



Australian and New Zealand College of Veterinary Scientists

Fellowship Examination

June 2012

Veterinary Anaesthesia and Critical Care Paper 1

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

Time allowed: **Three (3)** hours after perusal

Answer your choice of any **SIX (6)** questions from the eight questions **ONLY**

All questions are of equal value

Answer **SIX** questions each worth 30 markstotal 180 marks

Paper 1: Veterinary Anaesthesia and Critical Care

Answer SIX (6) questions from eight (8) questions only

1. *Pharmacokinetics* is the quantitative study of the absorption, distribution, metabolism and excretion of injected and inhaled drugs and their metabolites.

Answer **all** subparts of this question:

- a) Define 'bioavailability'. List the factors which determine the bioavailability of a drug. (2 marks)
- b) Define 'volume of distribution' (2 marks), state the units commonly used to describe it (2 marks), list the major factors influencing drug volume of distribution (2 marks) and briefly explain its clinical significance (2 marks).
- c) Define 'clearance' (2 marks), state the units commonly used to describe it (2 marks), list major factors influencing drug clearance (2 marks) and briefly explain its clinical significance (2 marks).
- d) Define 'half-life' (2 marks), state the units commonly used to describe it (2 marks), list major factors influencing drug half-life (2 marks) and briefly explain its clinical significance (2 marks).
- e) Define and briefly explain the concept of 'context-sensitive half-time'. List **one (1)** injectable anaesthetic agent with a relative insensitive context-sensitive half time and **one (1)** injectable anaesthetic agent with a relatively significant context-sensitive half time (4 marks).

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

- a) Describe the mechanism of action of the benzodiazepine class of drugs; include in your answer details of the receptors activated by this class of drug and the clinical and pharmacological effects of receptor activation. *(10 marks)*
- b) Describe the known sedative and cardiopulmonary effects of intravenous diazepam when used as a sole agent in the dog, cat and horse. *(6 marks)*
- c) Benzodiazepine drugs are commonly used for the emergency treatment of seizures for dogs when intravenous access is unavailable. List **two (2)** routes of administration (other than intravenous, intramuscular and subcutaneous) that have been reported to be useful in veterinary medicine. *(2 marks)*
- d) Compare the benzodiazepine drugs, **midazolam** and **diazepam** with regard to their lipid solubility, routes of administration and commercial preparations. *(8 marks)*
- e) Name **one (1)** benzodiazepine antagonist agent and briefly describe **three (3)** clinical situations in which it has been described to be useful in veterinary medicine. *(4 marks)*

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

- a) Describe in detail, using illustrations and diagrams, how a pulse oximeter works. *(10 marks)*
- b) End tidal carbon dioxide can be measured using a variety of methods. Briefly describe how **two (2)** different types of end tidal carbon dioxide analysers work. *(5 marks)*
- c) Briefly describe how a pH electrode in a blood gas analyser works. *(5 marks)*
- d) Using illustrations and diagrams, describe the Mapleson classification of breathing systems. *(10 marks)*

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4. The appropriate choice and administration of synthetic colloids requires a thorough understanding of the mechanisms that control trans-vascular fluid shifts and a sound knowledge of commercially available synthetic colloids.
- a) Briefly describe the **two (2)** primary processes governing capillary fluid exchange. Add to your explanation any relevant equation and/or law that may predict trans-vascular fluid movement. *(10 marks)*
 - b) Based on the principles discussed in 4a) above, explain the difference in the duration of effect of colloids and crystalloids for intravascular volume expansion. *(4 marks)*
 - c) Define **two (2)** factors related to individual synthetic colloid formulation that influence the duration of vascular volume expansion. *(4 marks)*
 - d) Briefly explain the pharmacokinetics of artificial colloid molecules after reaching the intravascular space. *(4 marks)*
 - e) List **four (4)** clinical scenarios where synthetic colloid use is contraindicated and explain why their use is not recommended. *(8 marks)*

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

- a) You are asked by a drug company to investigate the analgesic properties of a new analgesic agent for cattle, in a clinical setting for publication in a peer-reviewed journal. You are expected to conduct the trial in accordance with ‘**Good Clinical Practice**’ (GCP) guidelines.

