ASSOCIATION OF VETERINARY ANAESTHETISTS

AVA SPRING MEETING 2022 NAFPLIO

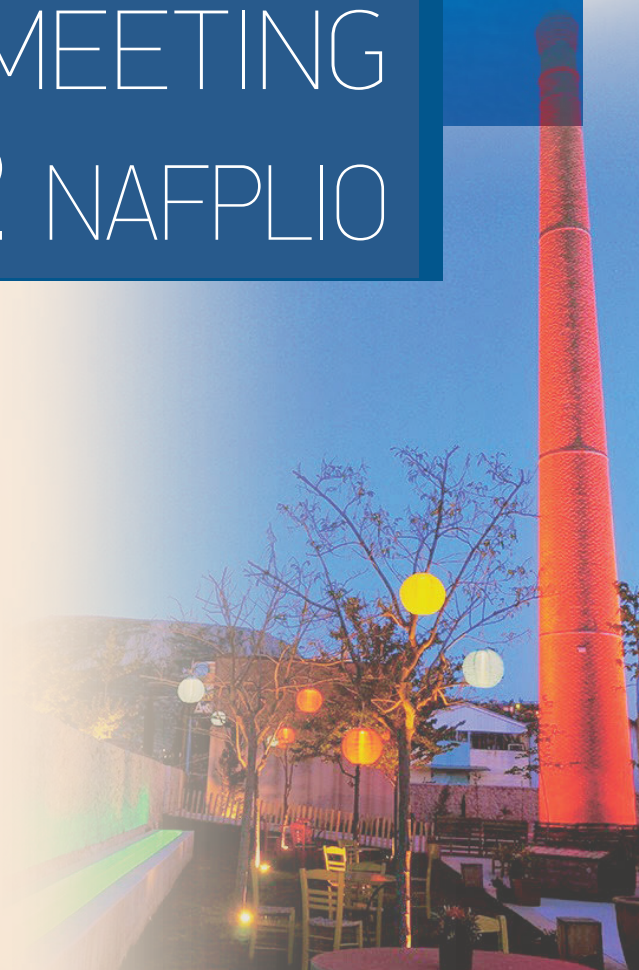
May 18th - 20th 2022

Fougaro Artcenter

NAFPLIO, GREECE

May 21st -22nd 2022

Post Congress Meeting for Greek Vets



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Welcome Address

Dear friends,

Two years after the last "live" AVA Meeting in Dublin in 2020, it is a great pleasure to organise the **AVA 2022 Spring Meeting in Nafplio**. The Meeting of our Association comes back to in-person participation reality, and the world comes back to a normality. The best news is that reasoning, sciences, and human intelligence finally prevailed, and showed that the only way we survive as creatures is to use our best organ we developed through the centuries of evolution: our brain.

Nafplio, the first capital city of Greece, about two centuries ago, is a small, picturesque city, with beautiful sights, which I am sure you will greatly enjoy during your stay here.

The topic of the scientific programme of the conference is "**Monitoring**". We tried to gather renowned scientist from around the globe to share with us current knowledge on monitoring techniques in Veterinary Anaesthesia.

In the proceedings you will also find a list of 66 contributions, oral and poster, of young scientists, who will present their scientific work during the conference. This was a big number of high-quality abstracts, and we tried to accommodate as many as possible oral presentations into our scientific programme

The Meeting also includes a pre-congress day, with seminars on monitoring, as well as a post-congress refresher course on monitoring for the Greek vets.

Without sponsorship this Meeting would not have been possible and thus, on behalf of the Organizing Committee and the delegates, I would like to express our genuine appreciation to our sponsors, namely our platinum sponsor VAS, our silver sponsors Burtons, Dechra, Improve International, and Gerolymatos International/Boehringer Ingelheim, Zoetis, PetLine, Virbac, Elanco Hellas & Altavet.

Administrative support is also important, and many thanks are due to all the members of the Organizing Committee, George Kazakos, Telis Anagnostou, and Dimitris (our Dimitris) Raptopoulos, as well as our Secretariat "Global Events" for undertaking most of the organization of this event.

Finally, I would like to express my sincere gratitude to a friend and partner **Kelly Pavlidou** without her inspiration, dedication, zealous efforts and constant vigilance, this congress would have never been materialized.

Best regards,
Ioannis Savvas
May 2022

Organizing Committee

Ioannis Savvas DVM, PhD
Professor of Veterinary Anaesthesia, Analgesia, and Intensive Care
School of Veterinary Medicine, Aristotle University of Thessaloniki, Greece

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Associate Professor School of Veterinary Medicine, Aristotle University of Thessaloniki, Greece

Dimitris Raptopoulos DVM, PhD, Dipl. ECVAA
Professor Emeritus School of Veterinary Medicine, Aristotle University of Thessaloniki, Greece

Programme

Pre-congress day

Wednesday, May 18th, 2022 - Gallery Hall

Moderator: **Tilemahos Anagnostou**

09:30-10:15	Pulse Oxymetry: basics, techniques and technicalities **Peter Kronen**
10:15-11:00	Blood pressure: Can anybody ever know what is it? **Peter Kronen**
11:00-11:30	Coffee break
11:30-12:15	Blood gases analysis: quick and dirty! **Peter Kronen**
12:15-13:00	Terms and conditions (physiologic & pathophysiologic) - Interactive discussion around respiratory monitoring from A-Z **Martina Mosing**
13:00-14:00	Lunch break
14:00-14:45	Terms and conditions (physiologic & pathophysiologic) - Interactive discussion around respiratory monitoring from A-Z **Martina Mosing**
14:45-15:30	Terms and conditions (physiologic & pathophysiologic) - Interactive discussion around respiratory monitoring from A-Z **Martina Mosing**
20:00	Welcome party

Thursday, May 19th, 2022

08:50-09:00	**Opening - Gallery Hall**	
	Moderator: **Ioannis Savvas**	
09:00-09:45	From One Health to One Welfare. A concept or a need? **Maria Linou**	
09:45-10:30	What We Want and What We Can! - Respiratory Monitoring in Anaesthesia! **Martina Mosing**	
10:30-11:00	Coffee break & Exhibition	
11:00-11:45	What anaesthesia monitoring equipment actually makes a difference to equine anaesthesia? **Karen Blissitt**	
11:45-12:30	Further distraction or real help? Using advanced gas monitoring in clinics **Annete Kutter**	
12:30-13:30	Lunch break - Poster session - AVA General Meeting	
	Gallery Hall	**Hall 9**
	Moderator: **Paul MacFarlane**	Moderator: **Polly Taylor**
13:30-13:45	**O59** - Effects of oral tasipimidine premedication on quality of anaesthesia induction and anaesthetic requirements with and without methadone and dexmedetomidine in Beagle dogs - Amon T., Kästner S., Söbbeler F., Tünsmeyer J., Saloranta L., Huhtinen M.	**O68** - A step forward in the fourth Confidential Enquiry into Perioperative Equine Fatalities (CEPEF4): data collection over 14 months using an internet-based method - Gozalo-Marcilla M., Bettschart-Wolfensberger R., Johnston M., Taylor P.M., Redondo J.I.
13:45-14:00	**O58** - Effects of tasipimidine pre-medication on blood pressure and perfusion in Beagle dogs anaesthetized with isoflurane with and without methadone and dexmedetomidine - Amon T., Huhtinen M., Tünsmeyer J., Noll M., Söbbeler F-J., Saloranta L., Kästner S.	**O69** - Mortality risks in horses undergoing standing sedation for surgery and advanced diagnostic imaging. Preliminary results of the fourth Confidential Enquiry into Perioperative Equine Fatalities (CEPEF4) - Gozalo-Marcilla M., Bettschart-Wolfensberger R., Johnston M., Taylor P.M., Redondo J.I.
14:00-14:15	**O44** - Fast sequence intubation protocol in healthy dogs induced with propofol and rocuronium - Trenholme H.N., Sakai D.M., Craig H.N., Torpy F., Reed R.A.	**O90** - Automated classification of behaviour in horses, preliminary results - Martin-Ciera A., Novak. M, Auer U.
14:15-14:30	**O56** - Evaluation of rocuronium-induced neuromuscular block on the patient state index in dogs anaesthetised with propofol - Sakai D., Reed R., Trenholme N., Torpy F., Craig H.A.	**O91** - Validation of a commercially available automated video tracking system for horses - Auer U., Ertelt K.
14:30-14:45	**O24** - An investigation into the detection of the pulse in conscious and anaesthetised dogs - Dagnall C., Wilson H., Khenissi L.	**O92** - Influence of experimentally induced endotoxemia on microcirculatory variables in horses - Sauter P.K., Steblaj B., Kästner S.B.R., Söbbeler F.J., Reiners J., Kutter A.P.N., Gutiérrez Bautista A.J., Neudeck S.

14:45-15:00	**O26** - Optimisation of cat neutering anaesthesia protocols for use in the community - Holgate A.C.P., Yates D.G., White K.L.	**O40** - Effects of endotracheal intubation on respiratory pattern and distribution of ventilation in anaesthetised horses - Moreno-Martinez F., Byrne D., Raisis A., Hosgood G., Waldmann A., Mosing M.
15:00-15:30	Coffee break & Exhibition	
	Moderator: **Olivier Levionnois**	Moderator: **Regula Bettschart-Wolfensberge**
15:30-15:45	**O57** - Propofol-induced reduction in the patient state index in dogs - Sakai D., Reed R., Trenholme N., Craig H.A., Torpy F.	**O41** - Effect of ketamine on xylazine based sedation in horses during standing ventriculocordectomy and laryngoplasty - Granados M.M., Quirós S., Caravaca E., Sánchez de Medina A., Funes F.J., Medina F., Gómez-Villamandos R.J., Navarrete R.
15:45-16:00	**O23** - The effect of remifentanil infusion on sevoflurane MAC_{NM} and bispectral index in dogs - Seddighi R., Geist A., Knych H., Sun X.	**O53** - Comparison of iatrogenic trauma to the upper airway in horses during endotracheal intubation using 2 different sized endotracheal tubes - Sidhu ABS, Rosanowski SM, Taylor AH
16:00-16:15	**O70** - Association between body mass and hypotension in dogs under general anaesthesia: a retrospective study of 1789 cases - Miller L., Duncan J.C., Handel I.G., Shaw D.J., McKenzie H.E., Greenhalgh S.N.	**O62** - Clinical comparison between subcutaneous and intramuscular repeated injection of dexmedetomidine in anaesthetized horses: preliminary investigation - Rabbogliatti V., Amari M., Brioschi F.A., Di Cesare F., Zani D.D., De Zani D., Ravasio G.
16:15-16:30	**O49** - Haemodynamic effects of pimobendan during general anaesthesia in dogs - Sández I., Redondo J.I., Gómez J.	**O64** - The effect of morphine on mechanical nociceptive thresholds in donkeys - Maney J.K., Escobar A., Dzikiti B.T., Bennett R.C.
16:30-16:45	**O77** - The pre-operative use of two different types of insulin in diabetic dogs undergoing phacoemulsification surgery: preliminary results - Papastefanou A., Fustero C., Redondo J.I., Rioja E.	**O66** - Comparison between the effects of two post-anaesthetic doses of medetomidine on characteristics of recovery from isoflurane anaesthesia in horses - Medina F., Navarrete R., Quirós-Carmona S., Sánchez de Medina A., Morgaz J., Caravaca E., Dominguez J.M., Granados M.M.
16:45-17:00	**O81** - Effect of gabapentin on propofol and isoflurane anaesthesia and perioperative analgesia in dogs - Georgiou S.G., Margeti C.D., Flouraki E., Meletis E.I., Pappa E.I., Sideri A.I., Galatos A.D.	**O84** - Phenylbutazone, flunixin and meloxicam clinical efficacy for lameness and laminitis in horses - Scicluna C.
20:30	**Gala dinner**	

Friday, May 20th , 2022

Gallery Hall

Moderator: **Apostolos Galatos**

09:30-10:15	Target-controlled infusion anaesthesia **Chrysanthi Sardeli**
10:15-11:00	Monitoring cardiovascular function using Doppler echocardiography; Can it guide management to improve outcomes? **Karen Blissitt**
11:00-11:30	Coffee break & Exhibition
11:30-12:15	Monitoring-based treatment of hypotension - the end of trial-and-error anaesthesia? **Annete Kutter**
12:15-13:00	That's your problem - professional responsibility of Anaesthesia Specialists in Monitoring **Peter Kronen**
13:00-14:30	Lunch break - Poster session

	Gallery Hall	**Hall 9**
	Moderator: **Rima Nadine Bektas**	Moderator: **Ilaria Cerasoli**
14:30-14:45	**O29** - Can cat carers reliably assess acute pain in cats using the Feline Grimace Scale? A large bilingual global survey - Monteiro B.P., Lee N.H.Y., Steagall P.V.	**O30** - Economic and environmental impact of reducing fresh gas flow rates in one veterinary hospital - Khenissi L., McFadzean W.
14:45-15:00	**O54** - The effects of sedation with dexmedetomidine - butorphanol and anaesthesia with propofol-isoflurane on Feline Grimace Scale scores - Watanabe R., Monteiro B.P., Ruel H.L.M., Cheng A., Marangoni S., Steagall P.V.	**O95** - Carbon footprint of a canine tibial plateau levelling osteotomy (TPLO) - preliminary results - Ryan A., Pierce J.M.T., Matchwick A., Cockburn E., West E.
15:00-15:15	**O85** - Construct validity, responsiveness, and reliability of the Feline Grimace. Scale in kittens - Cheng A.J., Malo A., Garbin M., Monteiro B.P., Steagall P.V.	**O63** - Comparison of intraperitoneal lidocaine and ropivacaine for postoperative analgesia in dogs undergoing major abdominal surgeries - Brioschi F.A., Rabbogliatti V., Amari M., Di Cesare F., Ferrari F., Romussi S., Ravasio G.
14:15-15:30	**O93** - Clinical Assessment of a supraglottic airway device in cats - Viscasillas J., Garcia A., Marti-Scharfhausen M., Cañon A., Hernandez E.Z., Martinez A., Redondo J.I.	**O67** - The pharmacokinetics of dexmedetomidine after perineural or single IV administration in anaesthetized dogs - Pavlica M., Kržan M., Nemec A., Kosjek T., Baš A., Seliškar A.
15:30-15:45	**O27** - Epidural anaesthesia-analgesia in dogs undergoing cholecystectomy: a single centre retrospective study - Sambugaro B., De Gennaro C., Hattersley R., Vettorato E.	**O31** - Comparison of hydromorphone vs. butorphanol for pain management in equine patients undergoing elective arthroscopy - Reed R., Trenholme N., Skrzypczak H., Chang K., Ishikawa Y., Barletta M., Quandt J., Sakai D.
15:45-16:15	Coffee break & Exhibition	

	Moderator: **Gwen Covey-Crump**	Moderator: **Simone Ringer**
16:15-16:30	**O34** - Pharmacokinetics of bupivacaine following administration by an ultrasound-guided transversus abdominis plane block in cats undergoing ovariohysterectomy - Garbin M., Javier B., Ruel H.L.M., Watanabe R., Monteiro B.P., Cagnardi P., Steagall P.V.	**O89** - Quadratus lumborum block in calves - a cadaveric study - Alonso B., Casteleyn C., Vanderperren K., Schauvliege S.
16:30-16:45	**O35** - Distribution of injectate spread using two approaches for an ultrasound-guided transversus abdominis plane block in cats: a cadaver and computed tomography study - Garbin M., Marangoni S., Finck C., Steagall P. V.	**O45** - A systematic review on the measurement properties of pain scoring instruments in farm animals - Tomacheuski R.M., Monteiro B.P., Evangelista M.C., Luna S.P.L., Steagall P.V.
16:45-17:00	**O37** - Updates on the anatomy of the brachial plexus in dogs: contralateral comparison and body weight correlation in a cadaveric study - Lambertini C., De Silva M., Grandis A., Martorelli M., Romagnoli N.	**O38** - Does opioid-free anaesthesia provide adequate analgesia within a multimodal protocol in cats undergoing ovariohysterectomy? - Rufiange M., Ruel H., Monteiro B., Watanabe R., Benedetti I.C.C., Benito J., Steagall P.V.
17:00-17:15	**O47** - Ultrasound-guided suprainguinal femoral nerve block in cat cadavers: a descriptive study - Trujanovic R., Angerer A., Marhofer P.	**O72** - A comparison of an opioid-free injectable anesthesia protocol with or without multimodal analgesia in kittens undergoing ovariohysterectomy - Malo A., Cheng A., Ruel H.L.M., Monteiro B.P., Lutevele N., Watanabe R., Garbin M., Steagall P.V.
17:15-17:30	**O55** - Retrobulbar block: an anatomical and computed tomography evaluation of two ultrasound-guided approaches in cat cadavers - Garbin M., Marangoni S., Finck C. Steagall P.V.	**O79** - Pharmacokinetics and behavioral effects of a single oral dose of trazodone in rabbits - Gibert A., Watanabe R., Desmarchelier M., Garbin M., Beaudry F., Benedetti I.C.
17:30-17:45	**O82** - A novel ultrasound-guided cranial segments of cervical plexus block in dogs - Cañón A., Viscasillas J., Aguilar N., Marti-Scharfhausen M., Hernandez E.Z., Martinez A., Redondo J.I., Garcia A.	**O73** - Comparison of invasive and modified oscillometric arterial blood pressure measurements in anaesthetised pigs undergoing magnetic resonance imaging - Calice I., Böhme F., Vogel C., Auer U.

List of posters

- P25 - **Ultrasound-guided saphenous nerve block in rabbits (Oryctolagus cuniculus): cadaveric study comparing two dye volumes** - Felisberto R., Flaherty D., Tayari H.
- P32 - **Disposable airway pressure manometers for endotracheal tube cuff inflation** - Klonner M.E., Mattaliano G., Casoria V., Braun C.
- P33 - **Assessment of an ultrasound-guided rectus sheath block: preliminary results of an anatomic study in foal cadavers** - Gutierrez-Bautista A., Koch. R.; Viscasillas J., Wittenberg-Voges L., Söbbeler F., Kästner S.
- P36 - **Understanding the Feline Grimace Scale: a study of dimensionality, the importance of each action unit and factors affecting assessment** - Steagall P.V., Monteiro B., Trindade P., Luna S.P.L.
- P39 - **Responsiveness of the UNESP-Botucatu Cattle Pain Scale in Bos taurus and Bos indicus** - Tomacheuski R.M., Oliveira A.R., Trindade P.H.E., Lobo C.P.C., Teixeira Neto F.J., Oliveira F.A., Luna S.P.L.
- P42 - **Experiences and attitudes of Slovenian pet owners regarding cannabinoid use in dogs and cats** - Tomsič K., Rakinić. K., Seliškar A.
- P48 - **Methods used for endotracheal tube cuff inflation and pressure verification in veterinary medicine: A questionnaire on contemporary practice** - Veen I., de Grauw J.
- P50 - **Evaluation of external physical features for estimation of endotracheal tube diameter in dogs** - Simanovsky S., Yaffe M., Epstein A., Bruchim Y., Peery D., Kushnir Y.
- P51 - **At recovery, does the nutritional status of dogs affect the decreasing rate of arterial oxygen measured with a multiwave pulse co-oximetry?** - Bellini L., Cardinali M., Zanusso F., De Benedictis G.M.
- P65 - **Mechanical ventilation in two male common hippopotami (Hippopotamus amphibius) undergoing surgical castration** - Amari M., Brioschi F.A., Rabbogliatti V., Di Cesare F., Pecile A., Groppetti D., Ferrari F., Oltolina M., Magnone W., Saini M., Ravasio G.
- P71 - **Incidence and treatment of postoperative hypoxemia in dogs undergoing general anaesthesia with variable FiO_2 and PEEP** - Stabile M., Di Bella C., Acquafredda C., Scardia A., Piemontese C., Vicenti C., Crovace A., Staffieri F.
- P74 - **Venous blood values in healthy captive Egyptian fruit bats (Rousettus aegyptiacus) during restraint versus under medetomidine-midazolam-fentanyl anesthesia, with or without oxygen supplementation** - Shilo-Benjamini Y., Yaakov H., Las L., Abu Ahmad W., Tuval A.
- P76 - **Electrical impedance tomography (EIT) in chickens (Gallus domesticus): effect of four different recumbencies on cranial air sac ventilation** - Wong A.M., Lum H.Y., Musk G.C., Bowden R.S., Hyndman T.H., Mosing M.
- P79 - **Influence of experimentally induced endotoxemia on macrocirculation and glycocalyx integrity in horses** - Sauter P.K., Steblaj B., Kästner S.B.R., Söbbeler F.J., Reiners J., Kutter A.P.N., Gutiérrez Bautista A.J., Neudeck S.
- P80 - **The efficacy of bedinvetmab in a referred population of osteoarthritis cases - a preliminary clinical audit** - Clark L., Coutts F.
- P83 - **Evaluation of the HemoCue Hemoglobine device as POC method in horses** - Scicluna C.
- P86 - **Effects of re-administration of a medetomidine-vatinoxan combination drug (Zenalpha) in dogs** - Turunen H., Barker L.
- P87 - **Branchial plexus block in a deer (Cervus elaphus): a case report** - Papageorgiou V., Krystalli A., Komnenou A., Savvas I., Kazakos G.
- P88 - **Postoperative acid-base and electrolyte changes in dogs after elective ovariohysterectomy. Preliminary results** - Papageorgiou V., Ververidis C., Anagnostou T., Savvas I., Kazakos G.
- P94 - **Immunohistochemical localization of cannabinoid receptor type I in the feline synovial membrane with and without degenerative lesions** - Ruel H.L.M., Monteiro B.P., Blais E., Richard H., St-Jean G., Laverty S., Steagall P.V.

Post-congress day for Greek vets

Saturday, May 21 - Gallery Hall

16:00-17:00 **Registration - Welcome coffee**

Moderator: **Eugenia Flouraki**

17:00-17:45 How do I ventilate the lungs correctly and how to monitor my actions? **Martina Mosing**

17:45-18:30 What to monitor and what to do?! - Anaesthetic equipment in private veterinary practice **Martina Mosing**

Sunday, May 22 - Gallery Hall

Moderator: **Anastasia Papastefanou**

10:30-11:15 Clinical application in pain treatment **Tamara Grubb**

11:15-12:00 Pain diagnosis today: Clinical applications in pain diagnosis **Peter Kronen**

12:00-13:00 Lunch break

13:00-13:45 Analgesia - the not-so-usual options! **Peter Kronen**

CONGRESS SPEAKERS

Karen Blissitt

BVSc PhD, DVA, DipECVAA, SFHEA, MRCVS. Professor of Equine Cardiology and Anaesthesia Royal (Dick) School of Veterinary Studies, University of Edinburgh, Easter Bush Veterinary Centre, Roslin, Midlothian EH25 9RG

Karen graduated BVSc from the University of Liverpool in June 1982. After 3 years in general practice, she joined the R(D)SVS Edinburgh where she is currently Professor of Equine Cardiology and Anaesthesia. She was a Horserace Betting Levy Board, Veterinary Research Training Scholar and was awarded her PhD in 1993 for her thesis echocardiographic studies of valvular and ventricular function in horses. Karen obtained the DVA in 1995, DipECVAA in 1997 and SFHEA in 2018.
Her clinical and research interests include transoesophageal echocardiography for assessing ventricular function in anaesthetised horses, sudden cardiac death in racing Thoroughbreds, 3D echocardiography and Transvenous Electrocardioversion for treatment of atrial fibrillation. Karen is married to Martyn and has two, now young adults Edward and Grace.

Tamara Grubb

DVM, PhD, Diplomate ACVAA President Elect, International Veterinary Academy of Pain Management

Dr. Tamara Grubb is a Diplomate of the American College of Veterinary Anesthesia & Analgesia with a strong focus in pain management. She is an anesthesia/analgesia consultant in small and large animal practices, a national/international educator and lecturer, a certified acupuncturist and an Adjunct Professor of Veterinary Anesthesia & Analgesia at Washington State University.
Dr. Grubb serves on the Board of Directors for the International Veterinary Academy of Pain Management (IVAPM) and is co-author of two books, Anesthesia & Pain Management for Veterinary Nurses and Technicians and Analgesia and Anesthesia for the Ill or Injured Dog and Cat.

Peter Kronen

DVM, DipECVAA, Dr.med.vet.

Peter Studied biological Chemistry at the Technical University of Munich (TU), Germany. He did his Vet School at University of Pisa, Italy and Munich (LMU), Germany, graduating from Laude. He worked then in a busy small animal referral centre in Lido di Camaiore, Italy and completed his Italian thesis at the same time. From there he went to the cardiovascular research division at the Brigham and Women's Hospital in Boston, MA, USA, then completed his residency at Cornell University in Ithaca, NY, where he continued at a junior faculty member at first. He then became a lecturer at the University of California in Davis, CA, USA. Afterwards, he moved to Switzerland to join the Anaesthesia Section at the University of Berne. During this time, he became a Diplomate of the ECVAA and completed his Swiss thesis (Dr med vet).
In 2006, he founded the first internationally operating Anaesthesia Service company, providing Anaesthesia expertise from the beginning in an international setup. Veterinary Anaesthesia Services-International today operates in a growing number of countries to provide specialist services in anaesthesia and analgesia. In 2008, he founded VASTA, today also internationally operating anaesthesia education for technicians, nurses and practitioners.
Peter has been very active in professional organisations and held leading positions in the AVA, IVAPM, WSAVA, but he is also active in Animal Research and Research Animal Protection (ethical committees etc).
Today, he is CEO of Veterinary Anaesthesia Services International, Director of VASTA, Head of Experimental Anaesthesia and Analgesia at the Center for Applied Biotechnology and Molecular Medicine, and the Musculo-Skeletal Research Unit of the University of Zurich and Member of the Global Pain Council.

Annette Brandau Kutter

Dr med vet, DipECVAA, Vetsuisse Faculty of the University of Zurich

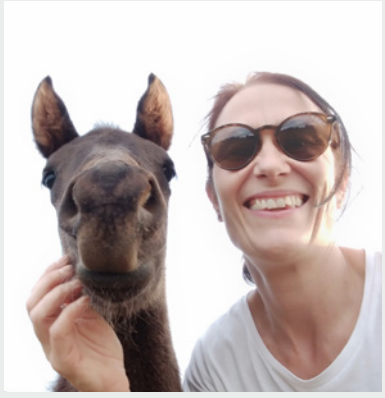
After graduation (1999) and doctoral thesis at the University of Zurich, Annette specialized in Veterinary Anaesthesia and Analgesia and became a Diplomate in 2005. She is also interested in alternative medicine to treat pain with the help of acupuncture and osteopathy. Since ever, she is interested in putting as many cables as possible near the animal and she evaluated many different monitoring techniques, always trying to understand what is going on in patients in anaesthesia and intensive care. She published and reviewed several studies mainly focussing on monitoring of changes in cardiopulmonary parameters and coagulation. Her current goal is to bring novel monitoring to the patients and let them profit from better understanding the actual impact of anaesthetics on the body instead of just guessing what is going on. Today she is head of small animal anaesthesia and co-supervisor of the ECVAA residency programme at the Vetsuisse Faculty of the University of Zurich.

Maria Linou

DVM, PhD
Hellenic Pasteur Institute
President of the Hellenic Veterinary Medical Society
General Secretary of the Hellenic Scientific One Health Society

Dr Maria Linou is an Aristotle University of Thessaloniki Veterinary School graduate and holds a PhD from the University of Athens Medical School. She is a member of the scientific staff of the Hellenic Pasteur Institute (HPI) (Diagnostic Department/Office of Networking) responsible for veterinary services and the coordinator of the HPI's One Health committee. She has been an active practitioner at her own pet clinic in Athens since 1995.

