Evaluation of current practices and presentation of recommendations for improvements to permissible methods

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This presentation is based on the following work

• Spot visits to slaughter plants, performed during WP2.2 in EU countries (Belgium, Germany, Italy, The Netherlands, Spain and The UK, Turkey and Australia in 18 cattle, 12 sheep, and 5 poultry abattoirs.
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• Two days Workshop: Religious slaughter practices, Girona (Spain), 3rd / 4th of February 2010 Hamid Ahmad (United Casing Corporation, Pakistan); Lotta Berg (Swedish University of Agricultural sciences, Sweden); Clyde Daly (Carne Technologies, New Zealand); Bruno Fiszon (La Grand Rabbinat de France, France); Troy Gibson (Royal Veterinary College, UK); James Kirkwood (Universities Federation for Animal Welfare, UK); Rasto Kolesar (World Society for the Protection of Animals, UK); Luc Mirabito (Instut de L’Elevage, France); Mohan Raj (Bristol University, UK); Joe Regenstein (Cornell University, USA); Shuja Shafi (The Muslim Council of Britain, UK); Yunus Teinaz (The Muslim Council of Britain, UK); Tahsin Yesildere (Istanbul Veteriner Hekimler Odasi, Turkey).

• The presentation represents the view of the authors and does not necessarily represent a position of the delegates of the workshop!
Evaluation of current practices and presentation of recommendations for improvements to permissible methods

WARNING:

➤ This presentation can be misleading without considering further information.
➤ For further information and full reference list please see http://www.dialrel.eu/images/veterinary-concerns.pdf

The final version of the recommendations will be discussed following the Istanbul workshop!

Restraining methods

- Neck cutting without stunning
- Post-cut period
  - animals slaughtered without stunning
- Reversible stunning

General requirements to restraint

- restrict movement / hold animal without stress
- present the animal in an optimum position
  - for application of the cut
    + during the bleeding period
      (Slaughter without stunning)
  - for application of stunning device
    + subsequent quick cutting/bleeding
      (Slaughter after stunning)
  - for application of the cut + subsequent quick stunning (Post cut stunning)

WARNING:

➤ This presentation may look incomplete because pictures had to be removed because of publication issues.
Restraining methods:
Example cattle

- upright restraint,
- inverted 180° (on the back)
- inverted 45°/90° (on the side)

Restraining methods:
Example sheep

- upright restraint
- lying on the side
- shackled

Restraining methods:
Example poultry

- By hand
- Cone/ funnel
- Shackled
Example: restraint - cattle

• **Rotary type** (chinlift, backpusher), every degree of turning possible from „upright“ to „on the back“
  - Impediments at entrance, e.g. incline, floor
  - Excessive pressure on the animal (effect on stress, bleeding)
  - Poorly designed headholder or chin lift (cut not performed correctly),
  - Operation bumpy and not smooth
  - These problems happen with both types of restraint

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restraint – cattle - upright

- Animal enter calmly,
- Possible to fix the head and present the neck within short time and at low stress level („good performance“: < 10 s)
- Good bleeding results because of calm animals
- People must be skilled, to perform a good cut in upright position („better performance“: 2-12 cutting movements)
- If the animal (700 kg) is not well held well managed after the cut, it may go down with the wound falling into the neck frame
- Blood irritates wound (also enters larynx, bronchi)

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restraint – cattle – turned on the back

- High working safety, also with struggling animals
- Cut may be easier to perform, if cattle are turned on the back (+: 2-12 cutting movements)
- Often stress during driving in, head restraint and turning, times until restraint ↑, vigorous ↑ and longer periods of struggling, vocalisations ↑, laboured breathing ↑, foaming at the mouth ↑, serum cortisol ↑, haematocrit ↑; (Dunn 1990, Koorts 1991).
- Discomfort due to rumen pressing upon the diaphragm and thoracic organs
- Signs of aversiveness/recovery often masked by facilities
- Blood and rumen content irritate wound (also larynx, aspiration of fluids)
- In some countries operated in recumbent position (90°/45°)
**restraint – cattle – turned / tilted**

Examples: intermediate turning positions (e.g. 45°, 90°)

- electrical stunning performed during turning
- post cut stunning after turning to 45°

Potential of turning to intermediate positions

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**Design: access to perform the neck cut**

<table>
<thead>
<tr>
<th>Cattle:</th>
<th>rotary</th>
<th>upright</th>
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<tbody>
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- impaired access for neck cutting
- cut may be difficult to perform, especially in smaller cattle

