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Mini Review

A Need for Clarity in Animal Welfare Regulation and Research Terminology: What is 'Cervical Dislocation' and 'Stunning' in On-farm Poultry Slaughter?

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Abstract

Clarity in the terminology used in animal welfare regulation and science is important. The use of the terms 'cervical dislocation' and 'stunning' in regulations regarding on-farm poultry slaughter and the role of the scientific evidence in developing these regulations are examined. It is concluded that the use of limited scientific evidence can unwittingly lead to a reduction in animal welfare standards. To avoid such dilemmas, it is suggested that clear definitions in the terminology used is essential at all levels from the design of experiments, the interpretation of results, the work of scientific committees and drafters of legislation and subsequently at the level of the competent authorities and enforcers. If this clarity is not achieved and it has not been achieved in some instances, then confusion and misunderstanding will arise, with negative consequences for animal welfare, primary producers and professionals.

Key words: Animal welfare, cervical dislocation, geese, on-farm slaughter, stunning

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INTRODUCTION

Clear and precise terminology is of great importance in science and law. This was recognized early in psychology, especially since the study of Stevens¹, who argued that the principles of operationism provide procedures by which concepts in psychology can be cast in a rigorous form. A concept has an empirical meaning only if it stands for definite, concrete operations capable of execution by normal human beings and so avoids the 'hazy ambiguities, which result in ceaseless argument and dissension'¹. The need for conceptual clarity in the study of animal behaviour has long been appreciated²⁻⁴. Bernard⁵ examined the use of the term 'instinct' in the psychology literature and found that, it was used in an uncritical manner without distinguishing being made between instincts and habits, environmental or inherited causations, reflexes etc. The term acquired ambiguous meanings limiting its explanatory usefulness and its abandonment was encouraged. Later for Tinbergen⁶ the study of instinct became an academic discipline. Here, authors will examine the use of some terminology in regulations on the welfare of animals at the time of slaughter (EU Regulation 1099/2009⁷). Two concepts, 'neck dislocation' as a procedure and 'stunning' as a psychological state are examined with reference to poultry.

The European Commission (DG SANTE) in 2017 published a report⁸ of the implementation of EU Regulation 1099/2009 titled the 'Preparation for best practice on the protection of animals at the time of killing'⁷ and focused on areas that 'were identified as problematic' during a recent audit that included the 'killing of animals on-farm'. According to the executive summary, 'The consultation identified areas of substantial disagreement between some consultees and the study team or between different groups of consultees' on issues such as 'qualifiers of certain methods of stunning in particular water bath and percussive blow to the head/cervical dislocation.'

European Commission⁸ makes it clear that the regulations require that a bird must be unconscious before killing it. Stunning before killing is a requirement from EU Regulation 1099/2009⁷: 'all of the methods should render the bird unconscious, or kill it right away.' (p153). Five methods are listed; (1) 'Penetrative captive bolt' ... through the skull and into the brain ... and birds should be killed by bleeding as soon as possible and within one minute after stunning (p155), (2) Non penetrative captive bolt and again birds should be killed as soon as possible and within one minute after stunning, (3) Head only electrical stunning, (4) Manual cervical dislocation. You may use cervical dislocation (or stretching) (p156) and a description of a method of manual cervical

dislocation is provided with a diagram of a domestic fowl and an alternative method using a heavy stick (such as a broomstick) can be used for larger birds with a maximum of 3 kg and pull the legs quickly backwards (p157), which is deemed to be an acceptable practice. Thus, there are different methods of cervical dislocation and it is this difference in methods that is a matter of interest and (5) Percussive blow to the head as a stunning method with bleeding or cervical dislocation to follow (p158).

After stunning a bird, you must immediately verify that it is unconscious. You must do so before you kill the bird (p158) and 'once you have verified that the bird is unconscious, you should immediately kill it by bleeding.' If the bird is not unconscious, you should not bleed it but immediately apply the procedure for re-stun' (p159⁸).

During the review process, substantive comments were received from selected reviewers that indicated considerable disagreement if not confusion in the use of terminology. Reviewers range from comments such as 'cervical dislocation (manual or mechanical) is not a stunning method!!! Birds do not become immediately insensible (it could be up to 30 sec)' citing⁹⁻¹¹ and these comments are based on a literature review (p356). Another respondent pointed out that 'for neck dislocation just pulling the vertebrate apart is rarely sufficient. There needs to be an aspect of torsion involved' (p357). Another commentator stated that 'Manual cervical dislocation is badly described, it is not just "stretching" the head must also be leveraged back...' (p359⁸).

