Calf disbudding and castration

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SUMMARY

The degree of tissue damage associated with disbudding is determined by the stage of development of the horn bud, eg. in younger calves, the burning of the vessels surrounding the horn bud is sufficient, whereas the whole bud needs to be removed (by levering it out from the side) when the horn is further developed. Setting definitive ages for disbudding or dehorning is difficult since horn bud development occurs later in beef breeds than in the dairy breeds.

Castration of bull calves induces a stress response (increase in the stress hormone, cortisol), which is influenced by the age of the calf. Castration-induced pain may be greater among younger calves compared with older calves because their nervous system and coping mechanisms (stress response) are not fully developed.

DISBUDDING

Disbudding is performed for economic and practical reasons: to prevent bullying and injury to other animals (with implications for productivity and carcase damage respectively); and human safety during handling. There are three techniques used: cautery, surgical and caustic paste. Cautery is recommended by the European Food Safety Authority (EFSA) and other authorities and is the only method of disbudding allowed in Ireland under S.I. 127 of 2014, which permits disbudding of calves up to 28 days old by thermal cauterisation. Local anaesthetic (LA) is required for disbudding on calves that have attained the age of 15 days. There is variation in the suggested upper age limits for disbudding of calves ranging from six to eight weeks of age.

In a recent Teagasc study, Marquette *et al* (2018) examined the effect of breed and age on horn bud size of calves at the time of disbudding. Horn bud size of 137 calves was measured at time of disbudding. The four calf breeds that were used, included Charolais (CH; n=28); Limousin (LM; n=47); Simmental (SI; n=21); and Holstein × Friesian (HF; n=48).

On the day of disbudding, calves were moved individually to a disbudding crate and gently restrained. The hair surrounding each horn bud was trimmed using a scissors and the horn bud exposed. The diameter (mm) and height (mm) of left and right horn buds were measured using a digital calliper (model 49-923-150; Linear Tools, UK). Cornual nerve blockade was achieved by injecting 2ml of local anaesthetic (Adrenacaine) through the skin between the eye and the base of the horn bud on the left and right side of each calf. Calves were released from the disbudding crate and allowed to mix with pen mates for 20 mins to allow the nerve blockade to develop. After 20 mins had elapsed, calves were again restrained in the disbudding crate and the left and right horn buds were removed using cautery disbudding. The disbudding device that was used had an internal diameter of 15mm (model 17460; Kerbl, De). Following removal of each horn bud, silver aluminium spray (Henry Schein, Dublin) was applied to the wound area.

The calves were retrospectively assigned to three age categories: 1) younger than 25 days old; 2) from 26 to 32 days old; 3) older than 33 days old. There was no significant effect of calf gender or beef sire breed type on horn bud size (diameter and height) of calves at a similar age. Dairy calves had greater horn bud diameters (mean 15.9mm; standard deviation (SD) 2.4mm) than beef calves (mean 13.2mm; SD 2.2mm). Dairy calves that were younger than 25 days of age had greater horn bud heights (mean 6.2mm; SD 2.3mm) than beef calves (mean 4.2mm; SD 1.7mm) of a similar age. Horn bud heights of dairy calves (mean 6.7mm; SD 1.7mm) were not different from beef calves (mean 5.5mm; SD 2.3mm) from 26 to 32 days of age. Dairy calves older than 33 days of age had greater horn bud heights (mean 9.1mm; SD 2.6mm) than beef calves (mean 4.6mm; SD 1.6mm) (Marquette *et al*., 2018).

CASTRATION

Castration of cattle is performed in order to prevent sexual behaviour, reduce aggression, and increase handling safety. In Ireland, a calf can be castrated, other than by a veterinary practitioner, before it attains six months of age using a

Burdizzo (castration device) or before it attains eight days of age using a rubber ring, in both cases without the use of local anaesthesia (LA) and analgesia (pain killers).

A Teagasc study examined the effect of age at castration on physiological stress indices in response to Burdizzo castration in dairy calves from 1.5 to five months of age, without use of analgesia or anaesthetic. In the study, castration was shown to raise the stress hormone, plasma cortisol, across all ages between 1·5 and 5·5 months old, as indicated by the increased integrated plasma cortisol response for the first three hours after castration compared with entire 5.5 months old calves (Figure 1). However, by reducing the age at castration from 5·5 months, the integrated cortisol response was markedly reduced by nearly half in the 1·5 months old and by one-third in the 4·5-month-old castrates. The most compelling reduction in cortisol response was observed in calves castrated at 1·5-month-old than at all other ages.

