COLLEGE OF INTENSIVE CARE MEDICINE
OF AUSTRALIA AND NEW ZEALAND

REPORT OF THE
INTENSIVE CARE FIRST PART EXAMINATION

AUGUST / OCTOBER 2018

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:	68
Number of candidates scoring > 50% in the written:	39
Number of candidates scoring 45 – 50% in the written:	2
Number of candidates carrying a written score:	0
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 Victoria Arthur
Dr Praveen Bajaj
Dr Timothy Brack
Dr John Brennan
Dr Monica Brook
Dr Adrian Clarke
Dr Kirstin Coggins
Dr Damien Coyle
Dr Jonathan Dallimore
Dr Ashleigh Drury
Dr Cassie Foote
Dr Shahn Forrester
Dr Joshua Ho
Dr Moira Johns
Dr Briony Jude
Dr Mohamed Kamal
Dr Benjamin Lim
Dr Abby McArthur
Dr Emma McDonnell
Dr Claire Michel
Dr Alexander Nesbitt
Dr Samuel Orton
Dr Tapan Parikh aka Parmar
Dr Priya Patel
Dr Ruth Paterson
Dr Natasha Pianca
Dr Umi Qamruddin
Dr Charles Qiu
Dr Vivekanand Rajendran
Dr Timothy Sandstrom
Dr Rishi Sarangi
Dr Sridevi Chikkaya Shetty
Dr Kogulan Sriranjan
Dr Carlos Stephenson
Dr Alexander Thom
Dr David Thomson
Dr Ka Wai Karen Tsang
Dr Ruoxi Wang
Dr Amanda White
Dr Rhiannon Williams

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 I" 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 surface anatomy of the anterior neck (30% of marks) and the underlying structures relevant to performing a tracheostomy (70% of marks).

79% of candidates passed this question.

Answers required a description of the surface anatomy outlining the midline structures including the hyoid bone and cartilages. The tissue layers should have been mentioned as should the relevant tracheal anatomy. The anterior, posterior and lateral relations of the trachea should also have been included along with the relevant nerves and blood vessels. Diagrams were not essential but could have been included.

Candidates should note that marks were not awarded for a description of how to perform a tracheostomy.

2. Compare and contrast amiodarone and digoxin.

82% of candidates passed this question.

Most candidates had a good structure for answering this question; a table was commonly used. Marks were awarded for indications and an explanation of the mechanism of action of both drugs, which was generally well explained. The pharmacodynamic effects were often listed in a general manner and more detail would have achieved a higher mark, including a list of the ECG effects. Some detail on the pharmacokinetics and adverse effects of the drugs was expected and this section was generally well answered. Better answers noted digoxin levels and potential drug interactions.

3. Explain the causes of the differences between measured end tidal and arterial partial pressures of carbon dioxide (CO_2).

29% of candidates passed this question.

The answer required an explanation of the causes of the difference between the $PaCO_2$ and $ETCO_2$. This required recognising how the end point of phase 3 of the capnograph trace corresponds with end tidal CO_2. The difference is caused by the alveolar dead space. The difference is normally very small in healthy adults with the $ETCO_2$ being lower than the $PaCO_2$.

It is increased with increasing alveolar dead space. Many incorrectly attributed anatomical dead space as a contributor to the $PaCO_2$-$ETCO_2$ gradient. Discussion of the various types of dead space did not score marks. Marks were awarded for the processes that cause an increased gradient e.g. low cardiac output and pulmonary embolism. Recognising physiological factors such as increasing gradient with increasing age scored marks. Marks were not awarded for descriptions on how dead space is measured.

4. Compare and contrast ketamine and midazolam.

62% of candidates passed this question.

In addition to the key PK and PD properties of each drug, a clear comparison was required to score well (why choose one drug over the other?). When a table was used the addition of a comparison column was helpful.