Other comments concern what are considered acceptable methodologies, such as 'head-only electrical stunning' stating that recent unpublished research showed that this method (of stunning) should not be recommended for geese, as contact impedance between electrodes and the head was too high for the voltage ranges available (p360⁸). This method had previously been recommended for geese¹². Thus, recommended methods may not achieve the objective, ie. 'stunning' methods may not render the bird unconscious.

So what is 'cervical dislocation', 'neck dislocation' or 'cervical neck dislocation'?. Further, terms such as manual and mechanical are used in this context suggesting that there are different methods and if so, one might expect different results in terms of 'stunning'.

These matters are of some importance for a number of reasons. On-farm slaughter of poultry in small quantities is a traditional practice and the dispatch and preparation of poultry on-farm for human consumption is an ancient and traditional practice and in the context of New York Dressing, it was granted TSG (Traditional Specialty Guaranteed) status by the EU (98/C405/06, Traditional Farmfresh Turkey¹³) after a

stringent food safety and animal welfare review process^{14,15}. Traditional production practices are protected by the EU under EU Regulation 852/2004 on the hygiene of foodstuffs¹⁶. New York Dressing is a traditional slaughtering and processing practice, where the cervical vertebrae and the spinal cord are disconnected. It results in blood pooling in the neck, which remains there during dry plucking and when the birds are cured for approximately 10 days before evisceration^{14,15}. This traditional production process does not require water and eliminates risks of contamination. On-farm methods of neck dislocation can and do differ from those described in the recent EU review⁸.

Secondly, the welfare of animals on-farm is increasingly becoming a matter of public concern and regulations, such as EU Regulation 1099/2009⁷ is enforced by competent authorities. Competence can then be an issue and a matter for scrutiny by professional bodies and others having consequences for both enforcers and primary carers of animals and indeed the animals themselves. Thus, it is essential that terminology and techniques are understood in a clear and unambiguous manner. So how have we come to the point where cervical neck dislocation has led to controversy as to its efficacy as a slaughter and stunning method for farmyard poultry?

HISTORIC BACKGROUND

The scientific panel on Animal Health and Welfare¹⁷ submitted an opinion to the EU Commission that 'Neck dislocation may not concuss poultry and therefore, it is uncertain whether it causes immediate unconsciousness' (p24¹⁰) and recommended that 'cervical dislocation or decapitation should be performed after the birds had been stunned by some other method' (p25¹⁰) without demonstrating what methods would be effective in achieving unconsciousness in an on-farm slaughter situation for particular species. The opinion was rather tentative in that it stated that, it 'may not concuss' and 'it is uncertain' but regulations developed as if it were certain and as if it did not concuss. This opinion was based on a report from the Scientific Panel (EFSA-Q-2003-093¹⁷), who had reviewed the current literature, which was for many species reportedly sparse.

The Scientific Panel reported that poultry species are frequently killed on-farm by either manual or mechanical neck dislocation^{10,17}. The study of Gregory and Wotton⁹ was crucial in informing the report and showed using domestic fowl (broilers) in a tripod killing cone (which was designed for the dispatch of small batches of geese and turkeys on-farm¹⁸). The

chicken (domestic fowl) necks were gripped in a clamp pivoted below the cone and then downward pressure was applied stretched the neck until it was broken. Other birds were dispatched using Semark pliers, crushing the neck at the first cervical vertebra. In all but one of the birds subject to neck dislocation by stretching (n = 8) the spinal cord was broken at the first cervical vertebrae (dislocated) but the carotid arteries remained intact. This would be an unusual form of neck dislocation in an on-farm slaughter operation. If the arteries were not broken with sufficient gap between the vertebrae then proper bleeding of the bird would not occur and would compromise meat quality. From welfare perspective, in this study, blood continued to flow to the brain after the procedure and similarly with the neck crushing method. In the one exception using stretching, the brain was damaged and both carotid veins were broken as one would expect in an on-farm slaughter situation. Neck dislocation as described above by either stretching or crushing methods could not constitute a slaughter method if the meat was not suitable for human consumption. Slaughter is part of the preparation of meat for human consumption. In the exceptional case, where the brain was damaged and both carotid arteries were broken, the animals experienced visual evoked responses for a shorter duration than the other birds. It can be noted that the visual evoked responses of 5 of the 8 birds in another group of broilers concussed with a Cash special, delivered to the contralateral side of the bird's head, were similar to 3 of the 8 birds, who experienced neck dislocation by stretching⁹. Thus there appears to be variation in the results corresponding to the severity of the methods used in the neck dislocation.