In a further study, Ting *et al* (2010) assessed the pain responses of calves castrated from 1.5 to 5.0 months of age to a thermal laser heat spot which was directed to the lower leg of the calves post-castration. On the day before the measurement of thermal nociception, calves were prepared by shaving the hairs off the hind limbs (plantar surface of metatarsal 3) between the fetlock and the hock joints. On the day of measurement (72, 12, 24, and 48 hours relative to the time of castration [0 hours]), all calves were haltered in their pens before the start of the test. The hind legs were quickly brushed if obstacles such as manure or straws were present, and the surrounding straw beds were levelled. Animals lying down were gently encouraged to stand before the measurement. The baseline surface skin temperature of the caudal aspect of the metatarsus of each hind leg was measured remotely using an infrared thermometer (with an accuracy of ±1%; Raytek MX series; Radionics Ltd., Rialto, Dublin, Ireland). Then a CO_2 laser (far infrared 10600nm; mm beam diameter; power = 5.5 watts; MPB Lamsor Inc., Dorval, QC, Canada) beam was applied to the same area using a validated method. The laser beam was immediately turned off when the animal responded by a leg movement, and time to react (in seconds) was recorded. The type of leg responses observed were: 1) moving the foot approximately 10 cm off the ground; 2) lifting the foot greater than 10cm off the ground; and 3) lifting the foot with a definitive kick back. If the animal moved its whole body, walked away, urinated, or defecated during the test, the test was stopped and repeated after allowing the animal to stand quietly. If the animal did not respond to the stimulus within 20 seconds, the laser was automatically stopped. The animal's reaction was monitored

