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Research Animal Anaesthesia Network (RAAN)

Position Statement

Content on peri-operative care for publications, including animal husbandry, animal preparation, anaesthesia, analgesia, pain assessment and post-procedural monitoring and interventions.

RAAN endorses both the PREPARE (1) and ARRIVE 2.0 (2, 3) guidelines in the promotion of experimental replicability and reproducibility. Full details of peri-operative animal care within a scientific report are essential to inform readers of all factors likely to influence study results. Furthermore, readers should be able to satisfy themselves that animal care and welfare have been optimised, adverse events identified, and appropriate interventions agreed upon *before* commencing animal-based research.

Resources:

1) *PREPARE*
   https://norecopa.no/prepare
2) *ARRIVE*
   https://arriveguidelines.org/resources/author-checklists

   https://arriveguidelines.org/arrive-guidelines/experimental-procedures/9a/explanation

Application of resources:

Based on the ARRIVE 2.0 guidelines, examples of content for the methodology section of a publication are provided below. Where a detailed description of peri-operative care is not included in the main manuscript, a brief or limited description should be provided and the detailed description made available as part of the supplementary material.

ARRIVE component	Detailed example	Brief example	Limited example
Animal husbandry			
Time since introduction to the facility Group or individual housing Diet	Twelve female Large white x Landrace x Duroc pigs weighing 30 (± 5) kg were used in this study. The pigs were 10 weeks of age, sourced from a commercial farm and acclimatized to the facility at the [Institution] for 2 weeks prior to surgery. Pigs were group-housed indoors in raised communal pens (4 x 5 metres; 3 pigs per pen), fed a grower diet twice daily (minimum 18.5% protein (https://thompsonandredwood.com.au/pig-feeds/grower) with fresh pumpkin and apples, and allowed free access to tap water. Environmental enrichment was provided with music during the day, various toys for play and daily human interaction. The room was maintained at 22±2 °C and a 12:12 hour light:dark cycle.	Twelve female Large white x Landrace x Duroc pigs weighing 30 (± 5) kg were used in this study. The pigs were 10 weeks of age, sourced from a commercial farm and acclimatized to the facility at the [Institution] for 2 weeks prior to surgery. They were fed a grower diet supplemented with fruit and had free access to water.	Twelve female Large white x Landrace x Duroc pigs weighing 30 (± 5) kg were used in this study. The pigs were 10 weeks of age, sourced from a commercial farm and acclimatized to the facility at the [Institution] for 2 weeks prior to surgery.

Animal preparation			
Training or acclimatisation strategies Diet changes Withholding period for food and water	The pigs were trained during the 2-week acclimatisation period using positive reinforcement methods to enter the weigh crate and to be handled over the dorsum for bandage changes post procedure. Before general anaesthesia food was withheld for 12 hours but free access to water was allowed.	Pigs were habituated to weighing and handling pre procedure. Before general anaesthesia food was withheld for 12 hours but free access to water was allowed.	Before general anaesthesia food was withheld for 12 hours but free access to water was allowed.
Anaesthesia			
Pre-anaesthetic medication Induction of anaesthesia Maintenance of anaesthesia All drugs: Drug name Dose mg/kg Route of administration Timing of administration	No pre-anaesthetic medication was administered. Anesthesia was induced with a combination of azaperone (1 mg kg^{-1}, Stresnil 40 mg mL^{-1}, Elanco, Australia), zolazepam, tiletamine (2 mg kg^{-1}, Zoletil 100, Virbac Australia Pty. Ltd., Australia) and xylazine (1 mg kg^{-1}, Ilium Xylazil 100 mg mL^{-1}, Troy Laboratories Australia Pty. Ltd., Australia) by intramuscular injection in the trapezius muscle of the neck. Five to 10 minutes later, with the pig in sternal recumbency, a branch of the right auricular vein was cannulated. Oxygen was delivered by facemask for at least 3 minutes. If required, propofol (1-2 mg kg^{-1}, Vetofol 1%, Norbrook	Anaesthesia was induced with a combination of azaperone (1 mg kg^{-1}, Stresnil 40 mg mL^{-1}, Elanco, Australia), zolazepam, tiletamine (2 mg kg^{-1}, Zoletil 100, Virbac Australia Pty. Ltd., Australia) and xylazine (1 mg kg^{-1} Xylazine, Ilium Xylazil 100 mg mL^{-1}, Troy Laboratories Australia Pty. Ltd., Australia) by intramuscular injection. If required, propofol (1-2 mg kg^{-1}, Vetofol 1 %, Norbrook Laboratories Ltd., Australia) was administered by intravenous injection to facilitate tracheal intubation. General anaesthesia was maintained with isoflurane (0.5-2%, Attane Isoflurane 1mL mL^{-1},	Anaesthesia was induced with a combination of azaperone (1 mg kg^{-1}), zolazepam, tiletamine (2 mg kg^{-1}) and xylazine (1 mg kg^{-1} Xylazine) by intramuscular injection. If required, propofol (1-2 mg kg^{-1}) was administered by intravenous injection to facilitate tracheal intubation. General anaesthesia was maintained with isoflurane (0.5-2%) in oxygen.

