Anaesthesia and analgesia in calves, goats, sheep and pigs used for biomedical research

Alenka Seliškar

Working Group 2020

Name	Affiliation	Representing	Specialty
Sabine Bischoff (Convenor)	Universität Jena	GV-SOLAS	Head of Animal Welfare Office
Gabrielle Musk	University of Western Australia	LASA UK	Large animal anaesthesia and analgesia
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Daniela Casoni	Universitat Bern	SGV	Veterinary Anaesthetist
Alenka Seliškar	Veterinarska fakulteta Univerze v Ljubljani	SLAS	Veterinary Anaesthetist Head Anaesth Dpt. SA Clinic

Working Group; Terms of Reference

"…….to review existing recommendations in veterinary (and medical) anaesthesia and analgesia in order to synthesize recommendations for the safe and practical administration of anaesthetics and analgesics that will optimize animal welfare and experimental data quality which are relevant to calves, goats, sheep and pigs used for biomedical research".

Over 270 references

Recommendations

1. Introduction
2. Procedures performed in pigs, sheep, cattle and goats
3. Training and methods of physical restraint
4. Intra-operative anaesthetic monitoring
5. Pain assessment
6. Recommendations for anaesthesia
7. Conclusions

1. Introduction

- Small proportion of production animals involved in research and teaching
- High severity of procedures
- Translation of clinical practices based on a strong base of evidence not always possible
- 3R $\rightarrow$ Refinement $\rightarrow$ good quality An&A with appropriately trained people$\rightarrow$ minimizing complications
  - Directive 2010/63 of the European Parliament and the Council of 22 September 2010 on the protection of animals used for scientific purposes
- Documentation and publication of An&A – details arising from projects