Turning times:

- external axis: 52 s
- center axis: 8-12 s

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**Recommendations - restraining**

- **Due care** during loading the animal;
- **Design**: properly lighted, non-slip flooring, where contact to animal: smooth rounded surfaces;
- A restraining device or method must suit the size and species and type of animals slaughtered;
- use concept of **optimal pressure**: hold the animal firmly enough to facilitate slaughter without struggle or undue delay but avoid excessive pressure;
- The restraining device or method must allow the correct application of the bleeding cut: adequate neck tension
- Post cut: allow good bleed-out, further processing only when unconscious, avoid stimuli on wound, allow intervention (see later)

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Recommendations – restraining ff.

Cattle:
• Although lateral recumbency and upright restraint are preferred, when rotary pens are used they must operate smoothly and at an appropriate uninterrupted speed;
• Upright restraint: the belly plate must not lift the animal or any of its feet off the floor;
• Rotary pens: the head of the animal must be restrained before the start of the turning process;

Poultry:
• Preferred method for Kosher and Halal Slaughter: one person holds the bird whilst the other performs the cut;
• When birds are shackled, the duration of shackling before the cut must be kept to a minimum (1 min);

Slaughter without stunning – the cut

A) What happens?
• Tissues that are cut: skin, long hyoid bone muscle, trachea, oesophagus, both jugular veins, both common carotid arteries, both trunci vagosympathici, both nervi recurrentes, both trunci jugulares and parts of the long throat muscle (KGrä, 1999);
• Most of these tissues are well supplied with nociceptors

About pain:
• Pain is an unpleasant sensory or emotional experience associated with actual or potential tissue damage.
• Large wounds elicit a major pain response
• There are different qualities of pain:
  • Phasic or nociceptive pain = “first pain” (mechanical or thermal stimuli).
  • Tonic or inflammatory pain = “second pain” (chemical stimuli released by injury and inflammations)
• Both forms are produced during slaughter
• Only inflammatory pain can be influenced by the quality of the cut.
B) How to measure pain?

- Physiological indicators (e.g. blood metabolites, hormones, heart rate)
  - BUT: these react too slowly or are confounded by the process of slaughter
- Behavioural indicators are most important
  - BUT: very difficult to standardize
- Brain electrical activity

B) How to measure pain - behaviour

- Very variable behavioural signs (e.g. licking, wide open eyes, muscle tremor, motionless, struggling, withdrawal, vocalising)
- Expression by the animal may be faint or hidden
- Different statements by scientists:
  - Little or no reaction to the throat cut by calves / cattle, except for a slight flinch (Grandin Regenstein 1994)
  - Defence movements even at optimum conditions (Hazem et al. 1977, one call out of 10)
  - Neck movement 4 of 100 chicken (Barnett et al. 2007)
- Dialrel (variable practices):
  - Cattle: vocalizing, retract, shivering, struggling
  - Sheep: struggling, shivering
  - Poultry: retract, wing flapping

B) How to measure pain – brain electrical activity

Recent work by Gibson et al. 2007/2009 (EEG spectral analysis):

- Characteristic pain response (amputation dehorning in calves)
- This response is present during ventral neck cutting (calves)
- This response was due to incision and not loss of blood flow to the brain
- Conclusion: Ventral neck incision is noxious.
Slaughter without stunning – the cut

C) Performance of the cut

- Number of cuts/ swifts of knife
  Dialrel: ("better conditions")
  Cattle: 1-12 (up to 60 ("bad" conditions))
  Sheep: 1-6
  Poultry: 1

- Halal Ø 5.2 (n=116) / Shechita Ø 3.2 (n= 231)
  (Gregory et al. 2008)

- Multiple cuts/ additional cuts
  potential for further nociceptor activation
  ➢ Sharp knife, long enough, cutting all the vessels, smooth, one non interrupted cut,

- Scratching on the spinal bone causes additional pain.
- Severance of the spinal cord causes additional pain.
- Neck breaking causes additional pain.
- Clinical signs post cut can be masked.

- To control the performance of the cut!
  Only one carotid artery cut chicken: 42% (Shechita, Gregory and Wotton 1986)
  Only one carotid artery cut cattle:
    Halal 1% (n=116) Shechita 6% (n= 231)
    (Gregory et al. 2008)
Recommendations – cutting

- Delays between restraint and the neck cut must be minimized.
- The cut should be performed by a rapid, swift knife stroke with ideally no sawing motions. Ideally the cut should be performed by one single continuous movement of the knife.
- Both carotid arteries and jugular veins must be cut without touching the bones of the spine (vertebrae) with the knife.
- No neck breaking together with the cut.

