COLLEGE OF INTENSIVE CARE MEDICINE
OF AUSTRALIA AND NEW ZEALAND

REPORT OF THE
INTENSIVE CARE PRIMARY EXAMINATION

SEPTEMBER / NOVEMBER 2013

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. Answers provided are not model answers but guides to what was expected. Candidates should discuss the report with their tutors so that they may prepare appropriately for future examinations.

The exam included two, 2.5 hour written papers, each comprising of twelve short answer questions and twenty short fact questions. Candidates were required to perform at a satisfactory level in the written before being eligible to sit 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:	27
Number of candidates scoring > 50% in the written:	10
Number of candidates scoring 45 – 50% in the written:	7
Number of candidates carrying a written score:	0
Total number invited to the Oral section based on written marks:	17
Total number of candidates successful at the CICM Primary:	13

SUCCESSFUL CANDIDATES

Dr Kadaliparambil Ajay
Dr Sara Bassin
Dr Liam Byrne
Dr Dougal Carlisle
Dr Alun Ellis
Dr Rajee Fernando
Dr Leigh Fitzpatrick
Dr Belinda Gowen
Dr Kristin Hayres
Dr Kenneth Hoffman
Dr Pritish Korula
Dr David Reid
Dr Joshua Smith

WRITTEN SECTION

SAQ PAPER 1

1. Describe the pharmacology of suxamethonium.

This question was generally well answered. A structured approach that included headings such as pharmaceutics, mechanism of action, pharmacodynamics, kinetics, dose and side effects was associated with a good answer.

16 candidates passed (59.3 %).

2. Describe the various rapidly acting cardiac reflexes that influence cardiac function and the mechanisms by which they act.

Cardiac reflexes are fast-acting reflex loops between the heart and central nervous system that contribute to regulation of cardiac function and maintenance of physiologic homeostasis. It was expected candidates would include within their answer a mention of the stimulus and how it is sensed, the reflex arc and the resultant effect. Thus candidates could have mentioned the Baroreceptor Reflex/Carotid Sinus Reflex, Chemoreceptor, Bainbridge, Cushing, Oculocardiac and Bezold-Jarisch (involves response to ventricular stimuli, sensed by receptors within the LV wall that trigger vagal afferent type C fibers and the resultant triad of hypotension, bradycardia, and coronary artery dilatation) reflexes.

6 candidates passed (22.2%).

3. Outline the mechanisms of action of anti-platelet drugs. (50% of marks) Briefly describe the mechanism of action, and pharmacokinetics of aspirin, in relation to its use as an anti-platelet drug. (50% of marks).

Candidates should take note of how marks are apportioned to multi part questions and to avoid re-writing the same point more than twice. Generally there was a lack of sufficient breadth in knowledge in responses given for mechanism of action of anti-platelet drugs and sufficient depth of knowledge in relation to aspirin, in particular aspirin pharmacokinetics.

3 candidates passed (11.1%).

4. Briefly outline the functions of the liver.

This question was generally well answered with a good response being in some structured format, e.g. a mention, followed by a description for each function of the liver. For questions asking to outline a particular topic, a general overview of the topic is expected and not merely a "dot-point" list of the functions of the liver without actually delving into the way the liver does those functions. In general candidates should avoid making broad-brush statements, which do not get them any marks like "the Liver is the major organ in the body". Candidates were expected to list, and provide an overview for each, function of the liver.

24 candidates passed (88.9%).

5. Describe the principles of measurement of arterial haemoglobin O$_2$ saturation using a pulse oximeter. (60% of marks) Outline the limitations of this technique. (40% of marks)

A lack of understanding of the physics behind pulse oximetry was a common area of weakness amongst most candidates. Candidates were expected to mention the underlying principle of the "Beer Lambert" Law, absorption spectra and that the differential absorption of light at different wavelengths by different haemoglobin species is used to determine the fractions of haemoglobin types. Limitations should include mention of errors due to calibration as well as sources of false positive and false negative readings.

18 candidates passed (66.7%).

