

Public Veterinary Medicine: Food Safety and Handling

Objective scoring of animal handling and stunning practices at slaughter plants

Temple Grandin, PhD

Objective—To develop objective methods for monitoring animal welfare at slaughter plants to ensure compliance with the Humane Methods of Slaughter Act.

Design—Survey of existing procedures.

Sample Population—24 federally inspected slaughter plants.

Procedure—6 variables evaluated at each plant were stunning efficacy, insensibility of animals hanging on the bleeding rail, vocalization, electric prod use, number of animals slipping, and number of animals falling.

Results—Of 11 beef plants, only 4 were able to render 95% of cattle insensible with a single shot from a captive-bolt stunner. Personnel at 7 of 11 plants placed the stunning wand correctly on 99% or more of pigs and sheep. At 4 beef plants, percentage of cattle prodded with an electric prod ranged from 5% at a plant at which handlers only prodded cattle that refused to move to 90% at another plant. Use of electric prods at 6 pork plants scored for prod use ranged from 15 to almost 100% of pigs. Percentage of cattle that vocalized during stunning and handling ranged from 1.1% at a plant at which electric prods were only used on cattle that refused to move to 32% at another plant at which electric prods were used on 90% of cattle and a restraint device was inappropriately used to apply excessive pressure.

Clinical Implications—To obtain the most accurate assessment of animal welfare at slaughter plants, it is important to score all of the aforementioned variables. (*J Am Vet Med Assoc* 1998;212:36–39)

During the past 25 years, animal handling and stunning at more than 100 US slaughter plants have been increasingly scrutinized. During the past 10 years, handling practices have apparently improved, but there is still great variation in enforcement of the Humane Methods of Slaughter Act.¹ It is the responsibility of the USDA veterinarian in charge at each federally inspected slaughter plant to ensure that animals

are handled humanely and are painlessly stunned. However, what one veterinarian may consider to be good handling practices, another may think is abusive cruelty. Objective methods of scoring and quantifying animal welfare are needed to ensure compliance with the Humane Methods of Slaughter Act.

For a scoring system to be effective, it should be simple to use under commercial conditions. Minimal training should be required to conduct an assessment of handling and stunning practices. It is important for scoring to be objective so that all observers may obtain similar results. For example, subjective evaluations of “rough handling” may vary greatly among observers, because it is not possible to define rough handling in specific and precise terms. However, an objective measure, such as tabulating the number of animals prodded with electric prods, is easy to define.

Procedure

In 1996, a survey was conducted for the USDA on stunning and handling practices at federally inspected plants.² Objective scoring and subjective evaluations were used to assess animal welfare. Twenty-four plants in 10 states were visited. All visits were announced and scheduled. Sixteen plants in the vicinity of 4 randomly chosen cities were visited. To gain cooperation of the meat-packing industry, confidentiality of survey data was ensured by surveying an additional 8 plants, the identities of which were not disclosed to the USDA. Yes or no scoring was used for measuring the following 6 variables: stunning efficacy, insensibility on the bleeding rail, electric prod use, vocalization, number of animals slipping, and number of animals falling.

Results

Stunning scores—One hundred to 200 animals were scored at each of 11 pork or sheep plants to determine the percentage of animals on which stunning wands were correctly positioned. The electric stunning wand must be correctly positioned on the head to ensure that electricity passes through the brain to produce instant unconsciousness. Personnel at 7 plants positioned the stunning wand correctly on 99% of animals. At 2 plants, the electric stunning wand was

From the Department of Animal Science, College of Veterinary Medicine and Biomedical Sciences, Colorado State University, Fort Collins, CO 80523.

Supported by USDA, Agricultural Research Service project No. 3602-3200-002-086.

placed in the wrong position on 10 to 35% of animals. The main cause of this problem was poor wand design. Of 11 pork and sheep plants, 10 used wands with sufficient current to ensure instant unconsciousness. Recommendations on parameters for electrical current for stunning are reported elsewhere.³⁻⁸

At beef and veal plants, the percentage of cattle or calves rendered instantly insensible with one use of a captive-bolt stunner was tabulated. Personnel at 4 of 11 plants were able to render 95 to 100% of cattle insensible with one use of the captive-bolt stunner. At 6 plants, more than 10% of cattle were insufficiently stunned during the first attempt. At 4 plants, the cause of an ineffective first attempt was poor stunner maintenance. At 2 other plants, the cause of ineffective use was poor ergonomic design of the pneumatic captive-bolt stunner, which was bulky and required excessive physical effort to aim. Thus, when operators became fatigued, animals were not appropriately stunned and additional stunning attempts were required.

