance with examples of drug class. Few mentioned the mechanisms by which resistance is present; acquired or generated.

**10. Outline the sequence of haemostatic events after injury to a blood vessel wall (50% of marks). Discuss the role of naturally occurring anticoagulants in preventing clot formation in-vivo (50% of marks).**

40% of candidates passed this question.

This question was best answered in a chronological manner. Many candidates omitted initial vasoconstriction and its mechanism. The platelet plug and formation of the clot should have then been described followed by the fate of the clot, including in-growth of fibroblasts. Strictly, fibrinolysis is a system for repairing / limiting clot propagation after the fact. Anticoagulants refer to antithrombin III, heparin, thrombomodulin and protein C and S. An explanation of the interaction of these naturally occurring anticoagulants was expected. The clotting factors that are specifically inhibited was expected as part of the discussion. The glycocalyx and vessel wall also plays a role in preventing coagulation.

**11. Describe the physiology of cerebrospinal fluid (CSF) (60% of marks). Describe the anatomy relevant to performing a lumbar puncture (40% of marks).**

86% of candidates passed this question.

Better answers had a structure with headings such as function, formation, circulation, absorption and composition with dot point facts under each heading. The second part of the question lent itself to a diagram with labelling which scored well. Precise surface anatomy and mentioning all layers from the skin to the sub-arachnoid space scored well.

**12. Compare and contrast the pharmacology of salbutamol and ipratropium bromide.**

46% of candidates passed this question.

Overall candidates had a superficial knowledge of these level 1 drugs. To pass candidates needed to identify points of difference and overlap in various areas such as structure, pharmaceuticals, pharmacokinetics, pharmacodynamics, mechanism of action, adverse effects and contraindications.

**13. Classify circulatory shock and provide examples (40% of marks). Outline the cardiovascular responses (60% of marks).**

83% of candidates passed this question.

Answers should have included the various types of shock and provided clear examples. Cardiovascular responses including sensor, integrator, effector mechanisms were necessary to pass.

**14. Compare and contrast the mechanism of action, pharmacokinetics and adverse effects of digoxin and sotalol.**

19% of candidates passed this question.

Good answers listed class and the multiple mechanisms of action for both these antiarrhythmics, briefly outlining relevant downstream physiological effects and contrasting effects on inotropy. Knowledge of specific pharmacokinetic parameters of these agents was generally lacking. Clinically relevant adverse effects were frequently omitted (e.g. prolonged QT/Torsades for sotalol, hypokalaemia potentiating toxicity of digoxin).

**15. Describe the physiology of the NMDA (N-Methyl D-aspartate) receptor (40% of marks). Outline the pharmacology of ketamine (60% of marks).**

49% of candidates passed this question.

The NMDA receptor is a ligand gated voltage dependent ion channel located on post synaptic membranes throughout the CNS, with glutamate, an excitatory neurotransmitter, its natural ligand. A brief description of its structure, roles of glycine and magnesium, ions conducted, result of activation, role in memory and learning and agonists/antagonists was expected. Detail on structure and functions of the receptor were a common omission.

Ketamine, a phencyclidine derivative, is a non-competitive antagonist at the NMDA receptor. It is presented as a racemic mixture or as the single S(+) enantiomer (2-3 X potency). Administration routes and doses scored marks. Pharmacodynamics were generally well covered including CVS (direct and indirect effects), CNS (anaesthesia, analgesia, amnesia, delirium, effects on CBF and ICP) respiratory (bronchodilator with preservation of airway reflexes) GIT effects (salivation, N and V). Knowledge of specific pharmacokinetic parameters was less well covered, including low oral bioavailability and protein binding and active metabolite (norketamine).

**16. Describe the role of carbon dioxide in the control of alveolar ventilation.**

57% of candidates passed this question.

Better answers considered the role of CO<sub>2</sub> in the control of alveolar ventilation in terms of sensors, central processing and effectors - with an emphasis on sensors. Features of central and peripheral chemoreceptors should have been described in detail. The PCO<sub>2</sub>/ventilation response curve is best described using a graph, with key features of the curve identified (including gradient and axes). Various factors affecting the gradient of this curve and how CO<sub>2</sub> affects the response to hypoxic drive should be described.

### **17. Explain the physiology of neuromuscular transmission.**

60% of candidates passed this question.

Description of sequential events from axon conduction to detail at the neuromuscular junction was required. Well-constructed answers defined neuromuscular transmission, elucidated the structure of the neuromuscular junction (best done with a detailed diagram), described the central importance of acetylcholine, including synthesis, storage, receptors, and degradation. An ideal answer also described both pre-synaptic (e.g. voltage-gated calcium channels, exocytosis of vesicles) and post-synaptic events (acetylcholine receptors, end plate potentials, and the events that lead to excitation-contraction coupling in skeletal muscle).

### **18. Describe the pharmacology of frusemide.**

13% of candidates passed this question.

The majority of answers were well structured, some using tables and others using key headings. In general, for a commonly used drug that is listed in the syllabus as Level 1 of understanding, detailed information was lacking. In particular, mechanism of action, dose threshold and ceiling effect and pharmacokinetics lacked detail and/or accuracy.

### **19. Describe the effects of ageing on the respiratory system.**

5% of candidates passed this question.

