Australian and New Zealand College of Veterinary Scientists

Fellowship Examination

June 2016

Veterinary Emergency Medicine and Critical Care

Paper 1

Perusal time: **Twenty (20)** minutes

Time allowed: **Four (4)** hours after perusal

Section A: Answer **ONE (1)** question

Section B: Answer **ALL FIVE (5)** questions

Section C: Answer **ALL TEN (10)** questions

Section A: Answer **ONE** essay-style question worth 60 marks .....total 60 marks

Section B: Answer **FIVE** short-answer questions each worth 24 marks.....total 120 marks

Section C: Answer **TEN** short-answer questions each worth 6 marks.....total 60 marks

Paper 1: Veterinary Emergency Medicine and Critical Care

Section A: Answer ONE (1) essay-style question

1. Answer **all** parts of this question:

   a) Define the systemic inflammatory response syndrome, sepsis, severe sepsis, septic shock, and multiple organ dysfunction syndrome using current veterinary terminology and clinical criteria in dogs. *(15 marks)*

   b) Briefly compare and contrast the pathophysiology of the initial immune response to non-infectious versus infectious insults, giving examples of specific insults and molecular patterns sensed by the host. *(5 marks)*

   c) Describe the innate immune response to gram negative bacterial infection including key mediators of the subsequent clinical syndrome. *(20 marks)*

   d) Draw a diagram showing determinants of oxygen delivery (DO_2), then work through the algorithm discussing in detail the parameters affected by sepsis, and how **each** may be affected. *(10 marks)*

   e) Outline your treatment approach to septic shock in dogs; be specific with drugs and doses, and compare your approach to current guidelines in human medicine. Do not include the general management strategies for sepsis (i.e. antibiotics or source control) in your answer. Include second line therapies, monitoring and/or end-points. *(10 marks)*

Section B starts over page

Section B: Answer ALL five (5) short-answer questions

1. Answer **all** parts of this question:

   a) Define and outline the components of cerebral perfusion pressure. *(2 marks)*

   b) Draw and explain the cerebral compliance curve including a description of the Monroe-Kellie doctrine. Explain the implications of this pathophysiology for a head trauma patient. *(6 marks)*

   c) Describe the **two (2)** main mechanisms by which intracranial pressure (ICP) is regulated. *(3 marks)*

   d) The modified Glasgow coma scale (MGCS) score is used as a somewhat objective means to grade the severity of head injury in dogs. Identify the **three (3)** categories of the MGCS score, describe the neurologic signs associated with the lowest MGCS score, and state the lowest possible score (x out of y). *(6 marks)*

   e) Explain your approach to managing increased ICP. For pharmacologic therapies include information on dosing and mechanisms of action. *(7 marks)*

2. Answer **all** parts of this question:

   a) Compare and contrast pre-synaptic and post-synaptic neurotoxins from Elapid snakes with regard to their mechanism of action and therapeutic implications. *(4 marks)*

   b) Compare and contrast the predominant diseases that are differential diagnoses for ascending flaccid paralysis in Australia with regard to their clinical syndrome, and the diagnostic approach. *(16 marks)*

   c) Based on analysis of the current veterinary literature, briefly discuss the prognosis for animals with ascending flaccid paralysis requiring mechanical ventilation. *(4 marks)*

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3. Answer **all** parts of this question:

a) Identify the components of Virchow's triad and provide examples of diseases that cause each of its components. *(8 marks)*

b) Compare and contrast arterial versus venous thrombi and explain how these differences might influence thromboprophylaxis. *(4 marks)*

c) For **each** of the following drugs, outline the mode of action and rationale for use in the management of patients with thromboembolic disease: *(8 marks)*

i. unfractionated heparin (UFH)

ii. low molecular weight heparin (LMWH)

iii. tissue plasminogen activator (tPA)

iv. warfarin.

d) For **each** of the anticoagulant drugs (not tPA) in 3 c), briefly state how you would monitor therapy and identify the specific therapeutic target that you aim to reach. *(4 marks)*