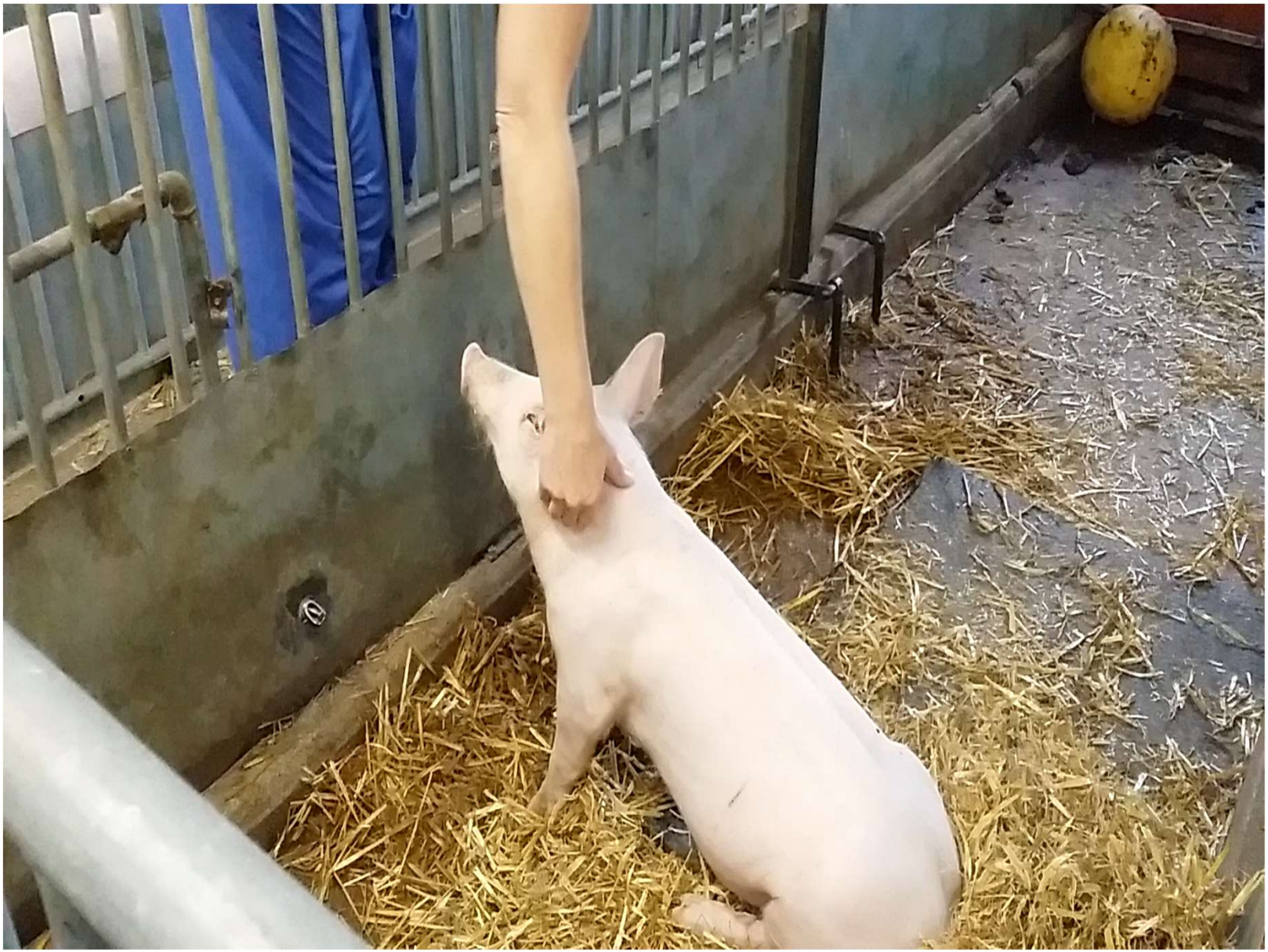

pig333.com

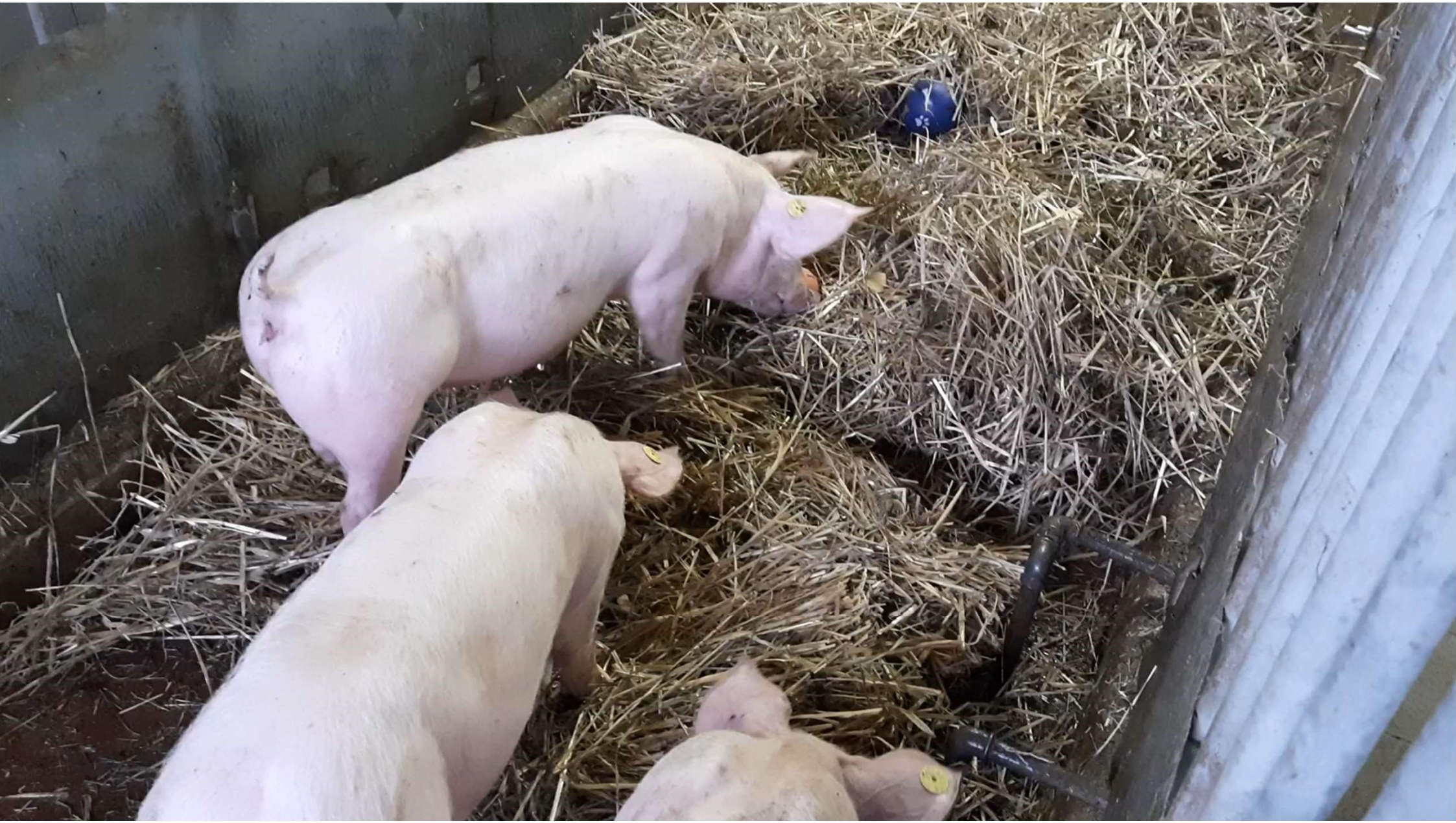
2. Procedures performed in pigs, sheep, cattle and goats

