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Examination of a Captive Bolt Stunner with 3 Different Bolt Lengths on Cattle Brain Damage and Specified Risk Materials Dispersion

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Objectives

Captive bolt stunning is a standard and effective method of rendering cattle unconscious for slaughter. An unrecoverable penetrating stun is ensured by correct placement of the captive bolt stunner. The purpose of this study was to determine the effect of different bolt lengths on sustained brain damage and presence of specified risk materials (SRM) in blood of Holstein and non-Holstein cattle. It was hypothesized that brain damage and SRM dispersion would not differ based on bolt length or breed type.

Materials and Methods

The study was designed as a randomized unbalanced block design. Test day served as a block and the experimental unit was animal. Data were analyzed with SAS (SAS Inst. Inc., Cary, NC) using a paired *t* test. Each collection was assigned 1 of 3 lengths; control (CON; 15.2 cm), medium (MED; 16.5 cm), or long (LON; 17.8 cm). All animals sampled were less than 30 mo of age. Blood was randomly sampled immediately following the start of exsanguination from 33 animals per treatment, with an equal split of Holstein and non-Holstein breed type. Blood samples were sent to IEH-Warren Analytical Laboratory (IEH, Greeley, CO) where the Colorado State University fluorescent enzyme-linked immunosorbent assay (F-ELISA) was conducted for detection of glial proteins. For brain damage assessment, 292 heads were randomly sampled across 3 collection periods, with an equal split between non-Holstein and Holstein breed type. Heads were collected, chilled, and brought to the Necropsy Laboratory (Colorado State University, Veterinary Teaching Hospital, Fort Collins, CO) for splitting and damage analysis. Skulls were split with a bandsaw through the median plane of the captive bolt penetration tract. Brains were photographed and assessed for damage to the frontal lobe (FL), parietal lobe (PL), occipital lobe (OL), olfactory bulb (OB), hypothalamus (HYP), corpus callosum (CC), fornix (FOR), and the thalamus (THAL). Brain structure disruption was determined with a graphic overlay along the median plane; each structure was recorded as either damaged or non-damaged. Additionally, evidence of double knocking (DK) or skull plate fragments in the brain tissue (BC) were recorded.

Results

The Colorado State University F-ELISA found that 97% of the CON blood samples were negative, 94% of the MED blood samples were negative, and 100% of the LON blood samples were negative. The level of brain damage did not differ between breed type for any structure measured ($P = 0.607$). The amount of brain damage was statistically different between CON and LON for FL, OL, and THAL ($P = 0.004$, $P = 0.025$, and $P = 0.002$, respectively). The FL, OL, CC, and THAL differed between MED and LON ($P = 0.022$, $P = 0.043$, $P = 0.043$, and $P = 0.002$, respectively). Comparisons between CON and MED showed that only FL damage differed ($P = 0.033$). The percentage of DK and BC in brain tissue did not differ based on treatment or breed type ($P = 0.399$, $P = 0.311$). The brainstem was not disrupted for any of the treatments.

Conclusion

There was sufficient evidence that differing bolt lengths affect the amount of brain damage to the skull and brain structures. Additionally, there was minimal evidence to support that changes in SRM dispersal occurred due to bolt length. Further work is required to determine how bolt length could affect SRM transmission in older animals.

