

The Welfare Impacts of Recent Developments in Calf-castration Alternatives and the use of Local Anaesthesia and Analgesia

By Rehana Hewavisenti

Word count: 996

Introduction

Castration is a common procedure in the cattle industry, increasing weight gain in steers and minimising management problems and injuries associated with aggression and sexual behaviour. It also has production-related advantages (i.e., reducing the incidence of dark cutting meat, thus improving carcass quality (Coetzee *et al.*, 2007; Fisher *et al.*, 1996)). Mechanical castration refers to surgical castration (SC), removal of testicles using a scalpel, and bloodless castration, involving latex bands or rubber rings, and Burdizzo clamps, which crush the testicular tissue, stopping blood flow to the testes (Becker *et al.*, 2012). Castration commonly occurs without local anaesthetic and/or analgesic in calves younger than 6 months, causing acute and chronic pain and stress. This can have major welfare implications, such as reduced feed intake, poor growth and performance, and increased morbidity and mortality (Becker *et al.*, 2012; Coetzee *et al.*, 2007). This paper examines recent studies by Becker *et al.* (2012), Ballou *et al.* (2013) and Onda *et al.* (2012), which investigated the impacts of a modified castration alternative and the use of local anaesthetic and analgesics on physiological, behavioural and production parameters of calves during castration.

Discussion

Rubber ring (RR) castration, an alternative to SC, involves placing a tight RR at the proximal end of the scrotum, stopping blood flow to the testes and resulting in degeneration (Becker *et al.*, 2012). Although research comparing RR castration, SC and Burdizzo castration has been evaluated (Molony *et al.*, 1995), Becker *et al.* (2012) made modifications to RR castration to examine pain responses in calves. Local anaesthetic (Lidocaine-hydrochloride) was administered to Simmental/Simmental-cross male calves (n=63) before castration, and calves were allocated to five treatment groups: RR castration, 1 RR and Burdizzo castration; 1 RR with scrotal tissue removed on day 9 (RCUT); 3RRs; and sham castration (control). Blood samples were taken before and at regular intervals up to 6 hours post-castration to assess plasma cortisol concentration (PCC), a physiological parameter reflecting stress associated with pain. Across treatment groups, pain-associated behavioural responses and PCCs showed similar peaks at 5 and 20 minutes post-castration, which is consistent with other studies (Stafford *et al.*, 2002; Thuer *et al.*, 2007). Calves in 3RR showed chronic pain with excessive scrotal swelling and licking, and poor wound healing, so it was discontinued. Wounds of RCUT calves healed faster, with a lower degree of swelling and pain response to local palpation than the other RR treatment groups. RCUT was the recommended alternative practice to RR castration to improve animal welfare. One limitation of the study was that calves varied between 4-6 weeks old, which may affect the degree of pain they experience. Older calves with larger testicles and more scrotal tissue experience greater pain (Stafford *et al.*, 2002). Similarly, Robertson *et al.* (1994) demonstrated that 6-day and 3-week-old calves showed fewer abnormal postures, pain-indicating behaviours, and lower PCCs compared to 6-week-old calves. The efficiency of RCUT should be further tested, to observe the degree of pain in calves of various ages .

Analgesia and/or local anaesthetic has been used to reduce pain associated with mechanical castration, which minimises animal stress and improves wound healing. Ballou *et al.* (2013) examined whether administering local anaesthetic and a non-steroidal anti-inflammatory drug (NSAID) would alleviate the suppression of neutrophils and inflammatory responses post-castration and post-dehorning in 12-week-old Holstein bull calves. The treatment groups involving castration included sham castration, SC with or without the use of local anaesthetic (lidocaine) and NSAID (flunixin meglumine) administered before SC. Blood samples collected before and at intervals up to 72 hours post-castration showed that calves given NSAID and local anaesthetic had lower haptoglobin levels (released due to tissue haemorrhage) in 24 hours, and lower PCCs from 0.5 hours post-castration. Increased counts of leucocytes and neutrophils were seen at 6 hours post-castration compared to other treatment groups. These results are consistent with other studies (Earley & Crowe, 2002; Ting *et al.*, 2005) and suggest that decrease in PCC and increase in leukocyte counts result in reduction in

risk of disease, which can have positive outcomes on daily feed intake, growth and health, with positive production benefits for weight gain and low risk of morbidity.

NSAIDs, such as ketoprofen, prolong post-operative analgesia and produce anti-inflammatory effects. NSAIDs inhibit enzymes important in activating prostaglandin, which increases nociception and post-operative pain and stress due to tissue injury (Coetzee, 2011). Onda *et al.* (2012) investigated the effectiveness of sodium salicylate (SS), a cheaper alternative to ketoprofen, in relieving stress. Holstein calves (n=20), 20-weeks-old, were assigned to 4 treatment groups: untreated sham castration; SC; untreated castration; SS treated and castrated, and ketoprofen treated and castrated. Local anaesthetic (procaine hydrochloride) was administered 20 minutes before castration. PCCs were measured in serum, collected 0.5 hours before castration and after castration at regular intervals. SS-treated calves had reduced PCCs compared to untreated castrated calves but higher PCCs than in ketoprofen-treated calves. Ketoprofen inhibits cyclooxygenase-1, -2 and lipoxigenase, enzymes important in inflammatory response, whereas SS only inhibits cyclooxygenase-1, which could explain why SS was less effective than ketoprofen (Onda *et al.*, 2012). However, SS still reduced PCCs, providing analgesic pain relief to SC calves, and presenting an economical alternative to beef producers. A major limitation of the study was that the effect of NSAID without local anaesthetic in SC was not examined.

