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STUDY REPORT: SYSTEMATIC LITERATURE REVIEW ON THE ANIMAL WELFARE ASPECTS OF THE USE OF ELECTRO-IMMOBILISATION IN LIVESTOCK

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Executive summary

This literature review features a systematic review of all published and unpublished original research of the effects of electro-immobilisation on livestock. The review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. Peer-reviewed articles were sourced from citation databases (such as Medline and CABi) while grey literature found on the World Wide Web was also scrutinized. Predetermined data was extracted from studies that met the pre-set limits. Findings were evaluated with the Cochrane Handbook Risk of Bias Assessment tool and Grading of Recommendations Assessment, Development and Evaluation (GRADE) system. In addition, position statements from international welfare role players were sourced and summarised. Information on devices available in South Africa, their recommended use and customer feedback was also included.

The literature search produced 387 records on livestock electro-immobilisation and animal models for human immobilisation devices. Of these, 20 studies on livestock electro-immobilisation and 23 studies on animal models for human immobilisation devices were eligible for inclusion in this review.

The included studies on electro-immobilisation of livestock indicated that the procedure can cause negative physiological and behavioural effects on animals but the certainty of this evidence is low to very low due to various biases, identified by the above-mentioned tools.

The following five bias categories were assessed according to the Cochrane Handbook Risk of Bias Assessment tool: (1) Selection bias, representing failure to ensure that study groups are equal. (2) Performance bias, which requires methods to ensure that all study subjects are handled equally. (3) Detection bias, which looks at whether all outcomes were assessed in an independent manner. (4) Attrition bias, which evaluates whether all available measured outcomes were reported. (5) Reporting bias, referring to reporting of all experiments. This assessment was conducted separately for each outcome from each study.

For the vast majority of outcomes and criteria the study reports did not supply sufficient information to assign risk, and thus unclear risk had to be assigned. The only category for which a high number of “low risk” could be recorded was detection bias, since the majority of outcome parameters could be classified as objective. Attrition bias was the most commonly

identified “high risk” category, indicating a high probability that only some of the parameters evaluated by the studies were reported.

The second quality assessment tool, namely the GRADE system, was used to ascertain whether the cumulative evidence from all the studies is trustworthy. According to the system, an initial rating is assigned based on the study design. The initial rating is downgraded for any of the following problems: (1) Methodological problems, referring to the outcome of the Cochrane Handbook Risk of Bias Assessment tool. (2) Inconsistency, when different studies report conflicting results. (3) Indirectness, referring to differences between the study population, intervention, comparators and/or evaluated outcomes and the “real world” scenario for which the application is intended. (4) Imprecision, when the cumulative sample size is small. (5) Publication bias, when it is likely that not all studies have been published.

The majority of included studies were classified as experimental challenge studies, and thus assigned a “moderate” initial rating. All outcomes suffered from one or more of the problems mentioned above. Methodological problems were common, as discussed above. Some outcomes (notably plasma cortisol and feeding behaviour) suffered from inconsistency. Concern of indirectness was identified particularly with regards to the device used (all published studies used one device), the duration of exposure (the majority evaluated the use of electro-immobilisation for between 1 and 5 minutes) and the comparators (less than half compared electro-immobilisation to another restraining method). Imprecision was identified due to the lack of large field trials resulting in no outcome evaluating a total population of 400 of more subjects. Lastly, a high probability of publication bias was identified since several published articles reference unpublished reports.

The principle effects of electro-immobilisation on livestock reported in the literature are the following, all with a very low level of certainty: (1) Preference and motivational tests indicate that animals choose against EI. (2) Hormonal indicators of stress (plasma cortisol and β-endorphin) were transiently increased in animals exposed to EI. (3) Statistically significant physiological effects of electro-immobilisation included periods of cessation of breathing, temporary systemic acidemia, increased heart rate and transient increase in CK and AST levels. (4) Corneal reflex is retained and animals react to painful stimuli. It must be noted that grey literature studies reported milder effects than published literature.

