ASSOCIATIONS BETWEEN DRIVING ACTIONS AND ANIMAL STRESS IN MOBILE SLAUGHTER OF CATTLE

Jan Hultgren, Charlotte Berg, Bo Algers
Department of Animal Environment and Health, Swedish University of Agricultural Sciences (SLU), Box 234, SE-532 23 Skara, Sweden

SUMMARY
Rough handling at slaughter can affect cattle welfare negatively. Aiming to study associations of stress-related animal behaviours and time intervals for driving, stunning and sticking with stockperson driving actions, we made initial observations at a commercial mobile slaughter plant (Hälsingestintan AB, Sweden) on 11 days at nine Swedish cattle farms.

The stun box and slaughter unit were housed in a truck trailer. Animals were driven 2.4 to 5.6 m from an inspection pen to the stun box by farm staff (55%), plant staff (13%) or both (32%). Stunning was carried out using a cartridge-driven penetrating captive bolt gun. Data were collected from 183 animals (135 beef and 48 dairy breed) through direct continuous observations. For each animal, the numbers of stress behaviour bouts in driving lane and stun box were recorded separately. Twenty-one driving actions involving physical interaction were observed, counting the total number of bouts per action, as well as the number of stockpersons driving. Associations were assessed using Spearman rank correlation for 18 driving actions that were observed in at least one animal.

Most associations were found for stress behaviours during driving and time in driving lane, which were positively correlated with patting using hand or tool, pressing using hand, tail twisting and using electric goad, typically producing rho values of 0.20 to 0.46. Seventeen percent of the animals were not subjected to any driving action and 37% displayed no stress behaviour during driving. Time in stun box and from stunning to sticking were negatively correlated with patting with hand (rho -0.35 and -0.20, respectively).

This study indicates moderately strong associations between stress-related behaviours during driving and forceful driving actions by stockpersons at mobile slaughter. Analyses of additional data including comparisons with conventional large-scale slaughter will follow.

Keywords: Cattle, Mobile slaughter, Stress

INTRODUCTION
Slaughter inevitably exposes production animals to risks of poor welfare. Although efforts have been made to reduce suffering, most farm animals still experience considerable stress shortly before slaughter (Warriss 1990; Cockram & Corley 1991), which may compromise their welfare. Pre-slaughter stress may also reduce meat quality due to depletion of glycogen reserves in the muscles (Ferguson & Warner 2008; Warren et al. 2010; Friedrich et al. 2014).

In many countries industrialised slaughter undergoes structural changes towards fewer and larger plants, resulting in longer transport distances and increased line speed. This may pose additional threats to animal welfare, increasing the need for well-designed slaughter facilities and proper routines to reduce animal stress (Grandin 1996).

Small-scale and farm-based stationary or mobile slaughter may have the potential to reduce animal stress, by shortening or eliminating the transport and the exposure to an unfamiliar environment, and is also associated with lower line speed. A mobile abattoir is a self-contained slaughter and cooling unit which can be moved between farms where animals are reared for slaughter. The effects of mobile slaughter on animal welfare have not been systematically studied before. In 2013 and 2014, a Swedish company (Hälsingestintan AB, Järvsö, Sweden) developed a mobile unit for commercial slaughter of large cattle in Sweden.

We aimed to assess the potential for the development of good animal welfare and meat quality in cattle slaughter, by studying associations of stress-related animal behaviours and time intervals for driving, stunning and sticking with stockperson driving actions in mobile cattle slaughter.

MATERIAL AND METHODS

Data were collected in connection with slaughter at the mobile abattoir of Hälsingestintan at nine farms on a total of 11 days during February to September 2016. The abattoir had a capacity of slaughtering approximately 35 head a day. Stun box and slaughter unit were housed in a truck trailer. Stunning was carried out using a cartridge-driven penetrating captive bolt gun, with cartridges adapted to animal size. The study occasions were spread out in time as evenly as possible but otherwise chosen with regard to practical feasibility. At each occasion as many animals as possible were studied, resulting in a reasonably representative sample of 8-21 animals per study day and 8-38 animals per farm, totally 183 cattle. All animals had been kept on the respective farm for at least 48 h prior to slaughter.

Observations were made during driving from a portable veterinary inspection pen to the stun box (2.4 to 5.6 m, pipe-fence sides), in the stun box and until sticking. All data were collected by two research technicians, one observing the animals up to the stun box and the other one carrying out all remaining observations. For each animal, direct observations were made of number of physical stockperson action bouts at driving, time for driving (from leaving the inspection pen to entering the stun box), time in the stun box (until first shot), time from stunning (last shot) to sticking, number of shots, and number of animal behaviour bouts during driving and in the stun box. Driving actions were categorised as touching, patting or hitting hind part or front part, restraining, pulling or pushing using the hand or a tool, tail twisting, kicking, pricking, hitting with gate, electric prodding, yelling/whistling or creating noise by hitting fittings, as well as number of stockpersons driving. Animal behaviours were recorded during driving and in the stun box separately and categorised as tiptoeing, running, backing, turning, mild slipping, severe slipping, falling, kicking, charging, struggling, freezing, vocalising, eliminating, and exploring. Showing one or more of these behaviours, excluding exploring, was classified as ‘stress behaviour’.

