The slaughtering of livestock animals in late phases of gestation

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Introduction

The key question:

Have this animals been conscious and sensible for pain and suffering during decease of the dam or before own death?
Monitoring stunning efficiency is mainly based on the evaluation of consciousness and sensibility of the animals. The consciousness of an animal is essentially its ability to feel emotions and control its voluntary mobility.

[...] an animal can be presumed to be unconscious when it loses its natural standing position, is not awake and does not show signs of positive or negative emotions such as fear or excitement.

Sensibility of an animal is essentially its ability to feel pain. In general, an animal can be presumed to be insensitive when it does not show any reflexes or reactions to stimulus such as sound, odour, light or physical contact.

**But: no specific provisions for the stunning of gravid animals and their fetuses**

**DIRECTIVE 2010/63/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the protection of animals used for scientific purposes**

(9) This Directive should also cover foetal forms of mammals, as there is scientific evidence showing that such forms in the last third of the period of their development are at an increased risk of experiencing pain, suffering and distress, which may also affect negatively their subsequent development.

Scientific evidence also shows that procedures carried out on embryonic and foetal forms at an earlier stage of development could result in pain, suffering, distress or lasting harm, should the developmental forms be allowed to live beyond the first two thirds of their development.
Current scientific background

“WELFARE ASPECTS OF ANIMAL STUNNING AND KILLING METHODS”

- In fetuses it is assumed that physical response to potentially painful stimuli observed during late gestation is not linked to perception of pain.
- Onset of breathing and increase in blood oxygen levels are essential to induce arousal and awareness.
- Fetuses that cannot inflate their lungs with air would not attain conscious state.
- Fetuses that are already be unaware could not be aroused or could suffer due to slaughter of pregnant animals.
- Shortage of oxygen in the foetal brain prevents foetal suffering and therefore, where practical, leaves the fetus in the uterus until it is dead.
- Lung inflation must be prevented if a fetus is exposed to air, either by keeping its head inside the amniotic sac, by clamping its trachea, or placing a plastic bag full of water over its head.
- Fetuses exposed to air may be killed by neck cut, decapitation or destruction of its brain with a captive bolt.

Current scientific background

TERRESTRIAL ANIMAL HEALTH CODE
CHAPTER 7. 5.
SLAUGHTER OF ANIMALS

Article 7.5.5.: Management of foetuses during slaughter of pregnant animals

- Foetuses should not be removed from the uterus sooner than 5 minutes after the maternal neck or chest cut, to ensure absence of consciousness. A foetal heartbeat will usually still be present and foetal movements may occur at this stage, but these are only a cause for concern if the exposed foetus successfully breathes air.
- If a live mature foetus is removed from the uterus, it should be prevented from inflating its lungs and breathing air (e.g. by clamping the trachea).
- All foetuses should be left inside the unopened uterus until they are dead. When uterine, placental or foetal tissues are to be collected, where practical, foetuses should not be removed from the uterus until at least 15-20 minutes after the maternal neck or chest cut.
- If there is any doubt about consciousness, the foetus should be killed with a captive bolt of appropriate size or a blow to the head with a suitable blunt instrument.

- Central and peripheral neuroanatomical structures for perception of nociceptive stimuli matured with beginning of 2nd gestational phase in mammal fetuses (sheep: 12.-13. week, humans: ~ 26. week).
- Fetus in a „state of sleep“ with REM, non-REM and intermediate phases.
- No cortical participation in responses on aversive stimuli.
- $O_2$-partial pressure in fetal blood circuit below level allowing „wakefulness“ represented by characteristic EEG, irregular EKG and breathing activity, open eyes, goal-directed motion of the head - this indicators are thought to be related to intermediate phase between REM- and non-REM-sleep.
- During hypoxia or asphyxia rising fetal stress hormone and mediator levels are leading to apnoea, akinesia, and low brain metabolism (EEG, only during non-REM) = damped reaction. Low brain metabolism is mediated by Adenosine or others.
- Cortical responses (EEG) representative for „higher arousal status“, but not for „cortical awareness“ or consciousness.
- „no pain – no brain“ status of neurological mature fetus (at birth) unless he is able to breath fresh air


- No own investigations on central or cortical responses to aversive or potentially painful stimuli of neuroanatomical mature mammal fetuses in utero.
- No investigations on fetuses after birth or after rescue without possibility to breath fresh air.
- „No-pain no-brain“ theory in doubt with scientific discussion on fish responses on aversive or painful stimuli.
Scientific evidence on fetal awareness

A crucial step in pain theory: the influence of blockade of pain perception by drugs on hormonal, physiological, and behavioural responses of the fetus during intervention:

- Hormones and endocrine mediators: Cortisol, Catecholamines, beta Endorphine, ...
- Physiology: Heart rate variability, arterial pulsatility, „Breathing“ frequency, ...
- Behaviour: hand and leg movements, facial expressions, change of posture, withdrawals, ...