- General anaesthesia/sedation/local anaesthesia (pros and cons)
  - the procedure to be performed, the animal factors, skills and experience of personnel and the availability of equipment
- Severity of pain associated with procedure
  - nil: imaging, clinical examination
  - minimal to mild: CVS catheterization, ocular – corneal and dental sx (implants), endoscopy
  - mild to moderate: minimal invasive sx, minimal laparatomy, craniotomy
  - moderate to severe: major laparatomy, orthopaedic and maxilofacial sx, thoracotomy, sternotomy, disease models (pancreatitis, burns, reproductive disease)

3. Training and methods of physical restraint

- Pre-procedural acclimatization
  - $\rightarrow$ adaptation to novel features of the environment
  - $\rightarrow$ bidirectional familiarisation with staff
- Low stress animal handling
- Positive reinforcement
- Environmental enrichment





Physical restraint

- species, size, breed, temperament, degree of domestication
- intended procedure
- restraint equipment

Prioritizing Humane Minimum-Stress Methods in Swine Facility & Protocol Design

September 2020 · Journal of Applied Animal Ethics Research 2(2):237-250

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Authors:

Linda M. Panepinto

4. Intra-operative anaesthetic monitoring

- Continuous monitoring by dedicated and skilled personnel
- Intermittent recording (at least every 5 minutes) of all monitored variables
- Direct observation of the animal with subjective assessment of various parameters
- Measurement and objective assessment of various parameters
- Monitoring the following components
  - Cardiovascular system (HR, BP)
  - Respiratory system (RR)
  - Thermoregulatory system (temperature)
  - Central nervous system (depth of AN)
  - Gastro-intestinal system (ruminants)


V Tach
Tachy
189
40/33
36.9
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Carestation 650
SEV
ISO
GE Healthcare