Monitoring and supportive care during anaesthesia	Laboratories Ltd., Australia) was administered by intravenous injection to facilitate tracheal intubation with a 7.0 mm internal diameter cuffed endotracheal tube (Portex, Smiths Medical, Minnesota, U.S.A.). General anaesthesia was maintained with isoflurane (0.5-2%, Attane Isoflurane 1mL mL^{-1}, Bayer Australia) in oxygen delivered via a circle breathing system. Volume-controlled mechanical ventilation was commenced immediately after tracheal intubation and adjusted to produce normocapnia (end-tidal CO_2 4.67 -6.00 kPa [35 to 45 mmHg]). Positive end-expiratory pressure was set at 5 cmH_2O. Intraoperative monitoring included oxyhemoglobin saturation and pulse rate as measured with a pulse oximeter placed on the pinna; capnography; non-invasive blood pressure; pharyngeal temperature and electrocardiography (Surgivet V9203 multivariable monitor, Polymount GCX corporation, U.S.A.). These variables were recorded every 5 minutes on a paper anaesthetic record.	Bayer Australia) in oxygen delivered via a circle breathing system.	

Analgesia			
All drugs: Drug name Dose mg kg^{-1} Route of administration Timing of administration Frequency of administration Duration of administration	Along with the analgesia from tiletamine and xylazine, a multi-modal analgesia regime was achieved with morphine (0.2 mg kg^{-1}, Morphine Sulfate Injection BP 10 mg mL^{-1}, Hospira Australia) administered by intramuscular injection soon after intubation, and 4 and 8 hours later. In addition, inverted 'L' blocks on each flank (5 mL on each side [6 injections each side] = total 10 mL were performed using 2% lidocaine with epinephrine 1:80,000, Xylocaine with Adrenaline, AstraZeneca Pty Ltd, North Ryde, NSW, Australia). Transdermal fentanyl patches (50 µg h^{-1} patch per pig, Durogesic, Jansen, Macquarie Park, NSW, Australia) were placed at the end of surgery and replaced three and six days later.	A multi-modal analgesia regime was achieved with morphine (0.2 mg kg^{-1}, Morphine Sulfate Injection BP 10 mg mL^{-1}, Hospira Australia) administered by intramuscular injection soon after intubation, and 4 and 8 hours later. In addition, inverted 'L' blocks on each flank performed using 2% lidocaine with epinephrine 1:80,000, Xylocaine with Adrenaline, AstraZeneca Pty Ltd, North Ryde, NSW, Australia). Transdermal fentanyl patches (50 µg h^{-1} patch per pig, Durogesic, Jansen, Macquarie Park, NSW, Australia) were placed at the end of surgery and replaced three and six days later.	Multimodal analgesia was achieved by administering tiletamine, xylazine, morphine, and fentanyl systemically, along with lidocaine infiltration at the surgical sites.

Other drugs and peri-operative management			
Drug name Dose mg/kg Route of administration Timing of administration Frequency of administration Duration of administration	Prophylactic antibiotic therapy was provided with amoxycillin (20 mg kg^{-1}, Betamox LA, Norbrook Laboratories, Tullamarine, Victoria, Australia) by subcutaneous injection immediately after induction of anaesthesia. Hartmann's solution (Compound Sodium Lactate, Fresenius Kabi Australia Pty. Ltd., Australia) was administered at 10 mL kg^{-1} h^{-1} IV into the auricular vein during anaesthesia.	Prophylactic antibiotic therapy was provided with amoxycillin (20 mg kg^{-1}, Betamox LA, Norbrook Laboratories, Tullamarine, Victoria, Australia) by subcutaneous injection immediately after induction of anaesthesia.	Prophylactic antibiotic therapy was provided with amoxycillin (20 mg kg^{-1}) by subcutaneous injection immediately after induction of anaesthesia.
Pain assessment and post-procedural monitoring			
Method Timing Frequency Interventions	Post-operative pain and the animal's demeanour were evaluated twice daily with specific observations of behaviour and interactions with personnel, breathing rate and effort, appetite and water intake, appearance of the surgery site, mucous membrane colour, gait and posture. The pigs were weighed once a week, and their body temperature was measured twice daily for the first three days and then twice a week. Veterinary assessment was arranged if any abnormalities were identified. Rescue analgesia was morphine 0.2 mg/kg by intramuscular injection.	Post-operative pain and the animal's demeanour were evaluated twice daily by assessing physiological and behavioural variables. The pigs were weighed weekly, and their body temperature was measured twice daily for the first three days and then twice a week. Veterinary assessment was arranged if any abnormalities were identified.	Post-operative pain and the animal's demeanour were evaluated twice daily by assessing physiological and behavioural variables. Veterinary assessment was arranged if any abnormalities were identified.

The animal's fate			
	At the end of the experiment the pigs were euthanized. Aazaperone, zolazepam, tiletamine and xylazine were injected by intramuscular injection (see doses above) followed by the intravenous injection of pentobarbitone (160 mg kg^{-1}, Lethabarb Euthanasia Injection, 325 mg mL^{-1}, Virbac Australia Pty Ltd, NSW, Australia).	At the end of the experiment the pigs were euthanized. Aazaperone, zolazepam, tiletamine and xylazine were injected by intramuscular injection (see doses above) followed by the intravenous injection of pentobarbitone (160 mg kg^{-1}, Lethabarb Euthanasia Injection, 325 mg mL^{-1}, Virbac Australia Pty Ltd, NSW, Australia).	At the end of the experiment the pigs were euthanased. Azaperone, zolazepam, tiletamine and xylazine were given by intramuscular injection (see doses above) followed by intravenous injection of pentobarbitone (160 mg kg^{-1}).

References:

1. Smith AJ, Clutton RE, Lilley E, Hansen KEA, Brattelid T. PREPARE: guidelines for planning animal research and testing. Laboratory Animals. 2018;52(2):135-41.
2. ARRIVE. ARRIVE guidelines https://arriveguidelines.org/2026 [Available from: https://arriveguidelines.org/.
3. Percie du Sert N, Hurst V, Ahluwalia A, Alam S, Avey MT, Baker M, et al. The ARRIVE guidelines 2.0: Updated guidelines for reporting animal research. PLOS Biology. 2020;18(7):e3000410.