6. Describe the pharmacology of short acting insulin (actrapid).

In general candidates lacked a sufficient depth of knowledge for this commonly used drug. Some candidates confused actrapid with novo rapid. A structured approach (e.g. pharmaceutics, mode of action, pharmacokinetics, etc.) was expected.

13 candidates passed (48.1%).

7. Outline the non-respiratory functions of the lung.

In general, this question was not well answered. In particular candidates did not demonstrate sufficient depth of information. Nunn's Applied Respiratory Physiology devotes an entire chapter to this topic (Ch. 12, in the 6th edition).

5 candidates passed (18.5%).

8. Give a classification for levels of evidence with respect to Evidence Based Medicine (EBM). (20% of marks) Discuss the strengths and weaknesses of meta-analysis. (80% of marks)

There is more than one classification system for level of evidence with respect to EBM, and any of those was acceptable. Most candidates struggled with the second part of the question. The strengths/weaknesses listed by candidates were often not related to the scientific or statistical principles/properties of a meta-analysis. A good answer would include a discussion about publication bias, duplicate publication, heterogeneity (different interventions), inclusions of outdated studies, inclusions of non-randomised trials, that pooled result may be biased towards the largest included trials as potential weaknesses and increased sample size and that more variables, sub-groups and outcomes can be examined can be considered as strengths.

6 candidates passed (22.2%).

9. Define basal metabolic rate and list the factors that affect it. (60% of marks) Describe the ways it may be measured. (40% of marks)

Basal metabolic rate is the amount of energy liberated by catabolism of food per unit time, under standardised conditions. Knowledge of those conditions (e.g. after a night's sleep, at rest and with no strenuous activity for at least 1 hour, a relaxed subject at a comfortable ambient temperature, at least 12 hours after a meal) was weak. Factors affecting (e.g. body temperature, various hormones, malnutrition, pregnancy, drugs, disease, etc.) it was often incomplete.

Knowledge of measurement was very poor. Candidates were expected to describe the direct (e.g. by using a whole body calorimeter) and indirect (e.g. measuring oxygen consumption) methods.

12 candidates passed (44.4%).

10. Compare and contrast the mechanism of action, pharmacokinetics, pharmacodynamics, and adverse effects of digoxin and levosimendan.

This question provided candidates with a clear structure and headings that were often ignored. Candidates wasted time on pharmaceutics, derivation ("foxglove" mentioned often) and dosing – these were not requested and scored no marks. Superficial answers such as "cardiac glycoside" or "calcium sensitiser" were not adequate. Responses such as "modest" for Vd are inadequate – marks could be gained for identifying at least the direction of the difference between the two agents. Likewise "hepatic metabolism and renal excretion" is inadequate. Both agents had quantitative and qualitative differences in outcome of metabolic products and the renal elimination of active drug. Confusing diagrams with inadequate labelling, arrows with two heads and the use of uncommon abbreviations without definition all served to confuse the examiners rather than help the candidate. Candidates should read the questions carefully.

11 candidates passed (40.8%).

11. Describe the relationship between creatinine clearance and serum creatinine. (60% of marks) What are the limitations in using serum creatinine to assess renal function in the critically ill? (40% of marks)

This was a straightforward question of core CICM material. Most candidates were able to describe the Fick equation as it related to clearance, and then relate it to Glomerular Filtration Rate (GFR). Formula relating GFR to serum creatinine were often quoted incorrectly, graphs poorly constructed and/or labelled and many answers were very superficially answered.

Better candidates were able to relate the graph to functional nephron loss and hence serum creatinine. The non-linear relationship between nephron mass (and function) and the serum creatinine was poorly appreciated by many. The nature of the variability of creatinine production with age, sex, ethnicity etc. was often omitted, as were the factors involved in the variability in an ICU patient.

4 candidates passed (14.8%).

12. Explain the following laws:
        Dalton's
        Boyles
        Henry's
        Graham's
        Fick's Law of Diffusion

The universal gas laws form the basis of oxygen therapy and delivery, pressure and volumetric monitoring as well as a key to understanding the solubility of gases in blood.