Insensibility on the bleeding rail—At beef, pork, and sheep plants, animals hanging on the rail were classified as sensible or insensible. Animals that had partial signs of sensibility were classified as sensible. Animals hanging on the rail that had rhythmic breathing, vocalization, eye reflexes in response to touching, eye blinking, or arched-back righting reflex were tabulated as sensible and not properly stunned. Animals should hang limply on the rail and have a floppy head.⁴ Limb movements were ignored. In the survey, more than 1,000 pigs and 1,000 cattle were observed. One of the pigs and one of the cattle were scored as sensible, displaying an arched-back righting reflex and all 5 indicators of sensibility, respectively.

Slipping and falling—Evaluation of the number of animals slipping and falling is an important measure of welfare, because quiet handling is impossible when animals become agitated as a result of losing their footing. Slipping and falling were scored independently for each animal. The number of animals slipping or falling in the crowd pen, single-file chute, stunning box, or restrainer was recorded.

Of 11 beef plants evaluated, slick floors at 2 caused cattle or veal calves to fall. At these 2 plants, 8 and 12% of cattle fell. At 4 beef plants, 15 to 30% of cattle slipped in the stunning chute area, but at 6 plants, none of the cattle slipped. At 1 plant, 3% of cattle slipped, but none fell. Slipping in the stunning box caused cattle to become agitated at 3 plants.

Slipping and falling were not detected at 2 sheep plants. Nine pork plants were surveyed for slipping and falling. None of the pigs slipped or fell in the stunning chute area. However, in the unloading area, which was not formally scored, pigs fell while walking on a slick unloading ramp.

Electric prod use—Reducing use of electric prods will improve animal welfare, because repeated prodding often results in increased vocalization and behavioral agitation. Use of electric prods is easy to measure objectively. Twelve pork and beef plants were scored for electric prod use. None of the personnel at these

plants used electric prods in the unloading area or stockyard pens. At 8 plants, well-trained employees only prodded animals that balked and refused to move. At 4 beef plants with well-trained employees, the percentage of cattle prodded with an electric prod was 5, 10, 10, and 64%. The plant with the 5% prod use score slaughtered more than 200 cattle/h. At the plant at which 64% of cattle had to be prodded, it was attributed to cattle being able to see a person's hand under the door of the stunning box. Electric prod use at these 4 plants was limited to the area of the single-file chute and stunning box or restrainer entrance. Prods were not used in crowd pens. Good animal welfare and a low percentage of animals prodded can be obtained in older facilities, as evidenced by a beef plant with old-fashioned facilities that had a low score of 10%.

At 4 pork plants at which an electric prod was used only on pigs that balked, the percentage of pigs prodded in crowd pens was 0, 18, 18, and 80%. At the plant with the highest use (80%), pigs balked because of shadows. All 4 pork plants had single-file chute systems and slaughter line speeds of more than 500 pigs/h. A fifth pork plant, which was not formally scored, had a state-of-the-art, double single-file chute system that was free of air drafts, shadows, and shiny reflections that would impede movement. All of its equipment had been engineered to produce little noise. Personnel responsible for moving pigs were able to keep up with a slaughter line speed of more than 800 pigs/h, despite using only plastic paddles and nonelectrified prods. Overall, pigs were prodded more than cattle. This may be attributable to the fact that modern swine hybrids bred to produce extremely lean pigs are extremely excitable and difficult to move.

At 4 plants, it appeared that employees handled animals roughly and used electric prods in an excessive manner. After baseline percentages were tabulated, employees were instructed to fill the crowd pen only half full and to attempt to move animals by tapping them on the rear before resorting to use of an electric prod. At the 2 beef plants with excessively rough handling, electric prod use in the single-file chute was reduced from 83 to 17%. At pork plants with excessively rough handling, electric prod use in the single-file chute decreased from 44 to 15%. Employees were able to move a sufficient number of animals to keep up with slaughter line speed when prod use was reduced.

Distractions such as sparkling reflections, air blowing in the faces of approaching animals, people visible in front of animals, hissing air, or shadows can make animals balk.⁹ Distractions that cause balking, in turn, increase electric prod use. Nineteen beef and pork plants were evaluated for distractions. Twelve plants were subjectively rated excellent or acceptable for distractions, but 7 plants were rated not acceptable or had a serious problem with distractions that could impede animal movement. Most distractions could be fixed with minimal expense. At 1 plant, shadows made it impossible to reduce electric prod use. Four beef plants had air hissing from pneumatic valves, which could easily be remedied by use of an inexpensive muf-

fler. At 2 other plants, animals balked because of noise from a ventilation fan and high-pitched whistling from a pump.