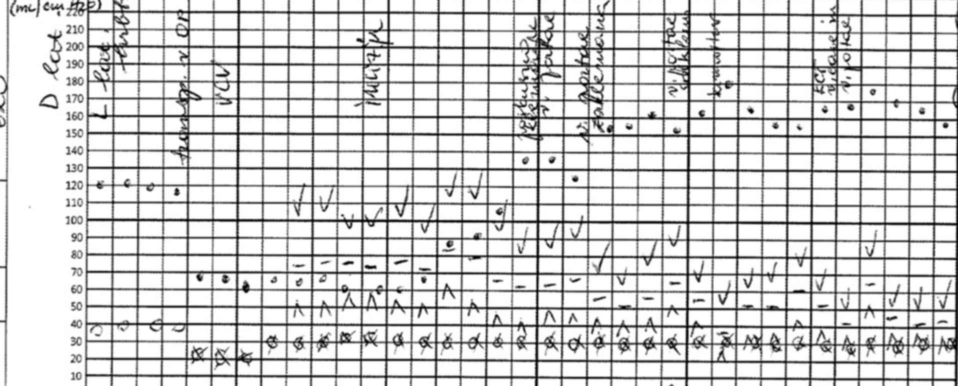
Voluven (ml/kg/h) 5 → 5 → → → → →
dobutamin 2,5 mg/ml (ml/h) 1,5 → 3 → → 6 → → → →
CRI fentanyl 50 µg/ml (ml/h) 5 → 5 → → 10 → → →

IZGUBA KRVI: ~100 ml

Čas	8:15	,20	,25	,30	,35	,40	,45	,50	,55	9:00	,05	,10	,15	,20	,25	9:30	,35	,40	,45	,50	,55	10:00	,05	,10	,15	,20	,25	,30	,35	,40	,45	,50	,55	11:00	,05
Opombe					1							▶	2						3					4	5										
Et iso					1,1	1,1	1,1	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,6	1,6	1,6	1,5	1,5	1,4	1,4	1,3	1,3	1,3	1,3	1,3
Iso insp.					1,3	1,3	1,3	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,4	1,8	1,8	1,8	1,7	1,6	1,6	1,5	1,4	1,4	1,4	1,4	1,4
FiO_2	1	1	1	1	0,47	0,47	0,46	0,41	0,41	0,41	0,41	0,41	0,41	0,41	0,41	0,41	0,41	0,41	0,41	0,41	0,41	0,41	0,41	0,41	0,41	0,41	0,41	0,41	0,41	0,41	0,41	0,41	0,41	0,41	0,41
PIP (cmH_2O)					21	21	20	19	19	20	18	18	19	21	21	21	20	20	15	15	21	21	21	21	18	20	17	18	18	20	20	20	21	17	16
TV (ml)					120	120	122	120	121	123	122	122	132	110	109	111	101	104	104	103	109	108	105	108	124	125	131	122	131	116	126	132	126	119	117
RC (ml/h)					250	→	→	→	→	→	→	→	→	→	→	→	→	100	→	→	→	→	→	250	→	100	→	→	→	→	→	→	→	→	1
PEEP (cmH_2O)					4	→	→	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
KOMPLIANCA (ml/cmH_2O)					7	7	8	8	8	8	10	10	8	6	7	7	7	6	8	10	7	7	6	7	8	8	10	10	10	8	8	9	8	8	10

Legenda
HR •
RR ○
IPPV ø
SAP ∨
MAP ×
DAP ∧
Doppler ⊙
Palpebralni refleks
Tonus čeljusti
-/+/++/+++
Položaj oči
↓/→

INVAZIVNO a. femor. sin.



