COLLEGE OF INTENSIVE CARE MEDICINE
OF AUSTRALIA AND NEW ZEALAND

REPORT OF THE
INTENSIVE CARE PRIMARY EXAMINATION

MARCH / MAY 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 the 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.

Successful candidates:

Dr Abhilasha Ahuja
Dr Umakant Rajaram Bhutada
Dr Peter Chan
Dr Chathuri Udayangani Dissanayake
Dr Aidan Murray Hodges
Dr Upul Kumara Hewajayasinghalage
Dr Prashanti Marella
Dr Rajesh Pachchigar
Dr Matthew Phillips
Dr Sile Smith
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WRITTEN SECTION

SAQ PAPER 1

1. List the different mechanisms of drug actions with examples.

A good answer to this question required candidates to think broadly about how drugs act and have a system for classifying their actions. One possible classification is action via receptors or non-receptor actions. Many candidates used categories such as physiochemical, receptor and enzymes. Common problems were failure to mention a whole class of drug actions e.g. drugs acting via voltage-gated ion channels or gene transcription regulation. Candidates also gave far too much detail in some sections e.g. a description of zero order and first order kinetics is not required. Candidates often did not give examples of the drug action they described.

2. Describe the physiology of cerebrospinal fluid (CSF). (70% of marks) Describe the anatomy relevant to the performance of a lumbar puncture. (30% of marks)

Most candidates performed well in this question. The physiology of cerebrospinal fluid (CSF) required candidates to write about CSF formation, circulation and absorption, compare the composition of CSF to plasma and describe normal volumes and pressures. The functions of CSF also need to be listed. Some candidates described the displacement of CSF when intracranial pressure rises as a function of CSF. No marks were given for this.
The best approach to the anatomy of a lumbar puncture was to describe the lumbar intervertebral space at which the lumbar puncture is done and then describe the anatomical structures that the needle would traverse from the skin to the subarachnoid space. Mentioning the indications for a lumbar puncture was not required.

3. What is the Valsalva manoeuvre? Explain the cardiovascular response and include graphs in your answer.

A good answer to this question required attention to detail and an ability to describe changes in many variables at each stage e.g. intrathoracic pressure, blood volumes, baroreceptor firing and the subsequent cardiovascular response (e.g. heart rate and blood pressure). Using graph(s) is a useful way to assist the explanation and was required as part of the answer. Dividing the response into four stages makes answering the question much easier. Overall there was a deficiency in a deep understanding of the integrated physiology associated with the Valsalva manoeuvre. The most common mistakes were describing a change but not saying why it happened, not considering each element at each stage and confusing terms e.g. saying increased cardiac output when the response was increased mean arterial pressure. Very few candidates drew accurate graphs. Graphs required were those of the changes in intrathoracic pressure, the pulse pressure response and the heart rate response.

4. Describe the pharmacology of tranexamic acid.

Tranexamic acid is a drug used to reduce bleeding in trauma or surgery. It is also used for hereditary angioedema and menstrual bleeding. It is being increasingly used in critically ill patients. As a Level B listed drug within the Primary Syllabus candidates would be expected to know it in some depth. Often basic information such as mechanism of action, pharmacokinetics and adverse effects was lacking.

5. Describe the hormonal response to a meal.

For a good answer candidates were expected to have an integrated knowledge of gastrointestinal physiology. Gut function is regulated by the enteric nervous system and by paracrine and endocrine hormones released by hormone secreting cells in the mucosa of the gut (enteroendocrine cells). These cells secrete hormones in response to neural innervation or in response to triggers associated with ingested food. Gut functions influenced include secretion, digestion, absorption and motility. The endocrine system also has an important role in the handling of nutrients following absorption and some mention of insulin was required.

6. Classify the oral hypoglycaemic drugs; include their mechanism of action, and their most significant side effects.

A good answer would have best been served by a tabular structure and some understanding of the information required. One system of classification of oral hypoglycaemic drugs is by their mechanism of action, or drug group e.g. Biguanides, Sulfonylureas, Thiazolidinediones, Alpha-glucosidase inhibitors, Meglitinides and Dipeptidyl peptidase (DPP) -IV inhibitors.

7. Describe how the respiratory system of a newborn differs from that of an adult.

This question required anatomical detail relating to the upper airway and bronchial tree, which was generally answered well. The functional implications of a highly compliant chest wall in defending FRC and the relationship of FRC to closing volume was less clearly explained. Better answers mentioned the high physiological dead space, oxygen consumption and work of breathing. Additional points were awarded for discussing the immaturity of the respiratory control centre and propensity for apnoea.