She is the President of the Hellenic Veterinary Medical Society (HVMS) and the General Secretary of the Hellenic Scientific Society for One Health
Her interests focus on the diagnosis, treatment and prevention of human and animal diseases through a One Health approach. She has been actively involved in the implementation of the One Health concept in Public Health, through scientific, research, clinical and social activities towards veterinarians, researchers, health professionals, decision makers, government and public.



Martina Mosing

PDhabil, Dip ECVAA, MANZCVS School of Veterinary Medicine, Murdoch University, Perth, Australia

Ini graduated from the Veterinary University in Vienna, Austria. Over the following 10 years she was involved in the building-up of the Clinic of Veterinary Anaesthesia and perioperative Intensive care in Vienna and did a residency in Veterinary Anaesthesia and Analgesia in Bern, Switzerland. She became a Diplomate of the European College of Veterinary Anaesthesia and Analgesia and soon afterwards decided to explore the British way of veterinary anaesthesia as senior lecturer at the University of Liverpool. Then she moved back to the continent (Europe) and was working in the Division of Anaesthesiology at the Vet-Suisse Faculty, University in Zurich, Switzerland. In 2016 she finally joined the anaesthesia team at Murdoch University in Perth, Western Australia and is enjoying The Aussie way of veterinary anaesthesia.
Her main research interest is in pulmonary ventilation and gas exchange during anaesthesia and monitoring of lung pathophysiology using electrical impedance tomography.

Chrysanthi Sardeli

MD, PhD, Obstetrician-Gynecologist, Clinical Pharmacologist, Associate Professor

ChrysanthiSardeli is an Obstetrician-Gynecologist, specializing in Reproductive Toxicology, an Associate Professor of Pharmacology-Clinical Pharmacology at the School of Medicine, Faculty of Health Sciences of the Aristotle University of Thessaloniki and an Ethics Expert at the Directorate General for Research & Innovation, European Commission.

INVITED SPEAKERS' ABSTRACTS

Pre-Congress Day Lectures

Pulse Oxymetry: basics, techniques and technicalities

Peter Kronen
DVM, DipECVAA, Dr.med.vet.DVM, DipECVAA, Dr.med.vet.

Physics bases of light absorption and SpO_2 monitoring. Oxygen binding to hemoglobin, what does Pulse-Oxymetry tell us exactly and why, can we and how deduct pulse pressure variations and further information from this, clinical relevance, correct measurements, false positives and false negative values, different clinical application techniques.

Blood pressure: Can anybody ever know what is it?

Peter Kronen
DVM, DipECVAA, Dr.med.vet.DVM, DipECVAA, Dr.med.vet.

Why is blood pressure important? What are the difficulties and limitations of blood pressure measurement/estimations, how is blood pressure estimated, how reliable are single estimation methods? What further information can I deduct from blood pressure measurement?

Blood gases analysis: quick and dirty!

Peter Kronen
DVM, DipECVAA, Dr.med.vet.DVM, DipECVAA, Dr.med.vet.

What do I need to know about sampling for BGA? What are the basic measurements obtained by BGA? Compensatory mechanisms. What is the primary problem, what the compensatory mechanism? Is compensation appropriate? Anion and delta gap calculations.

Terms and conditions (physiologic & pathophysiologic) - Interactive discussion around respiratory monitoring from A-Z

Martina Mosing
PDhabil, Dip ECVAA, MANZCVS School of Veterinary Medicine, Murdoch University, Perth, Australia

Video recording of the interactive event is available on the conference Website

Keynote Lectures

From One Health to One Welfare. A concept or a need?

Maria Linou
DVM, PhD, Hellenic Pasteur Institute, President of the Hellenic Veterinary Medical Society
General Secretary of the Hellenic Scientific One Health Society

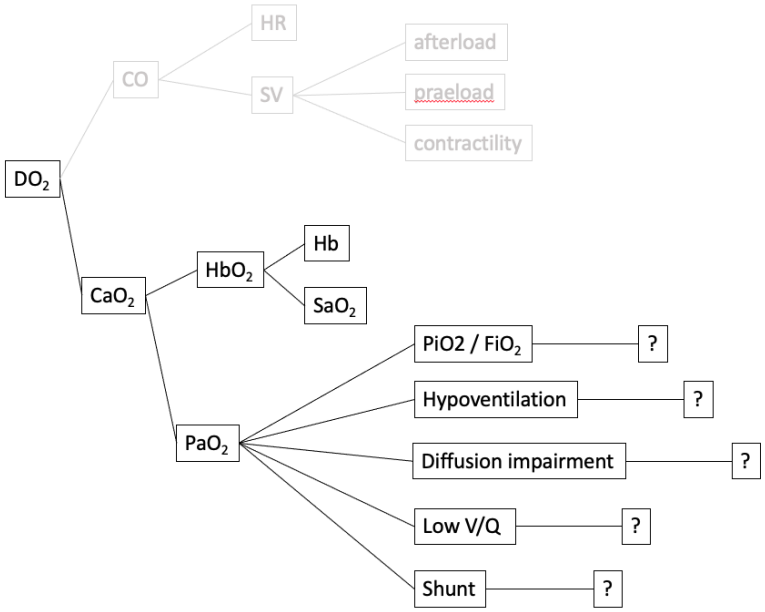
One Health is a concept that recognizes that the health of people is closely connected to the health of animals and our shared environment.
One Welfare is defined as the interconnections between animal welfare, human wellbeing and their physical and social environment.
We will discuss how we are transitioning from the One Health initiative to the newer One Welfare movement and explore the connections between these two concepts.
Both concepts are based on the basic principle that humans, animals (wild and domestic) and the environment are interconnected and interdependent and foster interdisciplinary collaborations. Even more so, the One Welfare approach can serve as a guide to One Health actions by providing a moral and societal ethical framework and ensure well-being as part of achieving optimal health.
Only through a One Health and a One Welfare approach a basic ethic of respect for other living and non-living elements of our planet can be established. The concept as a whole has a socio-ecological complexity and requires consideration of the health and well-being of humans, animals and ecosystems in a more fair and equal way.
The example of the current COVID19 pandemic illustrates and stresses the need for One Health and Welfare implementation. Society is now more mature than ever to appreciate a new holistic approach for health that includes, apart from physical health, mental and social health, as well as wellbeing, animal welfare, food security and sustainability

What We Want and What We Can! - Respiratory Monitoring in Anaesthesia!

Martina Mosing
PDhabil, Dip ECVAA, MANZCVS School of Veterinary Medicine, Murdoch University, Perth, Australia

This lecture aims to explain respiratory monitoring by discussing the physiology and pathophysiology of gas exchange and lung ventilation and perfusion and highlighting what can be measured (WHAT WE CAN!) to finally diagnose and treat the specific problem of the patient (WHAT WE WANT!).

The physiology and pathophysiology of gas exchange and lung ventilation and perfusion is illustrated in the following flow diagram:



The main aim of the anaesthetist is to maintain oxygen delivery (DO_2) to the central organ of the anaesthetised patient. But how can we monitor this? The clinician needs to be able to use the respiratory monitoring in a way to diagnose the underlying pathophysiology within a very short time period. This makes monitoring devices that measure the values continuously preferable which gives the clinician the opportunity to monitor, evaluate, diagnose and treat within a few minutes.

The main challenge in respiratory monitoring is to diagnose the underlying issue of hypoxaemia. Five reasons for hypoxaemia need to be examined and the main pathophysiology causing it diagnosed. In this lecture the monitoring devices being used for each pathophysiology will be explained:

1) Low FiO_2
Measurements using either electrochemical or paramagnetic O_2 analysis and checking the atmospheric pressure can easily provide the clinician with the information of an abnormal low FiO_2 (requires an increase in oxygen delivery to the breathing system by increasing the flowmeter setting or exchange the O_2 cylinder if empty) (WHAT WE WANT!).

2) Hypoventilation
a) Central hypoventilation due to drugs used for anaesthesia,
Alveolar hypoventilation is diagnosed by evaluation of arterial partial pressure of CO_2 ($PaCO_2$), end-tidal CO_2 using capnography or transcutaneous CO_2 and / or minute ventilation using spirometry. (WHAT WE WANT!). Problems with spirometry and capnography are especially relevant in large animal anaesthesia. Measurement of tidal volume is crucial (Adler et al. 1997; Herholz 2010; Moens 2010; Schramel et al. 2014; Kobler et al. 2016; Mosing et al. 2019; Brabant et al. 2021; Crivellari et al. 2021; Mosing et al. 2022).

b) Acute airflow limitations

Airflow limitations can be monitored and diagnosed based on a 'shark-fin' like capnogram, changes in SIII in volumetric capnography (Babik et al. 2012; Mosing et al. 2012; Scheffzek et al. 2012) but especially evaluation of respiratory mechanics with increase in peak inspiratory and / or expiratory flows resulting in increase in respiratory system resistance (Rrs) (WHAT WE WANT!).
ATTENTION: Partial upper airway obstruction does NOT cause any capnogram changes!

c) 'Relative' hypoventilation: hypercapnia with adequate VT
Areas of high V/Q and physiologic dead space cause 'relative' hypoventilation.
The difference between arterial and end-tidal CO_2 (P(a-ET)CO2), the alveolar dead space fraction (VDalvfrac = P(a-ET)CO2/PaCO2)) and the Enghoff V/Q index (V/Q index = (PaCO2 − PĒCO2)/PaCO2) - where PĒCO2 is the mixed expired partial pressure of CO_2 - all represent V/Q inequalities of lung units with low V/Q and high V/Q ratios (Tusman et al. 2012; Mosing et al. 2018).
In combination with a low PaO_2 à low V/Q the main problem (WHAT WE WANT!)
In combination with normal or high PaO_2 à high V/Q the main problem which might help to diagnose pulmonary embolism (Sacks & Mosing 2017)(WHAT WE WANT!)

Physiologic dead space can be calculated based on the equation VD / VT = (PACO2 - PĒCO2) / (PACO2 - PICO2), where PACO2 is the mean alveolar partial pressure of CO_2 which can be measured by volumetric capnography (Tusman et al. 2011; Mosing et al. 2018) (WHAT WE WANT!).

3) Diffusion impairment
Pulmonary tissue inflammation, interstitial or alveolar pulmonary edema or lung fibrosis can cause diffusion impairment. Static lung compliance decreases while no change in Rrs is observed (WHAT WE WANT!). A lack of reference range for dynamic and static compliance makes it difficult to diagnose these lung pathologies.
The distribution of ventilation is changed with all diseases causing an increase in extravascular lung water based on the "slinky spring model". Furthermore, the functional residual capacity decreases. This can be diagnosed using electrical impedance tomography (WHAT WE WANT!).

4) Low V/Q ratio
Bronchiole narrowing, changes in the distribution of ventilation due to position change, airway disease, pneumonia, pneumothorax, pulmonary hypertension and decreased chest wall compliance all can cause low V/Q ratios.
Changes in global dynamic Crs primarily resulting from higher airway pressures are used to diagnose the presence of areas with low V/Q. The EIT can provide regional dynamic compliance measurements with measurement of airway pressure synchronous with deltaZ (volume)(Shono & Kotani 2019). EIT can be used to visualise areas of low ventilation that especially during anaesthesia (less HPV) can be areas of low V/Q (Mosing et al. 2020)(WHAT WE WANT!).
There is no clinical method available to measure low V/Q areas directly. EIT can be used to measure lung perfusion and may offer an opportunity in the future where V/Q images can be provided (Xu et al. 2021).

5) Shunt
Beside anatomical shunt volume, shunted blood is due to complete lung collapse (one lung ventilation, tension pneumothorax, open pneumothorax) or complete airflow obstruction leading to atelectasis (absorption, compression & loss of surfactant).
Again, no routine clinical method to measure shunt volume is available. EIT can be used to measure collapsed lung areas (dependent silent space) in anaesthetised horses (Mosing et al. 2017)(WHAT WE WANT!).

The percent of venous admixture resulting from blood coming from areas of low V/Q and collapsed lung (shunt) can be calculated using Bergreen's equation (Berggren 1942) unfortunately also called shunt equation:
$Qs/Qt = (CcO_2\text{-}CaO2) / (CcO_2 - CvO_2)$
$Ca(v \& c)O_2 = 1.39 \times (Hb) \times Sa(v \& c)O_2 + 0.003 \times PO_2$
For CcO_2 the ScO_2 is assumed to be 100%

As this equation requires mixed venous blood sampling, we clinically often use oxygen indices (OIs), to es-

timate venous admixture based on P_aO_2. The OI can be categorised into oxygen tension-based indices and oxygen content-based indices (F-shunt). Clinically used OIs are: arterial oxygen tension to fraction of inspired oxygen ratio (P_aO_2/F_iO_2 = P/F ratio), arterial to alveolar oxygen tension ratio (P_aO_2/P_AO_2), alveolar to arterial oxygen atension difference ($P_{(A-a)}O_2$), respiratory index ($P_{(A-a)}O_2/P_aO_2$) and F-shunt (Moreno-Martinez et al. 2021). All these OIs are estimations of venous admixture which is NEARLY WHAT WE WANT.

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What anaesthesia monitoring equipment actually makes a difference to equine anaesthesia?

Professor Karen Blissitt

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Introduction

What do we want from our monitoring equipment? We want a monitor that measures relevant variables with sufficient accuracy to guide management changes to improve outcomes[1]. Monitors should alert the user to impairment of physiological functions and critical errors early enough to allow action to be taken to prevent critical incidents. Recently, a sudden decline in end tidal carbon dioxide tension in a clinical case, highlighted an acute reduction in cardiac output, allowing successful treatment and recovery, despite the development of 'agonal' breathing. Mosing et al. (2018) has previously referenced the sensitivity of changes in the volume of expired CO_2 as an indicator of changes in pulmonary blood flow[2]. Death in this case was prevented by actions taken following the observation of a sudden fall in the end tidal carbon dioxide concentration; the cause of which was then identified by transthoracic echocardiography. It is important to remember that it is our interventions based on the measurements from the monitoring device, and not the monitoring device itself, that alters outcome[3] and physiological impairment must be highlighted early enough such that successful treatment can be achieved.

Causes of perioperative mortality and critical incidents

If we want to monitor relevant values, we need to know the causes of equine perioperative mortality. The latest CEPEF 4 study showed a reduced mortality of 0.6%[4] compered to the previous prospective multicentre study in 2002[5]; the causes of death also appear to have changed. Whilst fractures in recovery were still the main cause of death in non-colic cases, an equal number of deaths due to post operative colic were now reported with a considerable reduction in the number of intraoperative cardiac arrests; only one fatal arrest was reported. A previous single centre study did not report any intraoperative cardiac deaths[6]; this was attributed to improved monitoring. Advances in monitoring were also proposed to explain the reduced number of intraoperative fatalities in another recent single centre study[7]. It has been suggested that advances in monitoring have now shifted the risk period to the recovery box where conditions are more difficult to control, which raises the question of not only what should we be monitoring but when and for how long should we be monitoring? Capnography can indicate respiratory obstruction, one of the causes of mortality in CEPEF 4[4], however this very rapidly leads to pulmonary oedema and death and tends to occur in the recovery phase when monitoring devices have been removed[8]. So can future improvements in intraoperative monitoring improve outcomes further, or are critical incident reporting systems and local prevention strategies now needed?[9] It has been suggested that improved intraoperative cardiovascular monitoring reduced the incidence and severity of post operative myopathy[6]; potentially reducing ataxia and weakness in recovery which may predispose to fractures[8]. There is also increasing interest in human medicine in new techniques to monitor the microcirculation, thought to play a role in the development of organ dysfunction[1]. However as these monitors are not yet available for clinical practice, hemodynamic monitoring, still focuses on the macrocirculation as an indicator of oxygen delivery. Noninvasive measure of cardiac output human medicine, has improved perioperative patient outcomes by enabling anaesthetists to make accurate decisions during surgery, and gauge fluid responsiveness. The ability to calculate stroke volume, systemic vascular resistance and oxygen delivery has allowed the causes of cardiovascular compromise to be diagnosed and changes in response to therapy monitored[10]. Cardiac output is currently rarely measured in equine clinical anaesthesia[11], however as cardiovascular dysfunction continues to be implicated in studies of perioperative equine mortality and morbidity, a noninvasive continuous monitor of cardiac output alongside other variables would be invaluable to allow anaesthetists to identify deterioration in cardiovascular function and oxygen delivery before a critical event. Hopefully future analysis of the large data set from the CEPEF 4 study[4] may highlight the cause of the post operative colic following anaesthesia and standing surgery in horses so that appropriate management changes may made.

Cardiovascular monitoring.

Although rare, cardiac arrhythmia has been reported as the definitive cause of death in clinically healthy

horses during general anaesthesia[12,13] and arrhythmia due to hyperkalaemia has been described as a preventable critical incident[8.] An ECG would allow accurate diagnosis and treatment to minimise this sporadic risk however as pulseless electrical activity occurs in horses, an alternative monitor of mechanical cardiac activity is required. Pulse oximetry does provides a continuous noninvasive record of mechanical cardiac activity, and haemoglobin oxygen saturation one of the determinants of oxygen delivery[11], however, the leathery thick equine tongue often results in erroneous readings with probes designed for human medicine.

Invasive measurement of arterial pressure and display of the arterial waveform allows mechanical activity to be identified and subjective assessment of vascular resistance, stroke volume and cardiac contractility. Changes in cardiac function can be continually assessed, deterioration identified and treatment with inotropes, vasopressors or fluids instigated. Arterial cannulation also enables blood to be readily sampled for analysis, aiding diagnosis and treatment of cardiovascular and respiratory dysfunction. Intraoperative recognition and treatment of hypotension has been shown to reduce the severity of postoperative myopathy[14]. However, errors can be made in assuming that normal arterial pressures indicate a good cardiac output. Clinical studies have shown that higher arterial pressures are often associated with a low cardiac output[15].

Monitors have been developed that estimate cardiac output from the arterial waveform, using the relationship between the systolic portion of the pressure curve and the dynamic impedance of the cardiovascular system[16]. Two systems PULSECO and PICCO have been validated in horses however both require expensive or invasive calibration to determine the true cardiac output[17]. These pulse contour monitors also display stroke volume and pulse pressure variation which are considered a useful indicator of fluid responsiveness and cardiovascular status. However, pulse contour monitors show limited accuracy in the presence of severe arrhythmias, vasoconstriction and hemodynamic instability, due to changes in aortic impedance and vascular resistance which affect the relationship between pressure and flow[17]. A pulse contour method which does not require calibration uses a pressure recording analytical method to estimate beat to beat changes in cardiovascular impedance. This has been shown to be of use in humans[16] and dogs[18] but requires catheterisation of a central artery and therefore may have limited value in equine anaesthesia. Transoesophageal echocardiography (TOE) has been validated[19,20] in Thoroughbred horses and used for routine monitoring of clinical cases but unfortunately this monitor is not commercially available for equine use.

Conclusion

A multiparameter monitor that allows continuous recording of invasive pressure, ECG, capnography, pulse oximetry along with an accurate method of measuring cardiac output and oxygen delivery has the potential to make equine anaesthesia safer. However as previously stated 'No piece of monitoring equipment exists that can replace a knowledgeable, trained, experienced, and attentive anesthetist'[21], and output from the monitor would need to be integrated with other information gained from clinical monitoring to ensure appropriate responses and treatment. Human involvement introduces human error which increases risk, therefore training, standardised procedures and checklists should be in place to reduce human error as a cause of equine mortality, as has occurred in human anaesthesia[22].

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Further distraction or real help? Using advanced gas monitoring in clinics

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This lecture discusses pros (real help) and cons (distraction from watching your patient) of gas monitoring in clinics. I want to put special emphasis on the clinical application of each parameter and to highlight the usefulness of gas monitoring to understand the cardiovascular status better.
How does gas monitoring help us to understand the pathophysiology? How can we use gas monitoring to understand if an intervention improved the situation? Understanding the lung and heart physiology and their interfaces enables the anaesthetist to use gas monitoring to better understand oxygenation, ventilation and cardiovascular status of their patients without being distracted further. .

Inhalation anaesthetics (IA):
The measurement of IA enables us to use minimal flow anaesthesia and still know how much IA we are administering and if the animal is still exhaling IA at the end of anaesthesia (real help). However, IA monitoring carries the risk that both experienced and unexperienced anaesthetists are aiming to reach a certain "MAC". My typical question to avoid such bad habits (= distraction from watching your patient) is: "how much IA does your patient need?" If the answer is "1.3% isoflurane" irrelevant of the situation, the answering anaesthetist first needs to learn to maintain inhalational anaesthesia without IA monitoring.
Nitrous Oxide
It is preferable to know how much nitrous oxide you are administering at the end of IA to avoid diffusion hypoxia.

Oxygen (inspired fraction, FiO_2)
Although many anaesthetist note FiO_2 on their protocol every 5 minutes, FiO_2 is often only used in horse anaesthesia, where arterial blood gases are available and oxygen indices are calculated on a regular bases (see preceding talks).
However, it also offers real help if arterial blood gases are not available. In this talk the approach to keep the FiO_2 in a range to maintain SpO_2 well above 90% but below 97% is presented. Under these circumstances you can use SpO_2 / FiO_2 ratio as a replacement for PaO_2 / FiO_2 ratio and estimate venous admixture non - invasively with the use of a pulse oximeter, a rotameter and FiO_2 measurement (Rice et al. 2007). This is extremely helpful when weaning patients from the ventilator or assessing if interventions were effectively improving gas exchange.

Carbon dioxide (inspired $FiCO_2$ and expired $ETCO_2$)
Typically, CO_2 analysis is used to exclude rebreathing of CO_2 and to assess alveolar ventilation. However, the content of CO_2 in the expired gas is not only dependent on the mixed venous partial pressure of CO_2 (Pmv CO_2) defined by CO_2 production (VCO_2) of the body and on alveolar ventilation, but also on the cardiac output (CO) of the right heart (= pulmonary blood flow) (Anderson & Breen 2000).

Any change (D) of $ETCO_2$ without concurrent changes in ventilation and CO_2 production reflects a change in CO. A D $ETCO_2$ > 1 mmHg has performed better to assess fluid responsiveness than other minimally invasive indexes retrieved with cardiovascular monitoring in mechanically ventilated patients in shock (Lakhal et al. 2017). It is well known that $ETCO_2$ measurements during CPCR is reflecting cardiac performance and shows return of spontaneous circulation (ROSC). Any fast decrease of $ETCO_2$ without changes in ventilation during anaesthesia must be taken as a sign for rapidly decreasing CO (Falk et al. 1988).

Basic spirometry (TV, MV, Compliance, Resistance, IE ratio)
The availability of spirometry would offer real help to measure how the patient and our ventilator are performing during the whole breathing cycle. However, in my clinical experience the numbers are often noted (distraction) but abnormal measurements are not identified and remain inconsequential. The more we measure, the more we must understand, what we are measuring, what is normal and why we are measuring it. Spirometry is extremely helpful if the patient cannot be watched directly (MRI, small patients under drapes)

and during the weaning procedure.

Metabolic monitoring under anaesthesia (VO_2 and VCO_2 measurement)

Measurement of VCO_2 can nowadays be accomplished by volumetric capnography or together with VO_2 over a modified sidestream spirometry module (GE Medical, Module E-COVX). For large animal anaesthesia both mainstream (Schramel et al. 2014) and sidestream (H-Lite, (Moens et al. 2009) spirometry adaptors are available, and it seems that the same conversion factor as for spirometry can be used for VO2 measurements with the H-Lite (Larenza and Kutter personal communication).

The Fick principle assumes that the pulmonary blood flow (CO of the right heart - shunt flow) through alveoli equals the oxygen consumption VO_2 (or elimination / production of CO_2 (VCO_2) divided by the difference in venous-to-arterial CO_2 (or O_2) content (Fick 1870; Jaffe 1999). $CO = VO_2 / (CmvO_2 - CaO_2)$ and $CO = VCO_2 / (CmvCO_2 - CaCO_2)$

The main limitation to use the Fick principle to measure CO in clinical practice was limited by the need to measure mixed venous blood content of O_2 (or CO_2). A technique using intermittent CO_2 rebreathing (NICO®) has been suggested to overcome the need for mixed venous blood gas analysis. This technique has never entered routine practice both for low agreement and only intermittent CO measurements (Gunkel et al. 2004; Giguere et al. 2005).

Around 40 years ago the so called “differential Fick method” for CO_2 was introduced to avoid mixed venous blood gas analysis (Gedeon et al. 1980). The authors suggested to use a step change in alveolar ventilation to change measured VCO_2 and $PECO_2$, while $CmvCO_2 - CaCO_2$ remained constant. Only recently the technical development has allowed the original idea of Gedeon to modulate ventilatory patterns automatically to calculate pulmonary blood flows and monitor CO continuously (Hallsjo Sander et al. 2014; Hällsjö Sander et al. 2015; Peyton et al. 2019). The method measuring effective pulmonary blood flow (not including the shunt flow) is called “capnodynamics”. Hopefully this new technique, which allows for truly non-invasive and continuous measurement of cardiac output in ventilated patients will make its way to clinical practice and allow the use of advanced hemodynamic monitoring in routine practice. This will in future potentially allow us to understand the cause of hypotension and to monitor the reaction to administered treatments.

Until capnodynamics will be available, the positive correlation of VCO_2 and VO_2 to pulmonary blood flow (CO) can already be used clinically (real help). Changes in VCO_2 or VO_2 allow to estimate changes in CO without measuring arterial and mixed venous blood gases (Stuart-Andrews et al. 2007; Bachmann et al. 2020). The comparison of VCO_2 measured by volumetric capnography in 8 horses showed a positive correlation with CO measured by lithium dilution, which was not influenced by dead space, venous admixture, and positive airway pressure (M. Mosing personal communication). Interestingly, increases in VO_2 predicted a lightened plane of anaesthesia before nystagmus occurred (Larenza and Kutter, personal communication). This finding does not surprise any users of closed-circuit anaesthesia that are always warned early about the arousal of their patient by an emptying of the reservoir bag.

In the future, non - invasive and continuous monitoring of CO by advanced gas analysis would allow for early diagnosis and aggressive therapy of low cardiac output or low vessel tone. This could possibly lower intra- and postoperative morbidity and mortality. Better knowledge of the cardiovascular system could help the anaesthetist to titrate fluid therapy, catecholamine and vasopressor support.

VO_2 and VCO_2 measurement already nowadays have the potential to improve cardiovascular and depth of anaesthesia monitoring non - invasively.

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Target-controlled infusion anaesthesia

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The goal of any method of drug delivery is to achieve and maintain desired drug effects while avoiding adverse effects. Target-controlled infusion (TCI) is a technique designed to facilitate IV infusion of drugs used to achieve a user-defined, predicted (''target'') concentration in a specific body compartment or tissue. The technology has been commercially available worldwide for clinical use in anesthesiology for the past 2,5 decades.

TCI systems deliver IV drugs according to the drugs' pharmacokinetic profiles (as described by population pharmacokinetic models constructed from clinical pharmacology studies) using an infusion pump controlled by a computer or a microprocessor. This method of infusion employs pharmacokinetic models to calculate the infusion rate required to achieve and maintain desired anesthetic drug concentrations that keep up with rapid changes in surgical stimulus intensity. Constant-rate infusions cannot increase drug concentrations rapidly enough to account for abrupt increases in stimulation or decrease concentrations rapidly enough to account for periods of decreased stimulation. Constant-rate infusions cannot, in fact, maintain steady drug concentrations in the plasma or tissues during periods of constant stimulation. A clinician selects the target drug concentration and enters patient parameters such as age, weight, gender and medical conditions and the software calculates the infusion rate necessary to achieve said target. TCI requires decreasing the infusion rate at regular intervals to account for the uptake of the infused drug into saturable body compartments, whereas constant-rate infusions result in continuous drug uptake.