Briefly define the concepts of GCP; explain ‘the 3R’s of animal research’; outline the design of your planned clinical trial and include a list of the information (eg data from previous studies) you would require before commencing the trial. (20 marks)

- b) Match the statistical test with the correct statistical procedure: (5 marks)

- i. Mann Whitney U-Test
- ii. Paired t test
- iii. Analysis of variance
- iv. Regression analysis
- v. Chi Square Test

- A) Comparing paired observations of a numerical variable
- B) Comparing three or more groups of numerical variable
- C) Categorical variable, comparing proportions in independent groups
- D) Comparing two independent groups, numerical variable, non-parametric test
- E) Investigate linear relationship between a variable x measured without error and a dependent variable y

- c) Briefly define the following terms as they are used in medical statistics:

(5 marks)

- i. Confidence interval
- ii. Standard error
- iii. Standard deviation
- iv. Type I error
- v. Type II error

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6. Answer **all** subparts of this question:
- a) Describe the anatomy and the functions of the respiratory system in mammals from the nose to the alveoli. (10 marks)
 - b) Discuss in detail, the transport/movement of oxygen from the atmosphere to the cell, including which factors affect the oxygen tension in each of the stages. (15 marks)
 - c) Use a graph, including numerical values, to illustrate the PO_2 changes that occur with the movement of oxygen from the atmosphere to the cell. (5 marks)
7. Answer **all** subparts of this question:
- a) Describe the main structures and pathways involved in the transduction, transmission and modulation of physiologic pain from a peripheral site of injury (for example, a paw or footpad injury) to the central nervous system. You may include diagrams or illustrations in your answer. (20 marks)
 - b) Define *wind-up* (spinal facilitation of pain), and describe any clinical, therapeutic and anatomical consequences and key receptors involved. (8 marks)
 - c) Indicate **two (2)** pharmacological agents thought to play a role in the prevention of *wind-up*. (2 marks)
8. Answer **all** subparts of this question:
- a) Define the ‘Hagen–Poiseuille’ equation. Using examples explain where this principle is clinically relevant in anaesthesia. (7½ marks)
 - b) Define the ‘Fick’ principle and describe how this principle can be applied to non-invasive cardiac output monitoring. (7½ marks)
 - c) Define the ‘Bernoulli’ principle and the ‘Venturi’ effect (you may use a diagram as part of your answer) and for one of these, give an example of its use in anaesthesia. (5 marks)
 - d) Outline the working principle of the oxygen concentrator (you may use a diagram as part of your answer). (5 marks)
 - e) Using illustrations/diagrams describe how a ‘bag/bellows in a box’ ventilator works during inspiration and expiration. (5 marks)

End of paper



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Veterinary Anaesthesia and Critical Care
Paper 2

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Paper 2: Veterinary Anaesthesia and Critical Care

Answer SIX (6) questions from eight (8) questions only

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

- a) Briefly state the mechanism of action of the following drugs when used during cardiopulmonary cerebral resuscitation: *(4 marks)*
 - i. epinephrine
 - ii. atropine
 - iii. vasopressin
 - iv. amiodarone.

- b) State when and how defibrillation should be carried out during CPR. Explain how defibrillation affects the myocardium and how it can treat an arrhythmia. *(6 marks)*

- c) Briefly discuss why is it hypothesised that vasopressin is a better drug for advanced life support in CPR than adrenaline *(3 marks)* citing evidence from the relevant published literature. *(7 marks)*.

- d) List ten individual causes of tachypnoea during general anaesthesia. *(10 marks)*

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2. You are required to anaesthetise an eight-year-old male castrated Maine Coon cat for a dental procedure requiring multiple dental extractions. The cat was diagnosed with primary hypertrophic cardiomyopathy (HCM) six months ago via echocardiography, however is currently asymptomatic and receiving no current medical treatment. During your physical examination, you notice a II/VI systolic heart murmur and a heart rate of approximately 200 beats per minute on auscultation. The cat is otherwise healthy; a complete blood cell count and biochemistry profile results are normal and the animal's demeanour in the clinic is quiet but friendly.

Answer **all** subparts of this question:

- a) Describe the pathophysiology of HCM in cats. *(12 marks)*
 - b) List the main goals of therapeutic intervention in symptomatic cats. *(5 marks)*
 - c) List the main goals of therapeutic intervention in asymptomatic cats. *(1 mark)*
 - d) Describe **six (6)** physiological aims in the anaesthetic management of this patient. *(6 marks)*
 - e) Outline an anaesthetic drug and analgesic plan for this cat, including the pre, peri and postoperative care and monitoring. *(6 marks)*
3. You are asked to anaesthetise a horse for phacoemulsification.

Answer **all** subparts of this question:

- a) Describe your considerations *(2 marks)* and anaesthetic regime for this case. *(8 marks)*
- b) Describe how you would monitor non depolarizing neuromuscular blockade in an adult horse, citing relevant published veterinary literature where appropriate. *(6 marks)*
- c) Describe **two (2)** parameters that can be used to ascertain adequate reversal of a neuromuscular blockade, citing relevant published veterinary literature where appropriate. *(8 marks)*
- d) List the factors that can affect neuromuscular blockade. *(6 marks)*

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4. Answer **all** subparts of this question:
- a) Describe your anaesthetic drug protocol for a sheep to be anaesthetised for a cardiac valve replacement surgical procedure. List the specialised anaesthetic equipment you would require. *(15 marks)*
 - b) Discuss the proposed mechanism for the development of post alpha 2 agonist pulmonary oedema in sheep, with reference to the published relevant veterinary literature. *(12 marks)*
 - c) What is the mechanism of action of the following listed drugs used during cardiopulmonary bypass? *(1 mark each)*
 - i. heparin
 - ii. cardioplegia solution
 - iii. protamine.