A good answer covered the following: ketamine has analgesic properties whilst midazolam does not; ketamine preserves airway reflexes and does not cause respiratory depression unlike midazolam; whilst ketamine increases cerebral blood flow and CMRO2, midazolam decreases it; ketamine has a direct myocardial depressant effect which is often offset by an increase in sympathetic tone, whilst midazolam has no direct cardiac depressant effects but may reduce BP due to reduced SVR; midazolam has anticonvulsant properties, ketamine does not; ketamine is a bronchodilator; both drug effects are offset by redistribution; midazolam is lipophillic at body pH and will accumulate with prolonged infusions, ketamine will not; both are metabolised in the liver; midazolam can be reliably reversed by flumazenil, whereas there is no reliable complete reversal of ketamine; midazolam exhibits tolerance, dependence and withdrawal, whereas patients will only experience tolerance to the analgesic properties of ketamine.

“Drugs in Anaesthesia and Intensive care” chapters on midazolam and ketamine outline the key facts to include in this answer; interpretation and comparison of these facts will help achieve a good mark.

5. Describe the carriage of carbon dioxide (CO_2) in the blood.

65% of candidates passed this question.

A definition of arterial and venous CO_2 content (mls and partial pressure) and an outline of the 3 forms of CO_2 in the blood and their contribution to the AV difference, followed by a detailed explanation of each form of carriage was required for this question. A good answer included a table of the contribution of each form of carriage to arterial and venous content and the AV difference; explained the concepts of chloride shift when describing carriage as HCO_3^-; detailed the Haldane effect and its contribution to carbamino carriage and referenced Henry’s law when describing dissolved CO_2.

West’s Chapter 6 on gas transport details the key information to score well on this question.

6. Outline the determinants of venous return to the heart.

31% of candidates passed this question.

Answers should have included a description of the need for a pressure gradient for flow and a discussion on right atrial pressure, mean systemic filling pressure and resistance to blood flow. The discussion of each of these factors included definitions, normal values, factors affecting them and the direction of change on venous return. Diagrams were not essential, but their use assisted some candidates in explaining the effects of RAP on venous return.

7. Describe protein binding and its significance in pharmacology.

19% of candidates passed this question.

Descriptions of protein binding were generally too brief (e.g. a statement saying that drugs and hormones bind to proteins in the plasma rather than a description of usually reversible binding with a drug-protein equilibrium).

It was expected that the factors which determine protein binding would be described. Marks were attributed if proteins, along with characteristics of the drugs they bind, were named. Candidates achieved better marks if they named the pharmacological parameters affected by protein binding and explained how and why change occurs along with the significance of those changes. Few candidates differentiated between tissue and plasma protein binding and the different effects on the volume of distribution.

8. Describe gastric emptying (40% of marks) and outline its regulation (60% of marks).

24% of candidates passed this question.

Candidates were required to provide a description of gastric emptying (40% marks). Although the question showed the allocation of marks, many candidates did not provide sufficient detail for this section. This required some description of what gastric emptying is (the co-ordinated emptying of chyme from the stomach into the duodenum).

Better answers provided detail regarding the process of gastric emptying in the fed and fasted state and differentiated between liquids, solids, carbohydrate, protein and fats. Factors regulating emptying included an outline of peristaltic waves, the basal electrical rhythm and its modulation, the migratory motor complex (MMC) and its modulation, neural input, stretch and hormonal control.

Many candidates erred by answering the question "the regulation of gastric secretions" rather than the question (the regulation of gastric emptying). Although they scored well for hormonal control, they missed out on marks for the other factors relevant to the regulation of gastric emptying.

9. Describe the renal handling of water including the modulation of water excretion.

37% of candidates passed this question.

This question required a brief introduction of the role the kidney plays in water balance; a more detailed description of how water is handled as it passes through the various segments of the nephron (glomerulus, PCT, Loop of Henle, DCT and Collecting Duct); the modulation of water excretion by the kidney due to ADH (vasopressin) and how this operates; and the stimuli (osmotic and non-osmotic) for ADH secretion. Although worth mentioning in the context of the effect they have on water movement through the kidney, detailed explanations of Starling's forces in the glomerulus, and of the operation and maintenance of the counter-current mechanism, were not required. More important was describing the control of water reabsorption in the collecting ducts (and thus modulation of water excretion by the kidney) under the influence of ADH.

10. Compare and contrast the pharmacology of vancomycin and flucloxacillin.

49% of candidates passed this question.

Most candidates structured their answers well. Expected information included: the class of antibiotic of each agent, their respective pharmaceutics, pharmacodynamics, pharmacokinetics, indications and adverse effects. Better answers provided pharmacodynamic and pharmacokinetic information relevant to each drug rather than generic statements. Good answers also included the common resistance mechanisms for both agents.

