

Identifying and monitoring pain in pigs and ruminants

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Definition of pain

In human (IASP)

An unpleasant
associated
described

Complex phenomenon
that includes sensory,
emotional and cognitive
components

ce
e, or

In animals

An aversive
represent
threat to t

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animal's physiology and behaviour to reduce or avoid
damage, to reduce the likelihood of recurrence and to
promote recovery

How to identify and monitor pain ?

✓ In human

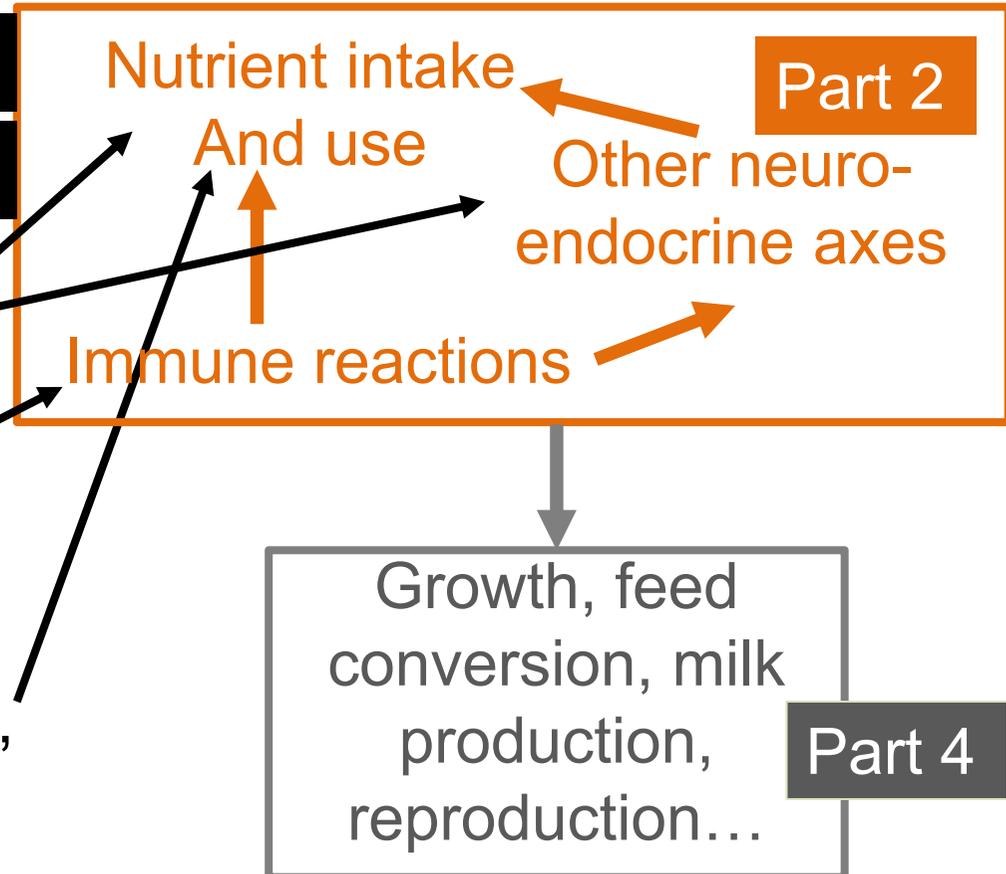
- The best evaluation of pain is self-report, on the basis of oral or written communication (Herr et al., 2006)

✓ In animal

- No self report, use of indicators that can be detected by external observers
- These indicators are based on phenomena tightly related to pain
- They should be valid (meaningful), sensitive, reproducible and feasible (for research ≠ on farms)

Phenomena related to pain

- ❑ Withdrawal reflexes **Part 1**
- ❑ Changes in posture **Part 1**
- ❑ Physiological reactions: autonomic and adrenal axes (pain = stressor) **Part 2**
- ❑ Tissue damages **Part 3**
- ❑ Behavioural changes, specific & general (feeding, reproduction) **Part 1**



Part 1. “Behavioural” indicators

Five categories:

1. Withdrawal reflexes, avoidance and defence behaviours
2. Vocalisations, facial expression
3. Behaviours directed towards the painful area
4. Postures and behaviours to avoid stimulation or to protect the painful area
5. Changes in the general behaviour

Withdrawal, avoidance, escape, defence

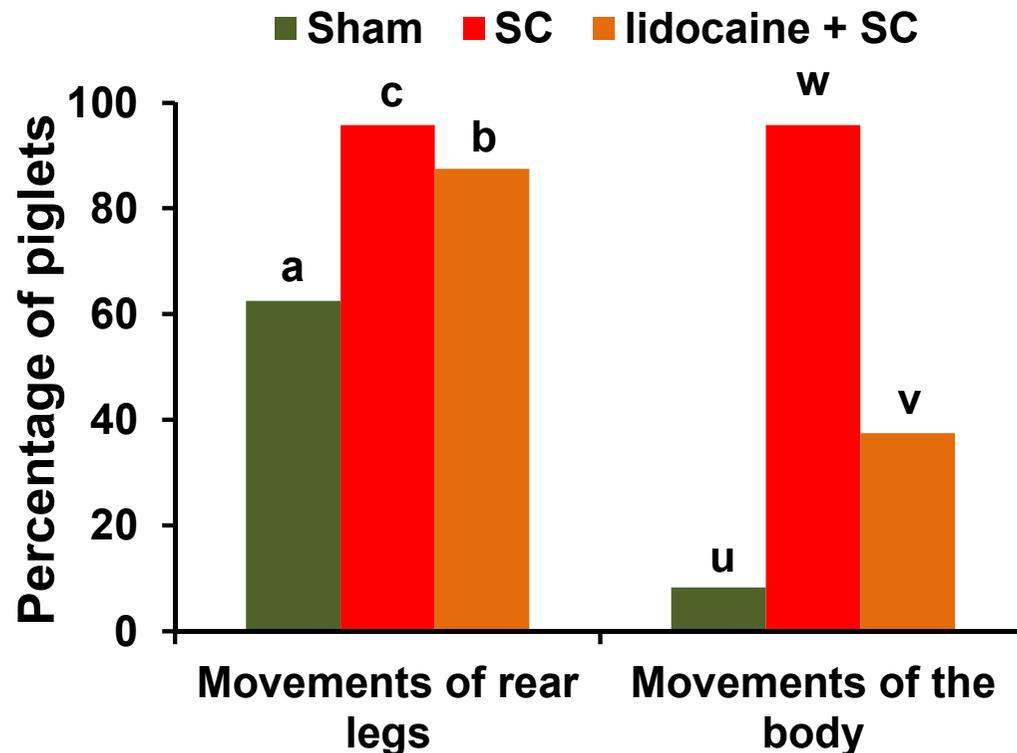
Withdrawal reflexes: involuntary and rapid movements, mediated by a reflex arc synapsing in the spinal cord, avoid a noxious stimulus: prick, burn, palpation of a painful area (kick)...