The final version of the recommendations will be discussed following the Istanbul workshop!

Recommendations – cutting ff.

- The knife used must be sufficiently long for each animal to minimize the need for multiple cuts. Ideally, the knife should be twice the length of the neck.
- The knife must be sharp for each animal.
- The knife should be checked between each animal.
- The cut should be inspected carefully without touching the outer cut surfaces, for complete section of both carotid arteries and jugular veins (for efficiency of bleeding, see later).
- If the cut is incomplete there must be immediate remedial stunning and slaughter.

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Slaughter without stunning – post cut

After the cut

- How long can consciousness last and why?
- What are the possible impacts on the wound?
- When can we further process animals?
- How do we recognize that they are definitely unconscious?
- What do we do in case of prolonged consciousness or if they re-awake?
Slaughter without stunning – post cut

Time to loss of consciousness:
- Cattle: Ø 20 s
  (5-80 s ........ up to 4 min /5 min)
- Sheep: Ø 15 s
  (2-22 s ........ up to 2 min)
- Poultry: Ø 15 s
  (12-25 s ........ up to ??)

Different criteria to be considered differently!

Time after the cut in seconds (Fielding, 2009)

Range for loss of brain function in calves / cattle

- Loss of righting behavior (Fielding, 2009)
- Collapse (Barrett, 1991)
- Loss of blood flow to brain (Fielding, 2009)
- Loss of loss of reflexes on EEG (Woodard, 1999)
- Loss of consciousness (Fielding and Blackmore, 1993)
- Loss of immobility (Fielding and Blackmore, 1993)
- Blood pH below 7.2 (Woodard, 1999)
- Blood lactate levels (Woodard, 1999)

Different criteria to be considered differently!

Huge range!

8% of cattle took longer than 60 s to collapse
2 /174 took more than 4 minutes to collapse

Gregory et al., 2010 Meat Science 85, 66-69
Slaughter without stunning – post cut

Example: blood pressure does not drop immediately in all animals
Lieben, 1925

Example: False aneurysms in cattle
Gregory et al., 2008 and 2010
Anil et al., 1995

Some animals take longer than others to lose consciousness

Possible impacts on the wound after the cut:
- Mediators by the cut tissue
- Blood borne metabolites
- Mechanical impacts like tearing, touching other material, e.g. metal
- Wound surfaces touch each other
- Stomach content
- Air draughts

These impacts are animal welfare concerns as long as the animals are conscious!
To improve methods of religious slaughter

**Slaughter without stunning – post cut**

**Mechanical** impacts on the wound after the cut:

- pictures (removed): example animal (cattle) goes down after upright restraint, wound surfaces touch neck frame in the frontside of the pen, animal lifts the neck
- pictures (removed): contact of the wound surfaces to the head gate can also happen in rotary pens (cattle)
- pictures (removed): mechanical impacts to the wound in sheep lying on the floor/ or sheep lying on the table if the head is not supported after the cut hanging down
- pictures (removed): mechanical impacts to the wound in shackled sheep

**Impacts on the wound after the cut:**

- **Blood aspiration is a potential welfare concern**
- **Blood sputtering on the larynx/glottis is a welfare concern**
- **the cough reflex cannot be expressed because of severance of the respective nerves**

*Gregory et al 2009, Meat Science 82, 13-16*

**Bleed-out** is best, if the animal is relaxed!

- When can we further process animals?
- How do we recognize that they are definitely unconscious?
Assessment of consciousness following slaughter without stunning

- Corneal reflex (may persist long, also in unconscious animals; if absent, consciousness is lost)
- Wide relaxed pupil / eyeball rolls back (may be transient state)
- Eye tracking of movements / focused eye movement / often together with spontaneous blinking (conscious)
- Rhythmic breathing (may persist long, also in unconscious animals; if absent consciousness is lost, if present ……)
- Gasping (does not indicate consciousness)
- Vocalization (cannot be expressed if throat is cut)
- Kicking (may also be unconscious due to lost inhibition of spinal patterns)
- Wing flapping (may be unconscious, but often indicates consciousness)
- No collapse / Righting (requires cortex, proprioception, muscletone) (conscious), (= floppy head in shackled animals = mostly unconscious)

Slaughter without stunning – assessment of permanent consciousness post cut

- cognitive threat test (Threat stimulus: rushing the hand towards the eyes ⇒ closing of eyes / moving the head backwards
  (requires perception of stimulus and motor response ⇒ indicator of consciousness) (Limon et al. 2010)
Recommendations – post cut period

- During bleeding animals shall be held secure but as relaxed as possible.
- No further processing of the animal after the cut before the loss of consciousness.
  - establish criteria for loss of consciousness
  - if methods not in place, wait 3/2 min (cattle/sheep).
- No interference with the wound until the animal is unconscious.
- Minimize mechanical and chemical stimuli on the wound!