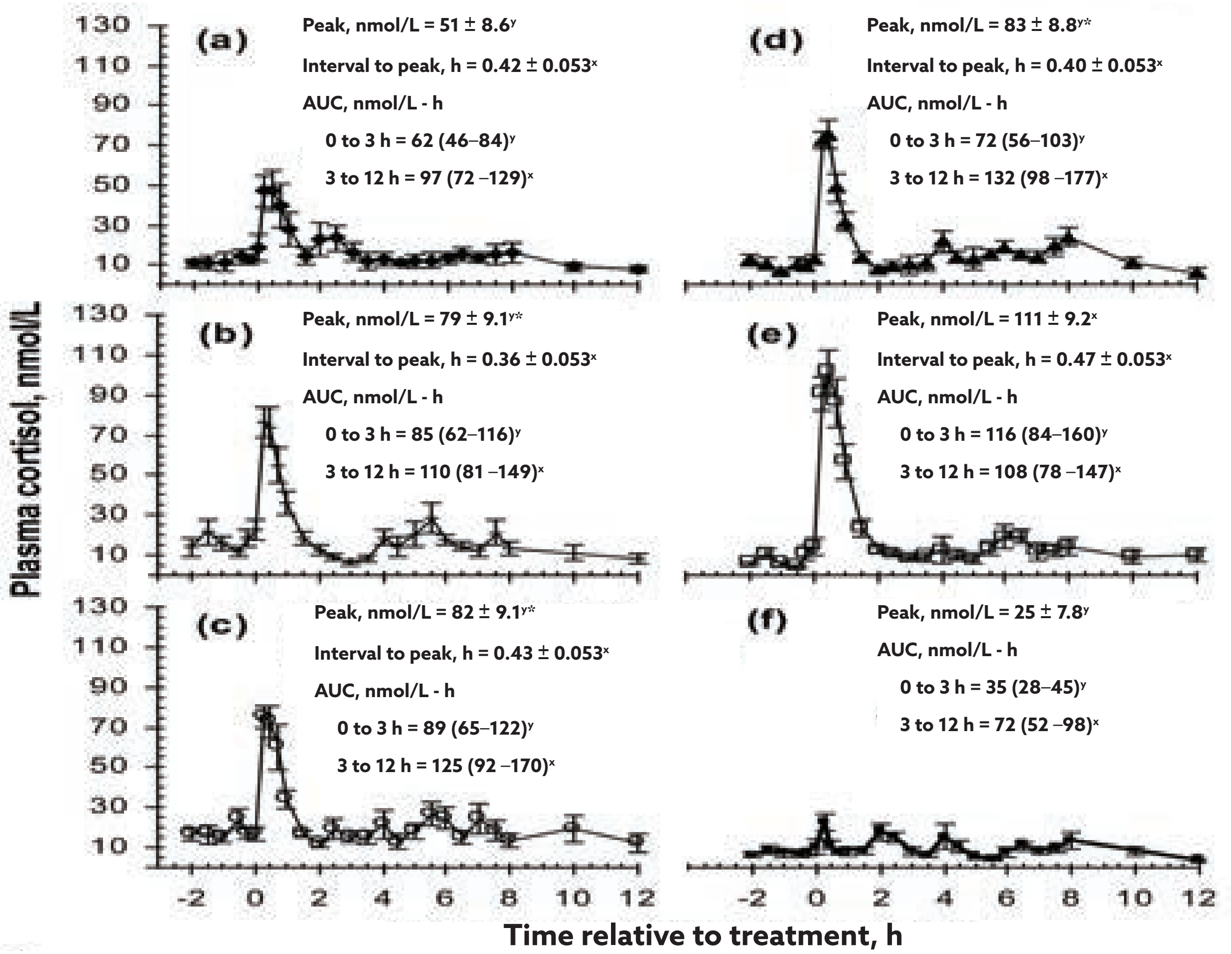

Figure 1: Mean ± SE plasma cortisol concentrations in bull calves subjected to Burdizzo castration (n = 10/treatment) at 1.5 (panel a; —♦—), 2.5 (panel b; —+—), 3.5 (panel c; —○—), 4.5 (panel d; —▲—), and 5.5 (panel e; —□—) mo. of age, or sham castration at 5.5 mo. of age as controls specific to this age group (panel f; —■—). xyWithin each summary index (least square mean ± SE peak cortisol, interval to peak cortisol concentrations, and back-transformed geometric mean [95% CL] area under the cortisol response curve [AUC] adjusted for baseline concentrations), means with a different superscript letter are different vs. 5.5 mo.-old castration group; and means with an asterisk (*) are different vs. 1.5 mo.-old castration group, P ≤ 0.05

for a further 5s, as it may have been possible to get a delayed response from the animal. If no response was observed during the 25s, the maximum latency was recorded (25s). Four consecutive laser exposures were applied to each animal by alternating between each side of the leg measurement and pausing for at least 30s between two measurements. Stimulation with the heat beam on the same spot of skin was avoided. Throughout the study, no visible signs of blistering or skin damage were observed. The baseline surface skin temperatures of the lower left leg of each calf, and the reaction time (latency in seconds) to a heat spot laser on the left hind leg of each calf was measured pre- and post-castration. Calves at 1.5 months old had lower surface skin before castration and had consistently lower skin temperatures than all other castrated calves throughout the study. At -72h, the 1.5-month-old calves had longer reaction time to the heat spot laser than older calves (Figure 2). In all calves, the reaction time increased after castration. In conclusion, the reaction time to the heat spot laser can be influenced by the surface skin temperature of the hind legs and the age of animals, particularly in calves less than two months of age, which have lower skin temperatures and longer reaction time to the laser heat spot. Due to the differences in skin temperature between younger and older calves, and reduced pain sensitivity, the findings suggest that the younger calf may be physiologically immature and unable to respond to pain stimuli and raises the question whether castration of calves at a younger age could be more welfare-unfriendly than castration at older ages.

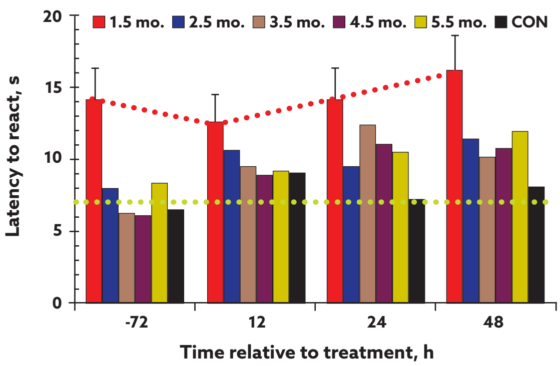

Figure 2. Type of hind-leg responses to a CO_2 laser test on thermal nociception of Holstein-Friesian bull calves assigned to either Burdizzo castration (n = 10/treatment) at: 1.5, 2.5, 3.5, 4.5, and 5.5 mo. of age, or sham castration at 5.5 mo. of age (Con, entire).

A suggestion that castration is less stressful for young animals likely arose because older animals have a greater peak of plasma cortisol after castration, and younger calves lose less weight after castration than older animals (Bretschneider 2005). However, a high peak of plasma cortisol after a known stressor may be a sign of a well-developed hypothalamic pituitary adrenal (HPA) axis (Mitra *et al*, 2009). In fact, Murray and Leslie (2013) suggest that pain may be even greater among neonatal animals compared with mature animals because their nervous system and HPA axis are not fully developed. Kampen *et al* (2006) reported that immune parameters in young calves differ from what is found in older calves and adult animals, and we believe that these age-related factors should be taken into consideration when assessing physiological responses in young calves in response to castration.

Dockweiler *et al* (2013) investigated the age-related differences (eight-week-old and six-month-old) in pain response of Holstein-Friesian calves subjected to surgical and band castration. They found evidence for a main effect of age on plasma cortisol concentration, which was increased in six-month-old calves relative to their eight-week-old counterparts, regardless of castration method. In the same study, they were able to identify that cortical functions in young calves are not developed enough to show the same electroencephalogram responses observed in older calves (Dockweiler *et al* 2013). This is further evidence of physiological immaturity of younger calves.

CONCLUSION

Horn buds develop later in beef calves than dairy calves. Castration increases stress hormone concentrations (plasma cortisol) in calves; the greater the age at concentration, the greater the increase. Future work at Teagasc, AGRIC, Grange will examine the optimum age and application of local anaesthesia and or pain relief (analgesia) for the disbudding and the castration of calves.

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