All the equations and relationship are straightforward so this question provided a good opportunity to score marks. Unfortunately many candidates were aware of the properties of the ideal gases but not the named laws. This led many candidates to omit major sections of the answer and thus scored no

marks. Several candidates wasted time with complicated diagrams as well as equations and descriptions (scoring no additional marks). Many candidates were unable to identify Grahams Law (rate of diffusion inversely proportional to the square root of the molecular weight) but included it in an expanded Fick's Equation.

7 candidates passed (25.9%).

SAQ PAPER 2

13. Outline the adverse consequences of a blood transfusion. (75% of marks) Define massive blood transfusion and list the adverse consequences associated with a massive blood transfusion. (25% of marks)

In general this question was well answered; however candidates often had difficulty differentiating specifically for a massive blood transfusion (defined as replacement of circulating volume in 24 hours, or greater than 4 units blood transfused in 1 hour of continuing blood loss, or loss of 50% circulating volume in 3 hours). Responses to the first part of the question generally lacked depth. It is suggested that candidates take a systematic approach (e.g. use of categories such as immune, infectious, storage, etc.) when answering these type of questions. Candidates are reminded that when asked to "outline", that the expectation for them to include a description that reflects understanding, and not just "dot-points".

17 candidates passed (63.3%).

14. Compare and contrast the mechanism of action, pharmacokinetics and central nervous system effects of morphine and tramadol.

In general candidates either lacked a depth of knowledge, or a deep enough understanding of the drugs so as to apply their knowledge specifically to the central nervous system (CNS). Mechanism of action and pharmacokinetics for morphine was better understood, in comparison to tramadol. Mention of the non-CNS effects of morphine and tramadol, was not expected, did not score marks, and would have wasted valuable exam time.

15 candidates passed (55.6%).

15. Explain the role of the skin.

The skin is the largest organ of the body, accounting for about 15% of the total adult body weight, with a rich, but tightly regulated blood flow. It performs many vital functions, including the protection against external physical, chemical, and biologic threats, the prevention of excess water loss from the body and thermoregulation. It is composed of three principle layers, the epidermis, dermis and subcutaneous tissue, each with their own purpose. In addition candidates were expected to describe those aspects of the skin that play a role in physical protection, immune, sensory, thermoregulatory and water regulation. Candidates lacked a sufficient breath and depth of knowledge in this area and often digressed beyond areas specific to the skin (e.g. thermoregulation not specific to the skin).

13 candidates passed (48.1%).

16. Describe the pharmacology of vancomycin.

A commonly used drug in intensive care practice, for which a high level of understanding is required (Level A). In general answers were sufficient for a pass, but there was still a lack of sufficient breadth of knowledge, in particular to pharmacokinetics and detailed mechanism of action.

16 candidates passed (59.3%).

17. Describe the anatomy of the sympathetic nervous system.

Knowledge of the anatomy of the sympathetic nervous system is important in helping to understand its physiology, and the pharmacology of drugs that affect it. Such information is widely available within most physiology, and even pharmacology texts when mentioning the sympathetic nervous system. In general candidates lacked depth and often were inaccurate in their description. A systematic approach (e.g. spinal levels, pre-ganglionic, post-ganglionic, etc.) was often lacking.

3 candidates passed (11.1%).

18. Describe the anatomy relevant to the cannulation of the left subclavian vein.

Understanding the anatomy of the subclavian is essential knowledge in intensive care practice. It was expected that candidates mention where it starts, where it ends, relationship to surrounding structures (in all directions, i.e. medial, lateral, anterior, posterior, etc.) and surface anatomy. In general, relationships and/or surface anatomy was either poorly understood or not mentioned.

9 candidates passed (33.3%).

19. Describe the cardiovascular changes during pregnancy.

Many candidates' answers included respiratory and other systems (e.g. endocrine) when only cardiovascular changes were asked for. Candidates are reminded to read the questions carefully. Poor candidates lacked detail of the progressive changes through the trimesters. Changes during (and immediately post) labour and delivery were often overlooked. This is listed as a core topic within the syllabus, that is readily covered by most physiology texts and candidates are expected to have a very sound knowledge of it.