Avoidance, trials to escape, defence movements during castration in pigs and sheep, heat cauterisation of the horn-producing area (= dusbudding) in cattle...

Behaviour of pigs during surgical castration

24 pigs/group, 4-6 days

Courboulais, Hémonic, Gadonna, Prunier et al 2010

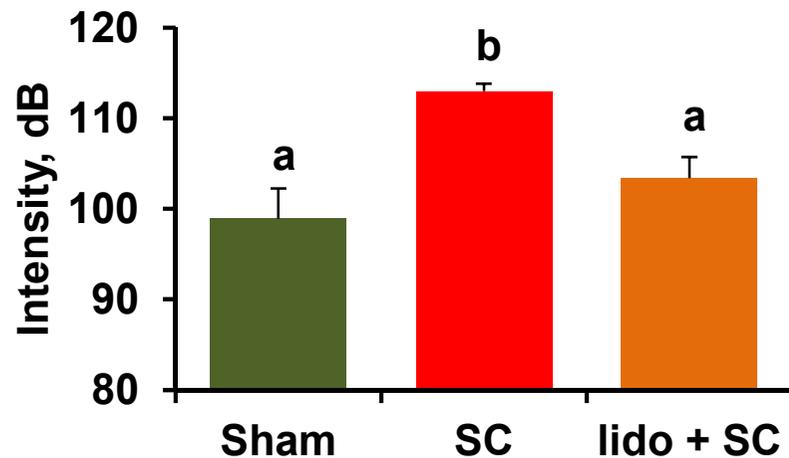


Surgical castration induces movements, local anaesthesia reduces the impact

Vocalisations

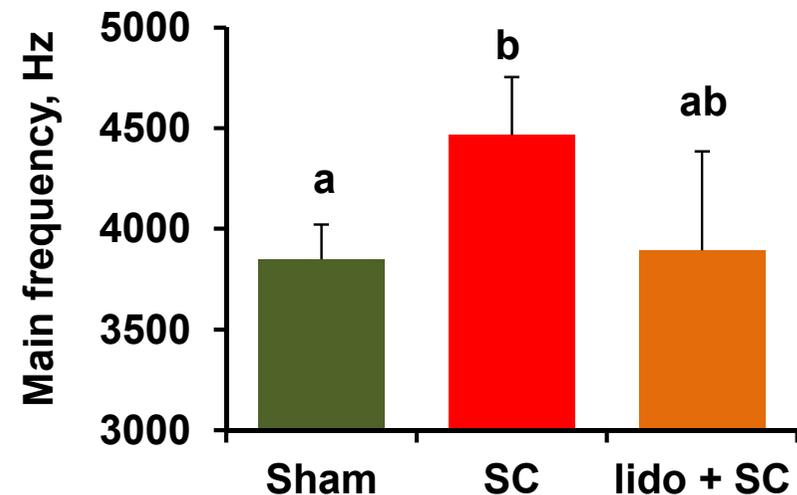
The number and features of vocalisations can be modified in case of painful situations (numerous studies in pigs and ruminants reviewed by Watts and Stookey 2000; Manteuffel et al 2004)

Intensity
Courboulay et al 2010



Piglets

Acoustic features
Kluyvers-Poodt et al 2012



Vocalisations in bovines



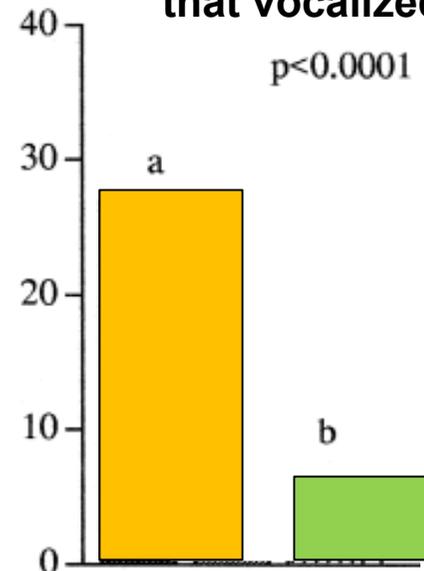
Response of steers to iron branding (Watts & Stookey 1999)



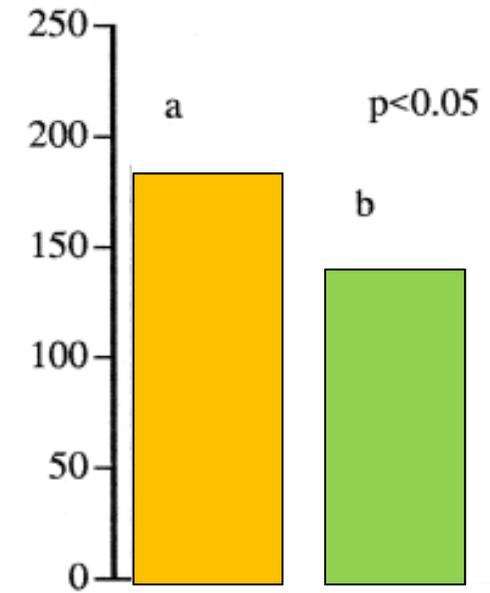
Restraining +
Branding

Restraining

Number of steers that vocalized



Maximum frequency of vocalization (Hz)



Vocalisations



- ✓ Animals may vocalise during non-painful handling (no difference between the control and painful situation in some studies: Lay et al., 1992a; Schwartzkopf-Genswein et al., 1998)
- ✓ After the acute response to a painful intervention, monitoring of vocalisations is of little efficacy to detect pain (Molony et al., 2002; Grant, 2004).