Answers should have included the effects of ageing on the efficiency of gas exchange, how the expected PaO<sub>2</sub> changes with age, and its causation. Anatomical changes should have been included as should changes in lung volumes, particularly the significance of an increased closing volume. Marks were not awarded for the effects of disease states.

### **20. Describe the cardiovascular effects of positive pressure ventilation on a patient who has received a long acting muscle relaxant.**

33% of candidates passed this question.

Structured answers separating effects of positive pressure on right and left ventricle, on preload and on afterload were expected. Overall there was a lack of depth and many candidates referred to pathological states such as the failing heart. Simply stating that positive pressure ventilation reduced right ventricular venous return and/or left ventricular afterload, without some additional explanation was not sufficient to achieve a pass level.

## **MULTIPLE CHOICE QUESTIONS – PAPERS 1 AND 2**

97% of candidates passed overall:

Paper 1	95% pass rate
Paper 2	95% pass rate

## ORAL SECTION

### **DAY 1**

#### **VIVA 1**

This is the plasma concentration-time curve.

Describe the features of this curve. What information does it give about a drug's pharmacokinetic profile?

*(Image removed from report.)*

100% of candidates passed this question.

#### **VIVA 2**

This viva is about paracetamol and its toxicity.

81% of candidates passed this question.

#### **VIVA 3**

This viva will explore opioid pharmacology.

What is the mechanism of action of morphine?

90% of candidates passed this question.

#### **VIVA 4**

This viva is about the ECG and important electrical currents in the heart.

Relate the phases of the ventricular myocyte action potential to the normal ECG.

*(Image removed from report.)*

76% of candidates passed this question.

#### **VIVA 5**

This viva is about the physiology and function of the liver.

Using the schematic below please outline the functional anatomy of the liver.

*(Image removed from report.)*

95% of candidates passed this question.

## **VIVA 6**

This viva is about renal function, including fluid and chloride clearance.

Define renal clearance and describe how we measure glomerular filtration.

90% of candidates passed this question.

## **VIVA 7**

This viva is about adrenaline and basic pharmacology.

An ampoule of adrenaline contains the active drug and excipients (additives).

What is the role of the excipient?

95% of candidates passed this question.

## **VIVA 8**

This viva is about obstetric and neonatal physiology.

Outline the functions of the placenta.

62% of candidates passed this question.

## **DAY 2**

### **VIVA 1**

This viva is about physiology and pharmacology related to the thyroid axis.

How does the thyroid gland synthesise thyroid hormone?

90% of candidates passed this question.

### **VIVA 2**

Estimate the values for an arterial blood gas expected for a patient who has a saturation of 85% on  $FiO_2 = 0.5$

Explain the values.

- pH
- $PO_2$
- $PCO_2$
- $HCO_3$
- BE
- A-a gradient

Use the paper and pen provided below and take into the viva.

86% of candidates passed this question.



### **VIVA 3**

This viva is about nutrition.

What is the daily caloric requirement for a 65-year-old female?

100% of candidates passed this question.

### **VIVA 4**

This viva is about respiratory physiology.

Which lung volumes can you measure with spirometry?

*(Image removed from report.)*

100% of candidates passed this question.

### **VIVA 5**

This viva is about pulmonary anatomy and circulation.

Please explain the components of this pulmonary artery catheter trace.

*(Image removed from report.)*

100% of candidates passed this question.

### **VIVA 6**

This viva is about acid base physiology.

What are acids and bases? Give an example of each found in the body.

100% of candidates passed this question.

### **VIVA 7**

This viva is about intracranial pressure.

Explain this pressure volume relationship for intracranial pressure.

*(Image removed from report.)*

100% of candidates passed this question.

## **VIVA 8**

This viva is about laryngeal anatomy.

This is a view of the larynx as seen during intubation.

Can you identify the following structures?

*(Image removed from report.)*

95% of candidates passed this question.

### **SUMMARY OF THE EXAMINATION**

The CICM First Part Examination explores the knowledge of the basic sciences that form the basis to Intensive Care practice. A detailed syllabus has been developed and clearly sets out the Level of Understanding expected for each listed topic and drug. It is important that Candidates follow the Syllabus in its entirety. All questions are sourced from the Syllabus and the recommended texts are a guide to study. Some sections will require more extensive research and the use of other textbooks.

Candidates are expected to attain a level of knowledge that goes beyond just the listing of pure facts but be able to explain, describe, collate and synthesize that knowledge across different scenarios as they apply to Intensive Care practice. Sufficient depth of understanding and a structured approach to topics continues to remain an area of weakness for many candidates.

This is a challenging exam; however, the pass rate was excellent once candidates achieved a sufficient mark to attend the vivas.

Candidates must allow sufficient time to prepare (typically approximately 12 months to study). Candidates are strongly encouraged to discuss their level of preparedness, and to trial written and oral questions, with their Supervisor of Training and other CICM Fellows, prior to undertaking the CICM First Part Examination. The examination reports are available as a guide to areas that are covered but do not provide model answers and should be read as such.

**A/Prof David Austin**  
**Chair**  
**CICM First Part Examination Committee**

**Dr Roslyn Purcell**  
**Deputy Chair**  
**CICM First Part Examination Committee**

**May 2019**