4 candidates passed (14.8%).

20. Describe the electrocardiographic (ECG) changes seen with hyperkalaemia. (30% of marks) Outline the pharmacologic principles of drugs used in the management of severe hyperkalemia. (70% of marks)

In general, knowledge of the ECG changes of hyperkalaemia was lacking. Most candidates could list the drugs used in hyperkalaemia, but few gave adequate detail of their mechanism of lowering potassium, dosing, time to onset and duration of action. Many candidates mentioned dialysis or renal replacement therapy which is not a drug therapy for hyperkalaemia; therefore no points were awarded for this.

23 candidates passed (85.2%).

21. Describe the pharmacology of propofol.

A high level of knowledge was expected as it is a commonly used drug in intensive care. Overall most candidates performed very well. Areas of weakness were those relating to propofol pharmacokinetics and pharmacodynamics.

19 candidates passed (70.4%).

22. Define pain. (10% of marks) Describe the anatomical and immediate physiological components of the response to pain arising from the insertion of an arterial line. (90% of marks)

The pain pathways following arterial line insertion involve sensing the stimulus and transmitting the sensation to the central nervous system. It was expected candidates could provide some detail about the major features along this pathway including a description of sensors, nerve types, spinal cord input and decussation with subsequent projection to higher centres. Better answers provided additional details about modulation and descending pathways. The question also required a description of the physiology with some discussion of the mediators involved and explanation of how a stimulus or tissue may result in the perception of pain. Common omissions included insufficient detail of the pain pathway and limited or no discussion of the physiological components.

11 candidates passed (40.8%).

23. What factors affect airway resistance? (80% of marks) Briefly outline how it may be measured and/or changes in flow are detected. (20% of marks)

This topic required a definition and understanding of airways resistance. It was expected candidates could identify that issues around the nature of flow (turbulent vs. laminar) and airway diameter were central determinants. It was expected candidates would describe the determinants of turbulent flow. The provision of formula and comments about Reynolds number helped demonstrate an understanding of this. Better answers discussed the transitional point in the airway and the paradox about size vs. total cross sectional area and its influence on total resistance. Several candidates confused pulmonary vascular resistance with airways resistance. Using graphs to help illustrate certain concepts would have been helpful. Measurement of resistance (indirectly via measurement of flow and pressure difference by a body plethysmography, spirometry) and detection of flow (spirometry, capnography) was in general poorly understood.

5 candidates passed (18.5%).

24. Outline the physiological responses to anaemia. (The specific physiological responses to hypovolaemia are NOT required.)

It was expected candidates would expand on the central role haemoglobin has in oxygen delivery and that in the presence of reduced haemoglobin there are various efforts aimed at maintaining oxygen delivery. Cardiac output is increased, systemic vascular resistance is reduced, modifications are seen in regional circulations and as tissue oxygenation begins to falter then the end products of anaerobic metabolism provide a further stimulus to enhance cardiac out and tissue oxygen delivery. Better answers also included a mention of additional factors that enhance tolerance of chronic anaemia (e.g. angiogenesis).

10 candidates passed (37.0%).

PAPER 1 and 2 CLOZE QUESTIONS

25 candidates passed (92.6%).

PAPER 1 and 2 RANK QUESTIONS

20 candidates passed (74.1%).

PAPER 1 and 2 MATCH QUESTIONS

20 candidates passed (74.1%).

ORAL SECTION

17 candidates were invited to attend the oral section based upon their written marks.

VIVA 1

This Viva tested knowledge of the hypersensitivity reactions. It began by asking about different types of hypersensitivity reactions, sought examples for each and also covered aspects of histamine, histamine receptors and adrenaline. Overall most candidates performed well, with knowledge of histamine and histamine receptors being a consistent area of weakness.

17 candidates passed (100%).

VIVA 2

This Viva explored knowledge of the physiology of swallowing and the passage of food through the oesophagus. It began by discussing the stages of swallowing, and then moved on to the cough reflex, the lower oesophageal sphincter and metoclopramide. Most candidates had a good knowledge of swallowing, but were less informed about the cough reflex and innervation of the larynx.