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5. A 13-year-old male Fox Terrier found unconscious in the owner's backyard presented unresponsive, tachycardic (HR 160 bpm), with mild fasciculation of the muscles of the face, lateral nystagmus and mydriasis and evidence of severe haemorrhagic diarrhoea. The PCV is 60% and TP measured by refractometry is 80g/L (8.0g/dl). The emergency clinician is considering toxicity, acute renal failure or central nervous system disease as the potential aetiology. When the blood gas sample was collected, a facemask was being held firmly around the dog's muzzle connected to oxygen with the flow meter set at 3 litres/min. The rectal temperature was 37.8°C.

- a) Describe the abnormalities found on the blood gas analysis results below. Define the acid-base and electrolyte abnormalities and determine the acid base status of the patient. (8 marks)

Blood Gas and Electrolytes (Venous sample) – Istat CG8 – Canine

Time of Sampling:7.30am

Parameter	Result	Reference range			Comments
		Venous	Arterial	Units	
pH	6.580	7.35 – 7.46			
pCO ₂	22.0	27 - 50	32 - 43	mmHg	
pO ₂	112	43 - 63	80 - 105	mmHg	
BE	<-30	-5 - +1			
HCO ₃	2.1	18 - 26			mmol/L
TCO ₂	<5	17 - 28			mmol/L
sO ₂	84	N/A			%
Na	154	140 - 150			mmol/L
K	8.9	3.9 – 4.9			mmol/L
iCa	1.3	1.25 – 1.5			mmol/L

- b) Compare the traditional approach to acid-base evaluation, based on the Henderson-Hasselbalch equation, to the non-traditional approach (Stewart's model). (4 marks)
- c) List your options for addressing the hyperkalaemia in this patient, describing your priorities, agents of choice and mechanisms of action for each selected treatment. (6 marks)
- d) List **three (3)** variables from the above blood gas analysis result that are directly measured from the blood sample. (3 marks)
- e) List **three (3)** variables from the above blood gas analysis result that are derived from the calculations. (3 marks)
- f) List **two (2)** additional parameters you could obtain from the remaining blood sample from the patient that would provide you with relevant information regarding prognosis and acid-base status. Justify your answer. (6 marks)

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6. You are asked to anaesthetise a black swan (*Cygnus atratus*) from the local Zoo for surgical repair of a closed transverse mid diaphyseal radius and ulna fracture.

Answer **all** subparts in this question:

- a) List **four (4)** specific anatomical and physiological differences found between aquatic avian species and domestic mammals. (4 marks)
- b) Describe the potential impact of the differences listed above on your anaesthetic management. (4 marks)
- c) What mechanisms play a role in a bird's ventilator response to carbon dioxide, when compared to mammals? (2 marks)
- d) Describe the main differences between the avian and mammalian lungs. (10 marks)
- e) List **three (3)** options for intravenous access in large waterfowl. (3 marks)
- f) List **one (1)** indication for the use of anticholinergics in avian species. List **one (1)** advantage and **one (1)** disadvantage related to the use of anticholinergics in avian species. (3 marks)
- g) List **two (2)** anaesthetic options or agents for induction of anaesthesia in this species, with advantages and disadvantages for each option. (4 marks)

7. Answer **all** subparts of this question:

- a) List the pathophysiologic causes of hypoxaemia. For each point on your list, give examples of disease states that can cause the changes and state whether or not the change would be oxygen responsive. (10 marks)
- b) Define a 'recruitment manoeuvre'. Briefly explain how you could perform this in a horse. Briefly describe the advantages and disadvantages of performing a recruitment manoeuvre in a hypoxaemic horse under general anaesthesia, citing the relevant published veterinary literature. (15 marks)
- c) Briefly describe other techniques that may be used to correct hypoxaemia in the anaesthetised horse, citing the relevant veterinary literature. (5 marks)

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8. You are called to the large animal clinic at the university to place an epidural catheter. The patient is a pregnant mare that has suffered a laceration of the hind limb and is in severe discomfort, despite systemic administration of non-steroidal anti-inflammatory agents. The large animal clinicians would like to repeatedly use the epidural catheter to administer epidural morphine.
- a) Describe using a diagram and illustrations, the anatomical structures relevant to a caudal epidural injection in the horse, including the site of termination of the spinal cord and its structures. *(12 marks)*
 - b) Describe in detail the technique for epidural catheter placement. *(10 marks)*
 - c) List **four (4)** potential complications or adverse outcomes that may result from epidural drug administration in horses. *(4 marks)*
 - d) Explain why morphine is considered the opioid drug of choice for epidural administration in comparison to other drugs of the same class. *(4 marks)*

End of paper