Ting *et al.* (2003) showed that ketoprofen alleviates PCCs after Burdizzo castration more effectively than anaesthetic alone, thus SS or ketoprofen may show similar results in SC. Arguably, different castration methods can damage different tissues, causing different physiological pain responses, thus changing NSAIDs' effectiveness as pain relief (Stafford & Mellor, 2005). Additionally, further research regarding SS drug residues in meat for human consumption are required, before economically viable NSAID treatments during SC of calves can be implemented.

Conclusion

The three studies provide valuable insight into modifications to improve current alternatives to SC and/or the use of analgesics and local anaesthetics to alleviate post-operative pain experienced by calves. Further research into improving pain-relief methods will provide better animal welfare and maximise growth and performance for cattle producers.

References

- Ballou, M.A., Sutherland, M.A., Brooks, T.A., Hulbert, L.E., Davis, B.L., Cobb, C.J. (2013) Administration of anaesthetic and analgesic prevent the suppression of many leukocyte responses following surgical castration and physical dehorning. *Veterinary Immunology and Immunopathology*, 151, 3-4, 285-293.
- Becker, J., Doherr, M.G., Bruckmaier, R.M., Bodmer, M., Zanolari, P., Steiner, A. (2012) Acute and chronic pain in calves after different methods of rubber-ring castration. *Veterinary Journal*, 194, 3, 380-385.
- Coetzee, J.F. (2011) A review of pain assessment techniques and pharmacological approaches to pain relief after bovine castration: Practical implications for cattle production within the United States. *Applied Animal Behaviour Science*, 135, 3, 192-213.
- Coetzee, J.F., Gehring, R., Bettenhausen, A.C., Lubbers, B.V., Toerber, S.E., Thomson, D.U., Kukanich, B., Apley, M.D. (2007) Attenuation of acute plasma cortisol response in calves following intravenous sodium salicylate administration prior to castration. *Journal of Veterinary Pharmacology and Therapeutics*, 30, 4, 305-313.
- Earley, B., Crowe, M.A. (2002) Effects of ketoprofen alone or in combination with local anesthesia during the castration of bull calves on plasma cortisol, immunological, and inflammatory responses. *Journal of Animal Science*, 80, 4, 1044-1052.
- Fisher, A.D., Crowe, M.A., delaVarga, M.E.A., Enright, W.J. (1996) Effect of castration method and the provision of local anesthesia on plasma cortisol, scrotal circumference, growth, and feed intake of bull calves. *Journal of Animal Science*, 74, 10, 2336-2343.

Molony, V., Kent, J.E., Robertson, I.S. (1995) Assessment of acute and chronic pain after different methods of castration of calves. *Applied Animal Behaviour Science*, 46, 1-2, 33-48.

Onda, K., Emura, Y., Saito, A., Ikeyama, T., Sato, R., Ochiai, H., Kaneko, K., Iriki, T., Wada, Y. (2012) *Journal of Animal and Veterinary Advances*, 11, 10, 1574-1577.

Robertson, I.S., Kent, J.E., Molony, V. (1994) Effect of different methods of castration on behavior and plasma-cortisol in calves of 3 ages. *Research in Veterinary Science*, 56, 1, 8-17.

Stafford, K.J., Mellor, D.J. (2005) The welfare significance of the castration of cattle: A review. *New Zealand Veterinary Journal*, 53, 5, 271-278.

Stafford, K.J., Mellor, D.J., Todd, S.E., Bruce, R.A., Ward, R.N. (2002) Effects of local anaesthesia or local anaesthesia plus a non-steroidal anti-inflammatory drug on the acute cortisol response of calves to five different methods of castration. *Research in Veterinary Science*, 73, 1, 61-70.

Ting, S.T.L., Earley, B., Hughes, J.M.L., Crowe, M.A. (2003) Effect of ketoprofen, lidocaine local anesthesia, and combined xylazine and lidocaine caudal epidural anesthesia during castration of beef cattle on stress responses, immunity, growth, and behavior. *Journal of Animal Science*, 81, 5, 1281-1293.

Ting, S.T.L., Earley, B., Veissier, I., Gupta, S., Crowe, M.A. (2005) Effects of age of Holstein-Friesian calves on plasma cortisol, acute-phase proteins, immunological function, scrotal measurements and growth in response to burdizzo castration. *Animal Science*, 80, 377-386.

Thuer, S., Doherr, M.G., Wechsler, B., Mellema, S.C., Nuss, K., Kirchhofer, M., Steiner, A. (2007) Influence of local anaesthesia on short- and long-term pain induced by three bloodless castration methods in calves. *The Veterinary Journal*, 173, 5, 334-342.