Čas	8:15	,20	,25	,30	,35	,40	,45	,50	,55	9:00	,05	,10	,15	,20	,25	9:30	,35	,40	,45	,50	,55	10:00	,05	,10	,15	,20	,25	,30	,35	,40	,45	,50	,55	11:00	,05
Iso / Sevo %	1	1	1	1	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	2	2	2	1,8	1,8	1,6	1,5	1,5	1,5	1,5	1,5	1,5
O_2 / N_2O / Zrak L/min	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Palpebralni refleks	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Položaj oči	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘	↘
Tonus čeljusti																																			
Kvaliteta pulza	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
$ETCO_2$ kPa/mmHg						69	63	60	60	60	59	59	58	55	55	56	58	59	68	70	52	53	54	58	55	61	71	64	62	53	51	55	51	56	69
SpO_2 / [illegible] %	[illegible]	[illegible]	[illegible]	[illegible]	93	93	95	96	96	96	96	96	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] *	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Telesna temperatura °C						36,4	36,0	35,8	35,6	→	35,3	35,3	35,4	35,1	35	→	→	→	34,9	34,8	34,7	→	34,5	→	→	34,4	→	→	34,3	34,2	→	34,1	→	34,2	→

SPV (mmHg) / / 6 3 3 4 3 5 5 5 7 6 7 6 6 5 / / – 3 8 4 / /
PPV (%) / / 6 6 6 8 7 14 17 11 19 22 21 15 18 27 / / 26 24 23 / /
22

Začetek posega: ▶ Konec posega: ◀
Zaščita žrela z zloženci: Nameščena ☐ Odstranjena ☐

Vol. krvi			
	Celokupni	______ml	Pes
	10%	______ml	85ml/kg
	20%	______ml	Mačka/kunec
	30%	______ml	55ml/kg

Opombe
1. ENROXIL 150 mg i/m
2. atrakurij 8 mg i/v
3. heparin 6000 I.E. i/v
4. propofol 6 mg i/v
5. atrakurij 5 mg i/v
(*) SpO_2 sonda 89% → PLINC 1 → SO_2 99,5%, V/Q mismatch
6. bleomycin 10234 I.E. i/v

Morfij 5 mg i/m (7)
RYCARFA 100 mg i/v (9)
DEXAGENT 4 mg i/v (8)
TREVONAK 2,5 ml i/v (10)
Lidokain 0,5% 25 mg = 5 ml (11) 80 inc, [illegible]

Tamponi, zloženci, vatiranci, treb. komprese		Ostri pripomočki	
Uporabljeni	Odstranjeni	Uporabljeni	Odstranjeni