Although TCI pumps use complex mathematical models to calculate the drug dosage, in general terms the dosage regimen is modeled after the Bolus-Elimination-Transfer (BET) method first described by Kruger Thiemer in 1968. This method relies on an initial dose administered bolus to achieve the target concentration, a continuous infusion to replace drug that has been eliminated and an exponentially decreasing infusion to replace the drug that is transferred to peripheral tissues. The infusion rates are updated frequently (as often as every 10 s), depending on the predictions of the pharmacokinetic model used and any changes in the target concentration set by the clinician. However, the BET infusion method has two major disadvantages. First, it can only be used to target the plasma concentration of a given drug. Second, the BET method is only applicable in the absence of previously administered drugs. The BET scheme cannot be used if the intent is to titrate the drug-to-drug effect. Subsequently, various research groups developed algorithms to titrate plasma or effect-site concentrations. Closed-form mathematical solutions calculating TCI rate were published and implemented by Shafer and Gregg, Shafer et al., and Jacobs. These approaches precisely tracked drug concentration, but the infusion rate was an approximate solution. Jacobs first described the correct solution in 1990. The following year, Bailey and Shafer published a simplified algorithm that provided exact solutions. This algorithm, extended by Shafer and Gregg to include the effect site, became the basis of all TCI systems.

TCI is an open-loop method of computer-controlled drug delivery, meaning that no feedback from the patient is automatically considered by the pump's infusion-control algorithm. The algorithm's prediction of the drug concentration at any given moment is the only feedback evaluated by the pump. The clinician must assess the adequacy of patient response and change the target concentration as necessary. Adding in feedback from technologies such as physiologic monitoring, electroencephalography (EEG) analysis, or neuromuscular monitoring could quantify patient response and close the loop to ensure the desired clinical effect has been achieved. Research using physiologic closed loop controlled (PCLC) devices continues in a variety of areas including administration of IV anesthesia, maintenance of medically induced coma, and blood pressure management. The potential benefits of PCLC devices include reducing cognitive load for clinicians and providing faster response to physiologic variations in the patient. However, automation also introduces new risks, such as automation bias (over-reliance on automated decision-making) and a lack of transparency.

TCI systems can improve certain outcomes (such as intraoperative hemodynamics, need for reversal agents, speed of recovery), however it has been difficult to demonstrate a truly compelling outcome improvement. Interestingly, most users tend to prefer using TCI systems to manual infusions. If and until large clinical trials demonstrate a clear improvement in outcomes through using TCI, in everyday clinical practice the technology is probably best viewed as an incremental advance and not as truly revolutionary. When discussing safety, neither the medical literature nor other information suggest that TCI of drugs is less safe than administration

by constant MCI rates. TCI pumps, in fact, have the potential to reduce medication errors, provided users receive adequate training. At the same time, TCI's role in clinical pharmacology research is considered indispensable. TCI systems enable researchers to establish steady-state drug concentrations very near a target concentration so that pharmacodynamic observations can be made without concern that drug concentrations are rapidly changing or are out of the intended range. Another research application of TCI systems is their use for simulation purposes, requiring only the software of a TCI system, not the hardware. Through simulation of TCI of drugs, it is possible to make comparisons about the clinical pharmacology of two drugs that are not possible in any other way.

Future perspectives of TCI systems are related to pharmacokinetic model selection and optimization, incorporation of more drugs, connectivity issues with drug advisory displays and anesthesia information management systems, integration into closed-loop systems, and as a tool to incorporate best practices into perioperative medicine.

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Monitoring cardiovascular function using Doppler echocardiography; Can it guide management to improve outcomes?

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Background

In 1964, Rushmer[1] used the term 'initial ventricular impulse', to describe the dynamic properties of ventricular ejection. Following studies in dogs with chronically indwelling ultrasonic flowmeters in the ascending aorta, he concluded that the force being applied by the contracting myocardium influenced the acceleration of blood flowing out of the ventricle (dv/dt) and the peak flow velocity (Vmax). He described increases in peak flow velocity during exercise and reduced acceleration associated with premature contractions, exsanguination hypotension, coronary occlusion and halothane anaesthesia. He also highlighted the value of continuously monitoring blood flow to observe beat to beat changes in ventricular function when different types of cardiac malfunction were simulated.

Doppler derived indices of ventricular function.

Advances in Doppler technology now allow Vmax and dv/dtmax to be recorded non invasively. Studies in dogs and horses[2] have shown these indices are as sensitive for detecting changes in left ventricular performance, and no more affected by changes in loading conditions, than the invasive dp/dt. Further indices of ventricular performance can also be determined from the velocity waveform. The average flow velocity over the cardiac cycle (VTI) is closely related to stroke volume and can be multiplied by the vessel area and heart rate to provide cardiac output. Doppler derived cardiac output measurements have been validated in horses[3] and whilst poor agreement has been reported by Day et al. (2007) in anesthetized dogs with acute hemorrhage[4], it has been accepted as the reference measurement in recent clinical dog studies[5]. The systolic time intervals, pre ejection period (PEP) and ejection time (ET) have also been used to evaluate ventricular performance[2]. The PEP, measured from the onset of the QRS complex of the ECG to the start of ventricular ejection, shortens with inotropic stimulation. The ET measured from the start to the end of ventricular ejection, decreases with both negative and positive inotropy; the ratio PEP/ET is commonly calculated to identify left ventricular dysfunction. The PEP is less influenced by heart rate than ET, and heart rate corrected values for the latter are commonly used; both values are influenced by loading conditions. None of the Doppler indices provide an absolute measure of cardiac contractility, however consideration of the changes in multiple variables, affected to different degrees by inotropy, stroke volume, heart rate and loading conditions, allows an understanding of the likely causes of observed changes in cardiovascular performance.

Limitations of the Doppler technique.

Accurate calculation of blood flow velocity can only be achieved when the Doppler ultrasound beam is aligned with blood flow. Differences in the thoracic location of the heart and great arteries between biped and quadruped species influence how easy this is to achieve. In humans, transthoracic placement of the transducer at the suprasternal notch as used with the USCOM[6] monitor or in a subcostal location, allows perfect alignment with aortic flow; views which cannot be achieved in quadrupeds[7]. Accurate estimation of cardiac output also requires calculation of vessel area from the site of the velocity recording. Errors in the measurement of vessel diameter for estimation of vessel area are a major source of error with this technique, therefore estimation of dimensions based on human nomograms of height and bodyweight are commonly used[8].

Transoesophageal Imaging.

In humans, difficulties in imaging barrel chested patients and those with lung disease led to the development of ultrasound transducers that could be located in the oesophagus. The close proximity of the heart and aorta to the oesophagus allows high resolution images to be obtained which have proved superior in the detection of aortic dissection, infective endocarditis, embolic disease and intracardiac masses, all which are of considerable importance in human medicine. The transoesophageal approach provides stable alignment and allows visualisation of the cardiac valves during surgery, direct assessment of LV filling and regional left ventricular wall motion which has been further enhanced by the development of 3D and tissue Doppler imaging. Unlike the transthoracic approach, transoesophageal imaging does not provide good alignment with aortic blood flow in humans. The descending aorta lies parallel to the oesophagus, therefore to record aortic

blood flow velocities, oesophageal Doppler probes have been developed with Doppler transducers fixed at an angle of 45° between the blood flow and the ultrasound beam (CardioQ-ODM)[9] Whilst this causes an error in the calculation of flow velocity, this is a constant error. Nomograms provide the aortic diameter and a correction factor is used as only approx. 70% of the cardiac output passes through the descending aorta[8]. These oesophageal Doppler monitors (ODMs) also measure heart rate corrected ET and VMax, however as these are recorded from the descending aorta, increased afterload dependence is theoretically more likely. In contrast to bipeds, location of the transducer in the oesophagus of quadrupeds, allows perfect alignment with blood flow in the ascending aorta, however the image quality of cardiac chambers can be poor depending on the size of the animal and the distance between the oesophagus and the heart.

Intraoperative monitoring by Doppler in veterinary species

Doppler indices of ventricular function have been successfully recorded from the ascending aorta via the transoesophageal route of horses[10] and used for many years to guide management in clinical cases. Studies in pigs have shown good alignment with flow and new indices have been developed to evaluate myocardial contractility and mechanics[11]. In dogs, as was initially the case in human medicine, transoesophageal echocardiographic probes have been used primarily for cardiac cases[12], with ODM of the descending aorta used for haemodynamic studies, with mixed results[13,14].

Can it improve outcome?

In human medicine, the application of basic perioperative echocardiography, defined as 'non-diagnostic monitoring within the customary practice of anesthesiology', can often dramatically influence a patient's intraoperative management[15]. However there is no evidence for this in the veterinary literature. Ten years of using transoesophageal Doppler ultrasound to monitor blood flow in the ascending aorta of horses, definitely changed my management of clinical cases such that cardiac function was optimised in individual cases. Did it improve outcome? There was a decrease in the incidence of myopathy during this time, which occurred before we stopped using halothane, however it is difficult to confirm cause and effect. In human medicine it has been argued that the superiority of echocardiography to assess volume responsiveness and cardiac function is such that acute care surgeons should master it[16]. Although Doppler monitoring may not accurately measure absolute values for SV or CO it does show good trending ability and distinct changes in the waveform with changes in cardiac performance. The development of veterinary transoesophageal probes to target the ascending aorta and basic training of personnel should improve our understanding of cardiovascular function, guide management and hopefully improve outcomes in our clinical cases.

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Monitoring-based treatment of hypotension - the end of trial and error anaesthesia?

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Both human and veterinary anaesthetists are faced with very limited possibilities to monitor the cardio- and the vascular state of our patients. Only non - invasive or invasive systemic arterial blood pressure (ABP) monitoring is clinically available, while both measurement of flow in big (i.e. cardiac output) and small vessels (i.e. microcirculation, perfusion) remain limited to research and the most critical clinical patients.
The ABP is the result of both the status of the heart and the vessels. The body tries to maintain ABP by regulating both the cardiac output and the vessel tone (systemic vascular resistance (SVR).
Mean ABP ~ cardiac output x SVR
Mean ABP ~ (heart rate x stroke volume) x SVR
SVR = 80 x (mean ABP - central venous pressure) / cardiac output
Which shows: the higher the cardiac output is, the lower vessel tone (SVR) needs to be.

It is important to remember that hypotension can be caused by:
- ¯ cardiac output and / or ¯ vessel tone / SVR

Additionally, ¯ cardiac output can be caused by
- ¯ heart rate and / or ¯ stroke volume: ¯ preload and / or ¯ contractility and / or afterload (SVR)

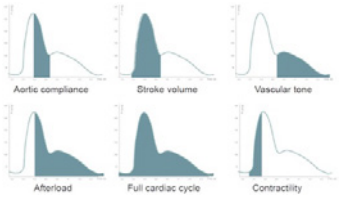
It has been shown in human medicine that length and severity of hypotension is associated with adverse outcomes (Wesselink et al. 2018). Therefore, the fight against intraoperative hypotension is important to reduce intra- and postoperative morbidity and mortality.

Ideally, we should address the cause of hypotension and not the symptom of hypotension (Lonjaret et al. 2014; Duke-Novakovski & Carr 2015), although we are not very good at diagnosing the cause of hypotension. Probably the less we are sure that we treat the right cause, the less determined we are while fighting the symptom hypotension.
On top of this, many anaesthetists “believe” every normal non-invasive ABP measurement, but would question any low SBP and control cuff position and measure repeatedly, until they are finally accepting low ABP measurements and are beginning to treat it. In small animals, low blood pressures are typically leading to missing values or are overestimated non-invasive ABP measurements, which further delays treatment of hypotension. In human medicine the use of invasive SBP measurement decreased the incidence of hypotension (Naylor et al. 2020), probably by decreasing the reaction time of the anaesthetist.

How can we clinically distinguish causes of hypotension and avoid trial and error?

Most anaesthetists have developed their individual way of addressing hypotension or other signs of abnormal cardiovascular status. This is typically a combination of titrating anaesthetic dose to a minimum to reduce their dose - dependent cardiovascular depression, administering fluid therapy with or w/o monitoring of fluid responsiveness and administering cardiovascularly active drugs such as catecholamines and vasopressors and controlling if the hypotension is resolved after each intervention.
This concept of trial and error is not following the primum non nocere principle and we cannot avoid treating the cause of hypotension sometimes with the wrong drugs and giving to much or too little fluid therapy. It has also been shown in dogs similar to human medicine that fluid overload negatively affects outcome in dogs (Cavanagh et al. 2016). However, there is evidence from human medicine that fluid therapy with a goal-directed approach guided by a fluid responsiveness algorithm can improve outcome and avoid fluid overload (Calvo-Vecino et al. 2018).
So probably both the implementation of fast or even preventive treatment of hypotension, as well as goal- or rather cause-directed therapy of hypotension into clinical practice have the potential to reduce mortality and morbidity.
Fluid responsiveness has been increasingly evaluated in the last years by means of different non-invasive monitoring tools in small animals. Most studies only assess the fluid responsiveness in healthy, euvolemic and non vasoplegic anaesthetized animals. These studies are probably not addressing the situations, where an

experienced anaesthetist is challenged to understand the cause of hypotension and where unnecessary fluid therapy may be especially detrimental. Only two studies in dogs are available that assessed fluid responsiveness during endotoxaemia (Muehlestein et al. 2021) and in animals with pulmonary hypertension caused by mitral valve disease (Sasaki et al. 2020).
Peripheral blood pressure curve analysis with PulseCO, PiCCO and PRAM was developed to continuously monitor stroke volume. It showed to be not accurate, but may be helpful in monitoring changes of stroke volume (Kutter et al. 2015a; Kutter et al. 2015b; Kutter et al. 2016; Briganti et al. 2018) and therefore may be used in fluid responsiveness algorithms.
The corrective mechanisms of the body, the interdependence of many parameters and the influence of vasopressor drugs on the ABP curve make the stroke volume estimation highly challenging and prone to mistake. Additionally, the pure analysis of fluid responsiveness is just addressing the preload and stroke volume part of above equations and is mostly not answering the question if contractility and / or afterload are normal or adequate for the current situation.
More modern approaches to analyze the invasive ABP curve aim at predicting hypotension by a software assessing of all parts of the ABP curve for signs of impeding hypotension. The use of hypotension prediction index decreased the incidence and duration of hypotension (Awadallah et al. 2021).



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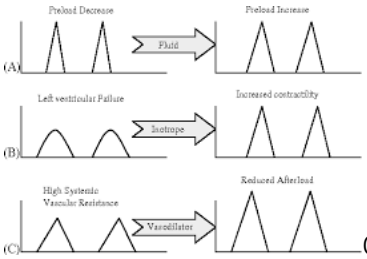
Instead of trying to assess the performance of the heart indirectly with the ABP curve measured in a peripheral artery, the assessment of flow after the heart to assess preload, contractility and afterload parameters would be more straightforward.
The concept of Doppler measurement of the velocity over time as a replacement for volume over time (= flow) has been introduced in the preceding presentation. The use of proper echocardiography probes combining Doppler with a 2-D mode is limited to experienced users and has not yet made the step into clinical veterinary anaesthesia monitoring practice. The assessment of the cardiovascular status by analysing only the velocity curve measured in the descending aorta with small oesophageal Doppler probes (ODM) is available for dogs down to 0.5 kg. With this system no measurement of the area of the vessel is possible and therefore only the velocity time integral (= stroke distance) is calculated as a surrogate for stroke volume (Chamberlain & Willshire 2010).
Interestingly the curve offers additional information about mean acceleration, peak velocity and the duration of blood flow (ejection time corrected to a heart rate of 60 beats / minute = Flow time corrected). Those ODM parameters can give us information about the status and the reaction of the cardiovascular system to therapeutic interventions and to guide intraoperative fluid and vasopressor therapy (Hett & Jonas 2004; Singer 2009a).



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However, the ODM has only recently been tested as part of an algorithm in clinical canine patients to reduce duration of intraoperative hypotension (Henze et al. under review). First results are not very promising, but the algorithm of that study only assessed the fluid responsiveness and did not allow for better understanding of the cardiovascular status.
Further research allowing the implementation of monitoring tools into daily practice and assessing their impact on outcome, especially for high-risk animals and for species with a relatively high intra- and postoperative morbidity and mortality (i.e. horses) are needed.

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That’s your problem- professional responsibility of Anaesthesia Specialists in Monitoring

Peter Kronen
DVM, DipECVAA, Dr.med.vet.

Indisputedly, monitoring during anaesthesia is an important safety factor. Some details shall be highlighted. A large difference between human and veterinary anaesthesia is availability of specialist care and monitoring capabilities. As veterinary specialists we are not and will not be soon numerous enough to cover all clinical needs in anaesthesia (monitoring). One reflection may be seen in increased anaesthesia risk. This results in a classical dilemma between what should and what can be done.

Parallels to human medicine (historical) development remain therefore difficult to draw and alternative designs may have to prevail. What are the responsibilities of anaesthesia specialists in this situation? Apparently, traditional training situations (for example at Vet Schools) seem insufficient to cover the safety requirements that a medical approach to veterinary anaesthesia would imply. How can/should we - given the reduced personell in comparison to human anaesthesia- provide a broader training to cover more anesthetics and consequently help in providing more safety?

Standard-of-care or minimum-level of care guidelines may help improve the situation faster.

Should specialists cooperate with equipment companies, or closer so, to shorten times to improve monitoring, its’ availability and/or its’ cost?

Should we push our colleagues more? Are there reasonable limitations?

Overall and not surprisingly: the input that veterinary anaesthesia specialists may have on prospective developments are as invaluable as they are urgently needed and in conclusion the veterinary anaesthesia specialist have a broad range of responsibilities regarding monitoring during anaesthesia - it IS our problem!

POST - CONGRESS LECTURES FOR GREEK VETS

How do I ventilate the lungs correctly and how to monitor my actions?

Martina Mosing
PDhabil, Dip ECVAA, MANZCVS School of Veterinary Medicine, Murdoch University, Perth, Australia

Step-by-step guide how to manually ventilate a patient correctly

1. Make sure the oxygen flow is set to a sufficient L/min setting
   a) Non rebreathing system: 200 mL/kg/min
   b) Rebreathing system: 2 L/min

2. check the connection between breathing system and the endotracheal tube

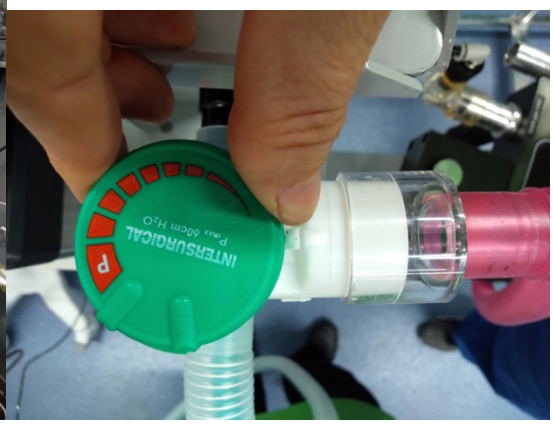
3. CHECK PULSE! This is important as positive pressure ventilation (=CMV = controlled manual / mechanical ventilation) will impair the cardiovascular system. When the pulse of the patient is already weak, you will need to also start supporting the cardiovascular system with an increased fluid rate, increase in heart rate or sympathomimetics if available.

4. Check DEPTH OF ANAESTHESIA and vaporizer setting: it has been shown that CMV increases mortality in veterinary medicine. This is not because CMV is harmful, but because it is often used when the anaesthetic depth is too deep and instead of lightening depth CMV is used. CMV furthermore increases depth as it delivers more volatile anaesthetic to the lungs - this means a vicious cycle starts if you are not aware of the depth of anaesthesia at the moment you start CMV!

5. Decide on a respiratory rate you want to use for CMV: dog & cat: normally start with 10 breath per minutes = 1 breath every 6 seconds

6. Close the APL valve PARTIALLY!! and give a breath while observing the movement of the chest. You should not get a good movement yet (otherwise you closed the APL valve too much on the first step)

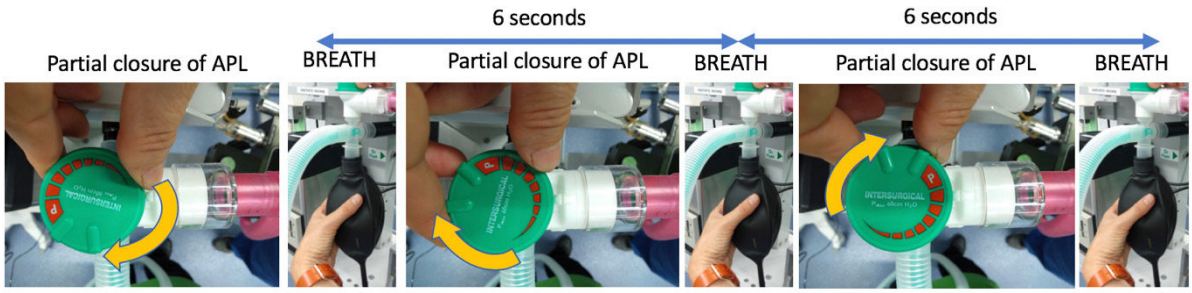
7. Close the APL valve a little bit more



8. Give another breath - as you are aiming for a respiratory rate of 10 bpm you will wait for the next breath for 6 sec.

9. Check the raise of the chest

10. Repeat step 6 -9 until you achieve adequate chest movement



11. Adequate chest movement is achieved with visible movement of the chest - this means that you reached your target TIDAL VOLUME for your patient. BE CAREFUL! We often use too much tidal volume in cats as their thorax is very compliant and we think we need to have some resistance to squeezing the breathing bag - this is NOT true! Try to observe a sleeping cat (and dog) and look at their chest movement - try to achieve the same with your CMV! This is especially important when you don't have a capnograph available as hyperventilation is as detrimental as hypoventilation!

12. if available: Check your end-tidal CO2 (ETCO2) on the monitor.

13. Adapt your respiratory rate up or down to achieve the target of an ETCO2 of less than 50 mmHg (perfect would be ETCO2 of 35-45 mmHg). You might have to MINIMALLY adapt the position of your APL valve (open or close) for this.

14. you now should be able to ventilate your patient adequately without touching the APL valve again - this gives you the opportunity to have your hands free and check the animal and adapt settings of fluids, vaporizer or administer drugs needed to stabilise the cardiovascular system - and give a breath in between…

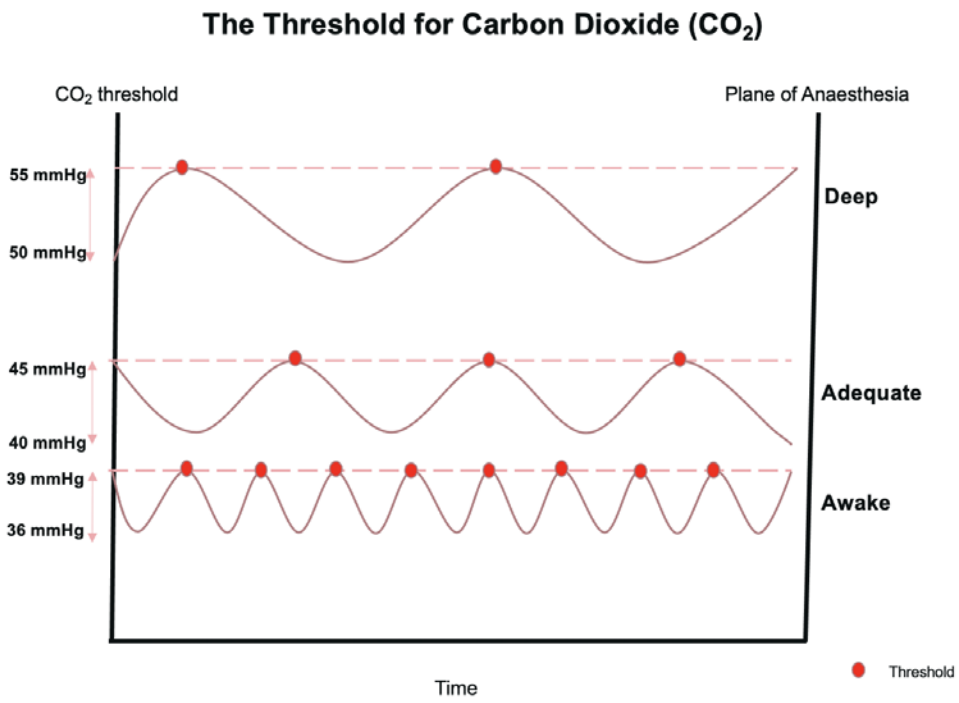
YOUR PATIENT STARTS TO BREATH SPONTANEOUSLY AGAIN!

15.Open the APL valve **COMPLETELY** and allow your patient to breath spontaneously

If you have a ventilator available in your practice following routine settings are used:

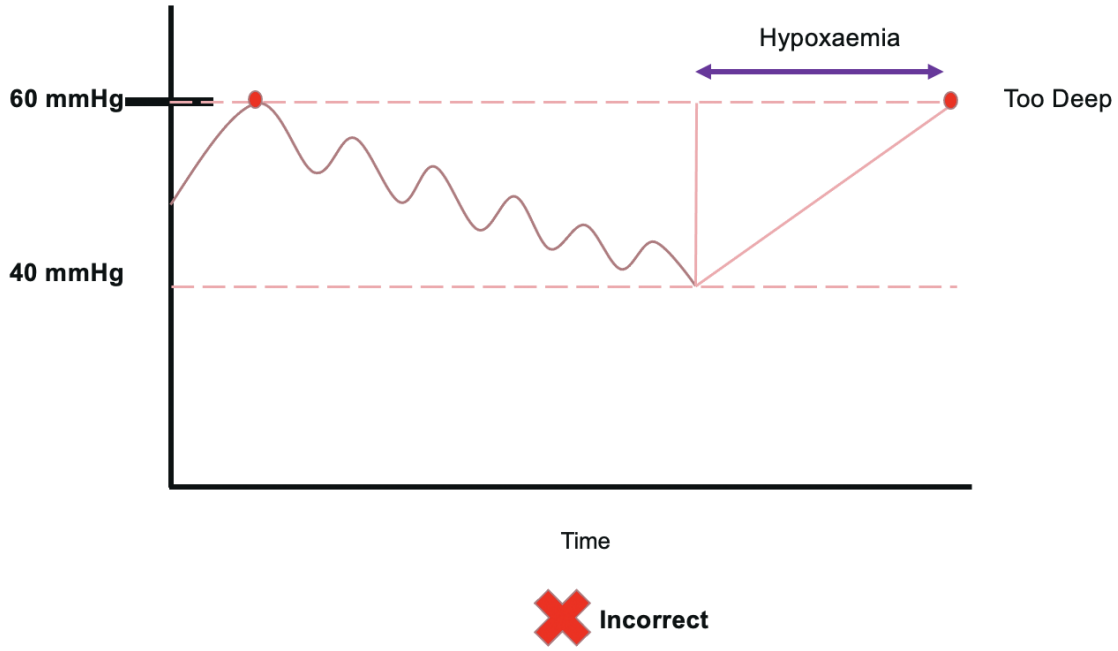
1. Tidal volume dog
   12-15 ml/kg
2. Tidal volume cat
   10 - 12 ml/kg
3. Peak inspiratory pressure (cat and dog)
   10 - 15 cmH2O
4. Respiratory rate
   big dog: 6-8 bpm
   little dog and cat: 12-15 bpm
5. Inspiratory time
   2 to 3 seconds
6. Inspiratory : expiratory ratio
   1:2 to 1:3

In our lecture we will discuss following graphs:



Notes:

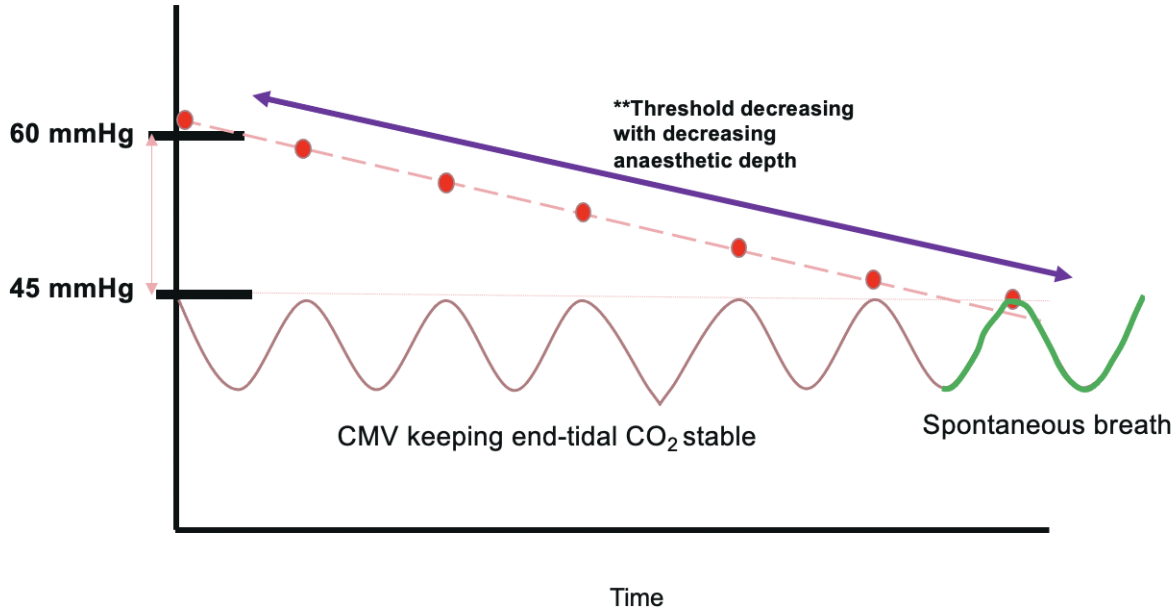
Intermittent Manual Ventilation



Notes:

Weaning from manual ventilation at the end of the procedure:

Allow the threshold for CO2 to decrease before you stop manual ventilation = decrease depth of anaesthesia first!