Associations between the number of bouts of different driving actions and the total number of stress-related animal behaviour bouts, during driving and in stun box separately, were analysed by Spearman rank correlation. Likewise rank correlations were estimated between the number of driving action bouts and the time for driving, time in the stun box and time to sticking. Due to the large number of tests (90), we applied a 1% significance level.

RESULTS

The studied animals were of beef (74%) or dairy (26%) breed, between 8 and 178 months of age. They were classified as young bulls (54%), steers (17%), heifers (23%) or cows (6%). No calves or adult bulls were included. Driving was carried out by farm staff (55% of animals), abattoir staff (13%) or both (32%). The weather conditions were sunny or partially cloudy when 55% of the animals were observed, and overcast or rainy in the rest of the cases, with temperatures ranging from -9 to +27 ˚C.

Forty-eight percent of the animals were driven by one person, 41% by two, 9% by three and 2% by four persons. Totally, 83% were driven using either the hand or a tool, and the number of driving actions per animal varied between 0 and 221 (mean 15.2, median 5 actions). The highest frequencies of driving actions per animal were recorded for patting with hand on hind part (maximum 129 actions per animal), patting with tool on hind part (112) and touching with hand on hind part (79). Violent actions in the form of kicking, pricking and hitting with gate were not observed. Inappropriate actions, including hitting any part of the animal with or without a tool >5 times, electric prodding >5 times, or tail twisting, were observed in 38 animals (21%).

The time for driving from the inspection pen to the stun box was between 0:05 and 18:41 min (mean 183, median 48.5 s). The time in the stun box prior to stunning was between 0:08 and 2:08 min (mean 35, median 27 s). The time from stunning (last shot) to sticking ranged from 0:24 to 3:22 min (mean 98, median 96 s). Young bulls had the longest driving times and cows had the longest times from stunning to sticking, while the times in the stun box did not vary substantially between animal types. Eighteen animals (10%) were reshot, of which one animal four times (3:17 min first to last).

During driving, the total number of stress-related behaviour bouts per animal ranged from 0 to 31 (mean 4.3, median 2 bouts), and 67 animals (37%) displayed no such behaviours at all. In the stun box the total number of bouts per animal ranged from 0 to 14 (mean 2.3, median 2 bouts), whereas 9 animals (5%) displayed no such behaviours. The highest frequencies of stress behaviour bouts per animal were seen for backing (maximum 14 bouts per animal), turning (12) and vocalising (10) during driving, and turning (6), mild slipping (5) and vocalizing (4) in the stun box. For all actions and behaviours observed, the distribution of bouts per animal was heavily positively skewed.

There was a significant but weak positive correlation (rho=0.20–0.40) between several types of actions and stress behaviour during driving (no. of persons driving; touching or patting hind or front part with hand; pushing with hand; patting hind or front part with tool; hitting front part with tool; tail twisting; and electric prodding), but not in the stun box. There was also a weak to moderate (rho=0.21-0.46) positive association of some types of actions with driving time (most of the mentioned actions), but not with time in stun box or sticking time; instead negative correlations were found of patting with hand with time in stun box (rho=-0.35) and time to sticking (-0.20), and of pushing and tail twisting with sticking time (-0.21 and -0.20, respectively).

DISCUSSION

In total 83% of the cattle slaughtered at a Swedish mobile abattoir received one or more of the recorded stockperson driving actions, and 95% displayed one or more of the recorded behaviours indicative of negatively affected animal welfare. Inappropriate actions were observed in relation to at least a fifth of the animals. Six percent of the animals received electric prodding, which is within the range usually seen at Swedish slaughterhouses.

Hitting with or without a tool is not an uncommon way to drive cattle at slaughter plants. However, current Swedish legislation prohibits forceful hitting just as it prohibits tail twisting and excessive electric prodding. Crowding can result from a suboptimal driving race design. If many animals move backwards, as observed in this study, or refuse to move forward it might be because they are distracted by e.g. light reflections, shadows, conspecifics or persons entering the flight zone in front of the point of balance (Grandin 2007).

For several driving actions, we found weak correlations between the number of action bouts per animal and the total number of stress-related animal behaviour bouts in the same animal during driving, but not in the stun box. Similarly, Hultgren et al. (2014) found several weak correlations, but no strong ones, between individual driving actions and individual animal behaviours, which they argued might suggest that plant design or events not aimed directly at the animals, such as disturbances close to the driveway, are more important for animal welfare than stockperson-animal interactions. Taken together, our results reveal a moderately strong association between forceful driving and stress-related animal behaviours during driving.