11. Describe the anatomy relevant to the insertion of an intercostal catheter.

56% of candidates passed this question.

An anatomy question expects the use of anatomical nomenclature to describe relationships. Good answers defined the “safe triangle” for the lateral approach, soft-tissue layers passed through from skin to pleura and relationship of the neurovascular bundle to the ribs and intercostal muscles. Additional marks were gained for describing the anterior approach and related structures. Common omissions included description of deeper structures (relations) including intrathoracic and intra-abdominal organs and level of the diaphragm with regard to rib space.

No marks were awarded for a description of intercostal catheter insertion.

12. Outline the control of blood glucose.

53% of candidates passed this question.

A definition of normal glucose levels was expected, mentioning how it is regulated despite variable intake. Most answers incorporated the roles of insulin/glucagon and the glucostat function of the liver. Sufficient detail regarding the mechanism of insulin release was often lacking. Extra marks were awarded for description of the role of the satiety centre in the hypothalamus, glucokinase and processes in fasting and starvation that maintain blood glucose levels.

Marks were not awarded for describing effects of insulin and glucagon unrelated to glucose control.

13. Compare and contrast rocuronium and cisatracurium.

32% of candidates passed this question.

This question was best answered using a tabular format outlining class of drug, pharmaceutics, pharmacokinetics, reversibility and side effects. Better answers commented on the significance of the differences between the two agents and its relevance to ICU practice. Many candidates confused these muscle relaxants with each other and with depolarising muscle relaxants.

14. Explain the detection and response to hypoxaemia.

34% of candidates passed this question.

A logical approach to answering this question included a definition of hypoxaemia and then a discussion of the sensors, integrators and effectors involved. It was expected that candidates would cover the peripheral chemoreceptor response (including the respiratory, cardiovascular and autonomic effects), time course of the ventilatory response, hypoxia-inducible factors, vascular effects (hypoxic vasoconstriction in the pulmonary circulation and vasodilatation in the systemic circulation) and metabolic changes (switch to anaerobic metabolism). No marks were awarded for discussing the causes of hypoxaemia. Many candidates incorrectly stated that hypoxaemia is detected by the central chemoreceptors.

15. Outline the production / absorption (30% of marks), composition (30% of marks) and function of cerebrospinal fluid (CSF) (40% of marks).

71% of candidates passed this question.

This question was generally well answered. Better answers noted production including an amount, site and mechanism. Similarly, absorption included the site, the rate and factors which affect the rate. The electrolyte and pH and how they compare to extracellular fluid should have been included in the section on composition.

16. Describe the forces that result in fluid exchange across capillary membranes.

57% of candidates passed this question.

The expected answer included a clear explanation of Starling's forces, including an understanding of the importance of the relative difference along the length of the capillary, with approximate values and examples of factors that influence them. Some explanation of what contributed to the hydrostatic or osmotic pressure gained more marks than merely stating there was a pressure. Several candidates digressed to Fick's law of diffusion or intracellular flow of ions which was not directly relevant to capillary flow.

17. Describe ketone bodies including their synthesis and metabolism.

35% of candidates passed this question.

Whilst most candidates understood that ketones provided an alternative source of substrate for energy production, many lacked a basic understanding of their synthesis and metabolism. Important facts included what ketone bodies are, where they were synthesised, where they were taken up and used as fuel, under what circumstances they are used and the integral role of insulin. Many candidates accurately reproduced the glycolytic and/or the TCA cycle, but this was not being examined, and did not score additional marks. Many candidates incorrectly stated that ketone production was the result of anaerobic metabolism.

18. Describe the factors affecting left ventricular function.

12% of candidates passed this question.

Candidates often misinterpreted the question and described determinants of cardiac output. The answer should have focussed on factors affecting/contributing to normal LV function - not pathological states. Some answers showed a lack of appreciation that normal left ventricular

function is afterload independent, due to compensatory reflexes. Answers needed to consider intrinsic and extrinsic factors affecting LV function - the latter (e.g. SNS, PSNS, hormones, drugs) was often left out. Answers needed to consider both systolic and diastolic function. An excellent answer included physiological phenomena such as the Treppe effect, Anrep effect and baroreceptor and chemoreceptor reflexes. Mention of normal conduction and pacing as well as blood supply limited by diastole scored additional marks.