Common omissions included not providing comparative adult data or a written description of how neonates differed from adults (or the significance of this). Candidates confused chest wall compliance (increased in newborns) with lung compliance (reduced in newborns but rapidly approaches normal adult values as “specific compliance”). Increased oxygen consumption necessitates increased minute ventilation (with tidal volumes equivalent to adults on a weight basis) via respiratory rate.

Functional Residual Capacity FRC (equivalent to adults) and Closing Capacity (increased relative to adults) were often confused.

Better answers provided responses often in tabular format. Discussion of cardiovascular responses and response to drugs were not requested and gained no marks.

8. Compare and contrast the mechanism of action, spectrum of activity and adverse effects of benzyl penicillin, metronidazole and clindamycin.

This question asked to compare and contrast, inviting candidates to tabulate their answers. Details concerning other elements of pharmacology (apart from mechanism, spectrum and adverse effects) were not required and did not attract marks.

There was a lack of accurate detail in answers regarding clindamycin. Spectrum of activity mentioned by candidates was often quite narrow. The gram negative and anaerobic spectrum of activity afforded by benzyl penicillin was also not mentioned by many candidates. Adverse reactions were an opportunity to score marks - all drugs can cause nausea, vomiting, rash and hypersensitivity phenomena - especially the antibiotics. However it is important that specific side effects for each agent are also mentioned by candidates. Information that related to the pharmaceutics, pharmacokinetic or pharmacodynamic properties of these drugs was not requested and did not score marks.

9. Outline the functions of the kidney.

Outline type questions require a comprehensive list and a brief explanation of each major function of the kidney. This should have included water balance, electrolyte balance, endocrine function, filtration, metabolism, acid-base balance, excretion and blood pressure control.

Adequate breadth was lacking in many answers. Marks were awarded for discussion of water reabsorption at specific points along the length of the nephron and the control mechanism through Aquaporins and ADH. It was expected answers would include calcium, magnesium, glucose and amino acid handling by the kidney (as well as sodium and potassium). Better answers discussed the elimination of fixed as well as volatile acids and outlined the role of ammonia. Discussion of the endocrine functions would include EPO, 1,25 dihydroxy-cholecalciferol, prostaglandin E, renin, angiotensin II and kallekrein.

Superficial responses such as, “the kidney is important in regulating volume” (or “waste” or “water” or “sodium”) were not sufficient.

10. Outline the pharmacokinetics, and mechanism of action of carvedilol and spironolactone.

Carvedilol and spironolactone are common drugs used in the management of cardiac failure. They have different mechanisms of action and pharmacokinetics. Both are drugs listed in the Syllabus as Level B and thus candidates are expected to have a general understanding of their pharmacology. Many candidates gave class specific information about beta blockers rather than demonstrating an understanding of carvedilol`s particular properties. Most candidates were able to score marks by commenting upon the results of aldosterone antagonism suggesting an understanding of the physiology of this hormone but

appeared to know little more about the pharmacology of spironolactone. Overall there was insufficient information provided by most candidates for both drugs.

11. Describe the oxygen cascade, from the atmosphere to the mitochondrion, in a patient breathing room air.

This topic is a core aspect of respiratory physiology. The vast majority of the candidates could draw the oxygen cascade, but were let down by not having sufficient breadth and/or depth of information (e.g. alveolar gas equation was either omitted, inaccurate or poorly described in relation to the oxygen cascade) to describe the physiological principals at each step of the cascade.

12. Describe the physiological role, distribution and regulation of potassium (K+).

Potassium is the second most common cation in the body and the main intracellular cation. It is widely distributed and has many important roles. Maintenance of potassium balance depends mainly on secretion by the kidneys in the distal and collecting tubules. Candidates were expected to mention the influence of aldosterone, and other hormones such as glucocorticoids, catecholamines and vasopressin have as well as factors such as acidosis/alkalosis. Candidates who had a systematic and structured approach performed better.

SAQ PAPER 2

13. Outline the effects of critical illness on drug pharmacokinetics. Give examples.

Most candidates answered the question under the subheadings absorption, distribution, metabolism and elimination. However, they didn't give any details of the direction or mechanism of change, often used vague statements without specifically addressing the question and failed to give examples. The impact of the shock state on different kinetic parameters including absorption from skin, tissue, muscles, enteral absorption and inhalational was often overlooked. Similarly, the consequences of changes in volume of distribution, protein binding (e.g. albumin and globulin, ionisation) was poorly understood as was alteration in liver and kidney function. Although this topic is very broad candidates were asked to only outline the details of this topic.

