***Ethical and Animal welfare considerations***

1. Physical castration causes pain and side effects.
2. Young calves recover quicker and have fewer complications than older calves.
3. Acute pain caused by Burdizzo methods is less than that caused by surgical, rubber-ring or latex-band castration.
4. There is no evidence to show young calves experience less pain than older calves.
5. Local anaesthesia eliminates acute pain caused by rubber-ring or latex-band castration.
6. Local anaesthesia combined with a systemic analgesic, such as the non-steroidal anti-inflammatory drug ketoprofen, eliminates pain caused by Burdizzo or surgical castration.
7. Ketoprofen alone may not eliminate pain-induced behaviour seen during the castration process.
8. Castration of older males without anaesthesia is deemed inhumane and unethical.
9. Use of pain relief is an additional cost for producers. Pain relief may be limited by the availability of drugs for farmers to use and the scarcity of veterinarians in farm animal practice.
10. In some countries, administration of local nerve blocks and castrate cattle less than two months of age while under immediate, direct or indirect supervision of a veterinarian. They may castrate cattle greater than two months of age when under immediate or direct supervision.

PAIN

***Calves must not be castrated over 2 months of age without an anaesthetic. Rubber rings must not be used above one week of age without an anaesthetic.***

Acute pain—All physical methods of castration cause pain. Animals exhibit pain responses during and after castration; these responses include struggling, kicking the hind legs, tail swishing, foot stamping, head turning, restlessness, stilted gait, reduced activity, increased recumbency, abnormal standing posture, reduced interest in dams and each other and reduced grazing and feed intake. Pain response to tandem or simultaneous castration and dehorning has been found to be additive. Pain responses due to combining these procedures have been shown to last unabated, up to and more than four hours when performed without pain mitigation. Pain associated with the surgical and Burdizzo clamp methods is relatively immediate, whereas pain resulting from elastrator ring/band placement is delayed due to interruption of the blood supply by the band/ring. Burdizzo castration also causes a more severe inflammatory response than band castration. Three-to four-week-old calves castrated using rubber rings exhibited no signs of pain at the time of ring placement; in contrast, Burdizzo castrated calves demonstrated marked signs of pain if not anesthetized, and mild to moderate pain if anesthetized prior to castration. Application of a tight band around the scrotum and testes produces extraluminal compression of the arteries and veins, resulting in impeded arterial flow to and venous drainage of the tissues. Lack of perfusion compromises the supply of oxygen and metabolic substrates to the tissues and results in ischemia. Continued ischemia induces severe cellular damage and coagulation necrosis. Ischemic lesions of the intestinal tract or limbs are widely known to cause pain during the acute phase, followed by reduced pain as the lesion progresses. Blood pressures and heart rates of 2-month-old lambs remained high 4 hours after placement of rubber rings, suggesting the persistence of pain. Intratesticular injection of an 88% lactic acid solution in 50- to 128-kg calves resulted in similar or increased severity of behavioral responses compared with those following surgical castration. No significant differences were observed in scrotal swelling and pain for the first two days after surgery. In addition, healing was prolonged and unsatisfactory for chemically castrated calves compared to those surgically castrated. Effect of age on response to castration has also been investigated. One- to seven-day old calves castrated using elastrator rings exhibited few behaviors associated with pain or distress, and plasma cortisol concentrations of castrated calves did not significantly differ from those of uncastrated controls. Although 6-day-old bull calves exhibited fewer violent pain responses than 21- or 42-day-old calves after castration, pain-associated behaviors were observed in all groups. Forty-two-day-old calves exhibited a high incidence of pain-associated behaviors and a marked increase in plasma cortisol concentration, possibly indicating these animals experienced more pain than 6- or 21-day-old calves. Supporting the value of early castration, it has been found that beef calves castrated before weaning ate more and had higher average daily gain (ADG) with lower inflammatory responses in the 14 days after Page 3 of 10 castration than calves that were castrated after weaning. Additionally, desynchronized electroencephalogram (EEG) and electrodermal activity readings (both indicative of pain response) were greater in 6-month-old calves compared to 8-week-old calves after castration. One author noted that similar cortisol concentrations were measured in castrated calves and those in which castration was simulated. However, substance P was significantly increased in calves that were castrated. This suggests that substance P is likely associated with nociception (pain) and may become a validated method of pain assessment in food-producing animals. More research in this area needs to be done as validated methods of pain assessment must be used for a drug to be indicated for pain relief in the target species.

Chronic pain—Persistent wounds were observed in 14-month-old bull calves castrated using emasculator bands; these wounds may produce chronic pain. Assessment of chronic pain has primarily been based on reduced weight gain and growth, but findings suggest that pain may persist for several weeks following castration. On the basis of behavioral parameters and the presence of inflammation and sepsis, it appears that castration with rubber rings produces both acute and chronic pain, whereas application of the Burdizzo clamp and surgical castration produce less chronic pain. Another author reported similar observations in 21- to 28-week-old calves. Calves castrated with rubber rings developed purulent inflammation at the site of ring placement, as well as swelling and hardening of the issues, until the distal scrotum detached after a mean of 47 days. Significantly more abnormal posturing was exhibited by rubber ring-castrated calves than by Burdizzo-castrated calves for the first week after castration. In addition, calves castrated with rubber rings exhibited signs of pain in response to scrotal palpation for up to 4 weeks longer than those castrated using Burdizzo clamps. So although banding may cause less immediate discomfort than surgery, the overall impact of banding may be greater (e.g. greater overall reduction in food intake and daily gain). Questions remain regarding the impact of chronic pain secondary to castration