19. Describe toxicity of local anaesthetic agents.

28% of candidates passed this question.

Most questions lacked a systematic approach to the question and specific detail. The relationship between systemic toxicity (CNS and CVS) and plasma levels should be described. Many candidates did not clearly state that CNS toxicity occurs at lower plasma levels that CVS toxicity. Factors that affect toxicity (e.g. drug factors, patient factors, interactions) needed to be elaborated with some detail. Patient factors such as age, pregnancy, acidosis, hyperkalaemia, hepatic failure were often omitted. Finally, marks were also awarded for noting methaemoglobinaemia as possible toxicity and the existence of specific therapy (intralipid).

20. Describe the pharmacology of heparin highlighting important differences between unfractionated and fractionated (low molecular weight) heparin.

71% of candidates passed this question.

Better answers were tabulated and included sections on pharmaceutics, indications and an explanation on how the difference in molecular weight influenced pharmacodynamics and pharmacokinetics. Knowledge of adverse effects was limited to bleeding and HITTS, often without consideration of relative risk from LMWH. Many candidates did not know the t1/2 of UFH or LMWH.

MULTIPLE CHOICE QUESTIONS – PAPERS 1 AND 2

97% of candidates passed overall:

Paper 1	96% pass rate
Paper 2	96% pass rate

ORAL SECTION

DAY 1

VIVA 1

This is the Oxygen Cascade.

Please describe the steps.

(Image removed from report.)

100% of candidates passed this question.

VIVA 2

This viva will explore your knowledge of heat and temperature.

Explain the physiological mechanisms for the control of body temperature.

90% of candidates passed this question.

VIVA 3

This viva will test your knowledge of respiratory physiology.

What is functional residual capacity (FRC)?

95% of candidates passed this question.

VIVA 4

This viva will explore your understanding of infection.

Classify the microbial pathogens that infect humans.

100% of candidates passed this question.

VIVA 5

This viva will examine the pharmacology of diuretics.

Demonstrate the mechanism of action of diuretics along the nephron.

(Image removed from report.)

100% of candidates passed this question.

VIVA 6

This viva is about foetal and neonatal physiology.

What are the differences between neonatal and adult airways?

95% of candidates passed this question.

VIVA 7

This viva will test your understanding of opioids.

Describe the mechanism of action of opioids.

95% of candidates passed this question.

VIVA 8

This viva will explore thromboelastography.

Can you label this trace of a normal thromboelastogram?

(Image removed from report.)

90% of candidates passed this question.

DAY 2

VIVA 1

This viva is on maternal oxygenation.

What are the values for the following parameters in an arterial blood gas for a female who is 38 weeks pregnant?

pH

pO_2

pCO_2

HCO_3

BE

SaO_2

90% of candidates passed this question.

VIVA 2

This station will explore your knowledge of Catecholamines.

This is adrenaline (epinephrine).

What are the important STRUCTURAL components?

(Image removed from report.)

90% of candidates passed this question.

VIVA 3

This viva will test your knowledge of cardiovascular physiology.

Explain the mechanical events shown in the left ventricular pressure-volume loop below:

(Image removed from report.)

100% of candidates passed this question.

VIVA 4

This viva will assess your understanding of cerebral blood flow.

What is normal cerebral blood flow (CBF) and how is it distributed?

95% of candidates passed this question.

VIVA 5

This viva will explore respiratory physiology.

Describe the spirometry trace, indicating the volumes and capacities of a 70 kg male.

(Image removed from report.)

100% of candidates passed this question.

VIVA 6

This viva will test your understanding of the juxtaglomerular apparatus.

What are the determinants of renal blood flow?

100% of candidates passed this question.

VIVA 7

This viva will test your understanding of the coronary circulation.

Describe the anatomy of the coronary circulation.

95% of candidates passed this question.

VIVA 8

This viva will initially explore the measurement of neuromuscular function and pharmacology of neuromuscular blocking drugs.

What are the principles of a peripheral nerve stimulator?

(Image removed from report.)

100% 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 viva's.

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.

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November 2018