Notes:

What to monitor and what to do?! - Anaesthetic equipment in private veterinary practice!

Martina Mosing
PDhabil, Dip ECVAA, MANZCVS School of Veterinary Medicine, Murdoch University, Perth, Australia

Step-by-step guide how to check a rebreathing system for leaks

Rebreathing system:

A. Occlude the patient end with your hand or red connector

B. Close the Adjustable Pressure Limiting valve (APL) by turning it fully clockwise,

C. Fill the system with oxygen to a pressure of 30-40 cmH2O (3-4 KPa) , or when your bag is fully inflated if the anaesthetic machine does not have a pressure gauge

D. Ensure that the system maintain the pressure between 30 and 40 cmH2O for at least 30 seconds. If not, the leak test failed. If the pressure holds steady the system is leak-free.

E. Open the APL valve and ensure that the pressure decreases immediately.

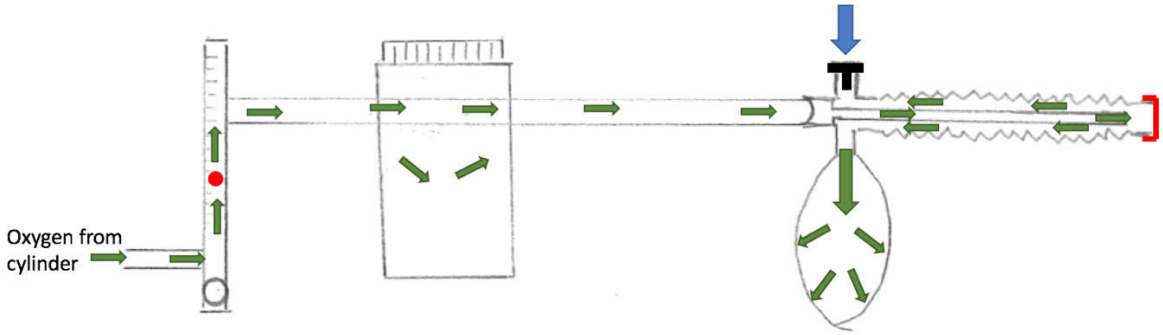
F. Before releasing the patient end from your thumb, ensure that the unidirectional valves are functional. Squeeze the reservoir bag several time and observe if both unidirectional valves open and close freely. NOTE if the bag is empty, you won't be able to get the valves to move as there will be no gas flowing through the system.

Step-by-step guide how to check a non-rebreathing system for leaks

A. Occlude the patient end with your hand or red connector

B. Close the APL completely

C. Turn the oxygen flow meter on (no rule for flow - depends on how quickly you want to fill the bag) in and wait for the bag to fill.



D. Once there are no 'wrinkles' evident in the bag, turn the flow meter off. If the 'wrinkles' do not disappear check if you really closed the APL valve - or if it is still in OPEN position.

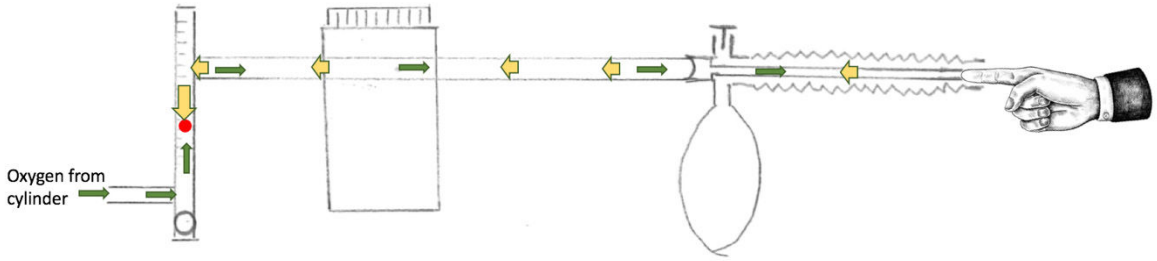
E. Wait 30 seconds to see if any 'wrinkles' reappear

F. If there are no 'wrinkles', there is no leak in the outer part of the system. Open the APL COMPLETELY to release the pressure in the system and check if your APL valve is working, then release the patient end. Note: NEVER, NEVER release the patient end first as you do not test the ability of the APL valve to release the pressure otherwise

G. If 'wrinkles' appear in the bag, there is a leak somewhere in the outer part of the system. You will need to troubleshoot until you find the leak and correct it. Hint: check the reservoir bag (most common source for leaks), the connections are tight and the scavenge is working.

H. Check the inner limb of the Bain system by turning the oxygen flow meter on (2L/min is appropriate).

I. Place your finger so that you occlude the inner limb of the Bain system and watch to see if the bobbin in the oxygen flow meter moves up and down. Note: do not leave you finger occluding the inner limb for longer than a couple of seconds. This can build up too much pressure in the system and damage the parts!



IT IS IMPORTANT TO GUARANTEE THAT THERE ARE NO LEAKS IN YOUR SYSTEM AS CHRONIC EXPOSURE TO VOLATILE ANAESTHETICS CAN CAUSE DEPRESSION AND ALZHEIMER!

Monitoring during anaesthesia

This list also gives the order of importance for monitoring during anaesthesia!

1. THE BEST MONITOR IS THE ANAESTHETIST WHO IS CHECKING DEPTH ON REGULAR BASIS!
    Jaw tone
    Pulse
    Mucous membrane
    Respiratory rate and chest movement
    Reflexes

2. THE MOST IMPORTANT APPARATIVE MONITORING VARIALBE IS HEART RATE!
It has been shown that continuous monitoring of heart rate reduces mortality significantely!

- Oesophageal stethoscope: sufficient
- Pulse oximeter: gives extra information about saturation of haemoglobin with oxygen. Might fail during states of peripheral vasoconstriction (alpha 2 agonists)
- ECG: gives also rhythm and always works

2. WEIGHT - a scale is very important! Over and underestimation of the body weight can lead to dangerous situations in the perioperative period

3. BODY TEMPERATURE
Most anaesthesia related fatalities happen during the recovery period. Very likely this is a combination of hypothermia which results in bradycardia and shivering causing a decrease in oxygen delivery with an increase in oxygen demand at the same time. Very often the animal is still hypoventilation. This leads to fatal hypoxaemia in an animal that was 'stable' throughout anaesthesia

4. VENTILATION
You can use a respiration monitor that gives you an audible signal for each breath or a capnograph.
Advantage of the capnograph is that it also gives you an idea of the sufficient minute ventilation as the end - tidal CO_2 increases over time with hypoventilation = decrease in minute ventilation.
The respiratory rate is not sufficient to rule out hypoventiatlion as the tidal volume might be too low.

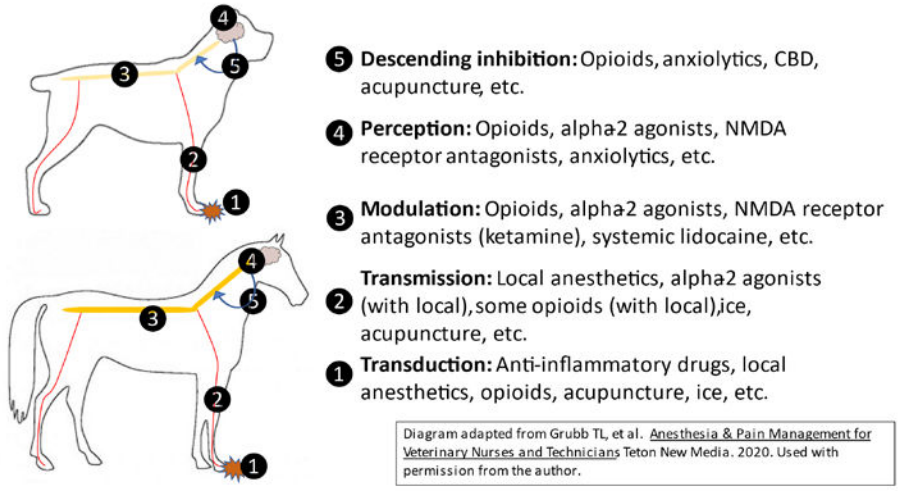
5. BLOOD PRESSURE
In the modern veterinary practice where more than healthy animals are anaesthetised a blood pressure monitor should be available nowadays.

- Blood pressure monitoring helps to guide adaptations to depth of anaesthesia (cats can be hypotensive with one vaporizer setting - perfect with just 0.1 % isoflurane less - and move with another 0.1% isoflurane less).
- Blood pressure monitoring helps to guide fluid therapy in sick animals: gastric dilation volvulus, trauma patients, haemoabdomen, foreign body surgery,…
- Blood pressure monitoring is necessary to guide the use of sympathomimetics during anaesthesia in sick animals especially septic patients.

Clinical Applications in Pain Relief: The Pathophysiology of Pain & Building an Effective Analgesic Protocol for Acute Pain

Tamara Grubb
DVM, PhD, Diplomate ACVAA President Elect, International Veterianary Academy of Pain Management

Pain has many sources and can impact the pain pathway in a myriad of different ways. Unfortunately, there is no 'one drug treats all' analgesic drug to address the complexity of pain. Balanced or multimodal analgesic protocols are essential for provision of adequate analgesia, which is essential for controlling FAS. The choice of analgesic drugs and techniques to balance the protocol should be made based on the location of action of that drug in the pain pathway.



Where do drugs work? Mammals have a pain pathway that is very well-preserved across species.
Thus, we can scientifically say that animals do experience pain. The pain pathway includes:

- Transduction - activation of noxious (ie, painful) stimuli by peripheral receptors
- Transmission - transmission of that stimuli up peripheral nerves
- Modulation - modulation of that stimuli in the spinal cord (modulation often means amplification)
- Perception - recognition of pain by the brain
- Descending inhibitory pathway - reflex feedback from the brain to the spinal cord

When listing drugs for treating acute pain, the opioids are often listed as the first class we consider. However, based on their effect on the pain pathway, perhaps we should start with NSAIDs and local anesthetics.

Non-steroidal anti-inflammatory drugs (NSAIDS)
Inflammation is generally a major component of acute pain. Because inflammation is also the pathology producing pain, control of inflammation decreases further tissue damage and promotes healing. A traditional NSAID or EP4 receptor antagonist should be administered to all appropriate patients.

- Advantages: Anti-inflammatory!!! Most surgical and trauma pain is due to pain of inflammation.
- Disadvantages: Can cause or exacerbate hepatic/renal disease, GI ulceration and bleeding disorders.
- Contraindications: Most patients with renal or hepatic dysfunction, GI ulceration, clotting dysfunction, etc…
- Precautions: Dose carefully in cats, but do not with-hold NSAIDs from cats.

Local anesthetic drugs
The pain signal is transmitted from the periphery to the central nervous system almost solely by opening and closing of sodium channels. This provides a unique opportunity to control pain because propagation of the pain signal is almost totally dependent on this mechanism. Local anesthetic drugs block sodium channels and provide complete pain relief from the nerves that are blocked. This fact led to the recommendation '… because of their safety and significant benefit, local anesthetics should be utilized, insofar as possible, with

every surgical procedure.' (AAHA/AAFP Pain Management Guidelines, Epstein et al. 2015). Often overlooked is the fact that local anesthetic blockade provides not only intra-operative but also post-operative pain relief. In humans, the inclusion of local blocks in analgesic protocols also decreases the likelihood that acute pain will lead to chronic pain. Because of the similarity of the pain pathway across mammalian species, this benefit is predicted in our patients.

- Advantages: Total loss of pain sensation! Cheap, easy to use, very effective.
- Disadvantages: None. Would be nice to have longer duration drugs.
- Contraindications: None
- Precautions: Dose carefully in cats and maybe in goats.
- This is one of the most effective, inexpensive and easy to use drug classes.
- Common blocks include: caudal maxillary, infraorbital, caudal mandibular, mental, auriculotemporal, brachial plexus, manus/pedus, thoracic, testicular, intraperitoneal, lumbosacral epidural, sacrococcygeal epidural, etc…
- Infusions (lidocaine only, controversial in cats) have been shown to provide analgesia in both acute (animals, humans) and chronic pain conditions (humans only so far - research needed in animals!)

Opioids

Opioids are potent, rapidly acting analgesic drugs, making them excellent for acute pain protocols. Full mu-opioid receptor agonists (morphine, etc) are the most potent but also the most impacted by regulatory control. Buprenorphine is less potent but with a long duration, especially the FDA-approved buprenorphine for cats (24-hour duration).

- Advantages: Potent class of systemically administered analgesic drugs; high safety margin, reversible.
- Disadvantages: Short duration when compared to duration of pain if administered IV or IM; Potential for sedation in dogs (usually a good thing for anesthesia) and excitement in cats and horses; Potential for GI effects (nausea/vomiting, slowed motility) that are generally clinically insignificant but might impact certain patients; Some decrease in respiratory function but almost always clinically insignificant.
- Contraindications: No absolute contraindications.
- Precautions: Patients in which vomiting, slowed GI motility, excitement/sedation or slight decrease in respiratory function could be problematic.
- Infusions allow decreased opioid dosing. Butorphanol duration of action can be prolonged if the drug is administered as an infusion.

Alpha-2 agonists

Consider sedation as soon as possible in patients with FAS. Dexmedetomidine and medetomidine provide both sedation and analgesia and their analgesic effects are synergistic with those of the opioids, thus enhancing the effects of the lesser potent opioids.

- Advantages: Sedation AND analgesia, reversible
- Disadvantages: Increases cardiac work because of vasoconstriction
- Contraindications: Most cardiovascular diseases
- Precautions: Any precautions associated with deep sedation (ataxia in horses, cows; mild respiratory depression, etc…)
- Infusions provide calming (or sedation if administered at higher dosages) and analgesia. Excellent addition to multimodal CRI.

N-methyl-D-aspartate (NMDA) -receptor antagonist (ketamine)

Ketamine, administered as a sub-anesthetic dose infusion in a multi-modal protocol, prevents or decreases the development of central sensitization, a condition that significantly amplifies the pain signal. Ketamine can play a major role in the reduction of both pain and with opioid consumption. Consensus guidelines promoting the use of ketamine in both acute and chronic pain states in humans have been developed (Schwenk et al. 2018; Cohen et al. 2018).

- Advantages: Role in controlling central sensitization, which can be tough to treat.
- Disadvantages: Must administer as a constant rate infusion (CRI) to achieve this effect
- Contraindications: None (CRI dose is REALLY low!).
- Precautions: Patients that may not be able to clear the drug through hepatic or renal pathways; patients with seizures.

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- Clinical Educator

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Potential adjunctive drugs

- Maropitant is a neurokinin-1 (NK-1) receptor antagonist. NK-1 receptors are found both in the emetic and pain pathways. Although minimal alveolar concentration (MAC) reduction studies do not prove analgesia (Reed and Doherty 2018), in a visceral pain model maropitant decreased MAC in cats (Niyom et al 2013) when administered at the label dose and in dogs when administered as an infusion (Boscan et al 2011). If not a true analgesic, the potential for increased patient comfort secondary to decreased vomiting makes maropitant a valid addition to a perioperative analgesic protocol.
- Gabapentin is used for treatment of chronic neuropathic pain and is unlikely to provide analgesia for acute inflammatory pain. However, gabapentin might be appropriate in patients with pre-existing neuropathic pain. NOTE: If administered for analgesia, the recommendation is continued dosing, rather than a single dose, at a minimum of 10 mg/kg PO BID. Gabapentin will also decrease FAS, which can decrease the intensity of pain.

Designing analgesic protocols for perioperative pain: To use analgesic drugs most effectively, the principles of analgesia should be followed to provide balanced analgesia:

1. **Preemptive analgesia**

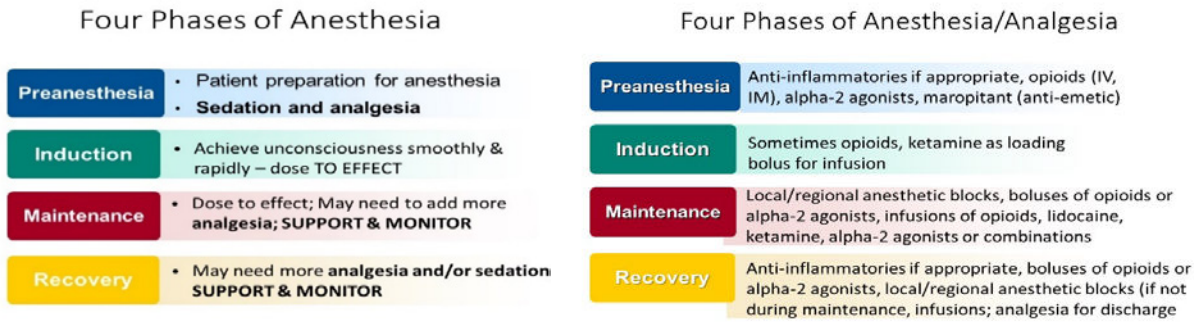
- Drugs administered prior to the pain stimulus are more effective. In part because the block input to or decrease the response of the neurons in the dorsal horn of the spinal cord, which decreases the likelihood of central sensitization.

2. **Multimodal analgesia**

- Using drugs from different classes or by different delivery routes (eg, IV vs epidural) 'interrupts' the pain pathway at different sites, allowing the effects of the drugs to be synergistic or even additive. This is one of the most important components of an effective analgesic protocol.

3. **Postoperative and post-discharge analgesia**

- Pain does not end at discharge from the hospital (in most cases) so analgesic drugs should not be discontinued on discharge from the hospital (in most cases). Pain should be controlled (remember - we don't usually eliminate pain - we just control it and improve quality of life!) until it dissipates to the level that it is not impacting patient welfare.



Summary: Balanced analgesic protocols are more effective than single-drug protocols at controlling pain and more efficacious pain management equates to lower FAS. Balance the protocol by choosing drugs from as many drug classes as appropriate, balancing both efficacy and safety. Include drugs to control FAS since FAS can amplify the sensation of pain.

Pain diagnosis today: Clinical applications in pain diagnosis

Peter Kronen
DVM, DipECVAA, Dr.med.vet.

Which tools are clinically available for diagnosing pain in dogs and cats and which clinical situations can they be applied to? How can I use and introduce them into my clinics?

Analgesia- the not-so-usual options!

Peter Kronen
DVM, DipECVAA, Dr.med.vet.

What can be done further to drug treatments? Background, applicability and usefulness of physical, low-level-laser, acupuncture, cannabinoid therapy, novel transcutaneous applications and maybe more

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Oral presentations

O59

Effects of oral tasipimidine premedication on quality of anaesthesia induction and anaesthetic requirements with and without methadone and dexmedetomidine in Beagle dogs

Amon T.[1], Kästner S.[1], Söbbeler F.[1], Tünsmeyer J.[1], Saloranta L.[2], Huhtinen M.[2]

[1]University of Veterinary Medicine Hannover, Hannover, Germany
[2]Orion Corporation, Orion Pharma, R&D, Espoo, Finland

The effects of tasipimidine, a new anxiolytic alpha-2A agonist, on quality of anaesthesia induction and anaesthetic requirements were studied.

Seven healthy Beagles underwent 4 treatments followed by isoflurane MAC immobility determination in random order (wash-out > 7 days) with the main investigator blind to treatment.

- P: Placebo p.o. 60 minutes before NaCl 0.9% IV followed by propofol IV.
- T-P: Tasipimidine 30 µg kg^{-1} p.o. 60 minutes before NaCl 0.9% i.v. followed by propofol IV.
- T-M-P: Tasipimidine 30 µg kg^{-1} p.o. 60 minutes before methadone 0.2 mg kg^{-1} i.v. followed by propofol IV.
- T-M-D-P: Tasipimidine 30 µg kg^{-1} 60 minutes before methadone 0.2 mg kg^{-1} and 1 µg kg^{-1} dexmedetomidine IV followed by propofol IV and dexmedetomidine at 1 µg kg^{-1} h^{-1}.

Sedation (0-19), catheter placement score (0-31), ease of catheter placement (0-4), time to intubation, intubation score (0-4), propofol dose, isoflurane MAC (electric stimulation) were analysed with repeated measures ANOVA and Kruskall-Wallis test (alpha = 5%).

	P		T-P		T-M-P		T-M-D-P	
	mean	**SD**	**mean**	**SD**	**mean**	**SD**	**mean**	**SD**
propofol dose (mg kg^{-1})	6.19	0.84^{a}	4.46	0.6^{b}	3.23	0.82^{c}	3.09	0.69^{c}
time to loss of consciousness (s)	117.7	17.4^{a}	84.3	15.6^{b}	67.8	21.1^{c}	64.3	31.9^{c}
time to intubation (s)	160.6	18.3^{a}	138.1	29.4^{a}	95	27.8^{b}	91.4	34.4^{b}
MAC (vol%)	1.26	0.12^{a}	1.02	0.09^{b}	0.83	0.13^{bc}	0.84	0.07^{c}

Tasipimidine induced mild sedation, differences in catheter placement conditions were not detected.
a,b different superscripts differ within row

An anxiolytic dose of oral tasipimidine may reduce anaesthetic dose requirements.

O58

Effects of tasipimidine pre-medication on blood pressure and perfusion in Beagle dogs anaesthetized with isoflurane with and without methadone and dexmedetomidine

Amon T.[1], Huhtinen M.[2], Tünsmeyer J.[1], Noll M.[1], Söbbeler F-J.[1], Saloranta L.[2], Kästner S.[1]

[1]University of Veterinary Medicine Hannover, Hannover, Germany
[2]Orion Corporation, Orion Pharma, R&D, Finland

Tasipimidine is a novel anxiolytic with high selectivity for alpha-2A adrenoceptors. The aim was to evaluate the effect of oral tasipimidine premedication on blood pressures and perfusion during general anaesthesia (GA) in dogs.

After instrumentation under sevoflurane and full recovery, 7 healthy Beagles received 4 treatments in random order, with at least 7 days wash-out, followed by individual isoflurane MAC for 120 minutes.

- P: Placebo PO 60 minutes before NaCl 0.9% IV followed by propofol IV.
- T-P: Tasipimidine 30 µg kg^{-1} PO 60 minutes before NaCl 0.9% IV followed by propofol IV.
- T-M-P: Tasipimidine 30 µg kg^{-1} PO 60 minutes before methadone 0.2 mg kg^{-1} IV followed by propofol IV.
- T-M-D-P: Tasipimidine 30 µg kg^{-1} PO 60 minutes before methadone 0.2 mg kg^{-1} and 1 µg kg^{-1} dexmedetomidine IV followed by propofol and dexmedetomidine at 1 µg kg^{-1} h^{-1} IV.

Blood pressures, CO (thermodilution), tissue oxygenation (stO_2, white light spectrophotometry) and tissue blood flow (TBF, laser Doppler) were measured at predetermined time points. Data were analysed by repeated measures ANOVA and Dunnett´s t-test (alpha = 5%).

Tasipimidine alone induced a significant reduction in HR and CO by 20-30% in conjunction with a decrease in MAP (10-15%), TBF and stO_2. Haemodynamic variables were within commonly observed ranges during GA in all groups. In individual animals, MAP dropped below 60 mmHg with lowest values in group P.

Oral pre-medication with tasipimidine at 30 µg kg^{-1} induces a characteristic low dose alpha-2 agonist effect, which needs to be considered during GA.

O44
Fast sequence intubation protocol in healthy dogs induced with propofol and rocuronium

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Difficult endotracheal intubation (EI) can be stressful, prolonged, and cause hypoxemia. Fast sequence intubation (FSI) might reduce stress and expedite EI.

Male intact Beagles (n = 6) received IV: acepromazine (0.03 mg kg^{-1}) and hydromorphone (0.1 mg kg^{-1}). In a masked block randomized cross-over design, following pre-oxygenation, induction was performed with propofol (2 mg kg^{-1}) IV over 5 seconds, followed by, placebo (0.9% NaCl; 0.06 mL kg^{-1}) or treatment (1% rocuronium; 0.6 mg kg^{-1}). Induction was 48 ± 10 minutes after premedication. Sugammadex (4 mg kg^{-1}) was administered IV after EI to dogs given rocuronium. Serum cortisol (SC), corrected blood glucose (cBG), PaO_2, $PaCO_2$, MAP, and HR were obtained at baseline and after EI (T1). Intubation time (IT), EI score, and spontaneous ventilation were recorded. Mixed-effect models and paired t-test were used for statistical analysis ($p < 0.05$).

Between groups, only treatment HR (90.1 ± 32.4) was higher than placebo (71.8 ± 15.8; p = 0.014). Baseline SC, cBG, PaO_2 were similar to T1. Baseline and T1 $PaCO_2$ (47.7 ± 6.2 and 58.8 ± 5.8 mmHg, p = 0.001), MAP (88.0 ± 9.9 and 81.2 ± 12.5 mmHg, p = 0.049) and HR (72 ± 16 and 78 ± 13 beats $minute^{-1}$, p = 0.014) had detected differences. The IT were similar for placebo (54.3 ± 6.9 seconds) and treatment (57.8 ± 5.2 seconds). All EI scores were acceptable. Spontaneous ventilation was always present after EI.

While FSI is feasible without distressing dogs, rocuronium addition did not improve intubation conditions.

O56
Evaluation of rocuronium-induced neuromuscular block on the patient state index in dogs anesthetized with propofol

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The patient state index (PSI) is an unitless number (0 to 100) derived from electroencephalography. Values of PSI between 25 and 50 indicates adequate anaesthesia level. The PSI calculation might be affected by neuromuscular block.

Six intact male Beagles, 12.3 ± 0.4 kg, received maropitant (1 mg kg^{-1}), acepromazine (0.03 mg kg^{-1}), and hydromorphone (0.1 mg kg^{-1}), all IV. Anaesthesia was induced with propofol IV at 2 mg kg^{-1} followed by an infusion of 13.2 mg kg^{-1} h^{-1}, adjusting the rate to maintain the PSI between 40 and 50 PSI. Electroencephalography electrodes in the forehead were used to measure PSI and the neuromuscular function was monitored with train-of-four ratios (TOFR). When the PSI readings were stable for 10 minutes during unchanged propofol infusion rate, TOFR and PSI values were recorded every 15 seconds for 12 minutes. Baseline data was collected in the initial 2 minutes, then rocuronium (0.6 mg kg^{-1}, IV) was administered. At 7 minutes, the dogs received sugammadex (4 mg kg^{-1}, IV) to reverse the neuromuscular block.