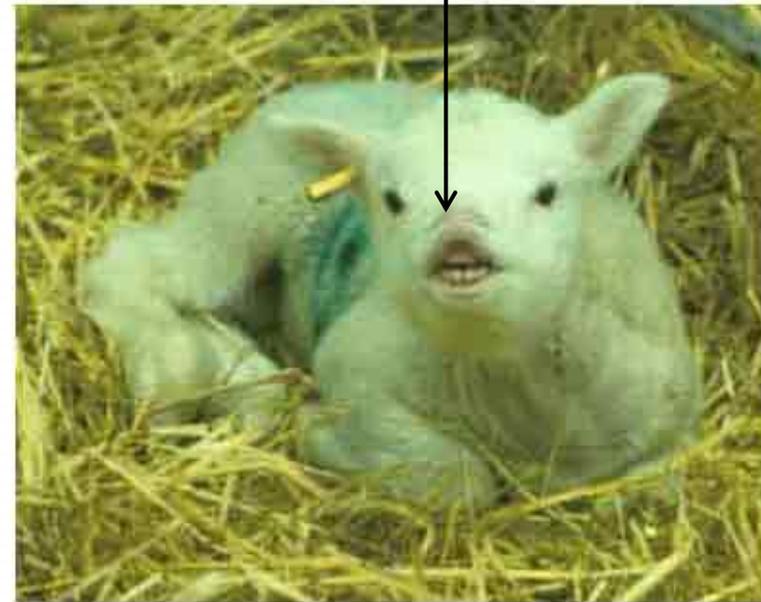
Facial expression

Animals suffering from pain may express changes in facial expression (Kent & Molony, <http://www.link.vet.ed.ac.uk/animalpain/>)

Ears back and wide open eyes in calf with bloat



Lip curling following rubber ring castration



Under scientific evaluation in domestic animals

Behaviours towards the painful area

- ❑ Licking: calves after tail docking (Eicher et al 2000) or castration (Molony et al 1995)
- ❑ Scratching/rubbing: rubbing the head with front legs after disbudding in veals (Morisse et al 1995); scratching of the scrotum area on the floor after castration in pigs (Hay et al 2003)
- ❑ Teeth champing after teeth clipping in pigs (Noonan et al 1994)

Etc.

Allow masking painful stimuli by tactile ones, « gate control » theory (Melzack, 1996)

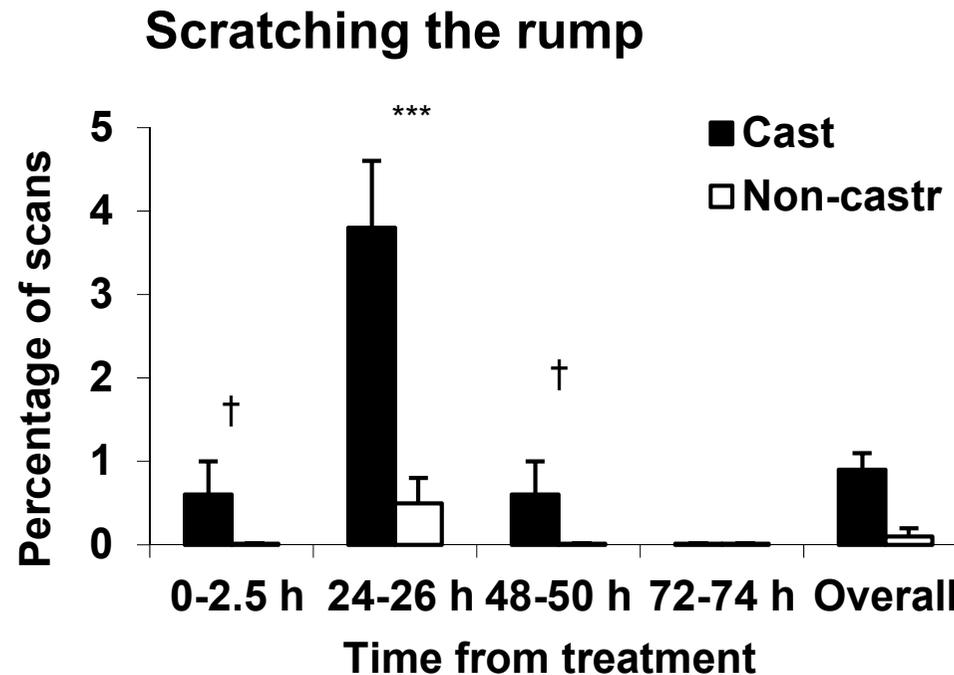
Postures and behaviours to avoid stimulation or to protect the painful area

- ❑ Lameness: numerous examples with various scales of evaluation
- ❑ Lying on the belly : sheep after castration (Molony et al 2013)
- ❑ Lying on the side with extended legs: sheep (Molony et al 1993) and pigs (Hay et al 2003) after castration
Etc.

“Aim”: limit pressing, stretching damaged areas

Scratching the rump after castration in pigs

(16 or 24 pigs/group, 5-7 days of age, Hay et al 2003)

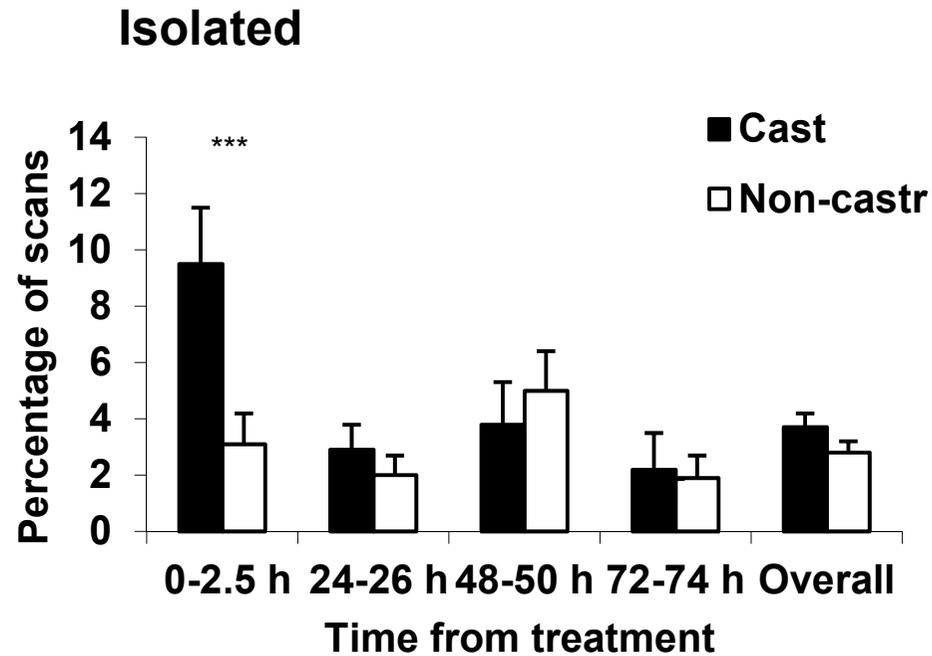


Changes in the general behaviour

- ❑ Signs of agitation: jumping, kicking, rolling on the soil... veals and lambs after castration combined or not with tail docking (Molony et al., 1995; Grant, 2004)
- ❑ Being motionless, awake inactive: pigs after castration (Hay et al 2003) or calves after dehorning (Theurer et al 2012) 'statue standing' after rubber-ring castration in lambs (Molony et al., 2002)
- ❑ Social isolation, behavioural desynchronisation: pig after castration (Hay et al 2003)
- ❑ Reduction in feeding behaviour after castration in pigs (Hay et al 2003) or calves (Robertson et al., 1994)