The final version of the recommendations will be discussed following the Istanbul workshop!

Recommendations – post cut period ff.

- In case of prolonged consciousness after neck cutting, animals must be stunned.
- Signs of prolonged consciousness suggested:
  - attempts to regain upright body posture
  - reactions to manipulations of the wound
  - eye tracking of movements in the vicinity
  - threatening response

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Reversible electrical stunning

- Correct application of electrodes (position, contact)
- Current passes through brain
- Correct current parameters
- Proper device
- Instantaneous effect
- Epileptic fit (tonic/clonic phase - signifies effective stunning)
- Quick bleeding, which is effective before animal re-awakes

Ag research, NZ – scientific evidence from EEG and measurement of neurotransmitters
To improve methods of religious slaughter

**Reversible electrical stunning**

- Bad maintenance of equipment
- Bad electrode position
- Bad electrical contact
- Improper performance/equipment is a welfare concern

**Proper equipment**

- Right electrode position
- Keep electrical contact
- Quick and effective bleeding

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**Example: Stunning – effect on bleeding?**

*Comparison of slaughter methods – on blood loss in sheep*

- Neuring
- Electrical stunning
- Captus multistunner

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*Comparison of religious slaughter of sheep with methods that include pre-slaughter stunning, and the lack of differences in exsanguination, packed cell volume and meat quality parameters.*

*Animal Welfare 13, 387-392*
Reversible electrical stunning - poultry

• Adequate equipment
• Uniform immersion of all birds (head and neck)
• Moistening of shackles
• Current parameters and duration of current flow
• Prevent pre-stun shocks

See also: http://www.heykes.de/isa/schlachtung/bet-en.htm

Importance of good bleeding in poultry slaughter

Gregory and Wotton 1986 – anaesthetized chicken
– to consider range of differences

Time to loss of brain function (s) for different cutting techniques

Reversibility of stunning methods

• Electrical stunning:
  - Correct electrode position and choice of current parameters will prevent, that heart fibrillation occurs;
  - Heart continues to beat after current flow stops (Gregory, 1998a)

• Mechanical stunning methods
  (non penetrative) penetrating captive bolt
  - Regular heart activity up to 4 minutes
  (e.g. Cattle: Viram et al 1983, Kaegi 1988; Sheep: Schulze et al 1978)

• Gas stunning (poultry, used for Halal slaughter)
  - Regular heart beat for minimum 250-320 seconds after end of gas exposure (Curran et al 2003)

• stunning effectiveness not satisfactory!

photos Stork, NL
photos Termet, F
Control of effective stunning

- **Electrical stunning:**
  - rigid body (flexed hind legs, collapse) during current flow
  - then typical tonic clonic cramps = signs of an epileptic fit
  - during and after current flow: no rhythmic breathing, no righting,
  - no vocalisation, no eye tracing of movements, no wing flapping
- **Mechanical stunning methods (non penetrative / penetrating captive bolt)**
  - collapse, breathing stops
  - legs flexed, forelegs then straightening, clonic cramps may follow
  - no rhythmic breathing, no rotation of eyeball but fixed stare
- **Gas stunning (poultry)**
  - relaxed body, no righting, no wing flapping,
  - no vocalization
  - no rhythmic breathing

**Recommendations – Stunning**

- Induce immediate loss of consciousness by adequately maintained equipment, properly operated according to species and size of animal
- **Prompt neck cutting** to ensure that the animals do not re-awake during bleeding
- Animals must be **alive at the time of neck cutting** (monitor blood flow, pulsatility)
- Apply **criteria for effective stunning** according to stunning system and species
- Properly **re-stun** animals in case they show signs of re-awakening
- If **post neck cut stunning** is used, it has to be applied immediately following the cut.

The final version of the recommendations will be discussed following the Istanbul workshop!

Thank You very much!

The most important achievement of this project is, that we have started the dialog with each other!