Vocalization—Vocalization scoring can be used as an indicator of animal discomfort. In cattle, an increase in vocalization during restraint is correlated with increases in cortisol concentration.¹⁰ Restraining cattle in an inverted position causes a significantly greater number of cattle to vocalize, compared with restraint in an upright position.¹⁰ Vocalization (moos or bellows) were tabulated in 100 to 250 cattle at each plant. Each of the cattle was scored as a vocalizer or nonvocalizer. Attempts were not made to measure intensity of vocalization or to count the number of vocalizations per animal. Cattle were scored while they were passing through the crowd pen, single-file chute, stunning box, or restrainer. Vocalization was not scored in stockyard pens, because cattle standing undisturbed often vocalize to each other. Mean percentage of cattle vocalizing was 4.5% at 4 plants with careful, quiet handling and 22% at the 2 plants with rough handling. Vocalization scores for the 4 plants with careful, quiet handling were 1.1, 2.6, 6.6, and 7.5%. Vocalization scores for the 2 plants with rough handling were 12 and 32%. When excessive electric prodding in the 2 rough-handling plants was stopped, percentage of vocalizing cattle decreased significantly ($\chi^2 = 21.68$; $P < 0.01$) from a mean of 22% to a mean of 7%.

Prodding with an electric prod caused more than half of the vocalizations at all beef plants. Remaining vocalizations were caused by other aversive events, such as excessive pressure from a restraint device powered by pneumatic cylinders, ineffective stunning, or slipping on the floor of the stunning box. One hundred twelve of 1,125 cattle vocalized during handling in the stunning chute area. With the exception of 2 cattle, all vocalizations were caused by the aforementioned events. Because 98% of vocalizing cattle were responding to an easily observed aversive event, decreasing the percentage of cattle that vocalize at beef plants may contribute to improved welfare.

Since the survey was conducted, 4 large beef plants that had restrainer conveyors have been visited. At all of these plants, handlers moved cattle at a walk, and electric prods were only used on cattle that refused to move. At 3 of these 4 plants, 3% of cattle vocalized. At 1 plant, approximately 10% of cattle vocalized because of a slippery entrance ramp to the restrainer conveyor.

It was not possible to score the number of pigs that vocalized during handling in the crowd pen and single-file chute, because it was impossible to count specific squeals and accurately identify particular pigs squealing in the crowd pen. However, it was possible to count specific pig squeals in the conveyor restrainer, and the results were tabulated. Intensity of pig squeals is correlated with stress.¹¹ Researchers in England used a sound meter that recorded intensity of squeals throughout a 5-minute period.¹² They found that intensity of squealing was correlated with physiologic stress measurements. Plants that careful-

ly handle pigs and use electric prods minimally have less squealing.

Vocalization scores for cattle and pigs in the restrainer or stunning box were tabulated for 14 plants. At 7 pork plants, the percentage of pigs that squealed in the restrainer was 0 to 2% for 6 plants. At the remaining plant, the percentage was 14%. At that plant, the restrainer had a missing part. At a large pork plant that was not included in the survey, many pigs vocalized and struggled in a V-shaped conveyor restrainer when 1 side of the restrainer was moving faster than the other side.

At 3 of 7 beef plants, none of the cattle vocalized in the conveyor restrainer or stunning box. At the remaining 4 plants, the percentage of cattle that vocalized during restraint was 0.6, 0.6, 6.0, and 7.5%. The plant with the score of 6% used an electric device to paralyze cattle for stunning, and the plant with the vocalization score of 7.5% had cattle that slipped on the stunning-box floor and had excessive pressure exerted on them by a restraining gate. It has been reported in 3 studies¹³⁻¹⁵ that restraining animals with electricity is highly aversive.

Vocalization scores were not tabulated for sheep. Whereas cattle in the stunning-chute area vocalize in direct response to an observed aversive event, sheep naturally vocalize to each other when they are being quietly moved through chutes. Therefore, vocalization would not be a reliable indicator of aversive events that might be detrimental to sheep welfare.

Discussion

To assess animal welfare during handling, stunning, and slaughter, 6 variables should be evaluated (Appendix). These variables are easily quantifiable, objective measures of animal handling and stunning practices. Scoring of these variables can easily be done under commercial conditions. Scores more accurately reflect the true performance of a plant when a large number of animals are evaluated. It is recommended that investigators score a minimum of 50 animals/variable. At large plants, assessing 100 to 200 animals is recommended.