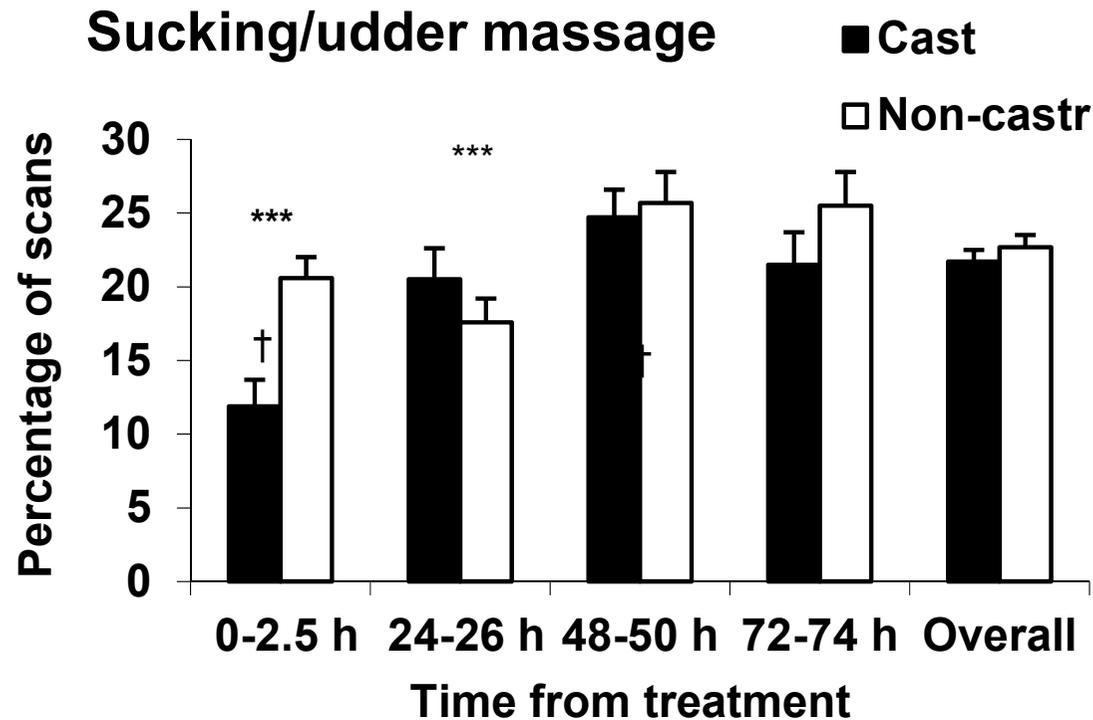
Etc...

Change in social behaviour after castration in pigs (16 or 24 pigs/group, 5-7 days of age, Hay et al 2003)

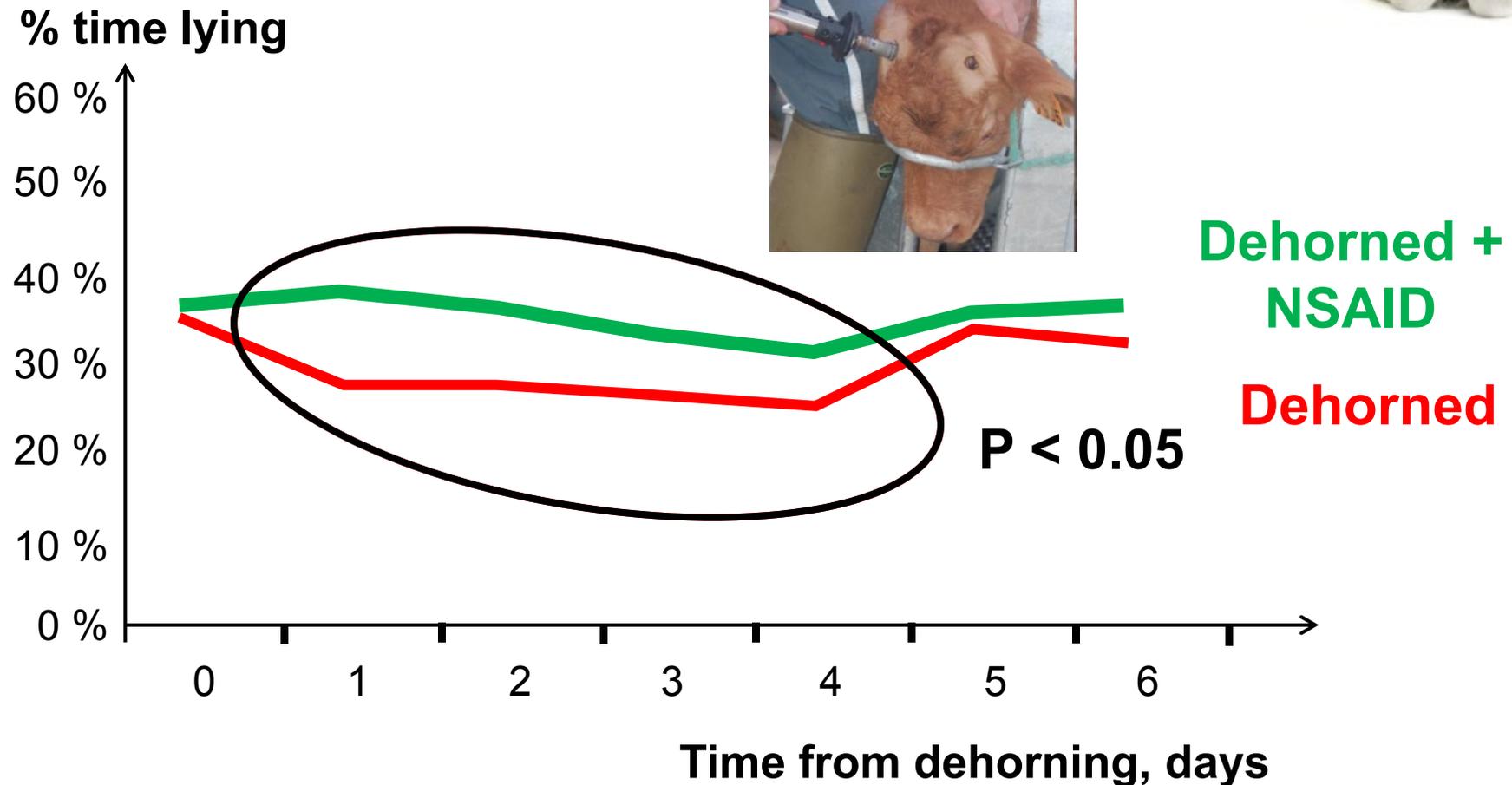


Change in sucking behaviour after castration in pigs

(16 or 24 pigs/group, 5-7 days of age, Hay et al 2003)