Baseline PSI was 41 ± 6 and the overall average was 42 ± 5 after the administration of rocuronium and sugammadex (P = 0.497). The baseline TOFR was 0.97 ± 0.08 and complete block was confirmed with TOFR = 0 in all dogs. Sugammadex successfully reversed all dogs (TOFR = 0.97 ± 0.09 at 12 minutes).

No effect on PSI was observed for both rocuronium and sugammadex. The PSI can be used in propofol-anesthetized dogs with or without neuromuscular block.

O24
An investigation into the detection of the pulse in conscious and anaesthetised dogs

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Pulse palpation is a simple technique requiring no equipment but there are no studies investigating how efficient veterinary professionals and students are at this skill and how reliable any findings are.

Prospective, observational, randomised study. A sample of 54 client-owned dogs scheduled for general anaesthesia was included. For each dog, three participants (senior anaesthetist, anaesthesia resident/nurse, veterinary student/animal care assistants) attempted pulse palpation at three locations (femoral, radial and dorsal pedal pulse) in conscious and anaesthetised dogs. Time-to-successful pulse palpation data was collected and modelled using a multivariate Cox regression survival analysis.

The overall success rate of pulse palpation was 77% (median time to pulse palpation = 10.91 seconds (IQR 19.09 seconds)). Success rate was lower in conscious than anaesthetised dogs. For both anaesthetised and conscious dogs there was a 77% lower likelihood of success at the radial compared to the femoral pulse (hazard ratio 0.23, 95% CI 0.38 - 0.69, $p < 0.001$). Veterinary students/animal care assistants had a 71% lower likelihood of success compared to senior anaesthetists (hazard ratio 0.29, 95% CI 0.22-0.39, $p < 0.001$). The median time to palpation was less than 10 secs for all experience groups at the femoral location in both anaesthetised and conscious dogs.

Palpation of the femoral location had the greatest likelihood of success and took the least amount of time. Monitoring the femoral pulse during induction of anaesthesia is suggested as a method for confirming spontaneous circulation. Pulse palpation improves with clinical experience.

O26
Optimisation of cat neutering anaesthesia protocols for use in the community

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The aim of this study was to determine whether sedative combinations supplemented with isoflurane mask induction provided both appropriate anaesthesia for cat castrations and rapid recoveries suitable for ambulatory neutering services.

Two sedative combinations, medetomidine 600 mcg m^{-2} and buprenorphine 180 mcg m^{-2} or medetomidine 500 mcg m^{-2} and methadone 5 mg m^{-2}, were given by intramuscular injection and their sedative effects were scored prior to mask induction using a simple descriptive scale adapted from Gurney et al (2000) consisting of 7 components with a total score of 18 possible. Meloxicam was given subcutaneously at 0.3 mg kg^{-1} prior to surgery. Endotracheal intubation and maintenance with isoflurane were used throughout orchidectomy in 89 cats. Atipamezole 5mg/ml was given intramuscularly at half of the original medetomidine volume following the completion of each surgery and recovery times were monitored to include sternal and entering portal times. Both combinations were compared for sedation quality and recovery times using the t-test.

The medetomidine and methadone combination provided higher sedation scores (13 ± 2.9), and shorter recovery times (4.9 ± 3.6 minutes), than the medetomidine and buprenorphine combination (12 ± 2.8) and (7.3 ± 3.6 minutes) respectively. Both combinations provided sufficient sedation to allow mask induction and endotracheal intubation prior to cat castration.

Medetomidine can be used in combination with methadone to provide rapid onset and reliable sedation in the cat. This permits mask induction, endotracheal intubation and rapid recovery following atipamezole administration.

O68

A step forward in the fourth Confidential Enquiry into Perioperative Equine Fatalities (CEPEF4): data collection over 14 months using an internet-based method

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The CEPEF2 is the largest study to evaluate equine anaesthetic risk (noncolic death rate 0.9%) (Johnson et al., 2002). Preliminary results from CEPEF4 (6.701 cases in six months), suggest a trend towards reduced mortality (Gozallo et al.,2021). This report updates the data, now from almost 20.000 cases.

Data were collected using an internet-based method, cleaned, and processed with the statistical software R.

Over 14 months, 19.796 general anaesthetics were collected from 77 centers. Of these cases, anaesthesia was maintained with partial intravenous anaesthesia (PIVA) in 10.982, inhalation only (INH) in 7.249 and total intravenous anaesthesia in 1.565. Mortality rates within seven days of general anaesthesia were: overall 0.9%, 0.6% in noncolics and 2.9% in colics. Common anaesthesia practices include: i) sedation with drug combinations, primarily alpha-2-agonists/opioids ± acepromazine (71.2%); ii) induction with ketamine/benzodiazepines (86.6%); iii) isoflurane as the most common inhalant (87.2% of inhalant-based anaesthetics); iv) PIVA (60.2%) is used more commonly than INH (39.8%) for inhalant-based protocols; and recovery v) light sedation with alpha-2-agonists (68.3%), vi) either with ropes (46.3%), free (44.0%) or manually-assisted (9.7%). Finally, vi) monitoring usually included electrocardiogram (90.9%), pulse-oximetry (87.7%), end-tidal carbon dioxide (84.3%) and invasive blood pressure (80.2%). Arterial blood gases were taken in 46.1% of horses, 72.5% if undergoing colic surgery.

This report confirms the previous preliminary results (2). Horses still die unexpectedly, but with a trend towards a lower frequency. Current anaesthetic practices have evolved from Johnston et al. (2002); in particular with increased use of opioid combination premedication, ketamine/benzodiazepine induction and PIVA maintenance, isoflurane-based.

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O69

Mortality risks in horses undergoing standing sedation for surgery and advanced diagnostic imaging. Preliminary results of the fourth Confidential Enquiry into Perioperative Equine Fatalities (CEPEF4)

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Although general anaesthesia has the highest risk of complications, procedures carried out under sedation are not risk-free. Preliminary data showed 0.2% mortality after procedures in 1.955 standing sedated horses (Gozallo et al., 2021). We report updated data from over 5.000 cases.

Horses undergoing standing sedation for surgery or advanced imaging using continuous rate infusions (CRI) or at least one extra "top-up" were included. Data were collected and processed as for general anaesthetic cases in CEPEF4.

Over 14 months, data from 5.536 standing sedations in 57 centres were collected. Overall mortality for procedures under standing sedation was 0.2%. Eleven horses died within the seven-days period due to complications: colitis (3 horses), post-operative colic (3 horses) septic peritonitis (2 horses), re-fractures in the stable (2 horses) and surgical complications (1 horses). Premedication was usually based on combinations of alpha-2-agonists/opioids ± acepromazine (82.3%). Maintenance was either with "top-ups" (69.8%) or CRI (30.2%). For "top-ups", detomidine was the most common alpha-2-agonist (82.0%) and butorphanol the most common opioid (86.5%). For CRI, detomidine was the most common alpha-2-agonist (83.9%), and butorphanol (58.8%) or morphine (39.3%) the most common opioids. Monitoring was minimal, with only temperature, ECG and pulse-oximetry used in 5.7%, 3.3% and 1.1% of the patients, respectively.

Including more data supports the previous results, indicating that standing sedation in horses is not risk-free (Gozallo et al., 2021). The main limitation was that not every centre reported all their standing sedation cases.

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O90
Automated classification of behaviour in horses, preliminary results

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Continuous and automated assessment of discomfort or pain in horses may be possible with the use of neuronal network tracking of their position, posture, activity, and special behaviours. The use of long short-term memory (LSTM), an artificial recurrent neural network architecture, was therefore tested in this study.
Ten horses were video-recorded for 4 hours and the behaviours resting, lying, moving, alert and feeding/foraging scored manually. Additionally, the same videos were analysed with an image processing software able to recognize nine key points (nose, ears, withers, tail, and hoof). Firstly, the data obtained from the key point analysis of five horses were used to train the LSTM model to automatically predict resting/alert and feeding/foraging behaviours. Then, the data from the remaining horses were used to test the model. The accuracy of LSTM was obtained comparing manual versus automatic scoring and calculating the proportion of correct predictions (both true positives and true negatives) over the total number of cases examined.

The LSTM model showed a global accuracy of prediction of 95.65%. Accuracy of the prediction during training for resting/alert and feeding/foraging behaviours was 98.58% and 93.58%, respectively. However, less accuracy was observed during testing of the model.

The model showed acceptable accuracy to predict resting/alert and feeding/foraging behaviours during training. Although these preliminary results render LSTM as a promising tool for continuous and automated detection of pain and discomfort in horses, further studies with larger data are required to improve the accuracy of the prediction this model.

O91
Validation of a commercially available automated video tracking system for horses

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Measurement of activity time budgets in horses is a promising method to determine animal welfare and discomfort. The use of cameras including artificial intelligence (AI) can be used to automatically assess activity and evaluate basic behaviours. However, validation of the method is required prior to clinical application.
Ten horses standing in a box were observed for 24 hours with a commercially available camera (ACARIS Horse Protector, *), with integrated AI. The camera analysed in real time the eating, resting, and lying behaviour of the horse and displayed the obtained data via an application in percentage per behaviour and per hour. Additionally, the videos were recorded. Likewise, these videos were manually scored for the same behaviours with a behaviour scoring software. Automatic and manually obtained data were compared using Bland-Altmann analysis.

The bias for eating, resting, and lying was -10.30%, 12.63% and 1.11% with a standard deviation of 23.42%, 23.60% and 10.03%. The correlation coefficient for eating, resting, and lying was 0.628, 0.615, and 0.808, respectively. The 95.0% lower confidence limit of mean was -13.87% for eating, 9.03% for resting and -0.4% for lying. The 95.0% upper confidence limit of mean was -6.74% for eating, 16.23% for resting and 2.64% for lying.

The camera analysed the behaviour with an overall acceptable accuracy. Further improvement of the accuracy of the used AI camera is required to render the method suitable for automated analysis of welfare and discomfort in horses.

O92
Influence of experimentally induced endotoxemia on microcirculatory variables in horses

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Endotoxemia can impair microcirculation by promoting vasoplegia and shunting of oxygenated blood (Ince 1999) leading to potential increase in mortality and morbidity in equids.

This was a prospective, randomized, controlled trial. Six healthy adult horses which were anaesthetized with isoflurane (ET_{Iso}~1.6) and mechanically ventilated (normocapnia), received dobutamine CRI. Endotoxemia was induced with E. coli B55:O5 LPS 30 ng kg^{-1} over 30 minutes IV. Microcirculation variables of buccal, intestinal, and genital mucosa were obtained by sidestream-darkfield microscopy [(perfused deBacker density, proportion of perfused vessels (PPV), microvascular flow index (MFI), heterogeneity index {(HI); calculated}, laser-doppler flowmetry (blood flow, (LDF)], and white light spectrometry [tissue oxygenation (tSO_2)]. Measurements were obtained before and after endotoxin infusion at predetermined time points. Data were analyzed by one-way-ANOVA and Wilcoxon signed-rank test.

After endotoxin, buccal, intestinal, and genital tSO_2 and LDF did not change significantly. Sidestream-darkfield microscopy revealed no changes in perfused DeBacker density and PPV, whereas MFI and HI (Table) decreased after endotoxin infusion.

	Baseline		**30-min**		**120-min**	
	MFI	**HI**	**MFI**	**MI**	**MFI**	**HI**
Buccal	2.9 (1.8; 3)	0.1 (0.04; 0.16)	2.5 (0.7; 3)	0.17 (0; 2.3)	1.9 (0.7; 3)	0.6 (0.04; 2)
Intestinal	1.8 (0.7; 2.6)	1 (0.1; 2)	1.2 (0.2; 2)	0.8 (0.4;3.3)	0.9 (0.8; 2.4)	1.1 (0.6; 1.6)
Genital	2.8 (2.28; 3)	0.12 (0; 0.4)	2.4 (2; 2.8)	0.3 (0.1; 0.5)	1.5 (0.4; 2.1)*	1 (0.4;3.3)*
median (min; max), * $p \leq 0.05$						

At the endotoxin dose used, short term experimental endotoxemia under isoflurane anaesthesia induced only minor alterations in microcirculation in horses.

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O40

Effects of endotracheal intubation on respiratory pattern and distribution of ventilation in anaesthetised horses

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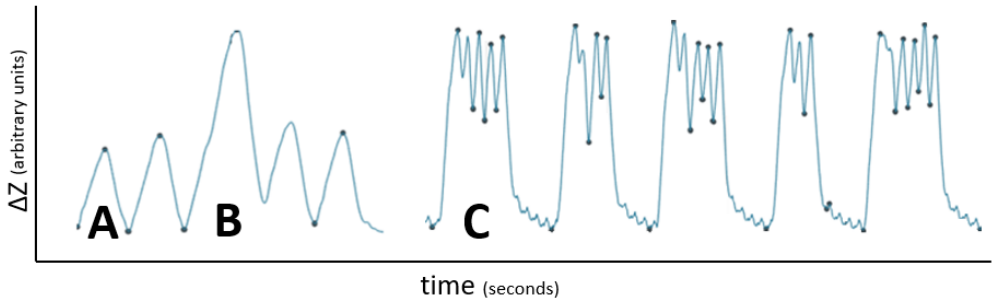
Equine respiratory physiology might be influenced by endotracheal intubation. This study aimed to compare breathing pattern (BrP) and ventilation distribution in anaesthetised horses spontaneously breathing room air via facemask (MASK) or endotracheal tube (ETT).

Electrical impedance tomography (EIT) via a thoracic belt was used in six horses anaesthetised with TIVA (xylazine, ketamine, guaiphenesin). Horses positioned in right lateral recumbency were randomly assigned to breathe spontaneously via one of two treatments (either ETT or MASK) for the first 30 minutes, followed by the other treatment for additional 30 minutes. One-month later, during a second anaesthesia, treatment order was inversed. EIT data were collected over 2 minutes every 15 minutes. The impedance change (ΔZ) curve was used to classify breaths as normal (linear inspiration and expiration), abnormal-sigh (>1.3 x ΔZ normal breath) and abnormal-crown-like (group of breaths with incomplete expiration in-between breaths) (Figure 1). Proportion of normal/abnormal breaths across treatments were compared using Cochran-Mantel-Haenszel analysis. Ventral-dorsal (CoVVD) and right-left centre of ventilation (CoVRL), inspiratory (t_i) and expiratory (t_e) times and I:E ratio were compared across treatments using a mixed linear model analysis.

Breathing pattern was associated with treatment (p=0.012) with more abnormal breaths during ETT. CoVRL showed more dependent ventilation during MASK (p = 0.025). Inspiratory time was shorter for ETT (p = 0.045) with lower I:E ratio (p = 0.017).

Endotracheal intubation alters BrP and shifts ventilation towards the non-dependent lung when compared to facemask in horses anaesthetised with TIVA.

Figure 1. Impedance curve examples: A) normal. B) abnormal-sigh. C) abnormal-crown-like.



O57
Propofol-induced reduction in the patient state index in dogs

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The patient state index (PSI) is an encephalographic-based unitless algorithm from 0 to 100 that monitors the level of consciousness in people; however, it was not tested in dogs.

Six intact male Beagles were medicated, IV, with maropitant (1 mg kg^{-1}), acepromazine (0.03 mg kg^{-1}), and hydromorphone (0.1 mg kg^{-1}). Electrodes were placed to measure PSI continuously and baseline was recorded before the administration of propofol, IV. An initial bolus of propofol (1.5 mg kg^{-1}, over 5 seconds) was followed 45 seconds later by a continuous rate infusion (CRI) of propofol (12 mg kg^{-1} h^{-1}). The PSI was recorded at 1-minute intervals for 5 minutes (T1 to T5) after the initial bolus. Anaesthesia onset time was determined from bolus to PSI ramp down. To decrease PSI below 50, additional doses of propofol (0.5 mg kg^{-1}) were administered with adjustments in the CRI (up to 16.7 mg kg^{-1} $hour^{-1}$). The plasma propofol concentration for each dog was estimated (CpE) at T5.

Onset time was 42.0 ± 22.0 seconds. The baseline PSI was 88.7 ± 2.5 and it was significantly lower at T2 to T5 (ranged from 47.3 ± 5.1 to 57.0 ± 15.8, one-way ANOVA for repeated measures, all $p < 0.022$) with adequate anaesthesia depth. Additional boluses and adjustments in the CRI of propofol were required in 4 of 6 dogs to decrease PSI less than 50. The CpE at T5 was 3.2 ± 0.5 µg mL^{-1}.

The PSI can track loss of consciousness during induction of anaesthesia in dogs.

O23
The Effect of Remifentanil Infusion on Sevoflurane MAC_{NM} and Bispectral Index in Dogs

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The objectives of the study were to evaluate the effect of remifentanil infusion on the minimum alveolar concentration of sevoflurane preventing movement ($SEVOMAC_{NM}$) and Bispectral index (BIS) in dogs.

Ten adult beagles were anesthetized with sevoflurane in oxygen and baseline $SEVOMAC_{NM}$ was determined. Each dog received remifentanil infusion at 5, 10 and 20 $\mu g^{-1}\ kg^{-1}\ hour^{-1}$, in sequence, with 20 minutes washout between infusions. BIS monitoring was performed throughout the anaesthesia. Treatment $SEVOMAC_{NM}$ determination started 20 minutes after the start of each infusion. Venous blood samples were collected to determine remifentanil plasma concentrations, at baseline, treatment $SEVOMAC_{NM}$ determination timepoint, and 20 minutes after each infusion was stopped. A mixed-model analysis was used to determine the effect of remifentanil infusion on response variables. The relationships between BIS and FE'SEVO, and between remifentanil plasma concentrations and the %decrease in $SEVOMAC_{NM}$ were evaluated. p value was set at <0.05.

The overall baseline $SEVOMAC_{NM}$ was 2.47 ± 0.11%. The percent decrease in baseline $SEVOMAC_{NM}$ was significantly different between remifentanil infusions at 5 and 10 $\mu g^{-1}\ kg^{-1}\ hour^{-1}$. The mean baseline BIS value was 69.48 ± 1.25 and was significantly lower than the BIS values recorded during remifentanil infusions. Mean baseline HR (107.7 ± 2) was greater than the HR during all remifentanil treatments. Conversely, for all remifentanil treatments, the MAP was greater than the values recorded at baseline (62.6 ± 1.2).

Remifentanil infusion at 5 and 10 $\mu g^{-1}\ kg^{-1}\ hour^{-1}$ reduced $SEVOMAC_{NM}$ in dogs. Remifentanil infusion at any rate studied did not reduce BIS values.

O70
Association between body mass and hypotension in dogs under general anaesthesia: a retrospective study of 1789 cases

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Conflicting evidence exists about whether body mass is negatively associated with risk of hypotension under general anaesthesia (GA) in dogs (Lizuka et al. 2013, Costa et al. 2015, Martin-Flores et al. 2019). This study examines whether previously reported associations between body mass and risk of hypotension persist in a larger, more diverse population.

Records from all dogs undergoing GA at a single institution from December 2018 to June 2020 were reviewed retrospectively. Data on patient characteristics and GA were extracted. Hypotension was defined as ≥ 2 consecutive readings at an interval of ≥ 5 minutes where mean arterial pressure was < 60 mmHg. A multivariable general linear model was used to identify associations between recorded variables and hypotension.

From 1932 dogs anaesthetised during the study period, 1789 anaesthetics met the inclusion criteria. Increasing body mass (per 10 kg) was significantly associated with decreasing odds of hypotension (odds ratio 0.68, 95% confidence interval 0.60 - 0.77). Premedication with alpha-2 agonists and higher body temperature were also independently associated with reduced odds. Brachycephaly (odds ratio 1.72, 95% confidence interval 1.25 - 2.38), higher American Society of Anesthesiologists physical status classification and having a surgical procedure (vs diagnostic) were associated with increased odds of hypotension.

Dogs of lower body mass and brachycephalic breeds may be at higher risk of hypotension under GA. These findings may also reflect the challenges of accurate blood pressure measurement in these patients. Particular attention should be given to monitoring blood pressure accurately in these groups.

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O49
Haemodynamic effects of pimobendan during general anesthesia in dogs

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The aim of this study was to evaluate the haemodynamic effects of pimobendan during general anaesthesia in dogs.

A prospective, randomized, triple-blinded, placebo-controlled, clinical study was conducted. Thirty-three dogs (median [range]: 9 [7-12] years, 11 [5-25] Kg; ASA I: 7 animals, ASA II: 26 dogs) were anaesthetised for different surgical procedures using dexmedetomidine (2-3 µg kg^{-1} IM) and methadone (0.2-0.3 mg kg^{-1} IM) as premedication, alfaxalone (0,5-1,5 mg kg^{-1} IV) as induction and isoflurane as maintenance agents. They were randomly allocated in two groups: eighteen dogs received pimobendan 0.15 mg kg^{-1} IV (PIMOBENDAN) and 15 saline solution 0.2 ml kg^{-1} IV (PLACEBO). Data were recorded before, 1 minute and 10 minutes after injection. Velocity integral time (VTi), aortic peak velocity (PVa) and aortic mean acceleration (MAa) were measured using an oesophageal Doppler monitor (CardioQ-ODM). Heart rate, MAP, fr, temperature, SpO_2, $EtCO_2$ and EtISO were also registered. Data were analysed using a two-way ANOVA for trimmed means, M-estimators, medians, and a general linear model ($p < 0.05$).

After injection, VTi (13.0 cm [10.4, 22.3],) PVa (95.0 [83.0, 160] m sec^{-1}), and MAa (12.6 [9.40, 17.0] m sec^{-2}) were higher and EtISO lower (1.10 [1.00, 1.20] %) in PIMOBENDAN when compared to PLACEBO (VTi: 10.5 [6.50, 17.4] cm, PVa: 80.0 [62.0, 103] m sec^{-1}, MAa: 10.2 [7.00, 16.0] m sec^2. EtISO: 1.15 [0.900, 1.40] %. No differences were observed in the other variables.

Pimobendan increases VTi, PVa and MAa measured by oesophageal Doppler monitor during anaesthesia.

O77

The pre-operative use of two different types of insulin in diabetic dogs undergoing phacoemulsification surgery: preliminary results

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The optimal protocol for glycaemic control of diabetic dogs does not exist and Caninsulin use prevails pre-operatively. A blood glucose (BG) target range associated with perioperative complications has not yet been established. The aim of the study is to compare neutral insulin administered intramuscularly (Group NEU) and Caninsulin administered subcutaneously (Group CAN), for their ability to maintain perioperative BG within the range of 8.3 - 11.1 mmol/L in dogs undergoing phacoemulsification surgery.

So far, 20 dogs have been included in the study (9 female and 11 male). The morning before surgery dogs were randomly allocated to either group CAN (n = 10) or to group NEU (n = 10). The dose of insulin depended on morning BG levels. Continuous data are presented as median [range] and categorical data are presented as number of observations.

Dogs' age and weight were 105 [48 - 147] months and 9.75 [4.1 - 40.7] kg, respectively. In group NEU, the episodes within, above and below the BG target range were 13/61, 19/61 and 29/61 intraoperatively, and 10/62, 25/62 and 26/62 postoperatively. In group CAN, these episodes were 12/62, 34/62 and 16/62 intra-operatively, and 12/63, 25/63 and 26/63, postoperatively. No animal developed hypoglycaemia (BG < 3.3 mmol/L) perioperatively, and 4/10 of dogs in group NEU and 2/10 in group CAN were hypotensive. Additional neutral insulin was administered to 3/10 of dogs. Glucose supplementation was administered to all dogs in group NEU and 8/10 of dogs in group CAN.

These are preliminary results, and no conclusions can be reached.

O81
Effect of gabapentin on propofol and isoflurane anaesthesia and perioperative analgesia in dogs

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Gabapentin is an antiepileptic drug exhibiting analgesic properties especially in chronic pain conditions. However, its effect on the perioperative period needs to be investigated, as studies in dogs present conflicting data.

A randomized, blinded, cross-over experimental study was conducted on 11 Beagles undergoing bilateral ulnar osteotomy, with an 8-months interval in-between. Oral gabapentin 10 mg kg^{-1} (Gaba group) or placebo (Control group) were administered, 2 hours before premedication and every 8 hours thereafter. All dogs were premedicated with ACP 0.05 mg kg^{-1} and Morphine 0.1 mg kg^{-1} IM, while anaesthesia was induced with propofol and maintained with isoflurane. Propofol and isoflurane requirements, vital signs, sedation, and pain levels were evaluated throughout the perioperative period and for 48 hours postoperatively. The Sign test for paired samples, a non-parametric statistical method, was evaluated given that the same animals were studied in both groups (significance level of 0.05).

Median values and range for sedation scores in Gaba and Control groups, 2 hours after gabapentin administration and 30 minutes after premedication, were 2 (0 - 3) versus 1 (0 - 2) and 7 (2 - 10) versus 2 (2 - 5), respectively, while induction propofol doses (mg kg^{-1}) were 4.5 (3 - 5) in Gaba versus 5 (3.5 - 5.5) in Control, all differences being significant. No differences were observed concerning isoflurane requirements or postoperative pain scores.

It seems that gabapentin contributes to better sedation levels and lower propofol consumption in dogs undergoing osteotomy but has no impact on acute postoperative pain.

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O41

Effect of ketamine on xylazine based sedation in horses during standing ventriculocordectomy and laryngoplasty

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Beneficial effects of low dose ketamine have been studied in standing procedures (Muller et al. 2017). The aim of this prospective, randomized, clinical study was to determine the rate of xylazine constant infusion (CI) when ketamine CI was administered in standing healthy horses undergoing elective laser ventriculocordectomy and laryngoplasty.

Acepromazine (0.3 mg kg^{-1} IM), 30 minutes before sedation with xylazine (0.7 mg kg^{-1}; initial rate 0.5 mg kg^{-1} $hour^{-1}$), and morphine (0.1 mg kg^{-1}) IV were given. Ten minutes later ketamine bolus (0.25 mg kg^{-1} in 15 minutes + 0.5 mg kg^{-1} $hour^{-1}$; Group K) or saline (same volume; Group S) were administered. Every 10 minutes f_R, HR, SAP, MAP, DAP, ataxia, sedation and surgical condition (0-3) were registered. The Ghent Sedation Algorithm was used to adjusted xylazine and if xylazine could not improve surgical conditions romifidine (4 µg kg^{-1}) was administered. A t-test or a Mann-Whitney U test (Range (25^{th}-75^{th})) were performed.

Thirty horses were included (13 S;17 K). Xylazine dose was significantly lower with ketamine (0.77 ± 0.31 vs 0.93 ± 0.42). No differences in romifidine bolus. Ataxia ($p = 0.001$), sedation ($p = 0.001$) and surgical conditions ($p = 0.001$) values were significantly different between S and K groups. Significant differences for f_R, HR, SAP, MAP and DAP existed between groups.

Ketamine CI reduced the xylazine dose and improved sedation quality.

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O53
Comparison of iatrogenic trauma to the upper airway in horses during endotracheal intubation using 2 different sized endotracheal tubes

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In horses, there is a significant risk of iatrogenic trauma to the upper airway during endotracheal intubation. The objective of this in-vivo study is to compare trauma caused during endotracheal intubation using two different sized endotracheal tubes in horses undergoing general anaesthesia.

Twenty-seven Thoroughbred racehorses undergoing surgery in dorsal recumbency were included in this study. Endoscopic examination of the upper airway was performed pre/post-operatively. If lesions were present pre-operatively the horses were excluded from the study. Horses were randomly intubated with either a 26mm internal diameter endotracheal tube (ETT) (n = 14) or a 20mm internal diameter ETT (n = 13). Post-operative endoscopy was performed following recovery and lesions in the larynx and trachea were noted along with intra-tracheal mucus plaques and graded on a scale from 0-3 (Heath et al 1989).