It is highly recommended to evaluate at the beginning and end of work shifts. Results of the survey reported here indicated that the number of ineffective stuns during the first attempt on an animal, using a captive-bolt stunner, increased late in the shift, when operators were fatigued.

It is important to assess all of the aforementioned variables. For example, if only stunning efficacy was measured, personnel at a plant might be tempted to use a restraint device that applied excessive pressure. Vocalization and electric prod scores would reveal inadequacy of such procedures.

Slaughter plant management should work to continuously improve scores, which will help improve animal welfare. Use of objective scoring also helps to improve animal welfare, and cost to the industry will be minimal. Objective scoring also has the benefit of reducing variability in enforcement of the humane slaughter regulations.

Appendix

Variables that should be evaluated to assess animal welfare during handling, stunning, and slaughter

Stunning efficacy

Percentage of animals rendered insensible by use of a captive-bolt stunner on the first attempt.

Percentage of animals on which electrodes are placed in the correct position so that electricity will pass through the brain during electric stunning.

Insensibility of stunned animals hanging on the bleeding rail

Percentage of stunned animals that do not have signs of sensibility or partial sensibility, such as rhythmic breathing, blinking, eye reflexes, righting reflexes, or vocalization.

Vocalization (should not be used when electricity is used to paralyze an animal because paralysis may prevent animals from vocalizing)

Percentage of cattle that vocalize in the stunning-chute area, which consists of the stunning box or restrainer, crowd pen, and single-file chute. Each animal is scored as a vocalizer or nonvocalizer.

Percentage of pigs that vocalize in the restrainer or stunning pen. Sound meters might be most efficacious in chutes and crowd pens.

Not recommended for assessing sheep.

Electric prod use

Percentage of animals prodded with an electric prod in the single-file chute area and crowd pen. Because it is often difficult to observe both of these areas simultaneously, separate observations should be made in each area.

Slipping

Percentage of animals that slip in the stunning-chute area. A slip is scored if it interferes with normal walking or causes an animal to become behaviorally agitated.

Falling down

Percentage of animals that fall down in the stunning-chute area. A fall is recorded when any part of the animal's body other than the hooves touches the floor.

References

1. Humane Methods of Slaughter Act of 1978. Public law 95-445. *Federal Register* 1979;44(232):68809-68817.
2. Grandin T. Survey of stunning and handling practices in

federally inspected, beef, veal, pork, and sheep slaughter plants. Project No. 3602-3200-002-086. Beltsville, Md: USDA-Agriculture Research Service, 1996.

3. Council of Europe. Council directive of 18 November on stunning of animals before slaughter (74/577/EEC). *Off J Eur Commun* 1991;316:10-11.

4. Grandin T. Euthanasia and slaughter of livestock. *J Am Vet Med Assoc* 1994;204:1354-1360.

5. Gregory NG. Humane slaughter, in *Proceedings*. 34th Int Congr Meat Sci Technol 1988;46-49.

6. Gregory NG, Wotton SB. Sheep slaughtering procedures. III. Head to back electric stunning. *Br Vet J* 1984;140:570-575.

7. Hoenderken R. Electrical and carbon dioxide stunning of pigs for slaughter. In: Eikelenboom G, ed. *Stunning of animals for slaughter*. Boston: Martinus Nijhoff Publishing, 1983;59-63.

8. Troeger K, Woltersdorf W. Measuring stress in pigs during slaughter. *Fleischweirtsch* 1989;69:373-376.

9. Grandin T. Factors that impede animal movement at slaughter plants. *J Am Vet Med Assoc* 1996;209:757-759.

10. Dunn CS. Stress reactions of cattle undergoing ritual slaughter using two methods of restraint. *Vet Rec* 1990;126:522-525.

11. White RG, DeShazer JA, Tressler CJ, et al. Vocalizations and physiological response of pigs during castration with and without anesthetic. *J Anim Sci* 1995;73:381-386.

12. Warris PD, Brown SN, Adams SJM. Relationships between subjective and objective assessments of stress at slaughter and meat quality in pigs. *Meat Sci* 1994;38:329-340.

13. Grandin T, Curtis SE, Widowski TM, et al. Electroimmobilization versus mechanical restraint in an avoid-avoid choice test. *J Anim Sci* 1986;62:1469-1480.

14. Pascoe PJ. Humaneness of electroimmobilization unit in cattle. *J Vet Res* 1986;10:2252-2256.

15. Lambooy E. Electroanesthesia or electroimmobilization of calves, sheep and pigs by the Feenix Stockstill. *Vet Q* 1985;7:120-126.