Change in general activity after dehorning in calves (Theurer et al 2012)



Conclusion on “behavioural” indicators

Limits

- ✓ Lack of validity: yes and no (take the context into account)
- ✓ Lack of reproducibility: no if good description and training

Advantages

- ✓ Non invasive
- ✓ Can be applied directly in commercial farms
- ✓ Sensitive
- ✓ Some are specific

Part 2-Physiological indicators

- ✓ Adrenal and sympathetic axes
- ✓ Immune system
- ✓ Metabolic and physiological consequences of stimulation of the stress response axes and of the immune system

Adrenal axis

Serial blood sampling
through permanent catheter



Occasional blood sample by
venipuncture



Components of the axis

- ❑ hypothalamus (CRH)
- ❑ pituitary (ACTH)
- ❑ Adrenal cortex (cortisol)

Possible measures:

- ❑ ACTH (blood)
- ❑ cortisol (blood, saliva)

Adrenal axis

Saliva collection on a gilt

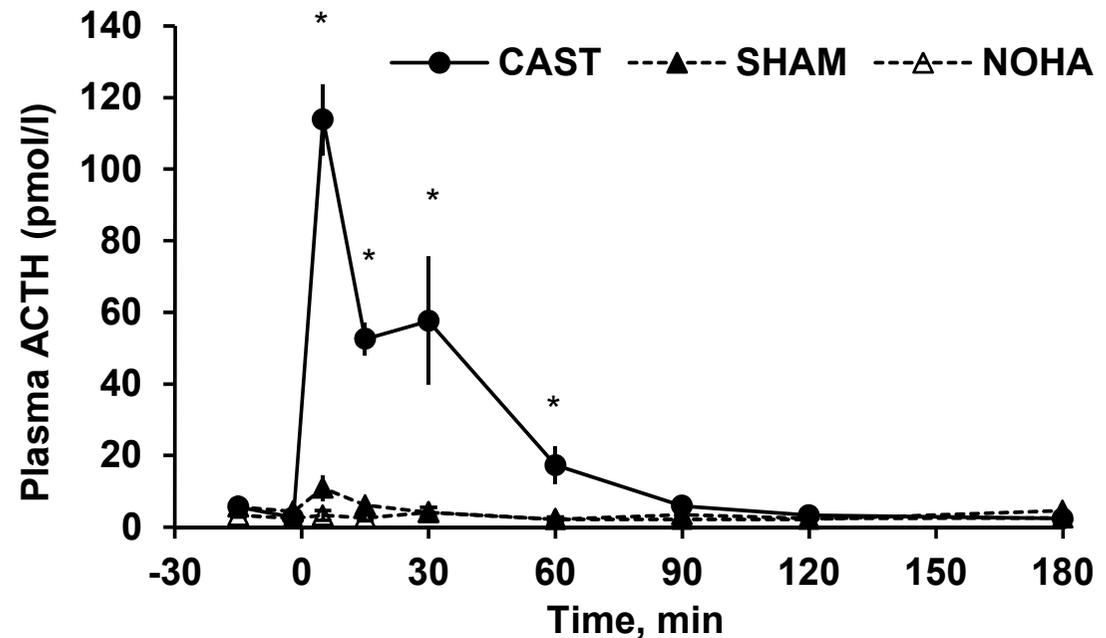


Cotton bud and tube
for centrifugation



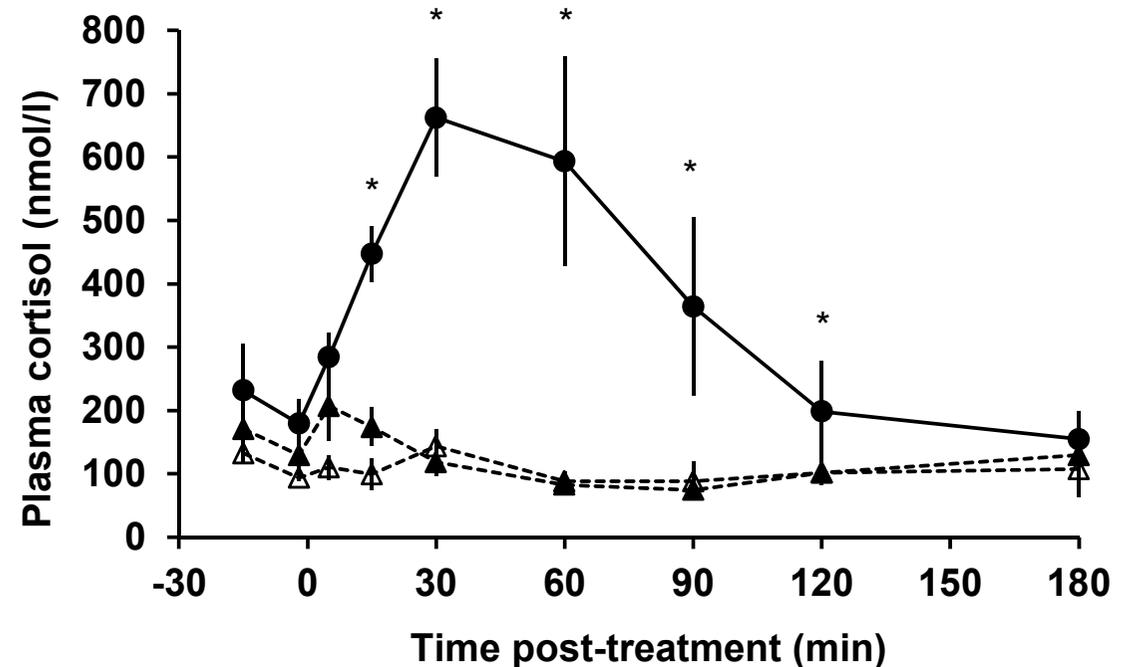
Adrenal axis

Pituitary response of pigs to surgical castration
(6 pigs/group, 5-7 days, Prunier et al 2005)