14. Describe the relevant anatomy for insertion of an intercostal catheter. (60% of marks) How does breathing 100% oxygen help in the resolution of a pneumothorax? (40% of marks)

Many candidates described the technique for insertion of an intercostal catheter which was not requested. Few identified the nerve supply to the area. Most identified the "safe" triangle but failed to correctly identify its borders or draw a diagram to show anatomic landmarks. Describing the anatomy from skin to lungs, including the neurovascular bundle, was needed to pass this part of the question.

Although most knew that 100% oxygen reduce the nitrogen content in a pneumothorax and this accelerates its adsorption, but did not go on to provide any quantification of partial pressure changes in blood and in the pneumothorax bubble.

15. Describe the pharmacology of naloxone.

Naloxone is a commonly used intravenous opioid antagonist, which acts as a competitive antagonist with high affinity for the mu, kappa, delta and sigma opioid receptors. It is used to ameliorate or reverse opioid effects at these sites. It has a shorter effect site and plasma half-life than most opiates so levels will fall before the opioid agonist it is being used to treat, thus a repeat dose maybe required to maintain opioid reversal. Overall candidates lacked sufficient depth of information to achieve high marks for this question.

16. Classify and describe immune hypersensitivity reactions. Give examples for each reaction.

Overall, this question was well answered. Candidates were expected to classify the hypersensitivity reactions into their typical groups (Type I – IV) and to describe the mechanisms within each group. Similar such questions have been asked in previous exams. Again, those candidates who could provide some structure to their answer tended to score well.

17. Compare and contrast the mechanism of action, pharmacokinetics, and side effects of adrenaline, steroids, and antihistamines when used for the treatment of anaphylaxis.

This question asked candidates to compare and contrast the mechanism of action, pharmacokinetics, and side effects of these drugs in the context of the treatment of anaphylaxis. Information beyond that did not score marks. A structured approach (e.g. a table) assisted in presenting the information.

18. Describe liver blood flow and its regulation.

The liver has a unique dual supply – a portal venous system, and a hepatic arterial system, that floods the hepatic sinusoids and drain into the hepatic veins and then the inferior vena-cava. Knowledge of liver blood flow is essential for the understanding of certain pathophysiological mechanisms associated with disease and/or injury states of the liver. These two systems have unique characteristics, which most candidates seemed to have some knowledge of. A common area of weakness was the understanding/omission of the factors/mechanisms involved in the regulation of liver blood flow.

19. Describe and compare the action potentials from cardiac ventricular muscle and the sinoatrial node.

A fundamental aspect of cardiac physiology, that overall was well answered. The majority of candidates used figures to good effect. Candidates are reminded that all figures must be

correctly labelled (e.g. X and Y axis, phases of action potential, etc.). Common omissions were those that reflected an adequate depth of knowledge (e.g. some of the current flows).

20. Compare and contrast the pharmacology of frusemide and acetazolamide.

Frusemide and acetazolamide are commonly used drugs and candidates were expected to have a sound knowledge of their pharmacology, including (amongst other features) their site and mode of action, renal and other organ effects, adverse effects and essential pharmacokinetics.

21. How is alveolar ventilation regulated?

This is a core topic (syllabus Level 1) and a high level of understanding was expected. Overall candidates failed to demonstrate sufficient depth and breadth in their knowledge. A structured response considering the three basic elements underpinning the control of alveolar ventilation (the Sensors, Central integration and control and the Effectors) was core material. A detailed description of each was expected.

22. Describe the actions of endogenous vasopressin. (60% of marks) List the vasopressin analogues and their uses. (40% of marks)

Overall the first section was not answered in sufficient detail. Aspects such as the anti-diuretic effects of vasopressin were often overlooked. Some candidates spent more time on outlining the clinical contexts in which vasopressin is used (which did not score marks), rather than the physiology (which did score marks). DDAVP was the most common analogue mentioned, with the others often being omitted (e.g. terlipressin, ornipressin, etc.).

23. How do chemical messengers in the extracellular fluid bring about changes in cell function? Give an example of a chemical messenger for each mechanism noted.