The principle findings of studies involving animal models to evaluate human immobilisation devices were that electro-immobilisation can cause temporary systemic acidemia, increased blood CO_2 levels and decreased O_2 levels, increased blood lactate and glucose, increase in haematocrit, increased serum Na^+ and Ca^{2+} and variable effects on K^+. However, the acidemia is short lived and the clinical significance of the increase in blood lactate is limited. No consistent changes in heart rate, CK and respiratory rate are found across the studies. The effect on stress hormones is also variable: one study reports no increase in cortisol but an increase in catecholamines (no indication of statistical significance) while another reports no significant changes in catecholamines.

Additional limitations to the reported findings, other than the identified biases, are also explored in the full text.

Position statements were found for several animal welfare and veterinary organisations. Electro-immobilisation is banned in England and Ireland. The use of electro-immobilisation is disapproved by Australian Veterinary Association, the American Veterinary Medical Association, the Canadian Veterinary Medical Association, the New Zealand Veterinary Association, the Farm Animal Welfare Advisory Council of Ireland, the Canadian Council on Animal Care, the British Columbia Society for the Prevention of Cruelty to Animals, the National SPCA of South Africa, and the World Society for the Protection of Animals, Australia. It should be noted that all these role players base their assumptions on research reports from the 1980s, involving one device (the Stockstill immobiliser).

Evaluation of the manufacturer information available indicates that at least 10 commercial products are or have been available worldwide, with tens of thousands of devices sold. Manufacturers recommend their products mainly for use in cattle, but other species are also mentioned, including farm ruminants, pigs, camelids, equids, large game species, ratites and crocodiles. Electro-immobilisation devices are recommended for restraint of animals during common husbandry procedures, particularly dehorning, castrations, branding, hoof trimming, vaccination, nose ringing and ear marking, restraint for treatment of animals for mastitis, eye infections, administration of capsules and assisted calvings, and to allow cross-fostering of calves and milk let-down. Some manufacturers recommended training before use and some indicated that their devices should only be used by trained personnel but no face-to-face training opportunities are currently available.

A finding that is of particular concern is the contradictory statements of manufacturers on the use of electro-immobilisation as an anaesthetic. Although some manufacturers warn users that the devices do not provide pain relief, others state or imply that their product can be used as an alternative to anaesthesia. No support for electro-immobilisation to provide anaesthesia could be sourced in scientific literature.

Significant gaps were identified in the literature pertaining to the physics and physiology of electro-immobilisation. It is accepted that immobilisation is the consequence of generalised spastic paralysis. Literature on human immobilisation devices indicates that the mechanism of inducing muscle contraction is through depolarization of α-motor neurons, but scientific proof is lacking. Some publications report that depolarization of Aδ nerve fibres, responsible for acute nociception, might occur simultaneous to depolarization of α-motor neurons, thus resulting in an acute pain sensation. It is unclear to what extent this “induced” nociception would be conveyed to and perceived by the central nervous system as pain.

Studies into human devices indicate differences in devices based on the electrical current applied. Optimum electrical current characteristics, including type, frequency and level has not been evaluated for livestock devices. For livestock devices available in SA, it was found that this information could not be sourced in the public domain. The placement of electrodes also needs investigation. Studies into human immobilisation devices discovered an optimum distance between electrodes of 20cm but similar studies with livestock devices could not be sourced.

Reliable statistics regarding the use of electro-immobilisation by SA citizens is not available and thus the level of use and potential misuse has not been quantified. From the limited data available (customer testimonies, communication with stakeholders), it appears that electro-immobilisation is used as an adjunct method of restraint when procedures require personnel to be in close contact with animals.

The outcome of this review indicates that the use of EI is a controversial topic and that various stakeholders need to be involved in deciding on the future use of EI as a method of restraint. The evidence from the current literature give the impression that closer regulation of EI devices may be necessary (particularly with consumers’ growing concern for humane animal handling). Unfortunately, the literature is insufficient to provide a definitive answer on various aspects of EI, particularly with regards to “newer” devices.

Aspects in urgent need of further investigation include the physics and physiology behind livestock EI (especially current type, -strength and electrode placement), the differences between devices and their effect on animals, comparisons between EI and other methods of restraint (taking both animal welfare and human safety into consideration) and the present use of EI by livestock producers.