Adrenal axis

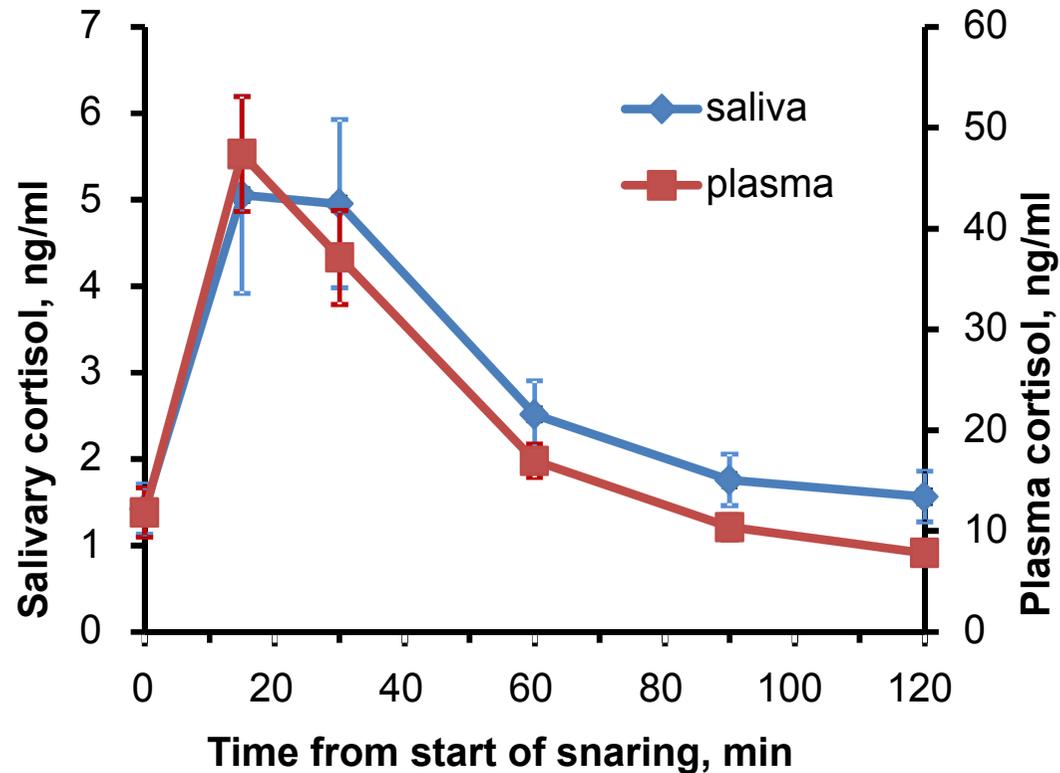
Adrenal response of pigs to surgical castration (6 pigs/group, 5-7 days, Prunier et al 2005)



Slower, less « intense » but of longer duration

Adrenal axis

Comparison of cortisol variation in plasma and saliva after a painful stimulus (snaring for 5 min) in gilts (8 pigs/group, Merlot et al 2011)



Sympathetic axis

Components of the axis:

- ❑ Nerves and ganglia, the adrenal medulla (80% adrenalin, 20% noradrenalin)

Possible measures:

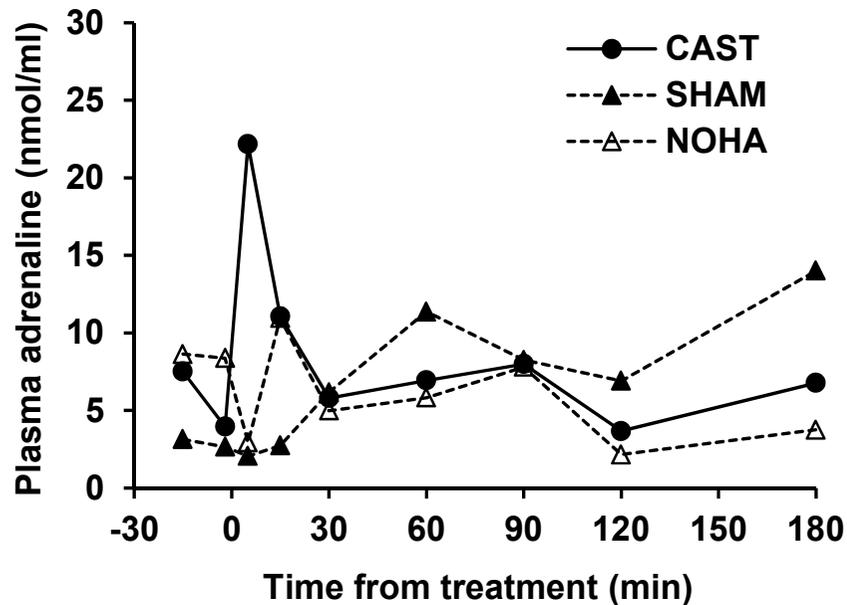
- ❑ Adrenalin (blood)
- ❑ Noradrenalin (blood)

Blood sampling without stress
via a catheter

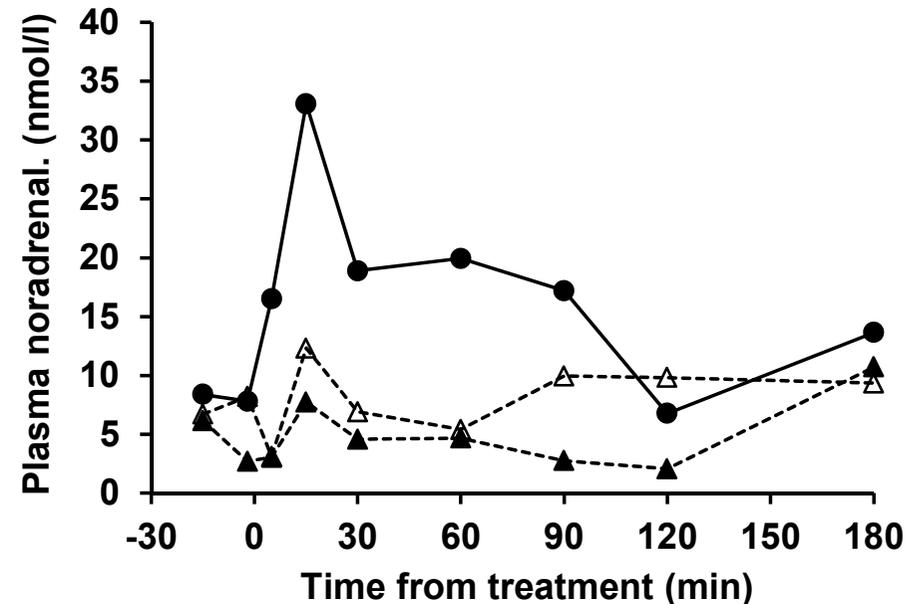


Sympathetic axis

Plasma catecholamine response of pigs to surgical castration (6 pigs/group, 5-7 days, Prunier et al 2005)