14 candidates passed (82.4%).

VIVA 3

This Viva tested knowledge of renal physiology and pharmacology. It began by asking what the normal Glomerular Filtration Rate (GFR) is and what the determinants of GFR are. It also explored knowledge of glomerular-tubular feedback, the counter current system and diuretics. Although most candidates had a good knowledge of GFR and its determinants, fewer were as confident to recall the actual values or to apply that physiology to scenarios like hypovolaemia. Some candidates struggled to explain the counter current mechanism, in particular the "multiplier" effect. Mechanism of action of diuretics was well answered.

12 candidates passed (70.6%).

VIVA 4

This Viva explored knowledge of the principles of the electrocardiography (ECG) and statistical tests. Specifically it tested knowledge of the recording of the normal ECG, sources of error and statistics (sensitivity, specificity, prevalence, etc.). Most candidates performed well, with knowledge of sources of error in the ECG and the measures of performance of a diagnostic test being an area of weakness.

15 candidates passed (88.2%).

VIVA 5

This Viva explored knowledge of the control of the heart rate. It assessed knowledge of the origin of the heart rate, its regulation, and catecholamines. Most candidates performed well. Anatomical location of the SA node, ionic currents related to the action potential, structure-activity of catecholamines and dobutamine pharmacokinetics were areas of weakness.

14 candidates passed (82.4%).

VIVA 6

This Viva tested knowledge of on the physiology of calcium and the pharmacology of calcium channel antagonists. Although some candidates performed well, there was generally a lack of sufficient knowledge of the control of calcium.

14 candidates passed (82.4%).

VIVA 7

This viva examined anatomy of the neck (specifically to the major vessels), ultrasound and general pharmacology. Candidates were shown an axial ultrasound image of the right neck, taken at the time of insertion of a central line, and asked to identify the major anatomical structures. Overall most candidates performed well, with a good knowledge of ultrasound in general, and of general pharmacodynamics.

16 candidates passed (94.1%).

VIVA 8

This focused upon knowledge of aspects of respiratory physiology, measurement and oxygen delivery. Candidates were shown a chest X-ray, and told it represented complete collapse of the left lung. The opening question was what processes might contribute to hypoxia in that patient. It viva then went on to examine knowledge of shunt, dead space and measurement of oxygen. Overall most candidates performed well, with overall the depth of knowledge of the physiological mechanisms of hypoxia being the area of weakness.

14 candidates passed (82.4%).

SUMMARY OF THE EXAMINATION

The CICM Primary Examination explores the knowledge of the basic sciences that form the basis to Intensive Care practice. A detailed syllabus has been developed and forms the foundation for the knowledge required for this examination. The Syllabus reflects the basic sciences as they apply to Intensive Care practice. The Syllabus clearly sets out the Level of Understanding expected for each listed topic and drug. It is important that candidates follow the Syllabus closely, and in its entirety. All questions are sourced directly from that syllabus. Following each examination a detailed report, such as this one, is produced which outlines the level of understanding that is expected.

Candidates are expected to read widely and to attain a level of knowledge that goes beyond just the listing of pure facts, but to also be able to explain, describe, collate and synthesize that knowledge across different scenarios as they apply to intensive care practice. They should also be able to do so in a systematic way (e.g. use of categories) as well as via a variety of means (e.g. free text, illustrations and graphs). This still remains an area of weakness for most candidates, in particular the lack of sufficient depth of understanding. There is however evidence that candidates are developing a greater insight into the required knowledge as increasingly the better candidates appears to be achieving higher scores.

This is a fundamental and challenging exam. 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 Primary Examination.

On behalf of the Examination Panel, I would like to congratulate the successful candidates at this CICM Primary Examination and wish them every success in their future training in Intensive Care, and in their preparation for the College of Intensive Care Medicine Fellowship examination.

A/Prof Arthas Flabouris
Chair, Primary Examination Committee
November 2013

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