ASSOCIATION OF VETERINARY ANAESTHETISTS

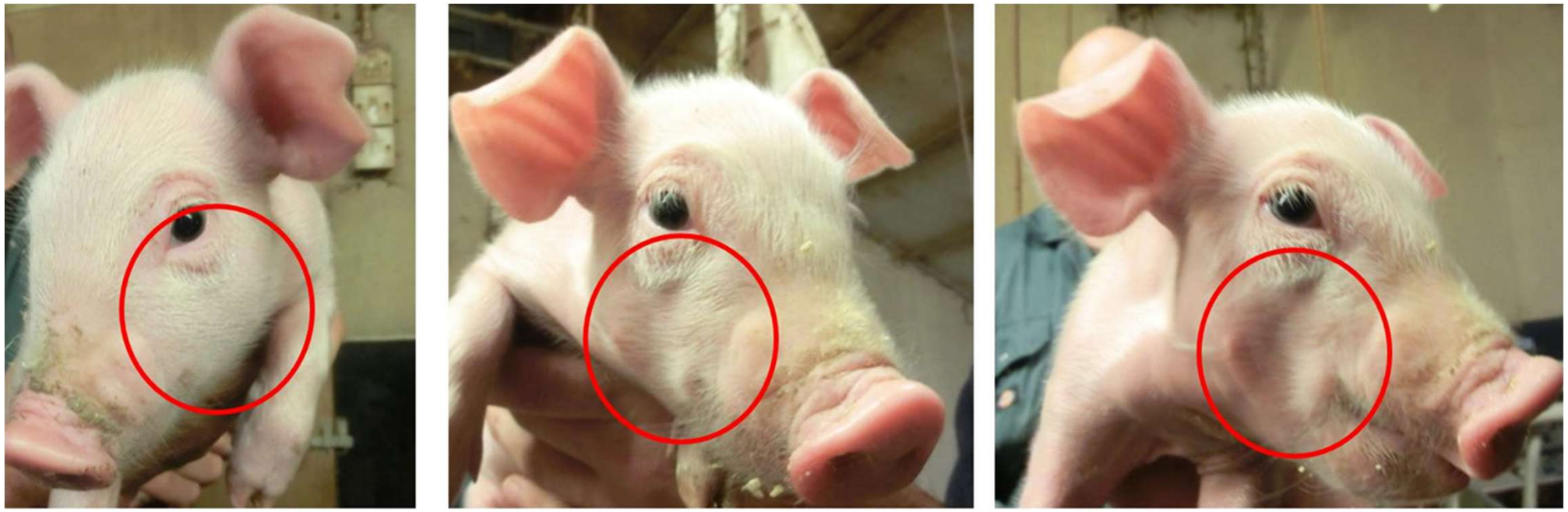
5. Pain assessment

If no assessment plan

- Analgesia is withheld because pain is not identified – ethically unacceptable!
- Analgesia is administered based on the assumption that the experience for the animal will be the same as for a human – inadequate pain management or overdosing!