All horses in the 26mm ETT group had abnormal findings at endoscopy following recovery. These findings included grade 3 lesions (n = 7), grade 2 lesions (n = 4) and grade 1 lesions (n = 3). For horses intubated with the 20mm ETT included grade 2 lesions (n = 1), grade 1 lesions (n = 7) and no abnormalities were seen in 5 horses. A Chi Square and Fisher's exact tests were used to identify a significant difference between ETT size and whether the horse experienced mucosal trauma ($P = 0.002$), and the grade of intra-tracheal mucus plaques ($P < 0.001$).

Results suggest that 20mm internal diameter ETT is less likely to cause severe trauma to the larynx and trachea compared to a 26mm internal diameter ETT in horses undergoing elective surgery.

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O62

Clinical comparison between subcutaneous and intramuscular repeated injection of dexmedetomidine in anaesthetized horses: preliminary investigation

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Dexmedetomidine has been investigated in equine patients (Gozalo-Marcilla et al. 2018).

Horses received acepromazine 0.03 mg kg^{-1} and detomidine 10 µg kg^{-1} IV. Anaesthesia was induced by IV diazepam 0,05 mg kg^{-1} and ketamine 2,5 mg kg^{-1} and maintained with a steady state isoflurane (1.3%) in 60% oxygen by mechanical ventilation. Seven horses each randomly received (blindly) dexmedetomidine (2 mg kg^{-1}) administered every hour subcutaneously (group SC) or intramuscularly (group IM). Ringer's lactate and dobutamine to maintain MAP > 70 mmHg were administered IV. Physiological parameters, arterial blood gases and recovery score (Young and Taylor 1993) were recorded. Data distribution was tested with Kolmogorov-Smirnoff test. Student's t, Mann-Whitney and ANOVA tests were applied ($p \leq 0.05$).

Arterial blood gas parameters were not statistically different between groups and within physiological ranges. No differences in anaesthesia (minutes) (IM 133 ± 19; SC 151 ± 11) and extubating times (minutes) (IM 15 ± 11; SC 9 ± 3), time (minutes) to attain sternal (IM 41 ± 9; SC 44 ± 10) and standing position (IM 52 ± 7; SC 55 ± 7) together with recovery score (IM 1.4 ± 0.5; SC 1.4 ± 0.5) were detected. There was significant difference in urinary output (ml kg^{-1} $hour^{-1}$ IM 6.3 ± 2.7 SC 9.8 ± 2.2) and dobutamine (µg kg^{-1} $minute^{-1}$ IM 0.40 ± 0.15; SC 0.56 ± 0.10).

Dexmedetomidine administered either by IM or SC injection at indicated dosages, showed similar effects; further studies could elucidate whether this contributed to anaesthesia and recovery quality.

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O64
The effect of morphine on mechanical nociceptive thresholds in donkeys

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To determine if morphine has an antinociceptive effect on mechanical nociceptive thresholds (MNT) in donkeys.

Eight clinically healthy standard donkeys were used. Following jugular catheter placement, animals acclimatised for 1 hour. Donkeys received 0.1 (LDM), 0.5 (HDM) mg kg^{-1} morphine or 0.9% saline (S) intravenously. Drugs were diluted to a final volume of 10 mL and injected over 60 seconds at time 0. Order of treatments was randomized with a washout period of ≥ 7 days. An MNT testing boot was placed on one thoracic limb with a sham boot on the contralateral limb. The first treatment limb was randomized and alternated subsequently. Baseline MNT measurements were made immediately before drug injection in triplicate and averaged. MNT were measured at 15, 30, 45, 60, 90, 120, 150, 180, 210, 240, 300 and 360 minutes after. Assessments were made by an observer blinded to treatment. Data were assessed for normality and analysed for differences between treatments and within a treatment with Friedman's test and Dunn's post hoc test, $p < 0.05$.

Overall median (range) baseline MNT was 8.9 (6.1-16.6 N) and did not differ between treatments. Following saline administration there was no change in MNT over time. Peak median MNTs were 16.2 N and 25 N at T60 with LDM and HDM, respectively. $p < 0.026$ for S versus HDM. Within HDM, MNTs increased from baseline between T45-T180 ($p < 0.001$ and 0.014 respectively).

In this group of donkeys, HDM had the greater antinociceptive mechanical effect compared with LDM or saline.

O66

Comparison between the effects of two post-anaesthetic doses of medetomidine on characteristics of recovery from isoflurane anaesthesia in horses

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Recovery is the most dangerous phase of general anaesthesia in horses (Gozalo-Marcilla and Ringer 2021). Alpha$_2$-agonists enhance its quality but increasing the recovery time (Santos et al. 2003).

Prospective, blinded, randomized, clinical study to compare the effect on recovery of two doses of medetomidine. Horses were under a standard general anaesthesia protocol for arthroscopy. Medetomidine (0.5 or 1 µg kg^{-1}) IV was administered just after isoflurane was discontinued. Time of different recovery phases and number of attempts were recorded. Numerical scales NS1 (1: poor - 5: excellent) and NS2 (0: excellent - 4: poor) and a composite scale (CS) (1: excellent - 6: accident) were used for quality assessment. Mann-Whitney U-test was performed ($p < 0.05$). Median (range) is presented.

Twenty-two horses per group were included. Results for 0.5 and 1 µg kg^{-1} groups were respectively: lateral recumbency time: 35 (16 - 91), 43 (21 - 75) minutes; sternal recumbency time: 6 (0 - 51), 6 (0 - 37) minutes; total recovery time: 47 (22 - 98), 49 (32 - 80) minutes; number of attempts to sternal: 1 (1 - 3), 1 (0 - 3) and to standing: 2 (1 - 5), 1 (1 - 7); quality according NS1: 5 (2 - 5), 5 (3 - 5); NS2: 1 (0 - 3), 0 (0 - 2); and CS: 2 (1 - 4), 1(1 - 3). No significant differences between groups were found.

Medetomidine 0.5 µg kg^{-1} dose did not decrease the recovery time but maintained the recovery quality.

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O84

Phenylbutazone, flunixin and meloxicam clinical efficacy for lameness and laminitis in horses

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This study aims to compare the effects of phenylbutazone (PBZ), flunixin (FLU) and meloxicam (MEL) in equine lameness and laminitis. If PBZ was clearly superior to FLU and MEL, then it could support its inclusion in the 'essential list' for horses.

During the crossover blinded study, ten horses and ponies presenting with laminitis (4) or lameness (6) received orally, randomly and alternatively (2 days washout) PBZ, FLU and MEL (4, 1.1, 0.6 mg kg^{-1}) once a day for 2 days. Lameness and laminitis scores (LS) were established from videos recorded morning and evening for 3 days (AAEP scale 0 to 5). Total scores, means and changes were compared among treatments (Friedmann rank-sum test, BiostaTGV).

From same initial LS (32; mean 3.56), day 1 and day 3 LS improvements are FLU (-3; 3.22), MEL (-4; 3.22), PBZ (-9; 2.56) $p < 0.008$ and FLU (-1; -0.17), MEL (-2; -0.22), PBZ (-12; -1.33) $p < 0.01$. Day 2 dose allows the best clinical changes, (-6; -5; -12) respectively and a residual effect (evening day 3) with PBZ only (-8; -0.89) $p = 0.27$.

Results suggest faster onset of action, longer action, and more persistent clinical benefits for PBZ in horse's lameness and laminitis pain management. PBZ appeared clinically superior to FLU and MEL in this study, which supports its potential inclusion in the essential list for horses and should inform clinical decision making to use better pain treatment without having horses to be signed out of the food chain.

O29
Can cat carers reliably assess acute pain in cats using the Feline Grimace Scale? A large bilingual global survey

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This study aimed to investigate if cat carers could reliably assess acute pain using the Feline Grimace Scale (FGS) and if participants' demographics could affect scores.

An online survey in English and Spanish was advertised by the International Cat Care and other platforms (March to May 2021) using a convenience sample. Eligible participants were cat carers over 16 years-old and non-veterinary health professionals. Participants and a group of eight veterinarians scored 10 images of cats with different levels of pain. Data were analysed using linear models and intraclass correlation coefficient (ICC) ($p < 0.05$). Interpretation of ICC was: < 0.2 = poor; 0.21-0.4 = reasonable; 0.41 - 0.60 = moderate; 0.61 - 0.80 = good; 0.81 - 1.0 = very good (Altman 1991).

A total of 3039 responses were received with 1262 completed answers from 66 countries (86%, 11.1% and 2.9% identified as 'female', 'male' or 'other'). Scores for each action unit (AU) (ear position, orbital tightening, muzzle tension, whiskers change and head position) and their sum (FGS score) were not significantly different between carers and veterinarians, except for muzzle (carers: 0.9 ± 0.0; veterinarians: 0.7 ± 0.1, $p = 0.035$). The ICC single (carers) was 0.65, 0.69, 0.58, 0.37, 0.38, and 0.65 for AU ears, eyes, muzzle, whiskers, head, and sum of scores, respectively. Demographic data did not affect FGS scores.

The FGS scores had good reliability when used by cat carers regardless of demographic data showing potential applicability of the instrument to improve feline pain management and welfare worldwide.

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O54

The effects of sedation with dexmedetomidine-butorphanol and anaesthesia with propofol-isoflurane on Feline Grimace Scale scores

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This study aimed to evaluate the effects of sedation and anaesthesia on the Feline Grimace Scale (FGS) scores in healthy cats.

Ten healthy adult cats (4.4 ± 0.7 kg) were included in a prospective, blinded, randomized, cross-over study with a 14-day wash-out. Saline (G1) or dexmedetomidine (5 µg kg^{-1})-butorphanol (0.2 mg kg^{-1}) IM (G2) was administered 15 minutes before anaesthetic induction with propofol and maintenance with isoflurane (30 minutes). Saline (G1) or atipamezole (50 µg kg^{-1}) (G2) was administered at the end of anaesthesia. Video-filming/image capturing was performed up to 24 hours after the anaesthesia. A total of 125 images were independently evaluated by four raters blinded to treatment using the FGS [ear/eye/muzzle/whiskers/head position; action units (AU)]. Inter-rater reliability and effects of sedation/anaesthesia were analysed with intraclass correlation coefficient [single measures (95% confidence interval)] and linear mixed model, respectively ($p < 0.05$).

Reliability was good for total scores [0.76 (0.69-0.82)], eye [0.79 (0.73-0.84)], muzzle [0.62 (0.54-0.70)] and head position [0.69 (0.61-0.76)], moderate for ears [0.60 (0.51-0.68)], and poor for whiskers [0.37 (0.22-0.51)]. Total and each AU scores were significantly higher in G2 than G1 after dexmedetomidine-butorphanol. In G1, total, eye, whiskers and head position scores were significantly higher than baseline at 0.5 hour post-anaesthesia. In G2, when compared with baseline, total and each AU scores were significantly higher after sedation whereas eye scores were significantly higher at 0.5 hour post-anaesthesia.

Sedation with dexmedetomidine-butorphanol and anaesthesia with propofol-isoflurane affect FGS scores on a short-term basis and may bias clinical pain assessment.

O85
Construct validity, responsiveness, and reliability of the Feline Grimace. Scale in kittens

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This study aimed to investigate construct validity, responsiveness, and reliability of the Feline Grimace Scale (FGS) in kittens.

Following ethics committee approval, thirty-six healthy kittens (aged 10 weeks to 6 months) were included in a prospective, randomized, blinded study. Video-recordings of kittens were performed before, and 1 and 2 hours after ovariohysterectomy using an opioid-free injectable aneasthetic protocol with or without multimodal analgesia, as well as before and 1 hour after administration of rescue analgesia (buprenorphine 0.02 mg kg^{-1} IM). Screenshots of facial images were collected from video-recordings for FGS scoring. Four observers unaware of time-points scored 111 randomized images independently and twice within a 5-week interval. Five action units (AU) were scored (ear position, orbital tightening, muzzle tension, whiskers position, and head position; 0-2 each). Construct validity, responsiveness, and inter- and intra-rater reliability were evaluated using linear models with Benjamini-Hochberg corrections, Wilcoxon signed rank test, and intra-class correlation coefficients (ICC), respectively ($p < 0.05$).

Total FGS scores were higher at 1 and 2 hours after ovariohysterectomy (2.96 ± 1.68 and 2.88 ± 1.69, respectively) than baseline (1.63 ± 1.73) ($p < 0.001$), and lower after the administration of rescue analgesia (before: 3.79 ± 1.94, after: 2.43 ± 1.79) ($p < 0.001$). Inter-rater ICC was 0.91 for FGS total scores and > 0.77 for all AU, except for whiskers (0.63). Intra-rater ICC was > 0.77 for FGS total scores.

The FGS is a valid and responsive acute pain scoring instrument with good to excellent reliability in kittens undergoing ovariohysterectomy.

O93
Clinical Assessment of a supraglottic airway device in cats

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This retrospective study aimed to assess the positioning of a supraglottic airway device designed for cats and determine potential factors which could anticipate its incorrect positioning.

The study was performed at the University CEU Cardenal-Herrera after obtaining ethical approval. Computed Tomography (CT) scans of cats anaesthetised for different clinical reasons were assessed. Normal capnographs were recorded in all cases during the CT scanning and no side effects were recorded. Veterinary students placed the devices under the supervision of an anaesthetist. The data recorded were the cat age, weight, gender, device shoulders position, bowl fitting around the larynx, oesophagus closure, device size used, and the relationship between the device size used and the recommended by the manufacturer in each case.

Data were analysed using "R" statistical software. Logistic regressions were used to identify the factors. Results were shown as numbers (n/n), median and range. A significant difference was defined when $p < 0.05$.

Fifty-five CT scans were assessed. Results were shown in Table 1. No significant differences were found among the recorded data and bowl fitting or oesophagus closure.

Our results show that an adequate capnography wave does not confirm the correct positioning of the supraglottic device.

Table 1.

Gender	Female: 28/55 Male: 27/55
Age	< 1-year-old: 1/55 1-12 year-old: 52/55 12-year-old: 2/55
Weight	3.25 (1.67-6) kg
Size	C2: 29/55 C3: 15/55 C4: 11/55
Recommended size	Correct: 42/55 Bigger: 5/55 Smaller: 8/55
Shoulders	Yes: 18/55 No: 37/55
Bowl fitting	Yes: 46/55 No: 9 /55
Oesophagus closure	Yes: 11/55 No: 43/55 Missing: 1/55

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O27
Epidural anaesthesia-analgesia in dogs undergoing cholecystectomy: a single centre retrospective study

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To assess the effects of epidural anaesthesia-analgesia (EAA) in dogs undergoing cholecystectomy.

Records of dogs undergoing cholecystectomy (2011 - 2019) were retrieved and allocated to group EAA or SA (systemic analgesia). Information (Table 1) was compared using Student t-test or Mann-Whitney U test, and Fisher's Exact test.

Of the 41 records included, 22 and 19 were allocated to groups EAA and SA, respectively. An epidural catheter (EC) was placed preoperatively in 8 dogs. In the remaining, EC was placed postoperatively but an epidural was performed preoperatively. The EC tip was between the 4th lumbar and the 10th thoracic vertebrae. Post-operatively, 3 dogs were excluded from group EAA: one (euthanasia) during the first 24 hours (F24h); two (euthanasia and EC dislodgment) during the second 24 hours (S24h).

When compared to SA, EAA reduced the perioperative analgesic requirements and promoted food intake in dogs undergoing cholecystectomy.

Table 1: (*p < 0.05)		**EAA**		**SA**	
		Yes	No	Yes	No
Preoperative	Levobupivacaine (%)	0.38 (0.19 - 0.48)			
Intraoperative	Opioid requirement (dogs)*	9	13	19	0
Postoperative	Levobupivacaine (%)	0.17 (0.125 - 0.25)			
F24h	Methadone (dogs)*	9	12	18	1
	Methadone administrations (n)*	0 (0 - 3)		5 (0 - 7)	
	Analgesic infusion (dogs)*	1	20	11	8
	Food intake (area under the curve)*	428 ± 249		241 ± 187	
S24h	Methadone (dogs)*	3	16	13	6
	Methadone administrations (n)*	0 (0 - 3)		3 (0 - 6)	
	Analgesic infusion (dogs)*	0	19	9	10
	Food intake (area under the curve)*	818 ± 300		499 ± 257	

O30
Economic and environmental impact of reducing fresh gas flow rates in one veterinary hospital

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In alignment with the Climate Change Agreement, it is essential the veterinary industry assesses its carbon footprint. The economic and environmental impact of a policy to implement the use of Low Fresh Gas Flow (LFGF) during sedation and general anaesthesia (GA) has been evaluated in a small animal hospital.

Prospective stratified study organised into 3 phases over 5 consecutive weeks:

Phase One - Observational Phase of 2 weeks duration.

Phase Two - Training Phase of 1 week duration. All staff were trained in the new policy regarding LFGF (re-breathing circuit = oxygen flow of 10 ml kg^{-1} min^{-1}, non-rebreathing circuit = fresh gas flow of 100 ml kg^{-1} min^{-1}).

Phase Three - Implementation Phase: lasting 2 weeks. The new policy was used for all patients undergoing sedation or general anaesthesia.

In all phases all patients admitted for sedation or GA were included.

The volume of isoflurane and sevoflurane used was estimated using a daily inventory during phase 1 and 3. A weekly inventory of oxygen, air, and nitrous oxide cylinders used was taken. The economic and environmental impact between phase 1 and 3 was calculated. Deviations from the LFGF policy, and the reason for the deviation, were recorded. Complications related to LFGF were also recorded.

Despite a violation of the policy was recorded in 52% of anaesthetics or sedations, a saving of 23 tonnes $CO2_e$ and cost reduction of £9000 per annum could be achieved. The use of LFGF anaesthesia produces a substantial economic and environmental saving and should be used where possible.

O95
Carbon footprint of a canine tibial plateau levelling osteotomy (TPLO)- preliminary results

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The carbon footprint of veterinary procedures is unpublished despite increasing environmental awareness. This prospective study calculated the carbon footprint of a canine cruciate surgery at a veterinary hospital.

Ethical approval and informed consent were obtained. Five dogs presenting for tibial plateau levelling osteotomy (TPLO) to a UK referral centre with board-level anaesthetists were recruited. The following data were collected and presented as median (range): duration of anaesthesia, weight of sevoflurane used per procedure, consumables used (weight, material) from kennel to the end of the surgery, travel data for client and four staff, hospital energy use, and waste disposal. Carbon dioxide equivalents (CO_2e, kg) were calculated using available conversion factors (Campbell & Pierce, 2015; Circular Ecology 2019; NHS 2011). Pearson's correlation coefficient (PCC) was used to assess the relationship between carbon emissions and duration of anaesthesia, and distance travelled to the clinic. Results are presented as median (range).

The carbon emissions per TPLO surgery were 73.5 (51 - 100.8) kgCO_2e. Anaesthetic duration was 150 (135 - 195) minutes. The largest emissions contributors were volatile anaesthetic agent 26.5% (9.6 - 39.4%); other pharmaceuticals 26.4% (12 - 34.2%) and transport 22.9% (19.6 - 26.8%) Total carbon emissions correlated closely with anaesthesia duration (PCC 0.96) and miles travelled (PCC 0.90).

Reducing the carbon emissions of a procedure should focus on efforts to reduce the volatile anaesthetic agent, pharmaceutical and transport emissions. Further research is needed to confirm achievable reductions from various strategies. Further clinical comparisons using isoflurane as an alternative to sevoflurane should be performed.

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O63
Comparison of intraperitoneal lidocaine and ropivacaine for postoperative analgesia in dogs undergoing major abdominal surgeries

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This study aimed to compare the postoperative analgesic efficacy of intraperitoneal lidocaine versus ropivacaine in dogs undergoing major abdominal surgeries.

Dogs were administered intramuscular dexmedetomidine and methadone. Anaesthesia was induced with propofol and maintained with isoflurane. At the end of surgery, dogs (n = 8/group) randomly received intraperitoneal lidocaine (4 mg kg^{-1}, diluted with 0.9% saline to 5 ml kg^{-1}, L group), ropivacaine (4 mg kg^{-1}, diluted to 5 ml kg^{-1}, R group) or 0.9% saline (5 ml kg^{-1}, C group). Pain was assessed preoperatively and at different time points up to 24 hours after extubation, using the Short Form of Glasgow Composite Pain Scale (SF-GCPS). Rescue methadone was administered if SF-GCPS ≥ 6/24 (Reid et al. 2007). Data were analysed using Kruskal-Wallis and Friedman tests.

In group C, postoperative SF-GCPS scores were significantly higher than in groups L and R, at 1 [4 (4 - 4), 2 (1 - 4), 1.5 (1 - 4)], 2 [4 (3 - 8), 2 (1 - 3), 1.5 (1 - 3)] and 4 [5 (2 - 8), 2 (1 - 4), 2.5 (2 - 3)] hours. Postoperative SF-GCPS significantly decreased in groups L and R when compared to preoperative scores. Treatment failure rate was 37,5% (3/8 dogs) at 9 hours in L group, 12.5% (1/8 dogs) at 12 hours in R group, and 100% (8/8 dogs) at 4 hours in C group.

Intraperitoneal lidocaine and ropivacaine provides a reliable postoperative analgesia compared to control, but longer-lasting in group R.

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O67
The pharmacokinetics of dexmedetomidine after perineural or single IV administration in anaesthetized dogs

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This study investigated the pharmacokinetics of dexmedetomidine (DEX) as an adjunctive drug to levobupivacaine for regional anaesthesia of oral cavity in dogs.

Thirty dogs undergoing dental procedures were assigned to three groups (n = 10) to receive levobupivacaine (all four dental blocks, Pascoe 2020) with DEX 0.5 µg kg^{-1} IO (infraorbital block), IA (inferior alveolar block) or IV. Placebo (IV group) or DEX (IO and IA group) was administered together with levobupivacaine perineurally at the last block, after which the DEX (IV group) or placebo (IO and IA group) was injected IV within 2 minutes. Blood samples were collected before and immediately after administration of the last oral block and 3, 4, 7, 12, 17, 32, 47, 62, 92, and 122 minutes thereafter. Quantification of DEX in plasma was performed using liquid chromatography coupled with tandem mass spectrometry. Pharmacokinetic parameters were calculated by analysis of plasma concentration-time curves using Graph Pad Prism

The results are shown in Table (mean ± SEM).

	C_{max} (ng mL^{-1})	**T_{max} (minute)**	**Bioavailability**	**$t_{1/2}$ (minutes)**	**AUC (ng mL^{-1} minute)**	**V_D (L kg^{-1})**	**Cl (mL $minute^{-1}$ kg^{-1})**
IV	5.23 ± 0.85			5.98 ± 0.46	42.11 ± 5.01	0.12 ± 0.02	14.17 ± 1.58
IO	0.47 ± 0.08	7.22 ± 1.28	0.48	63.44 ± 24.15*	20.08 ± 3.82*		
IA	0.76 ± 0.09	7.50 ± 1.63	0.56	23.78 ± 3.78*	23.78 ± 3.78*		

* Comparing to IV administration ($P < 0.01$, one-way ANOVA)

Infraorbital administration resulted in faster absorption, lower bioavailability and slower elimination compared with IA administration.

Reference

Pascoe PJ (2020) Anaesthesia and Pain Management. In: Oral and Maxillofacial Surgery in Dogs and Cats (2nd edn). Verstraete, FJM, Lommer MJ, Arzi B (eds.) Elsevier, USA. pp. 22-43.

O31
Comparison of hydromorphone vs. butorphanol for pain management in equine patients undergoing elective arthroscopy

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Hydromorphone is a mu-opioid agonist with anti-nociceptive effects; however, it is unknown whether it provides superior analgesia compared to butorphanol in horses.

Forty healthy horses presenting for elective arthroscopy of any joint were enrolled. Horses randomly received equipotent doses of hydromorphone (0.04 mg kg^{-1}; TxH; n = 19) or butorphanol (0.02 mg kg^{-2}; TxB; n = 21) prior to surgery as part of a standardised anaesthetic protocol including flunixin meglumine. Horses were scored for pain by two masked observers using the Equine Utrecht University Scale for Facial Assessment of Pain (EQUUS-FAP) and a composite pain scale (CPS) at three timepoints: the day prior to surgery (baseline), two hours (P2), and four hours (P4) following anaesthetic recovery. Data were analysed with a mixed-effect model.

Mean ± SD EQUUS-FAP scores at baseline, P2, and P4 were 1.2 ± 0.2, 0.9 ± 0.2, and 1.1 ± 0.2, respectively, with no effect of treatment, timepoints or interaction (all $p > 0.116$). The overall CPS score at baseline was 2.9 ± 0.2. The CPS score increased at P2 (4.3 ± 0.5, $p < 0.001$) and P4 (4.2 ± 0.6, $p < 0.001$). Compared to baseline, CPS in TxH increased at P2 (4.7 ± 2.9, $p = 0.049$) and returned to baseline at P4 (3.8 ± 2.8, $p = 0.476$). The CPS score in TxB remained elevated at P2 (4.0 ± 2.9, $p = 0.009$) and P4 (4.6 ± 2.7, $p < 0.001$).

Hydromorphone, but not butorphanol, decreased CPS back to baseline four hours after recovery.

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O34

Pharmacokinetics of bupivacaine following administration by an ultrasound-guided transversus abdominis plane block in cats undergoing ovariohysterectomy

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This study describes the pharmacokinetics of bupivacaine following administration via an ultrasound-guided transversus abdominis plane (TAP) block in cats undergoing ovariohysterectomy.

Twelve healthy adult cats (3.7 ± 0.7 kg) were included in a randomized, prospective, blinded clinical trial. Anaesthetic protocol included acepromazine-buprenorphine-propofol-isoflurane-meloxicam. Each cat received 1 mL kg^{-1} of bupivacaine 2% or 2.5% (2 mg kg^{-1} or 2.5 mg kg^{-1}; BUPI2 and BUPI2.5, respectively) via bilateral two-point TAP block before surgery (n = 6/group). Blood was collected using a dedicated catheter placed into a cephalic vein before (time 0) and at 5, 10, 15, 30, 60, 120, 240, 360, and 480 minutes after TAP injection. Plasma concentrations of bupivacaine were analysed using liquid chromatography-tandem mass spectrometry. Bupivacaine pharmacokinetics was described using a one-compartment model and non-compartmental analysis.

No signs of bupivacaine toxicosis were observed. Bupivacaine was detected up to 480 minutes (335 ± 76 in BUPI 2 and 485 ± 198 ng mL^{-1} in BUPI 2.5). For BUPI2 and BUPI 2.5, maximum bupivacaine plasma concentrations (Cmax) were 1166 ± 511 and 1810 ± 536 ng mL^{-1} at 33 ± 14 and 47 ± 22 min (Tmax), clearance was 5.3 ± 1.8 and 4.9 ± 1.4 mL min kg^{-1} and elimination half-life was 253 ± 55 and 217 ± 52 min, respectively.

A TAP block with two doses of bupivacaine produced concentrations below toxic levels (Chadwick 1985). A dose of 2.5 mg kg^{-1} is safe to be administered and further studies are warranted to investigate the analgesic efficacy of this technique in cats.

Reference

Chadwick HS (1985) Toxicity and resuscitation in lidocaine- or bupivacaine-infused cats. Anesthesiology 63, 385-390.

O35

Distribution of injectate spread using two approaches for an ultrasound-guided transversus abdominis plane block in cats: a cadaver and computed tomography study

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This study compared the distribution of a bupivacaine-iohexol-dye solution administered by one- versus two-point ultrasound-guided transversus abdominis plane (TAP) injection in cats.

Eight cat cadavers were included in a randomized, prospective, blinded, anatomical and computed tomography study. On each side of each cadaver, volumes of 0.5 or 0.25 mL kg^{-1} per point of the solution were injected using either one (lateral; TAP-L) or two (subcostal and lateral; TAP-SL) in-plane injection points, respectively. Computed tomography assessed contrast distribution and cranio-caudal spread into the TAP. Anatomical dissection evaluated dye distribution and number of thoracic (T) and lumbar (L) spinal nerves stained >1 cm circumferentially. Student's t and Mann-Whitney tests were used for statistical analysis ($p < 0.05$).