4. Answer **all** parts of this question:

a) Write out the Starling-Landis equation, including a description of **each** component of the equation. *(7 marks)*

b) Describe the recent modification of our understanding of the Starling equation. *(3 marks)*

c) Describe at least **three (3)** factors that protect against the development of oedema in nondistensible tissues such as the lung. *(6 marks)*

d) List and explain the **two (2)** main pathophysiologic forms of pulmonary oedema with reference to the equation outlined in 4a). *(4 marks)*

e) List and explain the other **three (3)** recognised pathophysiologic mechanisms of oedema formation and provide examples of predisposing conditions for **each**. *(4 marks)*

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5. Answer **all** parts of this question:

a) In order of occurrence, identify the **three (3)** most common arrest rhythms in small animal patients and state the additional rhythm that has been recognised in humans. *(2 marks)*

b) State the equation that denotes myocardial perfusion pressure, and explain how this influences the decision to administer intravenous fluids during cardiopulmonary resuscitation (CPR). *(4 marks)*

c) Describe in detail the **two (2)** theories by which cardiac output is achieved during CPR and explain how these are associated with compression technique. *(6 marks)*

d) Explain the 3-phase model of ischaemia during ventricular fibrillation (VF), and how the duration of VF prior to defibrillation influences your approach to defibrillation. *(7 marks)*

e) Assuming other components of basic and advanced life support are occurring appropriately, describe the technique specifically for performing open chest CPR. *(5 marks)*

Section C starts over page

Section C: Answer ALL ten (10) short-answer questions

1. Describe the features of the Berlin definition of acute respiratory distress syndrome (ARDS), including how the severity of ARDS is incorporated into this definition. *(6 marks)*

2. Answer **all** parts of this question:

   a) State the most common cause for brown coloured mucous membranes. *(1 mark)*

   b) List **three (3)** disease processes which can cause this abnormality, including examples where appropriate. *(4 marks)*

   c) Explain how this condition can be quantified. *(1 mark)*

3. Using figures, explain the Bohr and Haldane effects. Include in your answer information about the chloride shift. *(6 marks)*

4. Describe the Fenton and Haber-Weiss reactions and explain their pathophysiologic significance. *(6 marks)*

5. Answer **all** parts of this question:

   a) Define and describe a bacterial biofilm. *(2 marks)*

   b) Give **four (4)** examples of common locations and situations where biofilms may develop and become problematic in small animal patients. *(2 marks)*

   c) List **two (2)** management strategies to reduce the clinical impact of bacterial biofilms. *(2 marks)*

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6. How is dead space ventilation subdivided/classified? Provide a brief explanation of **each** type of dead space. With respect to ventilation, define and differentiate different classification or types of dead space. *(6 marks)*

7. Outline how burns are classified based on the 'depth of tissue destruction' scheme. Include layers involved, wound characteristics and details of healing. *(6 marks)*

8. Answer **all** parts of this question:

   a) Define abdominal compartment syndrome (ACS). *(2 marks)*

   b) Differentiate among primary, secondary and tertiary ACS using examples. *(3 marks)*

   c) Give **one (1)** example of a method or technique that you could use to quantify the intra-abdominal pressure in a veterinary ICU patient. *(1 mark)*

9. Compare and contrast the toxic syndromes of carbamates and organophosphates with specific focus on which clinical signs are attributable to toxin binding at which receptor sites. *(6 marks)*

10. Answer **both** parts of this question:

    a) Define $ScvO_2$, explain its biological significance and state how it is measured. *(3 marks)*

    b) Identify the **two (2)** broad categories by which $ScvO_2$ can be decreased and name **two (2)** examples within **each** category. *(3 marks)*

End of paper

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Veterinary Emergency Medicine and Critical Care

Paper 2

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Answer **ALL <u>FIVE (5)</u>** questions

All five questions are of equal value.