Rapid and transient



Longer duration

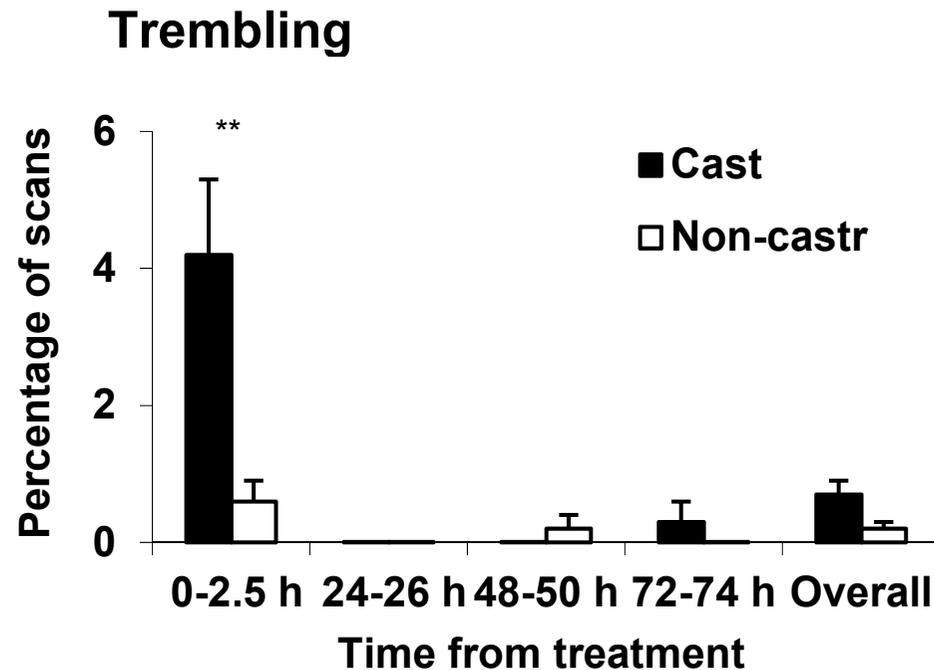
All the effects of acute stress (fight-or-flight response)

- ▲ Blood nutrient concentrations: glucose, lactate, NEFA
- ▲ Cardiac and respiratory rhythms
- ▲ Blood pressure
- ▲ Internal body temperature,
(Transient ▼) ▲ or eye temperature
- ▲ Diameter of the pupil
- ▲ Sweat secretion (not in pigs), electric conductivity of
the skin
- Muscular trembling

Well adapted to acute pain

Trembling after castration in pigs

(16 or 24 pigs/group, 5-7 days of age, Hay et al 2003)



Conclusion on physiological indicators

Limits

- ❑ Possible confusion with any other source of stress
- ❑ Are often invasive and need laboratory analyses
- ❑ Very few can be used in commercial farms

Advantages

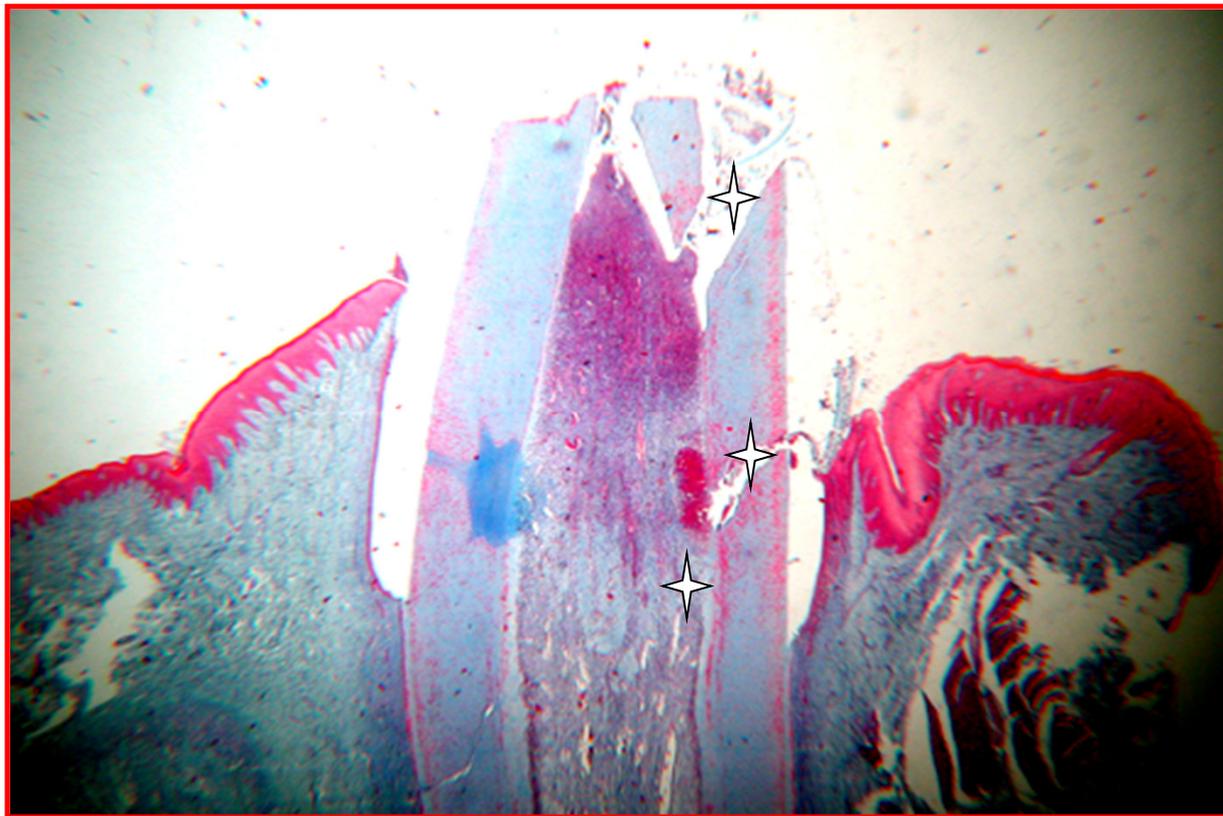
- ❑ Sensitive and quantitative
- ❑ Ideal for comparing experimental treatments
(identify practices that may generate pain, measure the influence antalgic treatments...)