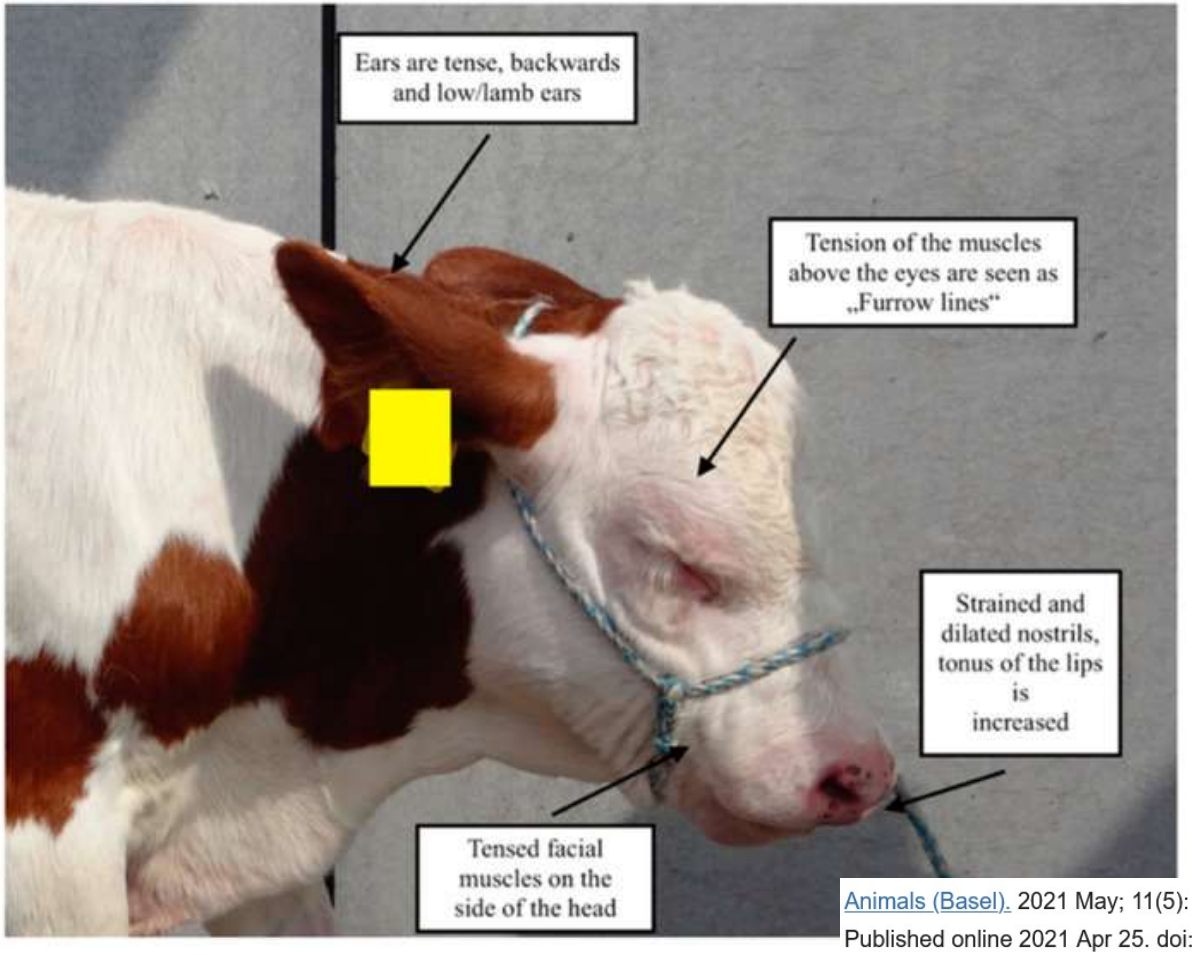
Pain assessment

- Physiological changes (HR, eye, rectal and skin T, BP, RR, pupillary diameter)
- Neurophysiological changes (EEG, nociceptive withdrawal reflex, nocieptive threshold testing – thermal, mechanical, electrical)
- Endocrine changes (cortisol, substance P)
- Behavioural changes (escape or avoidance behaviours, vocalization, attention to a painful site on the body, changes in posture, activity and food and water intake) → multimodal pain scales, grimace scales – species-specific!



0 **1** **2**

Lonardi C et al. The ‘Grimace Scale’: do piglets in pain change their facial expression? Proceedings of the Joint Meeting of the 5th European Symposium of Porcine Health Management and the 50th Anniversary Meeting of the Pig Veterinary Society of Great Britain, Edinburgh, UK, 22nd – 24th May 2013.



Animals (Basel). 2021 May; 11(5): 1235.
Published online 2021 Apr 25. doi: 10.3390/ani11051235
PMCID: PMC8146443
PMID: 33922942

Methods for Pain Assessment in Calves and Their Use for the Evaluation of Pain during Different Procedures—A Review

Theresa Tschoner

6. Recommendations for anaesthesia

Anaesthesia must not be regarded as a set of instructions in which specified drugs are given in a set sequence at pre-determined doses by prescribed routes.

Non-pharmacological considerations complicate the formulation of an anaesthetic technique and may have a greater effect on study outcome than the drugs used.

Factors affecting the AN & A protocol

1. Species characteristics (anatomy, ethology, physiology, pharmacology)
2. Individual characteristics (age, sex, temeperament, size, breed, health status, concurrent medication, reproductive status, source – lab/farm)
3. Procedural factors (duration, invasivness, required precision, repeated procedures, operative site, procedural effects on PK/PD profiles of AN)

Factors affecting the AN & A protocol

4. Human factors (the good surgeon deserves a good anaesthetist, who is indispensable for the bad surgeon)

   Yang T. Anaesthetists: heroes behind the scenes. Br J Surg. 2020;107(6):773-4.

5. Equipment factors (AN delivery, physiological monitoring, physiological support)
6. Study considerations (AN affects study outcome?)

7. Conclusions

Recommendations in form of tables

1. level of supervision and anaesthetic risk categories
2. guidelines for anaesthesia (AVA, AAGBI, WHO)
3. pre-operative procedural, personnel and animal preparation (PREPARE guidelines) $\rightarrow$ staff competence and expert assistance when required (veterinary anaesthetist, Dipl ECVAA, Dipl ECLAM)
4. pre-operative equipment preparation
5. pre-operative emergency preparation
6. minimum requirements during sedation and general anaesthesia
7. planning, early and late recovery from anaesthesia
8. neuromuscular blocking agent use

Questions?