Overall answers lacked structure and depth, to what is a very fundamental topic. This topic is generally covered within the opening chapters of most physiology texts. Common errors were not answering the question, writing lists rather than describing and explaining, and poor categorisation. Candidates were expected to mention and give example for mechanisms such as hormones binding to cytoplasmic or intra-nuclear receptors, binding to transmembrane receptors coupled to G proteins, cAMP, cGMP, tyrosine kinase, etc.

24. Describe the mechanism of action, and side effects of THREE (3) classes of drugs that are used to increase uterine tone and THREE (3) classes of drugs used to decrease uterine tone.

Candidates often appeared to have a sufficient awareness of the choice of drugs (e.g. oxytocin analogues, ergot alkaloids, beta-receptor agonists, calcium channel blockers, etc.), but then failed to produce sufficient depth of knowledge to adequately describe their mechanisms of action in respect to uterine tone. Candidates are reminded that if asked to

mention side effects, mentioning side effects of greatest relevance to intensive care (e.g. bronchospasm) in addition to the more generic side effects (e.g. rash).

PAPER 1 and 2 CLOZE QUESTIONS

PAPER 1 and 2 RANK QUESTIONS

PAPER 1 and 2 MATCH QUESTIONS

ORAL SECTION

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

VIVA 1

Tested knowledge of coronary perfusion and blood pressure measurement. It began by asking candidates to describe the coronary artery blood flow.

VIVA 2

Explored knowledge of oxygen administration and oxygen measurement (including arterial oxygen saturation and partial pressure). It began by asking candidates to describe the design principles of commonly used oxygen delivery masks.

VIVA 3

This Viva was centered around the physiology of thyroid and the thyroid hormone. It also briefly covered anti-thyroidal drugs. Candidates were first shown a picture of the histology of the thyroid and asked to discuss those features labelled within the picture.

VIVA 4

This Viva explored knowledge of intracranial pressure and sedating drugs.

VIVA 5

This Viva explored knowledge of the pressure waveforms associated with the right side of the heart. Candidates were first asked to draw the right atrial pressure trace (central venous pressure) and describe its features.

VIVA 6

This Viva tested knowledge of the pain pathways and analgesia. The first question asked candidates to describe what would be the immediate response to a cut to the hand.

VIVA 7

This viva examined the physiology of acid/base and the role of the kidney in acid/base balance. The opening question was "What is the Henderson Hasselbalch equation?"

VIVA 8

This focused upon knowledge of respiratory physiology. The first question asked candidates to use a pre-supplied graph below to draw a dynamic pulmonary compliance (pressure volume loop) graph of a normal healthy adult, as you would see with a *maximal inspiratory* effort followed by *total exhalation*. Explain the characteristics of the curves. The other major area of respiratory physiology to be tested was that of the expiratory flow curve.

SUMMARY OF THE EXAMINATION

The CICM Primary Examination explores the knowledge of the basic sciences that forms 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. 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.

The Syllabus clearly sets out the Level of Understanding expected for each of the topics. Candidates are strongly encouraged to read and ascertain enough breadth (i.e. to include Level 3 topics and Level C drugs) and just as importantly, sufficient depth (in particular of Level 1 and 2 topics and Level A and B drugs). To do so candidates must read widely, beyond any one textbook, and develop a level of knowledge that allows them to accurately discuss, explain, translate and illustrate essential aspects of the basic sciences. It is also necessary for candidates to be able to collate and synthesize knowledge across many topics, and from more than one source. This still remains an area of weakness for most candidates. In particular there is a lack of sufficient depth of understanding of the higher level topics/drugs. This is important for not just success at this exam, as higher level topics/drugs will be examined frequently, but also future understanding of intensive care practice.

Candidates are also tested in their capacity to provide organised answers. Some candidates feel time pressured when answering any particular type of question. We strongly encourage candidates to not only attempt all questions, but to aim to at least present the more relevant information that is being sought in the time allowed. Writing legibly, use of some structure (tables, figures, lists, etc.) would greatly assist them in doing so. This requires a

great deal of practice, and so candidates should be well practiced in doing so before presenting to the written and the oral sections of the exam.

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 once again congratulate the successful candidates at this CICM Primary Examination and wish them every success in their future training in Intensive Care, and in preparation for the College of Intensive Care Medicine Fellowship examination.

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

OVERALL STATISTICS

Total number of candidates presenting for the written examination:	21
Number of candidates scoring >50% in the written:	8
Number of candidates scoring 45-50% in the written:	6
Number of candidates carrying a written score:	0
Total number invited to the Oral section based on written marks:	14
Total number of candidates successful at the CICM Primary:	12

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