Clearly, short handling times and few negative stockperson-animal interactions are generally beneficial for animal welfare. Improper plant design will probably result in long handling times and high counts. On the other hand, a low line speed means fewer stockperson actions and animal behaviours associated with poor animal welfare per time unit because the animals are less stressed, although the total handling times will be longer. Some animals were patted many times, representing fast sequences of repeated mild actions, which is in accordance with the observations of Hultgren et al. (2014). It is unclear whether or not the stockpersons carried out these actions deliberately, or if

they acted habitually or even unintentionally. Overall, the time from stunning to sticking was unacceptably long, and in single cases exceptionally long, which may be explained by inappropriate stun box design and difficulties to shackle stunned animals rapidly enough.

Ten percent of the animals were reshot, which is consistent with Atkinson et al. (2013). In other countries, studies of cattle shot with penetrating bolt weapons have reported 9 to 32% of the animals being incorrectly stunned (Gregory et al. 2007; Gouveia et al. 2009; von Wenzlawowicz et al. 2012). Inadequate bolt stunning probably has a major negative impact on animal welfare (Grandin 1998; Gregory & Shaw 2000). In this study, however, we did not evaluate stun accuracy or stun quality *per se*, hence the reshots were made on the initiative of the abattoir staff only.

These results are preliminary and definite conclusions can therefore not be drawn. However, the results indicate that forceful driving to the stun box at mobile slaughter of cattle is associated with increased animal stress and a long driving time, and to some extent with a shorter time in the stun box and until sticking. Further analysis of these and additional project data should include estimation of the variation in driving routines between stockpersons, the influence on driving actions and animal behaviour of extraneous factors like farm conditions and weather, animal factors like breed, sex, age, earlier experience, level of excitation when driving starts, and interaction between animals that are handled together, as well as comparisons with conventional large-scale slaughter.

ACKNOWLEDGEMENTS

We thank Hälsingestintan AB for giving us access to their mobile unit, and their abattoir staff for excellent collaboration. The efforts of research technicians Anne Larsen and Karin Wallin in data collection are highly appreciated. The Marie-Claire Cronstedt Foundation and the Swedish Animal Welfare Association generously provided project funding.

LITERATURE CITED

Atkinson, S., A. Velarde, and B. Algers. 2013. Assessment of stun quality at commercial slaughter in cattle shot with captive bolt. Anim. Welf. 22: 473-481.

Cockram, M., and K. T. T. Corley. 1991. Effect of pre-slaughter handling on the behaviour and blood composition of beef cattle. Brit. Vet. J. 147:444–454.

Ferguson, D. M., and R. D. Warner. 2008. Have we underestimated the impact of pre-slaughter stress on meat quality in ruminants? Meat Sci. 80:12–19.

Friedrich, M., K. J. Schiffer, S. K. Retz, C. Stehling, I. Seuss-Baum, and O. Hensel. 2014. The effect of on-farm slaughter via gunshot and conventional slaughter on sensory and objective measures of beef quality parameters. J. Food Res. 4:27–35.

Gouveia, K. G., P. G. Ferreira, J. C. Roque de Costa, P. Vaz-Pires, and P. Martins da Costa. 2009. Assessment of the efficiency of captive-bolt stunning in cattle and feasibility of associated behavioural signs. Anim. Welf. 18:171–175.

Grandin, T. 1996. Factors that impede animal movement at slaughter plants. J.A.V.M.A. 209:757–759.

Grandin, T. 1998. Objective scoring of animal handling and stunning practices at slaughter plants. J.A.V.M.A. 212:36–39.

Grandin, T. 2007. Handling and welfare of livestock in slaughter plants. In: Grandin, T. (Ed.), Livestock Handling and Transport. CABI Publ., Wallingford, UK, pp. 329–353.

Gregory, N. G., C. J. Lee, and J. P. Widdicombe. 2007. Depth of concussion in cattle shot by penetrating captive bolt. Meat Sci. 77:499–503.

Gregory, N., and F. Shaw. 2000. Penetrating captive bolt stunning and exsanguination of cattle in abattoirs. J. Appl. Anim. Welf. Sci. 3:215–230.

Hultgren, J., S. Wiberg, L. Berg, K. Cvek, and C. Lunner Kolstrup. 2014. Cattle behaviours and stockperson actions related to impaired animal welfare at Swedish slaughter plants. Appl. Anim. Behav. Sci. 152:23–37.

Warren, L. A., I. B. Mandell, and K. G. Bateman. 2010. Road transport conditions of slaughter cattle: Effects on the prevalence of dark, firm and dry beef. Can. J. Anim. Sci. 90:471–482.

Warriss, P. D. 1990. The handling of cattle pre-slaughter and its effects on carcass and meat quality. Appl. Anim. Behav. Sci. 28:171–186.

Von Wenzlawowicz, M., K. von Holleben, and E. Eser. 2012. Identifying reasons for stun failures in slaughterhouses for cattle and pigs: a field study. Anim. Welf. 21:51–60.