Answer **FIVE** questions each worth 48 marks.....total 240 marks

Paper 2: Veterinary Emergency Medicine and Critical Care

Answer all five (5) questions

1. Answer **all** parts of this question:

   a) Describe the pathophysiology of vomiting. *(10 marks)*

   b) List **three (3)** anti-emetic drugs of different classes, describe their mechanism of action, dosing regimen, and any unique features. *(9 marks)*

   c) Name **two (2)** additional drugs that could potentially be used as prokinetics in a patient with regurgitation and/or gastrointestinal ileus. Describe their mechanism of action, dosing regimen, and any unique features. *(6 marks)*

   d) Discuss the arguments for and against early and delayed enteral nutrition in pancreatitis. *(7 marks)*

   e) List advantages and disadvantages of **four (4)** enteral feeding tube options. Do not include comparisons of cost in your answer. *(16 marks)*

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2. Answer **all** parts of this question:

a) Explain how mean arterial pressure (MAP) is calculated using the systolic arterial blood pressure (SAP) and diastolic arterial blood pressure (DAP). *(2 marks)*

b) Explain how accuracy of this MAP calculation is affected by patient heart rate. *(1 mark)*

c) Using an appropriate diagram, describe how to perform a 'square wave test', explain what this is for, and how overdamping and underdamping would be identified. *(5 marks)*

d) Identify cause(s) of underdamped and overdamped fluid-filled monitoring systems. *(4 marks)*

e) Define pulse pressure and use an equation to relate the **two (2)** main factors that determine pulse pressure. *(2 marks)*

f) List **two (2)** causes **each** of a narrow pulse pressure and a high (wide) pulse pressure. *(4 marks)*

g) Describe the theory behind, and potential clinical utility of, pulse pressure variation (PPV) in anaesthetised patients. *(4 marks)*

h) List **four (4)** techniques specifically used for measurement of cardiac output (CO). Describe how **each** technique is performed and provide **one (1)** limitation for **each** methodology listed (do not list the same limitation for multiple methodologies). *(16 marks)*

i) Once the cardiac output is measured, oxygen delivery (DO_2) and oxygen consumption (VO_2) can be calculated. State the formulas for calculating these two oxygen-derived variables. *(3 marks)*

j) Define systemic vascular resistance (SVR) and provide a formula for its calculation following determination of patient CO. *(2 marks)*

k) Define pulmonary artery occlusion pressure, how is it measured, and how can it be helpful in assessment of critically ill patients? Include **four (4)** factors that could result in deviation of pulmonary artery occlusion pressure from normal, and the nature of that deviation. *(5 marks)*

Continued over page

3. Answer **all** parts of this question:

a) Discuss glucagon's role in the pathophysiology of diabetic ketoacidosis (DKA). *(6 marks)*

b) Describe synthetic pathways of **each** of the ketones. Include in your answer the names of the **three (3)** ketones. (*3 marks)*

c) The nitroprusside reaction test is used to detect ketones in blood, plasma and urine. Explain how the nitroprusside reaction test can be negative despite the presence of ketones in the sample. *(2 marks)*

d) Patients with diabetic ketoacidosis are described as having a high anion gap (normochloraemic) metabolic acidosis.

Answer **all** parts of this sub-question:

i. Provide the formula for anion gap. *(1 mark)*

ii. Serum bicarbonate is expected to decrease in the presence of elevated serum anions. Explain why this occurs. *(1 mark)*

iii. List **four (4)** other causes of high anion gap metabolic acidosis. *(4 marks)*

e) Describe the pathophysiology of pseudohyponatraemia. Include in your answer, the expected degree of decrease in sodium, relative to increase in glucose. *(6 marks)*

f) You are treating a dog with diabetic ketoacidosis with the following laboratory values:

- Na^+: 132 mmol/L
- Cl^-: 106 mmol/L
- K^+: 5.2 mmol/L
- blood glucose: 38.5 mmol/L

For this patient, calculate the following two values. Show all workings:

i. corrected sodium *(3 marks)*

ii. corrected chloride. *(3 marks)*

Question 3 continued over page

g) List **four (4)** reasons for hyperkalaemia associated with diabetic ketoacidosis. *(2 marks)*

h) Discuss the mechanisms by which insulin therapy and fluid therapy decreases serum potassium and phosphorus. *(2 marks)*

i) Severe hypophosphataemia (< 0.3 mmol/L) is a possible complication of the treatment of diabetic ketoacidosis.

