

Improving pain control during band castration

by Alberta Beef Producers

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Project Title:

Analgesic Elastrator Bands Development

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Background:

Band castration is a common practice used nationwide in cattle production. The procedure is bloodless, but it causes short term discomfort when the band is applied, as well as significant long-term pain as the scrotal tissue necroses due to lack of blood flow. Given the practicalities of cattle handling, and the desire of producers to mitigate the stress of handling, a product that can offer near-immediate as well as long term pain mitigation in a single castration handling event would represent a significant advancement in band castration pain control.

Objectives:

The objectives of this study were to:

- 1) Develop and manufacture elastrator bands of different sizes containing lidocaine (an anesthetic) that releases into scrotal tissues following band application.
- 2) Evaluate the release of lidocaine from the elastrator bands over time
- 3) Evaluate lidocaine release rates into scrotal neck tissues and response to pain following application of elastrator bands in calves

What They Did:

Three different sized bands were developed for evaluation and field trials. These were large Callicrate bands (>400 lbs), medium Tri-Bander bands (200-500 lbs), and small green cheerios (<200 lbs). Using these existing bands already on the market, they were infused with different concentrations of lidocaine, solvents (to get the lidocaine into the band), and permeation enhancers (to get the lidocaine from the band into the tissue) to find the right formulation.

Once the formulation was optimized, lidocaine release from the bands was measured using high pressure liquid chromatography over 0 min, 30 min, 1, 3, 6, 9, 12, 24, 36, 48 and 72 hours.

Field trials using dairy calves (dairy calves were used because different sized calves were available at the same time, as opposed to beef calves that are more uniform at various times of the year) examined if levels of lidocaine released from the bands were effective in controlling pain, and for how long, by measuring electrostimulation and behavioural responses.

For all band sizes, 24 calves received the bands with lidocaine, while 24 calves received a regular band along with an injection of lidocaine as the control. All animals were observed for clinical signs of pain and inflammation. Electrostimulation sensitivity and tissue samples from the scrotum tissue in contact with the band were taken at 30 mins, 1, 2, 4, 24, 48 hours, and 7 days after castration.

What They Learned:

The amount of lidocaine contained within each band varied, with 52 mg/band in the large Callicrate bands, 250 mg/band in the medium sized Tri-Bander bands, and 100 mg/band in the small green cheerios. This was largely a function of band material and size.

Laboratory analysis indicated that the bulk of lidocaine (50-60%) was released in the first 30 minutes, indicating that over half of the lidocaine is loaded near the surface of the bands. They also used steak cubes to simulate tissue, finding that the initial release of lidocaine was followed by a sustained slow release over time. This was also demonstrated in the pilot field trials.

In the field trials, no statistically significant differences in lidocaine concentration were observed between the lidocaine-banded group and control group for the first six hours. But the lidocaine bands provided higher levels of lidocaine for a longer time period (out to 7 days). Infrared imaging indicated that scrotal temperature in the lidocaine-banded group was 2-fold lower. While not statistically significant, a slight trend of improved average daily gain was observed in lidocaine-banded calves. In addition, electrostimulation response was significantly reduced in the lidocaine-banded calves over 7 days.

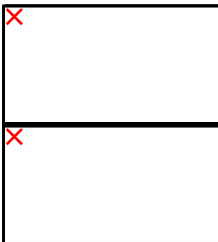
Given the small number of calves (50/study), there was expected variation in lidocaine tissue concentrations and pain responses, but in general, the trends described above were the same for all band sizes.

What It Means:

The release of significant concentrations of the lidocaine from the bands soon after application indicates an opportunity for near-immediate pain relief to assist with procedural pain. The sustained release of lidocaine from the bands also suggests a long-term availability for pain control when the scrotum necroses and dies, but this will need to be verified in longer term studies (up to 3-4 weeks from castration). The reduction in scrotal temperature could be a sign of reduced inflammation in the lidocaine-banded calves, and this, along with a reduction of reaction to electrostimulation and behavioural indicators of pain would indicate that these bands are effective at mitigating band castration pain. A patent has been filed as a result of this project, and commercialization is expected within 2-3 years. Future work that needs to be completed prior to commercialization includes studies with larger sample sizes, physiological and behavioural indicators of pain measured at time points longer than 7 days after band application, the durability of the bands under cold weather conditions, and the development of packaging to ensure safe handling for the user.

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