- Indirect fetal analgesia/anaesthesia for potentially painful diagnostic intervention:
- Direct fetal analgesia/anaesthesia
  intraamniotic treatment with opioids (Stümper et al. 2003)
  intravasal treatment with opioids (Fisk et al. 2001, DeWolf et al. 2003)

Anand (2007):

While there is abundant evidence that the human fetus can respond to painful stimuli as early as 18 to 20 weeks gestation, there is controversy regarding the cortical interpretation of fetal pain
Scientific evidence on fetal awareness

Spinal reflex and pain perception pathway in the fetus (Lowery et al., 2007):

(A) Reflex responses to noxious stimuli occur early in development, before thalamocortical circuits are functional; noxious stimuli trigger reflex movement without cortical involvement. Activated by a noxious stimulus (1) a peripheral sensory neuron (2) synapses on a dorsal horn interneuron (3) that in turn synapses on a ventral horn motor neuron (4), leading to reflex muscle contraction and limb withdrawal (5).

(B) Later in development, noxious stimuli (1) activate peripheral sensory neurons (2) that synapse on spinohalamic tract neurons (3), the axons of which extend up the spinal cord as the spinohalamic tract (4) to synapse on neurons of the thalamus (5). From here, thalamocortical axons (6) synapse on subplate and cortical neurons, resulting in the conscious perception of pain (7).

Figure: Anatomical and functional development related to pain perception in human fetus (Simons & Tibboel, 2006)
The new scientific view on fetal pain perception I

„old“ cartesian view:
Pain perception as a “hard-wired” system in which pain impulses are passively transmitted along sensory nerves, spinothalamic and thalamocortical pathways, until “perception” occurs, via activation of the primary somatosensory cortex.

„new“ scientific view:
Pain perception involves multi-layered networks of nociceptors, nerve fibers, neurons, and glia, distributed in multiple spinal and supraspinal areas, forming diverse feed-back and feedforward loops. The function and neurochemical profiles of these cellular elements are constantly modified by external and internal cues. Neurons, nociceptors, and nerve fibers participating in the perception of pain mature and begin to function at varying times. The developing neural elements may be immature, but they are not inactive; they demonstrate plasticity.

The new scientific view on fetal pain perception II

- Fetal neural structures and mechanisms used for pain processing are completely different from those used by adults
- Structures/mechanisms are not maintained beyond specific periods of early and later development
- Immature pain system thus plays a signaling role during each stage of development
- Pain is viewed as a homeostatic emotion, with the thalamus playing a first central role in pain processing and regulating with a transient functionality
- Second transient “centre” in fetal development of pain perception is the “subplate zone” as a first layer of neocortical activity (thalamo-cortical connections) in later states of gestation
- Pain impulses are processed also in other subcortical structures, including the hypothalamic pituitary system, amygdala, basal ganglia, and brain stem
- Constant and repetitive painful stimuli result in permanent spinal cord level sensitization, also fetal brain development and organization is shaped by input from external stimuli
Practical experiences I

- In contrast to results of Mellor’s working group (damping effect of hypoxia) intrauterine bovine fetuses show excitative movements over several minutes after the neck cut of their dams during slaughter (Förster & Rehbein, 2004).
- Also after slow intravasal injection of barbiturates (Pentobarbital, 40 mg/kg) bovine fetuses showed excitative movements in utero over more than 20 minutes (Blank, 2005). Fetal heart activity was seen over up to 40 minutes after death of the dam.
- In no case a fetal death was seen within 30 minutes after the death of the mother animal (Peisker 2010, Riehn et al. 2011, Peisker et al. 2012). This is clearly not compatible with the intention of Regulation (EC) No. 1099/2009 and several national law.
- Intrauterine excitative movements of fetuses during and after death of the dam can be explained as hypoxic and/or hypercapnic fetal stress (attempts to remove amnion membranes), indicating the opposite of a status of narcosis due to low oxygen partial pressure in the fetal blood circuit. Nevertheless, the grade of suffering is not known.

Practical experiences II

Amount of pregnant animals slaughtered

- Lücker et al. 2003 (Germany): 10,8 % of bovine animals (survey in 10 Slaughterhouses)
- Riehn et al. 2010 (Germany): Questionnaire to 53 Slaughterhouses, up to 15 % of bovine animals slaughtered (90 % in 2. and 3. Trimester)
- Federal Chamber of Veterinarians (BTK, 2014): In average 10 % of female bovine animals (180,000) per year, mostly in late gestation
- Di Nicolo (2006): LUX: 5,3 % / 3100 cows, IT: 4,5 % / 3071 cows, BE: 10,1 % / 1091 cows, DE: 4,9 % / 1556 cows mostly in 5./6. month of gestation
Conclusions

• There is scientific evidence existing that fetuses are able to process efferent pain or other aversive stimuli in different ways in different gestational stages.
• Pain processing alters neuronal plasticity during fetal development, but it is not known up to date if and how the „emotional“ part is altered too. This requires further scientific investigations.
• Investigation of pain perception in developing fetuses requires new scientific techniques, as EEG is functioning as a correlate to cortical acitivity only.
• Afferent responses of fetuses to painful or aversive (hypoxic) stimuli indicate a lack of sedative acting substances in the amnion fluid or a hypoxic state of unconsciousness in contrast to Mellor’s statement.
• New scientific evidence indicate the possibility of fetal suffering about pain or hypoxic / hypercapnic stress. Unless the animal welfare protection of the fetus is not secured, slaughtering of pregnant animals without veterinary indication (severe illness or injury of the mother) have to be avoided in every case.