Eight TAP-L and eight TAP-SL injections were performed. The TAP-SL resulted in a wider spread of contrast (mm) compared with the TAP-L (87.0 ± 7.0 versus 71.4 ± 9.1; $p = 0.002$). The prevalence of nerve staining was higher using TAP-SL than TAP-L ($p = 0.001$). The ventral branches of T10, T11, T12, T13, L1 and L2 were stained in 2/8, 2/8, 5/8, 7/8, 4/8 and 1/8, and in 7/8, 7/8, 8/8, 8/8, 8/8 and 1/8 using TAP-L and TAP-SL approaches, respectively. Using computed tomography and dissection, minimal injectate was identified intraperitoneally or within the falciform ligament fat following both approaches TAP-L or TAP-SL.

Ultrasound-guided TAP-SL produced more consistent injectate spread around the thoracolumbar spinal nerves than TAP-L. Intraperitoneal injection is a possible risk. The efficacy of the TAP-SL block should be investigated in cats.

O37

Updates on the anatomy of the brachial plexus in dogs: contralateral comparison and body weight correlation in a cadaveric study

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In the present study, the anatomy of the brachial plexus in dogs was studied: the depth and diameter of each nerve were evaluated and compared with those of the contralateral limb.

Eighteen canine cadavers were included and divided into three groups: small (SB); medium (MB) and large (LB) breed dogs. Following anatomical dissection, the suprascapular, the subscapular, the axillary, the radial, the ulnar, the median and the musculocutaneous nerves were identified. For each nerve, their origin from the spinal nerves, the diameters of the nerves and nerve roots, as well as the distance of the nerve roots from the skin were recorded. Differences between groups were compared with a single way ANOVA. All data were compared between the contralateral limbs with a paired sample t-test.

A total of thirty-six brachial plexuses were evaluated and all were seen to originate from the ventral rami of the C6, C7, C8 and T1 spinal nerves. The diameters of the nerves and nerve roots and the mean distance of the nerve roots from the skin presented larger values in LB dogs, and they were positively correlated with body weight. No significant differences were recorded between contralateral limbs.

The contribution of the spinal nerves to the brachial plexus, the depth of the nerves and of their roots, as well as the nerve diameters were described. A deep anatomical knowledge might prove helpful for nerve location (Lemke and Creighton 2008), while reducing the incidence of complications (Campoy and Read 2013) during brachial plexus blocks.

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Lemke KA, Creighton CM (2008) Paravertebral blockade of the brachial plexus in dogs. Vet Clin North Am Small Anim Pract 38, 1231-1241.

O47
Ultrasound-guided suprainguinal femoral nerve block in cat cadavers: a descriptive study

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The aim of this study was to describe the ultrasound-guided technique for a suprainguinal approach to femoral nerve (FN) block in cat cadavers. A similar approach has been described in dogs.

Eight feline cadavers weighing 3.95 kg (range 3-5 kg) were used in our cadaveric study. Two cadavers (four limbs) were used to identify the anatomical features, and six cadavers (twelve limbs) were used to assess the spread of methylene blue dye after extra-epineural FN injection. The cadavers were placed in lateral recumbency, with the limb to be blocked uppermost, abducted, and extended caudally. A linear transducer was used for scanning and placed perpendicular to the midline at the level of the inguinal nipple. After visualization of the FN, methylene blue was injected extra-epineurally using a hyperechoic needle and an in-plane approach. The cat was turned, and the technique was repeated on the contralateral side. A volume of 0.15 mL kg^{-1} of methylene blue was used for injection. After injections, the area was dissected bilaterally, and the success was evaluated. A positive FN staining was considered for a coverage of >2 cm in their entire circumference.

Twelve ultrasound-guided femoral nerve injections were performed. The femoral nerve was visualized as a circular structure with a honeycomb pattern center in the ventral portion of the iliopsoas muscle in all cases. All FNs (100% of cases) were stained over a distance of >2 cm in their entire circumference.

The ultrasound-guided suprainguinal approach may be suitable and reproducible for a successful femoral nerve blockade in cats.

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O55

Retrobulbar block: an anatomical and computed tomography evaluation of two ultrasound-guided approaches in cat cadavers

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This study described two ultrasound-guided retrobulbar block techniques and compared their injectate spread using anatomical and computed tomography evaluation in cat cadavers.

Ten cadavers received two retrobulbar injections with 0.5 mL dye-iohexol-bupivacaine solution using either a rostral (RRB) or temporal (TRB) approach. For RRB, a microconvex transducer was positioned rostral to the globe and a spinal needle was introduced using an in-plane lateral-medial direction. For TRB, the transducer was placed perpendicularly to the temporal fossa and the needle introduced using an in-plane caudal-rostral direction. Ultrasound-guided needle visualization was scored (good, poor, absent). Computed tomography and dissections were performed to determine injectate spread. Statistical analysis was performed using the Fisher's exact test ($p < 0.05$).

Needle visualization was "good" in 20% RRB and 50% TRB and never "absent". Injectate distribution was always within the retrobulbar compartment. Following RRB and TRB, injectate spread was exclusively periconal in 40% and 70% injections, intraconal in 50% and 0%, and in both compartments in 10% and 30%, respectively. The intraconal compartment was 100% stained in 60% RRB and 0% TRB ($p = 0.011$). The maximum circumferential spread in the periconal compartment was 75% and occurred in 40% RRB and 80% TRB. Computed tomography showed injectate spread into the orbital fissure and within the temporal muscle (40% and 50% RRB versus 70% and 30% TRB, respectively).

The RRB and TRB approaches resulted in different periconal and intraconal spread. Future studies should assess the clinical efficacy and optimal injectate volumes of these techniques for enucleation.

O82
A novel ultrasound-guided cranial segments of cervical plexus block in dogs

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The aim of this anatomic study is to describe an ultrasound-guided technique for blocking the cranial roots of the intermediate cervical plexus block in dogs.

Nine canine thawed cadavers were used. Dissection of the cervical region was performed in one cadaver to recognize the relevant anatomy. Subsequently, an ultrasound-guided was carried out bilaterally inside the interfacial cervical plane below the superficial cervical muscles administering iodinated contrast at 0.3 ml kg^{-1}. The technique was repeated in seven more cadavers administering a 50:50 mixture of iodinated contrast: methylene blue at 0.15 ml kg^{-1} in each side, except in one cadaver (only iodinated contrast used). Computed tomography (CT) and dissection of both sides of the neck were carried out to evaluate the dye distribution. Results for distribution and nerve staining were presented in number (n/n).

The interfacial plane was recognized ultrasonographically in all the cadavers. All the injections resulted in a hydro-dissection of that plane. The C2, C3 and C4 ventral branches were stained in 12/12, 10/12 and 4/12 nerves, respectively. The fascia surrounding C2 and C3 ventral branches was stained in all the cases. CT images showed a cranial distribution up to C1 in 3/14 sides and a caudal distribution down to C6 in 1/14 sides. Contrast was observed inside the vertebral canal only administering 0.3 ml kg^{-1}.

This technique resulted in a predictable distribution and staining of C2 and C3 ventral branches. No spreading of contrast into vertebral canal was observed with low volume. Further studies will be necessary to demonstrate its clinical efficacy.

O89
Quadratus lumborum block in calves - a cadaveric study

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Quadratus lumborum block (QLB) is a technique that provides analgesia for the abdominal region in dogs (Viscasillas et al. 2021). The aim of this abstract is to report a preliminary cadaveric investigation of QLB feasibility in calves.

Five cadavers of calves weighing 33 to 50 kg and euthanised for reasons unrelated to this study were used. In one calf, an anatomical dissection of the region of interest was performed. In the other 4 calves 0.4 ml kg^{-1} of a mixture of methylene blue and saline (n=1) or methylene blue, saline and iodine contrast (n=3) was injected dorso-laterally to the quadratus lumborum muscle, ventrally to the first lumbar transverse process, under ultrasound guidance. Computed tomography (CT) was performed to assess the solution spread in 3 calves and dissection was performed to assess nerve staining in one calf.

During dissection, dye was consistently observed on the ventral branches of the first and second lumbar nerves and slightly present around the thirteenth thoracic nerve. On CT, contrast was observed from the 13^{th} thoracic to the 4^{th} lumbar vertebrae, surrounding the hypaxial musculature inside the retroperitoneal space. In one calf, contrast was observed inside the vertebral canal at the level of the 13^{th} thoracic vertebra. Dye or contrast were not observed inside the abdominal cavity or organs.

The QLB, as performed in dogs and cats, appears to be feasible in calves. Further studies are needed to evaluate the clinical efficacy.

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O45

A systematic review on the measurement properties of pain scoring instruments in farm animals

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This systematic review aimed to investigate evidence on measurement properties of pain scoring instruments in farm animals.

A registered report protocol was published with the methodology (Tomacheuski et al. 2021). Studies reporting the development and validation of acute and chronic pain scoring instruments based on behavioural and/or facial expressions of farm animals (bovine, ovine, caprine, camel, swine and poultry) were included. Data extraction and assessment were performed individually by two investigators using the Consensus-based Standards for the Selection of Health Measurement Instruments (COSMIN) guidelines (Prinsen et al. 2018). Nine categories were assessed: general design requirements and scale development, content validity and comprehensibility, internal consistency, reliability, measurement error, criterion and construct validity, responsiveness, and cross-cultural validity. Overall strength of evidence (high, moderate, low, or very low) of each instrument was scored based on methodological quality, number of studies and studies' findings.

Twenty instruments for three species (bovine, ovine and swine) were included. Three behavior-based instruments scored overall high evidence: UCAPS (Unesp-Botucatu Unidimensional Composite Pain Scale for assessing postoperative pain in cattle), USAPS (Unesp-Botucatu Sheep Acute Composite Pain Scale) and UPAPS (Unesp-Botucatu Pig Composite Acute Pain Scale). Four instruments scored overall moderate evidence: MPSS (Multidimensional Pain Scoring System for bovine), SPFES (Sheep Pain Facial Expression Scale), LGS (Lamb Grimace Scale) and PGS-B (Piglet Grimace Scale-B). Most instruments scored overall low or very low strength of evidence.

Pain scoring instruments showed considerable variability regarding their measurement properties. Instruments with reported validation are urgently required for pain assessment of goat, camel and avian species.

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O38

Does opioid-free anesthesia provide adequate analgesia within a multimodal protocol in cats undergoing ovariohysterectomy?

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This study aimed to compare the analgesic effects of an injectable protocol using multimodal analgesia with or without opioids in cats undergoing ovariohysterectomy (OVH).

Thirty-two healthy cats were enrolled in a prospective, blinded, randomized trial. Cats received a combination of ketamine (4 mg kg^{-1}), midazolam (0.25 mg kg^{-1}) and dexmedetomidine (40 µg kg^{-1}), and either buprenorphine (20 µg kg^{-1}) or saline (same volume as buprenorphine) IM [opioid (OPG) and opioid-free (OFG) groups, respectively]. Intraperitoneal bupivacaine 0.25% (2 mg kg^{-1}) and meloxicam (0.2 mg kg^{-1} SC) were administered before OVH. Atipamezole (400 µg kg^{-1} IM) was administered at the end of surgery. Pain and sedation were evaluated using the Feline Grimace Scale (FGS) and a dynamic interactive visual analog scale, respectively, for up to 24 hours. Intravenous buprenorphine was administered if FGS scores ≥ 4/10. Statistical analysis included repeated measures linear mixed models, Fisher's exact test and Bonferroni adjustments when appropriate ($p < 0.05$).

Twenty-seven cats were included. The prevalence of rescue analgesia was lower in OPG (n = 0/13) than in OFG (n = 5/14) (p = 0.04). The FGS scores (least square means and 95% CI) were higher in OFG at 1h [2.0 (1.3-2.7)] and 2h [2.2 (1.5-2.9)] than baseline [0.7 (0.0-1.4)], but not in OPG. Sedation scores were not significantly different between groups.

Opioid-free injectable anesthesia was appropriate for some cats using a multimodal approach. However, single dose IM buprenorphine eliminated the need for rescue analgesia and assured adequate pain management after OVH in cats.

O72

A comparison of an opioid-free injectable anesthesia protocol with or without multimodal analgesia in kittens undergoing ovariohysterectomy

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This study compared an opioid-free injectable anesthetic protocol with or without multimodal analgesia in kittens undergoing ovariohysterectomy.

In this prospective, randomized, and blinded clinical trial, twenty-nine healthy kittens (1.55 ± 0.46 kg and aged between 10 weeks and 6 months) were included. Anesthesia was performed with a single IM injection containing dexmedetomidine (40 µg kg^{-1}), ketamine (4 mg kg^{-1}) and midazolam (0.25 mg kg^{-1}). In the multimodal group (MMG), cats (n = 14) received SC meloxicam (0.1 mg kg^{-1}) and intraperitoneal bupivacaine 0.25% (2 mg kg^{-1}), whereas the same volume of saline was administered in the control group (CG, n = 15). Atipamezole (0.4 mg kg^{-1}) was given IM fifteen minutes after the end of ovariohysterectomy. Postoperative pain was assessed up to 24 hours using the UNESP-Botucatu multidimensional feline pain assessment scale - short form. Rescue analgesia (buprenorphine 0.02 mg kg^{-1} IM and also meloxicam 0.1 mg kg^{-1} in CG) was administered if pain scores were ≥ 4/12. Statistical analyses were performed with linear models and post-hoc pairwise comparison with Benjamini Hochberg corrections ($p < 0.05$).

Pain scores were significantly higher in CG at 1 and 2 hours postoperatively (4.0 ± 2.6, 3.0 ± 2.5, respectively) than MMG (1.6 ± 1.0, 1.1 ± 1.0, respectively). The prevalence of rescue analgesia was higher in CG (n = 15/15) than MMG (n = 1/14) ($p < 0.001$).

This opioid-free protocol using multimodal analgesia produced adequate postoperative pain relief while almost eliminating the need for rescue analgesia in kittens undergoing ovariohysterectomy.

O78
Pharmacokinetics and behavioral effects of a single oral dose of trazodone in rabbits

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This prospective randomized cross-over study evaluated the pharmacokinetics of a single oral dose of trazodone and its effects on activity and behaviour in six and eight healthy juvenile female New Zealand rabbits, respectively.

Trazodone plasma concentrations were determined by High Performance Liquid Chromatography-Mass Spectrometry in six rabbits immediately before and up to 24 hours following drug administration. Eight rabbits were equipped with accelerometers (activity) and video recorded. Three treatments were administered orally: trazodone (TRAZ; 20 mg kg^{-1}), placebo (PLAC), or no-treatment (CONTR); 3-day wash-out. Partial ethograms included exploring/grooming/vigilance/hiding. Analyses were performed over 10 hours with mixed linear models ($p < 0.05$).

Maximum plasma concentration was 6,592.6 ± 586.5 ng mL^{-1} 15 to 30 minutes after treatment. Mean half-life was 3.24 ± 0.36 hours. Area under the curve from zero to infinity was 25,412.5 ± 5,420.9 ng mL^{-1} $hour^{-1}$. Activity was greater in TRAZ and PLAC at 0-2 hours after treatment than CONTR. In TRAZ activity was reduced from 2-10 hours compared to 0-2 hours. Rabbits receiving TRAZ explored more than PLAC and CONTR at 0-2 hours; exploring was reduced in TRAZ from 2-10 hours compared to 0-2 hours. Grooming was more frequent from 0-2 hours in PLAC compared to TRAZ and CONTR and was reduced in PLAC from 2 hours onward. Compared to PLAC and CONTR, TRAZ hid less and CONTR were more vigilant than TRAZ and PLAC.

Rabbits receiving trazodone demonstrated reduced hiding and vigilance behaviours. Further studies are warranted to evaluate its clinical application.

O73

Comparison of invasive and modified oscillometric arterial blood pressure measurements in anaesthetised pigs undergoing magnetic resonance imaging

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Non-invasive blood pressure (NIBP) monitoring in magnetic resonance imaging (MRI) is challenging due to lack of MRI safe equipment.

Twelve Landrace pigs were anaesthetised with sevoflurane twice (n = 24), at 5 (9.0 ± 1.3 kg) and 12 weeks of age (35 ± 3.5 kg), for MRI. Oscillometric (petMAP graphic II, using a seven-meter prolongation outside the Faraday shield) and invasive blood pressure (IBP) measurements were compared. The metatarsal artery was catheterized, and the NIBP cuff placed on the contralateral metatarsus. Values of SAP, DAP and MAP were recorded every 5 minutes for 1 hour and analysed by comparison of variances and covariances, Bland-Altman and 4-quadrant graphs.

A total of 617 paired measurements were recorded. Assuming no correlation between methods' technical errors, estimated errors of the biological variance of IBP MAP and DAP were less than 5%, but 60% and 113% for NIBP, respectively. For SAP, estimates were 60% for NIBP and 65% for IBP. The bias for NIBP SAP, DAP and MAP was 2.75, 3.47 and 1.75 mmHg with a standard deviation of 14.3, 10.0 and 8.73 mmHg and a correlation coefficient of 0.57, 0.73 and 0.78, respectively. Adequate tracking of invasive blood pressure was shown over longer intervals.

Modified oscillometric measurements adequately reflected IBP in anaesthetised pigs undergoing MRI and met most of the ACVIM criteria for SAP, DAP and MAP except for the correlation criterion. While an absolute quantification of modified NIBP measurements might be misleading, relative temporal quantification was shown to be acceptable.

POSTER PRESENTATIONS

P25
Ultrasound-guided saphenous nerve block in rabbits (Oryctolagus cuniculus): cadaveric study comparing two dye volumes

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The saphenous nerve (SN) is the terminal sensory branch of the femoral nerve (FN). Preservation of hindlimb motor function makes the SN-block advantageous over the FN-block (Portela et al 2018). We aimed to develop an US-guided SN-block technique in rabbits that would adequately stain (≥ 1 cm) (Briley et al 2021) the SN without affecting the FN. Spread obtained using two different dye volumes was compared.

In ten hindlimbs from five cadavers (mean ± standard deviation 1.62 ± 0.1 kg), after randomization, the SN block was performed on the right or left hindlimb with 0.05 mL kg^{-1} or 0.1 mL kg^{-1} of tissue dye in lidocaine (1:50).

Dissections allowed nerve staining measurements (Figure-1; Table-1). The nerve length staining was significantly different between groups (p = 0.0476; Fisher exact test).

Regardless of the volume used, the US-guided SN technique adequately stained the SN but not the motor branch of the FN. Clinical studies are needed to assess if this technique provides analgesia without affecting FN motor function in rabbits.

Figure.1: US-guided SN block (A); sono-anatomy (B); dissection (C); SN staining obtained using two dye volumes (D). Femoral artery (FA); femoral vein (FV); pectineus-muscle (P).

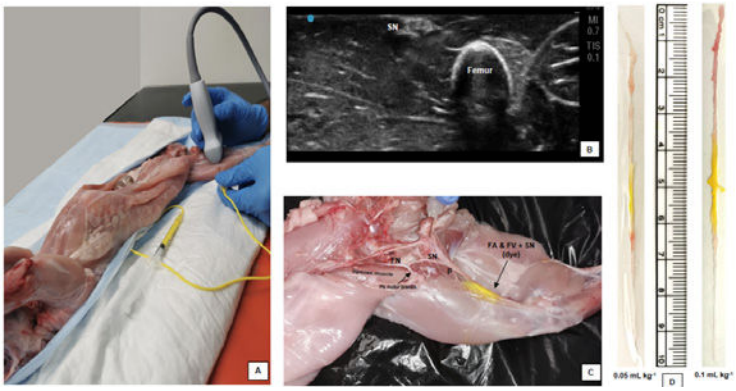

Table.1: Comparing nerve stain using two dye volumes.

	Saphenous Nerve total length (cm)	Staining length (cm)	
		0.05 mL kg^{-1}	0.1 mL kg^{-1}
Rabbit-1	8.8	1.5	3
Rabbit-2	9	1.9	2.4
Rabbit-3	9.8	2.0	4.2
Rabbit-4	9	1.9	2.9
Rabbit-5	10	1	1.9
Mean ± standard deviation	9.32 ± 0.5	1.66 ± 0.4	2.88 ± 0.8

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P32
Disposable airway pressure manometers for endotracheal tube cuff inflation

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The aim of this study was to assess the performance, accuracy, and repeatability of two models of disposable airway pressure manometers as cost-effective alternative for commercial cuff manometers for endotracheal tube (ETT) cuff inflation.

Eighteen units of each model were tested in a bench top model against a u-tube manometer. Each manometer was connected via three-way stopcocks to the inflation valve of a size 8.0 ETT with high-volume, low-pressure cuff placed in a model trachea. With each unit, three consecutive measurements were taken at pressures of 20, 25 and 30 cmH_2O. The cuff was inflated until target pressures were reached on the disposable manometer and true pressures were recorded from the u-manometer. Mean ± SD of recorded pressures and mean ± maximum deviation from target pressures were calculated for each model and target pressure.

For model A, mean ± SD pressures were 19.6 ± 0.70, 23.6 ± 0.75 and 28.3 ± 0.79 cmH_2O, for model B 19.3 ± 0.61, 24.3 ± 0.88 and 29.2 ± 0.66 cmH_2O for target pressures of 20, 25 and 30 cmH_2O respectively. Mean [± maximum] deviation from target pressures for model A were -0.40 [-1.87], -1.40 [-2.87], -1.67 [-3.23] cmH_2O, for model B -0.70 [-1.7], -0.72 [-2.63], -0.78 [-2.07] cmH_2O for target pressures of 20, 25 and 30 cmH2O respectively.

Both models exceeded manufacturer's specifications and showed results comparable to commercial cuff manometers. In conclusion, both models represent cost-effective, accurate and reliable tools for ETT cuff inflation.

P33

Assessment of an ultrasound-guided rectus sheath block: preliminary results of an anatomic study in foal cadavers

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Ultrasound-guided rectus sheath block has been described in several species (Ferguson et al., 1996; Ferreira et al., 2021; St James et al., 2020). It provides analgesia for midline abdominal wall from xiphoid process to pubic symphysis. The aim of this study was to describe the technique in foals and evaluate the distribution of the dye.

Ten fresh cadavers weighing 37 ± 5 kg were included. Four ultrasound-guided injections (two per hemiabdomen) were performed, two cranial and two caudal to the umbilicus. The injectate consisted of a 20:80 mixture of iodinated contrast: blue-tissue-dye at 0.25 ml kg^{-1} per point. The ultrasound probe was placed transversally on the linea alba and moved laterally until the edge of rectus abdominis muscle was identified. The needle was advanced in-plane, from lateral to medial, until its tip was located below this muscle. Dissection was performed to evaluate the injectate distribution. Intramuscular and intra-abdominal distribution were also recorded.

Results are summarized in Table 1, as frequency (n/n) and percentage (%) of nerves stained. Small amounts of dye were found inside the abdomen in 4/10 cadavers.

The described technique is easy to perform. The block could provide analgesia for umbilical surgery. Further studies are needed to evaluate effectiveness in live foals.

Table 1

NERVE	Percentage stained	Frequence (stained/identified)
TH13	15%	3/20
TH14	40%	8/20
TH15	80%	16/20
TH16	95%	19/20
TH17	90%	18/20
TH18	85%	17/20
L1	60%	12/20

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P36

Understanding the Feline Grimace Scale: a study of dimensionality, the importance of each action unit and factors affecting assessment

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This study aimed to investigate the dimensionality, importance of each action unit (AU), and factors affecting pain assessment using the Feline Grimace Scale (FGS).

One-hundred images of cat faces were scored using the FGS by five veterinarians and five veterinary students. Cats were classified as painful or pain-free whether cut-off for rescue analgesia was reached during real-time assessment. Scale dimensionality was studied using principal component analysis and calculating the loading value for each AU. Item-total correlation (Spearman rank correlation) investigated correlations between each AU and total FGS scores. Linear mixed models assessed responsiveness for each AU and factors influencing scores (age and sex of raters, pain condition and group). Multiple correspondence analysis (MCA) investigated the relationship between AU scores ($p < 0.05$).

Each AU presented high loading values (0.86, 0.83, 0.87, 0.83 and 0.84 for ear position, orbital tightening, muzzle tension, whiskers, and head position, respectively). High item-total correlation was observed among AUs, and AUs and FGS scores. Each AU and FGS total scores were significantly different between pain-free (0.16 ± 0.02) and painful (0.71 ± 0.03) cats. Muzzle had the lowest sensitivity (0.63) and whiskers had the lowest specificity (0.65). Male (0.39 ± 0.02) and female (0.48 ± 0.02) raters scored images significantly different.

The FGS is a unidimensional scale. Each AU has similar weight and high correlation. Responsiveness was confirmed for each AU. Total scores may be affected by rater sex and pain condition. Muzzle and whiskers are less discriminative than other AUs.

P39
Responsiveness of the UNESP-Botucatu Cattle Pain Scale in Bos taurus and Bos indicus

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This study aimed to assess the responsiveness of the Unesp-Botucatu Cattle Pain Scale (UCAPS) in Bos taurus (Angus) and Bos indicus (Nelore) undergoing orchiectomy.

Ten Nelore and nine Angus bulls were submitted to scrotal thermic stress (until 40°C) for 135 minutes, followed by orchiectomy. Sedation was administered with xylazine (0.05 mg kg^{-1}) IV. Anaesthesia was induced with ketamine (2.5 mg kg^{-1}) and diazepam (0.05 mg kg^{-1}) IV and maintained with isoflurane. Flunixin (1.1 mg kg^{-1}) IM and epidural xylazine (0.05 mg kg^{-1}) were administered before the surgery. Animals were filmed for 3 minutes 48 hours before surgery and before fasting (M0); before sedation (M1), 2 to 4 hours after they achieved sternal recumbence (M2 - before analgesia), 1 hour after morphine (0.1 mg kg^{-1} IM) (M3) and 24 hours after surgery (M4), when animals received flunixin 1.1 mg kg^{-1} IM. Two blinded observers scored the UCAPS (0 - 10) in 95 randomised videos, twice, one-month apart. Statistics was performed by the generalized linear mixed model ($p < 0.05$).

The medians (range) of UCAPS scores were M0 2 (0 - 9), M1 3 (0 - 9), M2 7 (0 - 10), M3 5 (0 - 10), and M4 5 (0 - 10). The median scores of the UCAPS were greater at M2 and M3 than M0 and M1.

The UCAPS was responsive to moderate and severe pain but not to rescue analgesia in Bos taurus and Bos indicus and may be used clinically for assessing pain in both species.

P42

Experiences and attitudes of Slovenian pet owners regarding cannabinoid use in dogs and cats

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People rely on cannabis-based products to treat medical conditions including pain in animals. This study investigated Slovenian pet owners' experiences and attitudes regarding cannabinoid (CBD) use in dogs and cats.

An open online survey targeted Slovenian pet owners. Questions addressed demographic data and personal experiences with CBDs, information about the participant's animal (dog/cat, health status, CBDs administered (yes/no)), experiences with, attitudes toward or reasons for not using CBDs in their pet, and postmodern health values (natural remedies, anti-science sentiment, holism, rejection of authority, individual responsibility, consumerism - valuing the possibility to choose from various therapeutic options). Descriptive statistics were conducted for demographics, personal experiences with CBDs, and experiences with CBDs in pets. Predictors of CBDs use were analysed using hierarchical multiple regression. Significance was set at $p \leq 0.05$.

From 408 questionnaires analysed, 85.8% of respondents were female, the mean age was 39.2 ± 11.6 years. Previous use of CBDs in animals was reported by 38.5% of respondents who reported mostly positive effects (Table 1).