The study of Gregory and Wotton⁹ was later developed by Erasmus *et al.*¹¹, using turkeys who comparing the effectiveness of a pneumatic non-penetrating captive bolt (Zephyr), with blunt force trauma using a metal pipe or metal bat and manual cervical dislocation (manual hand stretching) and mechanical cervical neck dislocation (burdizzo; to crush the vertebrae). The manual method with the hand emphasized stretching without the twist of the neck. Blunt force trauma using metal pipe or metal bat applied by hand and the pneumatic non-penetrative captive bolt (applied twice in quick succession, ie. modified nail gun with a convex nylon head) were found to be equally effective in inducing insensibility, using nictitating membrane reflex (eye) as a measure. The duration of eye reflexes were shorter using manual cervical dislocation than mechanical cervical dislocation by crushing. However, the time to death, as measured by end time of convulsions, was shorter using cervical dislocation than with the pneumatic non-penetrative captive bolt or blunt trauma.

It was noted in this study¹¹, that for one turkey cervical dislocation resulted in partial removal of the head from the neck and blood loss and this bird had shorter nictitating membrane reflexes (15 sec) than the other birds and no gasping was observed. This case is important. Cervical neck dislocation took a different form in that the head was partially removed corresponding to the exceptional case in the Gregory and Wotton⁹ study, where the carotid arteries were broken and the brain was damaged and eye reflexes were of shorter duration. Thus, there is a need to clearly define operationally what we mean by cervical neck dislocation if we are to understand its effects in a welfare context.

DOES CERVICAL NECK DISLOCATION STUN?

Verhoeven *et al.*¹⁹ reviewed the measures used to assess unconsciousness in varying livestock species, pointing out that while electroencephalogram (EEG) is suggested as the most objective measure used to evaluate unconsciousness and it is difficult to determine the exact moment of unconsciousness. They point out that positive eye reflexes alone do not necessarily indicate consciousness, as positive brain stem reflexes might occur as a result of residual brain stem activity and they do not distinguish clearly between consciousness and unconsciousness²⁰. Eye reflexes are inhibited after electrical stunning but the cerebral cortex is still functioning and the animal may still be conscious¹⁹ suggesting that such reflexes as measures of consciousness work only one way, when absent it is likely that the animal is unconscious but when present the animal is not necessarily conscious. While EEG (electroencephalogram) is regarded as the most reliable indicator of unconsciousness, its application in on-farm or even in slaughter house environment is difficult because of technical and animal related artefacts that can occur^{11,19} and so the assessment using EEG of 'Cervical neck dislocation in whatever form is difficult'. In the studies where EEG was used, the methods of cervical dislocation appear simplified to enable measurements to take place and thus may compromise the external validity³ of the research findings and conclusions, ie. they may not apply to the practices in the real world.

However, according to EU Regulation 1099/2009⁷, as of the 1st January 2013, cervical neck dislocation in the EU is only permitted as a backup stunning method, when no other methods are available. This is reassuring. What are the other methods?

The concern is that cervical dislocation may not necessarily concuss poultry and thus loss of consciousness may not be instantaneous¹⁰. However, the European Food

and Safety Authority (EFSA)¹⁰ report failed to define cervical dislocation as a method of slaughter in an operationally manner leaving it to the reader to presume what the method might involve. Sparrey *et al.*¹⁸ described and illustrated a number of methods regarded as cervical dislocation; (1) Manual dislocation, (2) Mechanical-heavy stick, (3) Mechanical-killing cone, (4) Mechanical-burdizzo, (5) Mechanical-pliers and (6) Mechanical-turkey neck pliers.

The killing cone, illustrated and described by Gregory and Wotton⁹, was marketed for the slaughtering small numbers of geese and turkeys on-farm for meat production¹⁸ and consists of a restraining cone mounted on a tripod with a neck clamp fixed to a pivot below the cone. The neck clamp has a kink in the clamping bar preventing the bars closing completely to avoid neck crushing. The clamp is then pulled swiftly down to dislocate the neck. This killing cone described and illustrated by Sparrey *et al.*¹⁸ differs from that illustrated and used by Gregory and Wotton⁹ in that the two bars in the latter study are side by side, rather than one under the other, as in the Sparrey *et al.*¹⁸ illustration. These two cones would have very different effects if used with geese and indeed other birds. When killing geese with the Gregory and Wotton⁹ cone the neck is placed under one bar and held by the other with the head in a more perpendicular position, the bird is then dispatched by bringing both bars down towards the ground. This method using the Gregory and Wotton⁹ cone is thought to have both a concussive blow effect¹¹ and a neck dislocating effect, ie. it involves first a concussive blow to the head immediately followed by neck dislocation with the blood vessels supplying the brain broken, leaving a gap between the vertebrae for the necessary blood pooling in an on-farm slaughter situation. The welfare implication of this method and with geese has not as yet been experimentally verified. Gregory and Wotton⁹ used this cone with chickens and the head was placed between the two bars and the head facing the ground before stretching. This is a very different procedure and would not be recommended for geese. In the older version of the killing cone, illustrated by Sparrey *et al.*¹⁸, with the positioning of the head parallel to the ground one would expect a less percussive effect. Again studies are necessary.

