



## UNIVERSITY OF CALGARY FACULTY OF VETERINARY MEDICINE

*This review accompanies the relevant episode of the Cutting Edge veterinary podcast. In each episode of this podcast, 3rd year students in the University of Calgary's veterinary medicine program fill you in on the most up-to-date literature and evidence-based practices on topics that matter to you, the practising veterinarian.*

### Bovine Castration: The Best Options for When and How

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With the multitude of factors that need to be considered when it comes to bovine castration, we as future and current practitioners must put ourselves in the producer's shoes and focus on the aspects of operational management and how it intermingles with animal welfare. With consumer awareness evidently increasing, animal welfare has been, and continues to be, an important factor when considering any production animal procedures. The age of the animal, the method of castration, and pain management are just some of the things that need to be considered when developing castration protocols. Our objective is to help different producers and veterinarians collaborate and integrate the options listed below into their bovine castration protocols.

The management of bovine castration is not a "one shoe fits all" phenomenon. This is why it is important to focus on the different stages at which a producer might castrate their bulls, along with what castration method and what pain mitigation method is best for animal welfare purposes. With the plethora of information on bovine castration available, it is also important to mention the limitations of the current literature along with the future directions that bovine castration can follow.

#### **Calf Stage**

For cattle that are a week old or younger, banding or surgical castration are acceptable practices, however, if minimal pain-mitigation is going to be used, it is recommended that banding is the more welfare-friendly option<sup>11</sup>. Due to the nature of surgical castration, it results in a more intense pain response on the day of castration, but the scrotum generally heals faster and swelling is decreased sooner when compared to banding<sup>12</sup>. Both of these procedures inherently cause pain, and there is evidence supporting the use of subcutaneous (SQ) meloxicam to reduce the level of acute pain felt seeing as both methods inflict different levels of pain<sup>10</sup>. However, it was found that the meloxicam does not decrease inflammatory factors, or speed up healing time<sup>10</sup>. The knife castration also resulted in a momentarily lower ADG when compared to band castrated calves<sup>11</sup>. It has been hypothesized that calves with larger,

developed testicles experience more discomfort, supporting the idea that castration at a younger age is favourable<sup>12</sup>.

### **Branding Stage**

This management strategy applies to traditional producers that choose to brand and castrate bovines in the age range of 2-4 months old. With the varying ages that can be seen in this group of cattle, it is important to look at all the methods available and the ease of application due to the traditional practices of these clients. Studies looking at 2 month old cattle found that band castration was the most welfare friendly method, when limited pain mitigation is available<sup>11</sup>. When looking at salivary cortisol, complete blood count/substance P, scrotal area temperature, rectal temperature, performance, accelerometer recordings, and stride length, there was no statistical difference between calves that were banded and control groups that were not castrated, however, there were behavioral changes between these two groups<sup>12</sup>. This evidence suggests that for calves that are 2 months old, banding along with a reliable method of pain control is the best practice for this age group<sup>11</sup>. When you move to older aged animals of approximately 3-4 months, the findings from the 2 month old calves are reversed. In calves near 4 months of age, it was found that banded calves spent less time laying and more time standing when compared to knife castrated and the control group indicating a potential sign of discomfort<sup>11</sup>. In this study the swelling and healing of the scrotal area was observed for banded and surgically castrated calves. A swelling and healing scale were used for this purpose. The swelling scale was 0-4, 0 being no swelling, and 4 being suppurative discharge needing interventions<sup>11</sup>. Never reached a swelling score of 0 during the study, while banded calves had a score of 0 on day 28<sup>11</sup>. The healing scale used was 1-5. 5 was completely healed, and 1 being the full incision still visible for surgical castration or restriction of blood flow to the scrotum with no necrotic tissue for banded calves<sup>11</sup>. Knife castrated calves reached a score of 5 on day 35, while banded calves never reached a score of 5 during the study<sup>11</sup>. These findings suggest that with older calves, knife castration is the better option, especially with pain control measures implemented. Another study looking at 3-month-old calves found that the use of a caudal lidocaine/epinephrine epidural with separately administered NSAIDs reduced the amount of pain felt based on visual observations and stride length<sup>6</sup>. The control of pain was successful for at least 8-12 hours post castration<sup>6</sup>. Therefore, with this age group of bovines, the best practice would be to use an epidural, and NSAIDs to help manage pain. At minimum, injectable NSAIDs should be used. If possible, at branding, younger animals should be banded, while cattle near or over the age of 3 months are surgically castrated with appropriate pain control for both groups. If this division is not possible, the use of surgical castration with pain control is the most appropriate procedure.

### **Weaning Stage**

As you can assume, weaning is recognized as one of the most stress inducing times of a young animal's life. For this reason, it is important to choose wisely on what method of castration is to be used if this stage works best for the producer's management timeline. A study that compared surgical castration near birth and at weaning, with and without the administration of

meloxicam, found that oral meloxicam administration at weaning did in fact reduce serum haptoglobin values, improved the average daily gain of the weaned calves and decreased the acute phase inflammatory response<sup>3</sup>. Additionally, the specific surgical method used between the Henderson Castrating Tool or emasculator was found to not have an impact on Daily Feed Intake (DFI), Daily Water Intake (DWI) and inflammatory response during a different study<sup>19</sup>. However, the banding of these animals was found to have a delayed negative impact on DWI, inflammation, and Average Daily Gain (ADG)<sup>19</sup>. This concludes that surgical castration along with oral meloxicam administration is the best practice for the castration of bovine animals that fall into this management category.