Part 3-Injuries and other lesional indicators

- ❑ Based on analogy (physiology, anatomy) between human and domestic animals: painful lesions in human can be considered to be painful in animals
- ❑ Most frequent lesions are sources of pain: bone fractures, tissue tearing, inflammation, abscesses, neuromas...
- ❑ Detected by clinical exam of live animals or by histological analysis

Injuries and other lesional indicators

Piglet's tooth cut at 2 days of age and observed at 7 days (Hay et al, 2004)



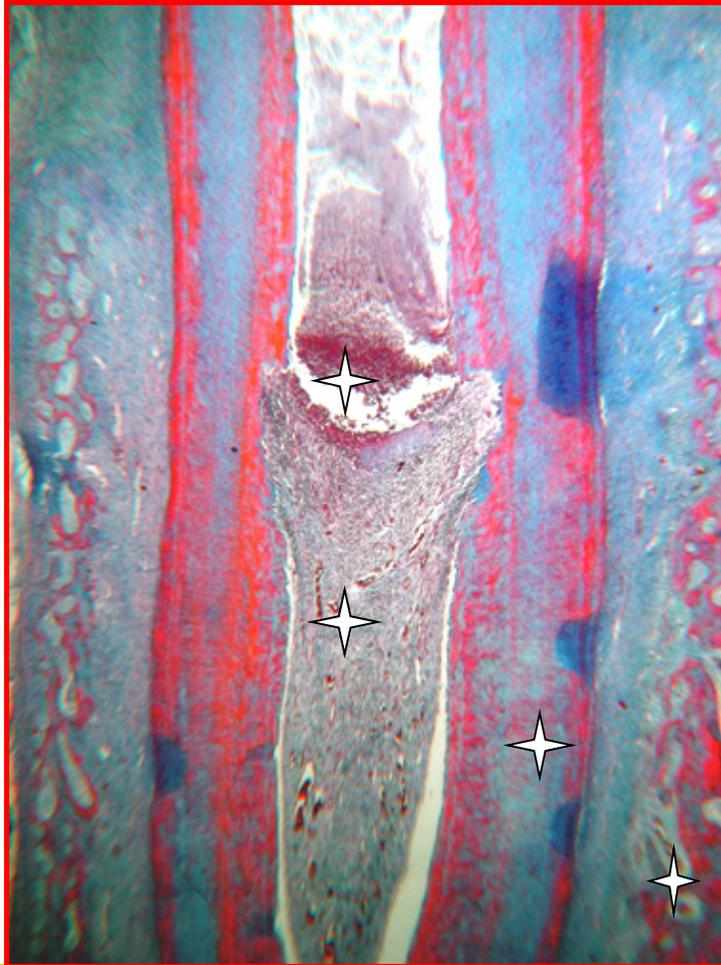
**Pulp lesion,
dentin debris**

Fracture

**Inflammation
(pulpitis)**

Injuries and other lesional indicators

Piglet's tooth cut at 2 days of age and observed at 28 days (Hay et al, 2004)



Abscess

Dental pulp

Dentin

Maxillary tissue

Conclusion on injuries and other lesional indicators

Limits

- ❑ A lesion is not always a source of pain
- ❑ Good conditions are necessary for observation of macroscopic lesions: space, light, cleanliness
- ❑ Histology analysis needs invasive sampling and laboratory analyses

Advantages

- ❑ Allows to locate some sources of pain
- ❑ Can be used in commercial farms when lesions are external
- ❑ Can be used on slaughter lines

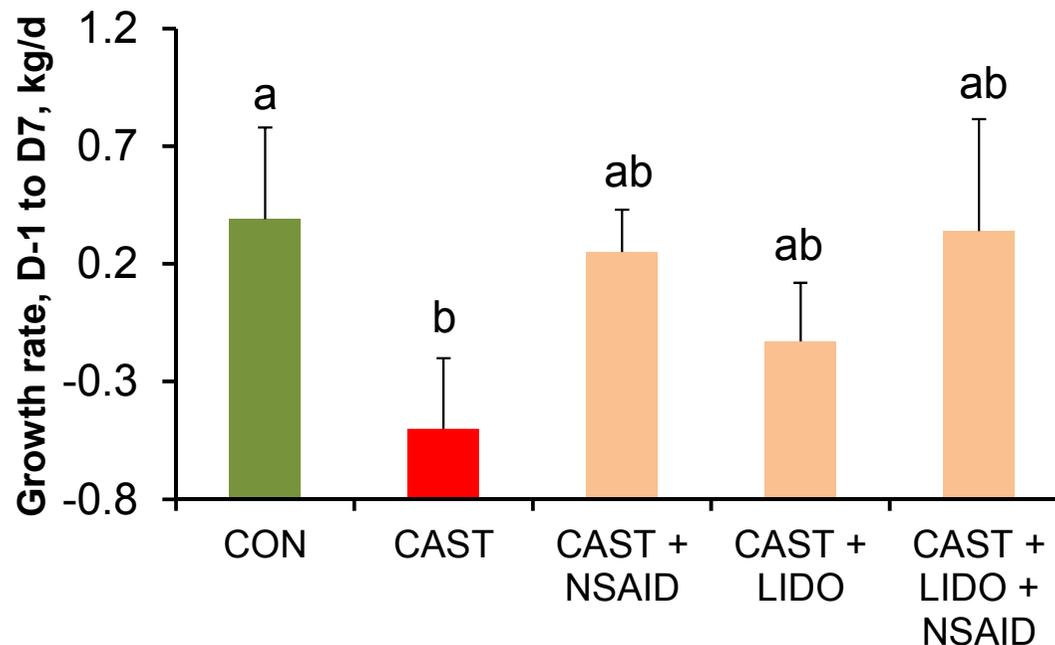
Part 4-Indicators related to production performance

Due to its effects on behaviour, adrenal and sympathetic axes, other neuroendocrines axes, pain can influence performance (especially if chronic):

- ▼ growth rate
- ▼ feed conversion
- ▼ reproduction performance: oestrus, fertility, prolificacy
- ▼ milk production

Performance indicators

Influence of surgical castration and pain relief on the growth rate in calves (n= 8/group, Earley and Crowe, 2002)



In piglets: no clear effect of castration and of pain relief: Hay et al 2003, Kluivers-Poodt 2012

Conclusion on performance indicators

Limits

- ❑ Low sensitivity (effects can be observed if pain is very intense and/or prolonged) and their validity may be questioned since numerous causes other than pain can be at the origin of performance decreases

Advantages

- ❑ Can be used in commercial farms
- ❑ Matter farmers that are motivated for a prompt reaction to improve performance

General conclusion

- ❑ In commercial farms : simple indicators, open to direct interpretation

Main indicators: behaviour, clinical exam and performance

Behaviour: early detection allows early action

A single (behavioural) can be sufficient but combining several indicators increases probability of detection

- ❑ For experimental purposes: more complex indicators can be used, numerous exist (behaviour, physiology...)

General conclusion

Progress has been achieved in many farms but more progress remains to be made

Convince farmers that improving welfare of the animals can be beneficial for:

- Health and performance of the animals
- Image of their production
- Greater job satisfaction/more positive self-image
-

Thanks for your attention!