ALTERNATIVE STUNNING METHODS AND THEIR EFFECTIVENESS

Under EU Regulation 1099/2009⁷, alternative stunning methods are permitted and their effectiveness is now being examined and are proving problematic from an animal welfare perspective. Hence, the recent report from the European Commission⁸. European Food and Safety Authority (EFSA)¹²

report stated that little research has been conducted on the stunning of geese and found only three methods, non-penetrative captive bolt stunner, electrical water bath stunning and head-only electrical stunning and these were recommended in the absence of validation in an on-farm slaughter environment.

The casualty (CASH) poultry killer (non-penetrative captive bolt; Accles and Shelvoke Ltd., UK) applied on ducks and geese^{21,22} uses a .22 calibre cartridge powered tool with an interchangeable flat or convex metal percussive head¹⁸. However, this was developed for casualty killing and its application is paired with a gunshot like sound with welfare implications for birds waiting to be killed. It is a killing device and its efficacy in on-farm slaughter environment with health and safety and food quality concerns is now being examined and like other non-penetrative captive bolt devices are proving effective when successfully used²³. The problem is non penetrative captive bolt devices are not effective in approximately 10% of turkeys with some equipment and birds can regain 'consciousness'²³. A penetrative captive bolt is permitted under EU Regulation 1099/2009⁷ and a modified form of same (Rabbit Zinger®) has been evaluated by Martin *et al.*²⁴, who found using chickens, laying hens and pullets that the permitted Rabbit Zinger had a success kill rate of only 72% compared to 100% for manual and modified mechanical cervical dislocation. The Rabbit Zinger was very successful when it did kill in terms of reduced eye reflexes, but with 28% of birds not killed but with various degrees of maimed it was not considered human²⁴. However, the penetrative captive bolt devices, similar to the Rabbit Zinger have been enforced by competent authorities within the EU causing much distress to birds and their carers. The manual and a novel mechanical cervical dislocation (involving metal inserts into a glove, to assist cervical dislocation) involved rotating the birds head upwards towards the back of the neck methods²⁴. This is a different form of neck dislocation than that described in the earlier studies of Gregory and Wotton⁹ and Erasmus *et al.*¹¹. Post mortem examination showed the number of birds having more than one carotid arteries severed was greater with novel mechanical cervical dislocation device than with manual cervical dislocation and factors such as neck gap distance had further positive effects on carotid severance. From a welfare perspective, Martin *et al.*²⁴ found nictitating membrane reflex in no more than 10% of birds in any of the killing methods studied and then for less than 5 sec, which is considerably shorter than in previous studies^{9,11} reflecting the difference in the methods of cervical dislocation used.

Thus, authors need to be concerned with the external validity³ of the findings and conclusions. From a close examination of methods used in the careful conducted earlier studies^{9,11} and recent findings^{18,24,25} that mimic more closely the methods used in on-farm cervical dislocation slaughter methods with an emphasis on the twisting motion and greater cervical gap distance. The methods employed in the earlier studies^{9,11} use techniques that differ from those employed in the traditional on-farm situation and thus, lack the necessary external validity. The methods of measurement reflect the constraints placed on the scientists to acquire the measures obtained. Scientific opinions are the foundation for EU Regulation 1099/2009⁷ and the recent report⁸ demonstrated the problems with understanding and enforcement the regulations.

CONCLUSION

It is essential that new techniques should first be validated before enforcement if animal welfare standards are to be improved or at least maintained. It is not surprising that the authors of the recent report⁸ have issued not just one but two disclaimers: "Elements of best practice are not of a legally binding nature and do not affect the requirements of the EU legislation on the protecting of animals at the time of killing or other relevant pieces of legislation. Nor do they commit the European Commission... The reader is, therefore, invited to consult this section in connection with the relevant provisions of the legislation and refer, when necessary, to the relevant competent authorities".

New techniques such as head only electrical stunning in geese and penetrative captive bolt stunning in poultry should in the first instance be validated by the competent authority at either EU or Member State level before implementation and as the development of such new techniques will involve experimental work, which in itself requires competent and regulated experimentation and this should not be the remit of primary producers or associated enforcers.

The use of terms such as 'stunning' can be misleading especially if it fails to distinguish between the method (e.g. electrical or penetrative captive bolt) and the desired effect (i.e. stun). Thus 'electrical stunning' or 'penetrative captive bolt stunning' can give a misleading sense of security that the techniques deliver a stun when it did not or that the stun may not be maintained^{19,23,26}. Similarly terms such as 'cervical dislocation' in poultry needs clear operational definition if its effects are to be understood.

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