### **Yearling Stage**

This management plan applies to purebred producers that are waiting to see how their bulls fill out and perform on spring semen testing, before being sent to their respective buyers. Banded yearling bulls had a lower ADG for 56 days following the castration procedure but due to compensatory growth, both banded and surgically castrated bulls performed the same to intact bulls in regards to their growth<sup>9</sup>. Both local anesthetic, lidocaine intratesticular for both methods, ring block for band and line block for surgical with the proper time waited for onset of action = 10 minutes, and systemic oral NSAIDs in the form of meloxicam should be procedural standard due to the size and age of the animal's<sup>9,17</sup>. Repeat treatments with NSAIDs are indicated due to the evidence showing that a single oral meloxicam treatment following castration decreased the acute inflammatory response, provided a delayed increase in rectal temperatures, lower eosinophil counts, and lower haptoglobin values<sup>16</sup>. Banding found that there is long term discomfort due to the amount of time needed for banding to lead to scrotal and testicular necrosis<sup>9</sup>. Surgical castration found that there are higher levels of discomfort in the short term, but with proper analgesic treatment, this can be mitigated<sup>9</sup>.

### **Limitations of Current Literature:**

While performing our research, we found that some limitations can be seen throughout the literature available on bovine castration. One of the most obvious limitations is the fact that measurements of pain currently are not as accurate as they were thought to be. A meta analysis looking at bovine castration found that vocalization, blood cortisol levels, and average daily gain (ADG) can be unreliable measurements<sup>4</sup>. Vocalization needs to be classified as to what type and this requires in depth knowledge and training in order to be accurate with classification<sup>4</sup>. Blood cortisol levels can reach a "ceiling effect" where the levels of cortisol are underestimated since they can reach peak levels and no longer increase with increased noxious stimuli<sup>4</sup>. Cortisol is a stress hormone, and stressful events such as handling can result in increased levels so it is not solely specific to painful events<sup>4</sup>. ADG and other production parameters do not directly reflect pain being felt by animals at the time of castration<sup>4</sup>. This makes it difficult to use as a measure of pain in a study. Papers have found that the castration method does not impact cattle when looking at long-term growth rates, which is another reason to question the validity of ADG for pain classification<sup>4</sup>. These potentially inaccurate measures of pain show that further research is needed to precisely grade pain being experienced by cattle, and other production animal

species. By gaining new and more accurate measures, this can help producers and veterinarians perform these procedures in the most ethical way possible. Another limitation we saw was that many studies looking at bovine castration have small sample sizes. Often studies will have 70-100 animals participating in the research with these animals further divided into multiple treatment groups, each with their own control group<sup>11, 12, 6</sup>. This greatly decreases the number of animals per group leading to some studies mentioning that a smaller population could have potentially impacted the results captured<sup>11</sup>.

### **Future Directions**

Looking at the future of bovine castration, it is evident that the public is becoming more aware of animal welfare which is a reason for why we must continue to push for more ethical castration practices. Due to this, it is imperative that the industry continues to advance and adapt new ways to achieve these goals. Some potential solutions to these goals that we investigated, are immunocastration and lidocaine infused castrator bands. Immunocastration is a type of vaccine that can be administered and will block the action of gonadotropin-releasing hormone which disrupts the normal function of the testes preventing spermatogenesis<sup>14</sup>. Immunocastration has shown to decrease testosterone to a level similar to physical castration methods after a booster is given<sup>14</sup>. The lack of physical castration results in decreased painful stimuli along with no risk of surgical/band site infection since these lesions are not present<sup>14</sup>. Immunocastration does appear to have promise when used in the bovine industry; however, it is still banned in Canada due to safety concerns. Self injection with the vaccine would potentially result in self-sterilization which has prevented its use across certain countries. The next innovation we would like to speak on is lidocaine loaded bands (LLB). In a recent study, therapeutic amounts of lidocaine along with a skin permeation enhancer were infused into green, beige, and callicrate bands with the goal of looking at pain mitigation<sup>18</sup>. Following these studies, the researchers found that LLBs were able to deliver just as much lidocaine as a control injection method over the short term (<6 hours)<sup>18</sup>. Over the long term (>6 hours) the LLB actually resulted in higher levels of lidocaine when compared to an injection<sup>18</sup>. The study thus found that LLB has the potential to provide a more long-term form of analgesia of at least 7 days versus a shorter acting lidocaine injection<sup>18</sup>.

### **Overall Outcome**

Overall, our research along with multiple veterinary associations and guidelines preach that animals should be castrated at the youngest age possible, with pain mitigation techniques and in association with the producers management plan and market goals<sup>1,5,8</sup>.

Additionally, the marketability of these animals and how they perform in feedlots or backgrounding operations is what provides producers with their annual income. For this reason, the goals of each operation need to be well understood and communicated between the producer and veterinarian. As we have seen in our examples, and as was discussed in a conversation with a current meat science professor from the University of Alberta (Bruce H 2023, oral communication, 6th January) compensatory growth comes into play in all instances

because the animals eventually even out and have enough time to catch up with the others following castration, if all else stays normal. However, compensatory growth may not always play in favor of the producer which is why this is important to take into consideration when a producer castrates their bulls. For example, if a producer castrates weanlings and sends them to a feedlot shortly after, the feedlot data manager may notice that those specific animals spend more days on feed to reach the specific market weight. This, in the end, costs the feedlot more money and may deter them from buying calves from that producer again simply because of the implemented castration protocol. That is why proper methods at specific ages with the recommended or required pain management strategy, are important factors to consider and discuss when performing bovine castrations.

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