Positive attitudes and previous personal experiences with CBDs were predictors of CBDs use in pets, but not demographics or postmodern health values. Owners' decision to use CBDs in pets was based on acquired information and personal experience.

Table 1. Reported effects of cannabinoids.

Positive	**%***
improved well-being	72.0
greater liveliness	35.7
improved mobility	34.4
other	29.9
improved appetite	28.0
no effect	8.3
Adverse	**%**
no effect	57.3
other	26.1
dizziness	10.8
excessive appetite/thirst	8.3
fatigue	6.4

*Multiple choice question: sum of % is greater than 100.

P48

Methods used for endotracheal tube cuff inflation and pressure verification in veterinary medicine: A questionnaire on contemporary practice

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No consensus guidelines exist for endotracheal tube cuff (ETC) inflation in veterinary medicine (Ferreira et al. 2021, White et al. 2019). This study investigates methods used for ETC inflation and pressure verification.

An online survey link was distributed via ECVAA and ACVA e-mail lists and a closed Facebook community for Dutch veterinarians. The questionnaire comprised six demographic and twelve cuff-related questions per species (dogs, cats, farm animals and horses). Data were statistically analysed using SPSS software.

A total of 348 completed questionnaires were analysed. Cuff pressure was measured by 30% of respondents in cats, 32% in dogs, 8% in farm animals and 9% in horses. Anaesthesia diplomates were not more likely to measure cuff pressure than others, except in cats (OR 1.8; 95% CI 1.1-2.9). Although > 30 cm H_2O was more frequently selected in horses and farm animals, 20-30 cmH_2O was the most common answer for recommended cuff pressure range regardless of species. The preferred method to verify cuff seal was minimal occlusive volume in dogs, cats and farm animals, and evaluation of capnogram waveform in horses. Preference for a method was largely dictated by training, and diplomates were more likely to use ≥ 3 techniques to verify cuff seal than others (OR 2.1; 95% CI 1.3-3.3).

ETC pressure is not commonly measured in veterinary medicine. Many anaesthesia providers seem unaware of possible differences in ETC pressure per species. As teaching heavily influences ETC inflation technique, development of evidence-based guidelines could improve practice.

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P50
Evaluation of external physical features for estimation of endotracheal tube diameter in dogs

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Endotracheal intubation, using the largest possible endotracheal tube (ETT), is essential for airway management in canine anaesthesia. Despite studies correlating tracheal diameter to inter-nare distance, weight or other external measures, evidence-based guidelines for ETT selection are lacking.

We prospectively recruited 36 dogs (2.2 - 75 kg), 10 brachycephalic and 26 non-brachycephalic, scheduled for head and neck computerized tomography (CT). Tracheal diameter at the level of the second cervical vertebra was measured on the CT scan. Weight, body condition score, and external measurements were recorded using a tape measure, including length of the humerus, and the minimal distance between nares, the eye and nare, eye and canine tooth, and both eyes. Correlations between external parameters and tracheal diameter were evaluated (Spearman or Pearson correlations). Parameters were compared between groups (t-test, Mann-Whitney U test and Fischer Z transformation).

Mean (± SD) tracheal diameter was smaller in brachycephalic dogs (13.50 ± 4.16 vs 17.61 ± 4.93) ($p < 0.05$). Weight had a significantly stronger correlation, and inter-nare distance a significantly weaker correlation, to tracheal diameter in non-brachycephalic ($r = 0.91$ and 0.47 respectively) vs. brachycephalic dogs ($r = 0.67$ and 0.88). Inter-nare distance was smaller than tracheal diameter in 36.1% of the cases. After excluding factors with multicollinearity four markers, weight, and inter-nare, inter-eye, and eye to nare distance, were found to predict tracheal diameter, describing 76% of tracheal diameter variation.

This study describes a novel method to predict tracheal diameter using external markers. Inter-nare distance alone is unreliable for ETT size estimation.

P51

At recovery, does the nutritional status of dogs affect the decreasing rate of arterial oxygen measured with a multiwave pulse co-oximetry?

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Arterial oxygen content is impaired in obese sedated dogs with the risk of PaO_2 derangement during anaesthesia recovery. This study compares the oxygen decreasing rate in normal-fit (body condition score (BCS) 4 - 5/9) and overweight (> 5/9) dogs.

In 31 ASA I - II dogs, PaO_2 was estimated with the oxygen reserve index (ORI) using the same technology of pulse oximetry. Dogs mechanically ventilated with a FiO_2 = 0.6 to maintain normocapnia had an ORI of 1.0 (estimated PaO_2 > 200 mmHg). Once anaesthesia was finished, the breathing system was disconnected, and the time to have an ORI of 0.9, 0.0 (estimated PaO_2 = 100 mmHg) or the lowest value of SpO_2 were compared between overweight or normal-fit dogs. The BCS, time and their interaction were inserted as fixed effects in a linear mixed effect models and dogs as random effects.

In normal-fit dogs, a mean of 135 seconds elapsed before reaching an ORI of 0.9, compared to 108 seconds in the other group. Despite this difference, the model showed no statistical effects of BCS in oxygen decreasing rate (p = 0.213). In normal-fit compared to overweight dogs, the mean time to observe an ORI of 0.0 from the value of 0.9 was 45 and 39 seconds, respectively. The lowest value of SpO_2 was reached 39 and 46 seconds in animals with a BCS of 4 - 5 and > 5, respectively.

This study suggests that in healthy dogs, nutritional status doesn't affect the oxygen decreasing rate at recovery from anaesthesia.

P65

Mechanical ventilation in two male common hippopotami (Hippopotamus amphibius) undergoing surgical castration

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Anaesthetized hippopotami may commonly develop respiratory depression and ventilation/perfusion mismatch when recumbent and anaesthetized (Miller et al., 2014).

Two healthy adult males (estimated bodyweight of 800 and 1800 kg) undergoing castration were darted intramuscularly with medetomidine (80 µg kg^{-1}) and ketamine (1 mg kg^{-1}). Animals were recumbent in 8 minutes and orotracheal intubation was achieved (26 and 28 mm endotracheal tube) at 28 and 37 minutes, respectively. Hippos were placed in dorsal recumbency, a 18G sublingual IV catheter was inserted, and anaesthesia was maintained with isoflurane (end-tidal concentration 0.8 ± 0.2 %) in oxygen. Non-invasive blood pressures, HR, fR, SpO_2, $Fe'CO_2$, venous blood gas and rectal temperature were recorded. Mechanical ventilation was initiated with a V_T 8-10 ml kg^{-1}, peak inspiratory pressure 25-30 cmH_2O, positive end-expiratory pressure 5 cmH_2O, inspiratory time 2 seconds, expiratory time to maintain normocapnia (Mallard ventilator 2800C). Ringer's lactate solution and dobutamine was provided intravenously. Intratesticular blocks (lidocaine 2%, 400 mg) were performed. Intramuscular atipamezole (0.32 mg kg^{-1}) was administered for recovery.

Anaesthesia lasted 171 and 196 minutes, respectively. Mean HR was 47 ± 3 beats $minute^{-1}$, MAP was 85 ± 4 mmHg and rectal temperature 34.4 ± 0.2 °C; both animals had transient bradycardia resolved after atropine (0.005 mg kg^{-1} IV) administration. During mechanical ventilation, fr was 4 ± 0.3, SpO_2 98.3 ± 1.8 %, $Fe'CO_2$ 36.82 ± 4.06 mmHg. Recovery was uneventful (5 ± 1 minutes) after reversal.

Mechanical ventilation in medetomidine-ketamine-isoflurane anaesthetised hippos ensured adequate pulmonary ventilation supporting gas exchange despite dorsal recumbency.

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P71

Incidence and treatment of postoperative hypoxemia in dogs undergoing general anaesthesia with variable FiO_2 and PEEP

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This study evaluates the incidence of postoperative hypoxemia (PH) and compares O_2 supplementation, 5 cm-H_2O continuous positive airway pressure (CPAP) or high flow nasal cannula (HFNC) for its treatment in dogs.

ASA 1 or 2 dogs were randomized for receiving spontaneous or mechanical ventilation with or without PEEP, FiO2 0.4 or > 0.8 during GA. Pulse-oximetry at room air was monitored every 15 minutes for one hour after extubation (EXT). Body condition score (BCS) was also recorded. Dogs that showed hypoxemia (SpO_2 < 95 %) at EXT were randomly treated with CPAP or O_2 or HFNC. Of the 600 dogs included in the study at EXT, 28% were hypoxemic of which 80 were treated with CPAP, 66 with O_2 and 23 with HFNC. T-test and odds ratios for occurrence of PH were used for analysis ($P < 0.05$).

SpO_2 was lower ($P < 0.05$) in the hypoxemic compared to normoxemic dogs at EXT (91.7 ± 3.2 % Vs 96.7 ± 1.6 %), 15 (91.8 ± 2.6 % Vs 97.2 ± 1.3 %) and 30 (94.1 ± 3.5 % Vs 97.2 ± 1.4 %) minutes after. Dorsal recumbency, no PEEP, BCS 4/5 and FiO2 > 0.8 were associated with PH (odds ratio: 1.92, 1.77, 5.80, and 3.79 respectively). Duration of hypoxemia was shorter with CPAP (17.8 ± 13.6 minutes) compared to HFNC (30.6 ± 21.9 minutes) and O_2 (41.6 ± 11.5 minutes).

Dorsal recumbency, obesity and high FiO_2 increase, while PEEP reduce the occurrence of PH in dogs.

P74

Venous blood values in healthy captive Egyptian fruit bats (Rousettus aegyptiacus) during restraint versus under medetomidine-midazolam-fentanyl anesthesia, with or without oxygen supplementation

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The objectives of this study were to evaluate the effects of medetomidine-midazolam-fentanyl anesthesia and oxygen supplementation on venous blood gas, electrolytes, glucose, hematocrit, and lactate in Egyptian fruit bats (Rousettus aegyptiacus).

Twelve adult healthy bats (6 males, 6 females) were anesthetized with subcutaneous medetomidine-midazolam-fentanyl (0.17-0.17-0.017 mg kg^{-1}). Additional third of the initial anesthetics dose was administered at 25 and 40 minutes. Oxygen was supplemented from 40 minutes. Rectal temperature, HR and f_R were monitored for 60 minutes, then atipamezole (5 times the medetomidine dose) was administered subcutaneously. Blood samples were drawn from the wing vein before (baseline) and following the initial anesthetics injection at 15, 35, 50 and 75 minutes, and analyzed using iSTAT (CG8+ cartridge). Lactate was measured in 5 of the bats. Friedman test was used for data analysis. Significance was set at 0.05.

Temperature, HR and f_R decreased significantly over time. $PvCO_2$ increased significantly from baseline to 50 minutes (28.7 ± 3.1 to 41.9 ± 4.4 mmHg), pH decreased (7.39 ± 0.03 to 7.30 ± 0.03) and hematocrit decreased (50.7 ± 3.4 to 45.5 ± 3.5%). Oxygen supplementation resulted in a significant increase in PvO_2 (63 ± 8 to 211 ± 92 mmHg). Glucose decreased following atipamezole administration (263 ± 173 to 128 ± 115 mg dL^{-1}).

Medetomidine-midazolam-fentanyl anesthesia resulted in decreased ventilation and respiratory acidosis. Furthermore, the increase in PvO_2 following oxygen supplementation may suggest that wing venous blood provides capillary bed values in fruit bats.

P76

Electrical impedance tomography (EIT) in chickens (Gallus domesticus): effect of four different recumbencies on cranial air sac ventilation

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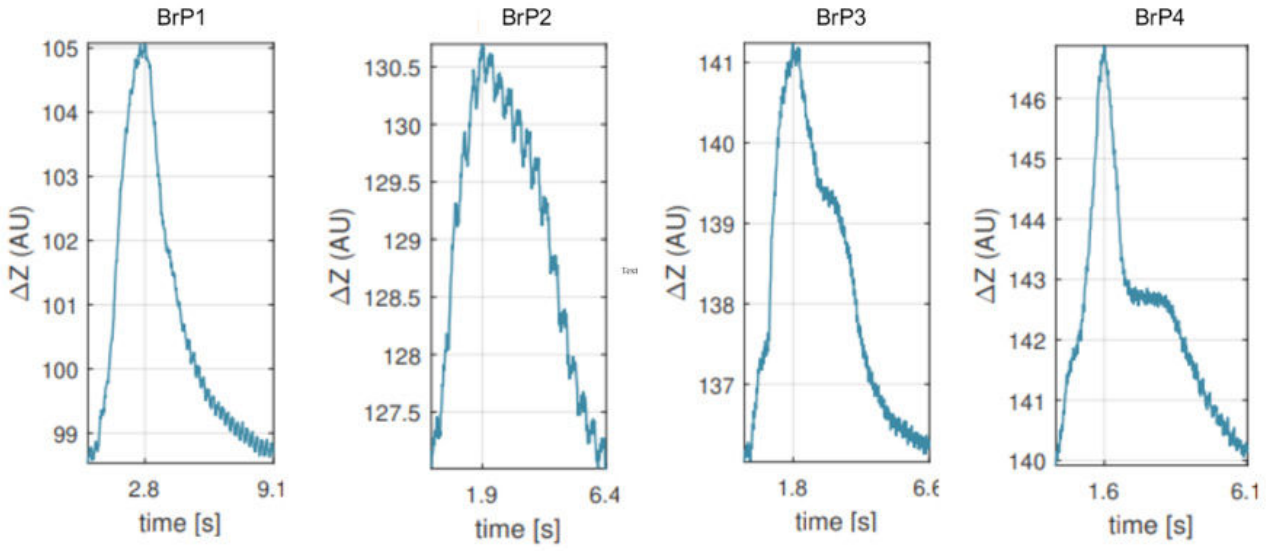
There are no published reports of electrical impedance tomography (EIT) in birds. This study aimed to evaluate this monitoring modality for ventilation in chickens in four recumbencies.

Anaesthesia was mask-induced and maintained in ten endotracheally intubated, spontaneously breathing chickens with 2% isoflurane in oxygen. An electrode belt was placed caudal to the wings. Chickens were placed in dorsal, ventral, left lateral, right lateral recumbency in a randomised order. Data were collected over 2 minutes after 10 minutes of stabilisation for each recumbency. Four of the chickens underwent computed tomography for transverse image at the belt location afterwards. Linear mixed model and Fisher's exact test were used to compare impedance change (ΔZ) and breathing patterns (BrP) between recumbencies, respectively.

The ΔZ observed were synchronous to ventilation, therefore represents tidal impedance variation (TIV). Computed tomography confirmed that ventilation in the cranial air sacs were monitored. No difference was found for TIV between recumbencies. Four BrP were categorized based on the expiratory curve (EC): BrP1 and BrP2 with convex and concave EC, respectively; BrP3 and BrP4 with EC with inflection point above 50% and below 50% of ΔZ, respectively (Figure 1.). Recumbency had a significant association with BrP ($p < 0.001$). Dorsally recumbent chickens predominantly demonstrated BrP1 (50%) and BrP4 (40%). Ventrally recumbent chickens demonstrated BrP3 (30%) and BrP4 (40%). Laterally recumbent chickens primarily demonstrated BrP3 (79%).

EIT can monitor cranial air sac ventilation in anaesthetized chickens. Recumbency does not influence cranial air sac TIV but does influence BrP.

Figure 1. The four categorized BrP.



P79

Influence of experimentally induced endotoxemia on macrocirculation and glycocalyx integrity in horses

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Endotoxemia with cardiovascular depression is a major cause of mortality and morbidity in equids (Parry et al., 1983) leading to potential destruction of the vascular glycocalyx. We hypothesize that endotoxemia impairs macrocirculation, leading to an increase in plasma glycocalyx shedding products.

In a prospective, randomized, controlled trial, endotoxemia was induced with E. coli B55:O5 LPS 30 ng kg^{-1} over 30 minutes IV in six healthy adult horses ventilated to normocapnia with isoflurane (ET_{Iso}~1.6) in oxygen. Standard cardiovascular variables were recorded and calculated. Plasma heparan sulphate and syndecan-1 were analysed by Enzyme-linked Immunosorbent Assay and leucocytes and lactate were measured. Baseline measurements were performed before endotoxin and repeatedly after. Data were analysed by one-way-ANOVA and Wilcoxon signed-rank test $p \leq 0.05$.

After endotoxin (120 minutes), significant changes occurred in cardiac index (43 ± 9 vs. 80 ±17 ml kg^{-1} min^{-1}, p = 0.004), oxygen delivery index (431 ± 178 vs. 950 ± 166 ml min^{-1} kg^{-1}, p = 0.004), lactate (2 ± 1 vs. 4 ± 1, p = 0.002), and systemic vascular resistance index (239 ± 70 vs. 89 ± 19 dynes s^{-1} cm^{-5}, p = 0.009), in conjunction with a significant drop in leukocytes (5 ± 1 vs. 2 ± 0 G l^{-1}, p = 0.005). Heparan sulphate (53 ± 11 vs 61 ± 10 µg ml^{-1}) and syndecan-1 (49 ± 14 vs 46 ± 9 µg ml^{-1}) did not change after endotoxin application.

Short term experimental endotoxemia under isoflurane induced hyperdynamic cardiovascular changes without significant glycocalyx shedding.

Reference

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P80
The efficacy of bedinvetmab in a referred population of osteoarthritis cases - a preliminary clinical audit

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Nerve growth factor (NGF) is involved in osteoarthritis (OA) pain. Bedinvetmab is a novel, licensed, canine anti-NGF antibody. This preliminary audit assessed the efficacy of bedinvetmab administered to dogs with moderate/severe OA.

Dogs were assessed at their first pain clinic visit using Liverpool Osteoarthritis in Dogs (LOAD). Current medication was continued. Data collection commenced February 2021, bedinvetmab supply problems meant that no cases started treatment after July. Repeat LOAD was undertaken September/October 2021. Each dog received ≥ 3 doses of bedinvetmab, (0.5 - 1.0 mg kg^{-1} SC monthly).

Forty-five dogs started treatment, dogs with incomplete data were excluded. Thirty-seven had pre- and post-treatment LOAD scores available. Mean age was 10.21 ± 2.88 years. Initial medication was:

Medication:	**Number**	**%**
NSAID	32	86.5
Gabapentinoid	24	64.8
Memantine/Amantadine	7	18.9
Paracetamol	20	54.1

Mean pre-treatment LOAD score was 28.7 ± 5.84, post-treatment 22.0 ± 7.25. Treatment response was individually assessed (Lascelles et al. 2015):

Treatment effect:	**Number**	**%**
Good (LOAD > 30% reduction)	13	35
Fair (LOAD 1 - 30% reduction	20	54
Poor (no change/worse LOAD score)	4	11

Corral et al. (2021) undertook a placebo-controlled clinical study where 86% of cases were moderately to very severely affected with musculoskeletal disease, 25.7% were medicated. Canine Brief Pain inventory-based treatment success at day 28 (single dose) was 43.5%, and 17% in placebo recipients. Our owners were aware of treatment, a 'caregiver placebo' effect is likely (Conzemius & Evans, 2012). Bedinvetmab efficacy was demonstrated, but confirmation with blinded and placebo-controlled methodology is required.

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P83
Evaluation of the HemoCue Hemoglobine device as POC method in horses

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Hemoglobine (Hb) is an important parameter of equine general health status, also used as diagnostic tool to detect anemia. HemoCue Hb 201+ System is a POC device validated as standard Hb measurement in humans that could be useful in routine equine practice.

To evaluate reliability, repeatability and clinical interest of the HemoCue Hb device (HC Hb) as a POC for equine medicine, samples from 28 examined healthy and sick horses were analyzed with Vet ABC (once) and HC Hb (3 times). Student t test was used to compare means. Variances and their coefficients were calculated to check reliability and repeatability. Accuracy was determined using both Bland Altman and Pearson correlation tests ($p < 0.05$ significant).

Means were statistically comparable ($p = 1.56$) for the 109 tests: $14.59 \pm 9\ g^{-1}$ (Vet ABC); $14.70 \pm 2.22\ g^{-1}$ (HC Hb). Variances were 4.263 and 4.741, with VC 14.43 and 15.10 % respectively for Vet ABC and HC Hb. Accuracy was good (mean bias $0.107\ g^{-1}$) and limit of agreements (CI) between -0.626 and $0.841\ g^{-1}$. Good and highly significant correlation coefficient was calculated (0.986; $p < 0.0001$). HC Hb was easy to use everywhere in any conditions with dry chips and on battery. Tests were inexpensive.

HC Hb evaluation demonstrated a clinically acceptable accuracy of Hb measurement compared to Vet ABC in equine practice. HemoCue Hb 201+ System can be useful as a POC standard technique in equine practice to detect early anemia and optimize therapeutic decisions on site.

P86
Effects of re-administration of a medetomidine-vatinoxan combination drug (Zenalpha) in dogs

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Zenalpha, a formulation combining medetomidine and vatinoxan, indicated to provide restraint, analgesia, and sedation in dogs, was studied to characterize the effects of its re-administration with intent to increase the intensity or length of sedation.

In this randomized, blinded, experimental cross-over study eight healthy instrumented Beagle dogs received a label dose of medetomidine (1 mg m^{-2}) and vatinoxan (20 mg m^{-2}) intramuscularly; 30 minutes later the same formulation was readministered with half of that dose. Control group (CG) received the label dose without re-administration. Cardiovascular safety was evaluated by continuous heart rate (HR) and mean arterial pressure (MAP) recordings, and sedation was assessed with a validated sedation scale (Wagner et al. 2017) at intervals, until 120 minutes after initial dosing. Differences between treatments were evaluated with a linear mixed model and Dunnett adjustment for multiple comparison ($p < 0.05$).

Significant differences in HR between groups were not detected except at 5 minutes after re-administration when HR was significantly lower when compared to CG (55 ± 12 versus 73 ± 7 beats $minute^{-1}$ [mean ± SD]). Significantly lower MAP was observed from 40 minutes after re-administration (74 ± 10 mmHg versus 87 ± 8 mmHg) until the end of the observation period in comparison to CG, and transient hypotension (lowest MAP 56 mmHg) was detected in one dog. Sedation scores were significantly higher from 20 to 40 minutes following re-administration when compared to CG.

To conclude, re-administration of Zenalpha intensified sedation to some extent but was associated with decreases in MAP.

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Wagner MC, Hecker KG, Pang DSJ (2017) Sedation Levels in Dogs: A Validation Study. BMC Vet Res 13, 110.

P87
Branchial plexus block in a deer (Cervus elaphus): a case report

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Regional block techniques have not been evaluated extensively in wild animals (Auer et al., 2010). We describe a brachial plexus block in a deer (Cervus elaphus) for external osteosynthesis of the right radius.

An approximately 4-month-old, 15 kg deer was referred with an open fracture of the radius. Anaesthetic protocol included dexmedetomidine 15μg kg^{-1}, propofol 2 mg kg^{-1} and isoflurane 1% in oxygen; meloxicam (0.1 mg kg^{-1}) was administered intravenously, for analgesia. An arterial catheter was inserted in the auricular artery. In addition, the skin area medial to the right scapulohumeral joint was aseptically prepared. A nerve stimulator was used to locate the nerves of the brachial plexus. Its negative electrode was attached to the proximal portion of a 22- gauge, 7.5 cm insulated needle. The current was gradually decreased to 0.5 mA, 0.1 msec and 2 Hz according to extension and flexion twitches of the limb. When approximately 5 cm of the needle was inserted, bupivacaine (1 mg kg^{-1}, total volume 3 ml) was used for brachial plexus block.

Throughout the surgery, which lasted 2 hours, the heart and respiratory rate were approximately 50 beats min^{-1} and 10 breaths min^{-1}, respectively. The recovery from anaesthesia was uneventful and no rescue analgesia was required. Two hours postoperatively the animal seemed like it could use its leg.

In our case, the brachial plexus block may have reduced anaesthetic requirements of the deer and possibly contributed to cardiovascular stability and analgesia.

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P88
Postoperative acid-base and electrolyte changes in dogs after elective ovariohysterectomy. Preliminary results

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The aim of the study was to evaluate postoperative acid-base and electrolyte changes in healthy canine patients.

Medical records of dogs underwent elective ovariohysterectomy were reviewed. Cases should include at least four arterial blood samples (preoperatively, right after extubation, 6, and 24 hours postoperatively) and have the same anaesthetic protocol. Values of arterial blood pH, carbon dioxide tension, bicarbonate, sodium, potassium and glucose concentrations were recorded. A general linear model for repeated measures was used to evaluate any statistically significant effect of time on the variables.

Eleven dogs were included. They had been premedicated with dexmedetomidine (200 μg kg^{-1}) and methadone (0.2 mg kg^{-1}) IM. Anaesthesia had been induced with propofol and maintained with isoflurane in oxygen. Meloxicam (0.1 mg kg^{-1}IV) had been administered for analgesia. Immediately postoperatively, a statistically significant increase was noted in serum glucose concentration and cardon dioxide tension, and a decrease in pH, sodium and bicarbonate concentrations. Serum potassium was statistically non-significantly altered immediately postoperatively. Although all recorded variables return to pre-operative values 6 hours postoperatively, a statistically significant decrease in serum potassium concentration (3.84 ± 0.25 mmol L^{-1}), compared to preoperative (4.26± 0.32 mmol L^{-1}) ($p < 0.001$), after extubation (4.48 ± 0.55 mmol L^{-1}) ($p = 0.004$), and 24 h postoperatively (4.28± 0.32 mmol L^{-1}) ($p < 0.001$) concentrations, was found.

Serum potassium levels may decrease significantly 6 hours postoperatively in healthy dogs undergoing elective ovariohysterectomy, although clinically non-significantly. Further studies are required in order to evaluate the clinical significance of this finding.

P94

Immunohistochemical localization of cannabinoid receptor type I in the feline synovial membrane with and without degenerative lesions

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This study aimed to evaluate cannabinoid receptor type I (CB1) expression in femoropatellar synovial membranes of adult cats with and without degenerative lesions.

Synovial tissues were collected post-mortem from twenty-seven joints. Samples were fixed, embedded in paraffin, and sectioned for histology and immunostained with anti-CB1 antibody (Ab23703 1%; antigen retrieval with EDTA buffer). Antibody specificity was tested on feline synovium samples employing western blot analysis. A board-certified pathologist graded the hematoxylin-eosin-stained sections according to patterns of osteoarthritis (OA) - associated synoviopathy including absence (0) or presence (1) of: synovial membrane proliferation, inflammatory infiltrate, villous hypertrophy, blood vessels proliferation and cartilage/bone detritus. The scores were summed to provide the final synovial sample grade (0-5). The localization of CB1 receptors within the synovium was assessed by immunohistochemistry.

Samples were represented as follow: grade (0) 18.5 %, (1) 48.1 %, (2) 29.7 %, (3) 0 %, (4) 0 % and (5) 3.7 %. Western blot analysis confirmed antibody specificity in the synovium (single band at the expected molecular weight). Positive cytoplasmic staining of CB1 was remarkable in the lining layer of the synovium and interstitial sublining layer areas of grade 5, but not grade 0 tissues. Grade 1 and 2 had milder positive staining than grade 5 tissues, mainly around blood vessels.

This study suggests that CB1 could be a relevant target for cannabinoid therapy and chronic pain management in osteoarthritic cats with high grading synovitis. Quantitative methods are warranted to evaluate the correlation between microscopic grading and synovial CB1 expression.

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Veterinary division aims at promoting animal care and wellbeing by supporting pet owners and breeders and assisting the veterinarians of our country for many years. The company represents the biggest and most renowned firms abroad, in the fields of veterinary medicines, OTC products and complementary feed: Elanco Animal Health, Orion Corporation, Nextmune, OTR3 etc., with highly innovative products! The roots of ELANCO HELLAS originate from 1962, when the first product of the multinational company ELI-LILLY SA (TREFLAN) begins marketing in Greece. In 1973 ELI-LILLY SA opens its own office in our country and in 1978 it is transformed into a trading company. In 1984 the original company evolved into the current ELANCO HELLAS!

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