Answer **both** parts of this sub-question:

i. Describe **two (2)** effects of severe hypophosphataemia on the red blood cells and the possible clinical consequences. *(2 marks)*

ii. List **two (2)** effects of severe hypophosphataemia on the neuromuscular system. *(1 mark)*

j) Outline a general approach to initial fluid therapy and potassium supplementation in patients with diabetic ketoacidosis. Include in your answer the type(s) of fluid you would use (for example, isotonic). *(7 marks)*

k) Outline a general approach to insulin therapy in patients with diabetic ketoacidosis. *(5 marks)*

Continued over page

4. Answer **all** parts of this question:

a) Regarding von Willebrand disease (vWD):

i. Outline the pathophysiology of the disease. *(4 marks)*

ii. Briefly explain how the disease is classified. List at least **two (2)** dog breeds predisposed to **each** type of vWD. *(4 marks)*

iii. State the typical pattern of bleeding for dogs with vWD. *(1 mark)*

iv. Name the definitive diagnostic test for vWD. *(1 mark)*

v. Identify the pharmacologic therapy that can be used for dogs with vWD and briefly explain how is it used. *(2 marks)*

vi. Name the blood component that is most efficient for the treatment of vWD and explain how it is made. *(2 marks)*

b) Regarding haemophilia A:

i. State the aetiology of the disease. *(2 marks)*

ii. Briefly explain how the disease is classified. *(2 marks)*

iii. State the typical pattern of bleeding for dogs with haemophilia A. *(2 marks)*

iv. Name the definitive diagnostic test for haemophilia A. *(1 mark)*

c) Regarding Glanzmann's thrombasthenia:

i. Outline the pathophysiology of the disease. *(2 marks)*

ii. List **one (1)** dog breed predisposed to Glanzmann's thrombasthenia. *(1 mark)*

iii. State the typical pattern of bleeding for dogs with Glanzmann's. *(1 mark)*

iv. Name the definitive diagnostic test for Glanzmann's thrombasthenia. *(1 mark)*

Question 4 continued over page

d) Regarding acute traumatic coagulopathy:

i. Describe the epidemiology and pathophysiology of the disease in human patients. *(9 marks)*

ii. Discuss the prevailing clinical approach to treating acute traumatic coagulopathy in human medicine, including consideration of evidence for the use of antifibrinolytic drugs. *(6 marks)*

iii. Summarise the evidence regarding the potential existence of acute traumatic coagulopathy in veterinary patients. *(7 marks)*

5. A two-year-old male neutered cat is presented for evaluation of a two-day history of lethargy and inappetence. Screening laboratory tests reveal marked azotaemia and isosthenuria with inactive urine sediment, prompting a diagnosis of acute kidney injury (AKI).

Answer **all** parts of this question:

a) List at least **four (4)** broad categories of possible underlying conditions/aetiologies for AKI in this cat, and give examples under **each** category to include at least **ten (10)** specific examples. *(7 marks)*

b) Describe the pathophysiology of AKI. *(10 marks)*

c) Compare and contrast **two (2)** grading schemes for AKI that are used in human medicine. *(10 marks)*

d) Compare and contrast **two (2)** grading schemes for AKI that are specifically described in veterinary patients. *(8 marks)*

e) Define the term biomarker and identify **two (2)** novel urinary biomarkers that have been evaluated in veterinary patients. *(3 marks)*

f) During hospitalisation, the cat's urine output drops precipitously. Describe at least **three (3)** pharmacologic interventions that could be used to improve urine output. Include specific mechanism of action for **each** drug and potential adverse effects. *(10 marks)*

End of paper