

Effect of Castration Technique on Beef Calf Performance, Residual Feed Intake, and Inflammatory Response

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Method of castration utilized had minimal impact on average daily gain, feed efficiency, water intake, residual feed intake or feeding frequency of beef calves castrated post weaning. Delaying castration and utilization of banding techniques was not more favorable to surgical methods.

Summary

The objective of this experiment was to evaluate the rate of growth, feed intake, water intake, residual feed intake (RFI), and inflammatory response of male beef calves during the feedlot phase in response to different methods of castration. Seventy-five beef calves (498 ± 75 lb; 200 ± 26 days of age) were placed in a GrowSafe 4000 feed intake facility 7 d post-weaning (15 calves/pen). Average daily gain (ADG), daily feed intake (DFI), and daily water intake (DWI) were recorded over an 84-d period. Blood was collected post-castration on 6 d during the first 2 wk post castration to assess inflammatory response. Calves were offered a mixed diet total digestible nutrients (TDN) = 67.3% and crude protein (CP) = 12.2%, dry matter (DM) = 89% ad libitum. On day 0 calves were assigned to one of five treatments (15 calves/treatment): 1) steers castrated surgically prior to weaning at a mean age of 52 d (range=8-85 d; CON); 2) intact bulls that remained intact for the entire 84 d experiment (BULL); 3) bulls castrated by the Callicrate Bander on d 0; 4) bulls castrated by the Henderson Castrating Tool on d 0 (HEN); and 5) bulls castrated surgically utilizing an emasculator on d 0 (SUR). Results indicate that castration decreased ADG d 0 to 14, but not d 0 to 84. Daily feed intake and DWI were unaffected by castration technique over the entire experiment. Gain:Feed was not impacted by castration technique; however, RFI was affected d 0 to 14 but not d 0 to 84. Acute phase

protein analyses indicated that surgical castration elicited a short-term inflammatory response, whereas banding elicited a delayed response. It appears that calves castrated pre-weaning were preferable in all measures of performance, intake, and inflammatory response. In this study, castration of weaned bull calves averaging 500 lbs in weight did not result in a long term decline in performance regardless of method of castration utilized.

Introduction

It is customary for cow/calf operators to castrate male beef calves prior to weaning. However, some calves are not castrated until after weaning. Several methods of castration are available and the decision of which method to utilize may be a function of the type and size of the calf (Zweiacher et al., 1979). Larger and older calves may have increased blood flow to the testes increasing the risk of blood loss after castration. This blood loss may be eliminated if a bloodless means of castration is used. However, these methods also have certain risks, and may be problematic in terms of anaerobic infections such as tetanus.

Several studies have demonstrated that male beef calves endure an observable degree of pain when castrated (Fisher et al., 1996; Ting et al., 2003). This pain increases in acuteness and duration as the calf's age, body weight, and

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testicular size increases (Chase et al., 1995; Stafford et al., 2002). All methods of castration cause significant acute pain and distress; however, surgical castration is suggested to be more painful, initially evidenced by increased plasma cortisol (Stafford et al., 2002). Pain and inflammation may also affect the growth rate and efficiency of beef calves (Fisher et al., 1997, Ratchiff et al., 2005). If specific methods of castration can be utilized to lessen the pain then theoretically growth rate and efficiency may be maximized.

Several studies have documented decreased growth rate in castrated calves compared to intact male calves but there has been minimal research on the effect of castration on feed efficiency (Brazle, 1992; Faulkner et al., 1992). There have been no studies investigating the effect of castration on residual feed intake (RFI) and whether variation in RFI exists among calves castrated by different methods. In addition, there have been no studies evaluating the effect of the Henderson Castrating Tool (Stone Manufacturing and Supply Co., Inc., Kansas City, MO) on beef calf performance or feed efficiency.

Materials and Methods

Animals and Treatments

Seventy-five male beef calves (498 ± 75 lb) were obtained from the University of Florida Santa Fe Beef Unit (Alachua, FL) at weaning. Calves were weaned for 7 d prior to transport 217 miles to the North Florida Research and Education Center's (NFREC) GrowSafe[®] feed efficiency facility in Marianna, Florida. Calves arrived at the NFREC in a single semi-load. The arrival date was 22 d prior to the initiation of the experiment. A pre-experimental period (acclimation period) began on d -21 and lasted until d 0 (day of castration). Calves were stratified by breed, age, and weaning weight and randomly allocated to one of five treatments (15 calves/treatment): 1) control steers (CON) were castrated surgically prior to weaning at an average age of 52 d (8-85 d); 2) intact bulls (BULL); 3) bulls castrated by the Callicrate Bander (No-Bull Enterprises, LLC, St. Francis, KS; BAN); 4) bulls castrated using the Henderson Castrating Tool (Stone Mfg &

Supply Co., Kansas City, MO; HEN); and 5) bulls castrated surgically (SUR). The experiment was comprised of two data collection periods, post-castration period (d 0 – 14), and overall period (d 0 – 84). Calves were randomly assigned to one of five pens so that all treatments were equally represented in all pens.

Calves were vaccinated prior to initiating the experiment against IBR, BVD, BRSV, PI3 (Cattle Master Gold, Pfizer Animal Health), blackleg (Ultra Choice 7, Pfizer Animal Health), and treated for internal and external parasites (Ivomec[®] Epirnax, Merial). Over the entire experiment calves exhibiting signs of respiratory disease were recorded and treated with Draxxin[®] (tulathromycin, Pfizer Animal Health) at label dose. Fifteen percent (n = 11) of calves were treated for respiratory disease one time, 11% of all calves (n = 7; 58% re-treat) were re-treated for respiratory disease and 1 calf was treated a third time. Two CON calves were treated once, one BULL calf was treated once and three were treated twice, one BAN calf was treated twice and one was treated a third time, two HEN calves were treated twice, and one SUR calf was treated once. These calves were treated during the first 4 wk of the experiment and after d 28 no cattle were treated during the remainder of the experiment. All calves were offered a mixed concentrate based diet (TDN = 67.3% and CP = 12.2%, DM = 89%) ad libitum.

Calves assigned to the BAN, HEN and SUR treatments were castrated on d 0. Castration was performed by trained technicians under the supervision of a University of Florida veterinarian. Calves were restrained in a chute and castration was completed by the same technician in the same manner for each calf for each treatment group. All calves on all treatments were vaccinated subcutaneously with 500 units of tetanus antitoxin on d 0.

For banded calves, the band was applied around the scrotum proximal to the testes. The elastic band was tightened by ratcheting until adequate tension was applied, a metal grommet was then crimped around the band to hold tension and decrease blood flow to the scrotum and testes,

causing subsequent sloughing of the scrotum and testes.

Henderson castrated calves were castrated by incising the scrotum with a Newberry knife, leaving an anterior and posterior flap. Testes were exposed and removed by the Henderson Castrating Tool. The castrating tool was clamped on each spermatic cord individually and rotated by a cordless drill approximately 20 rotations until the cord severed.

Surgically castrated calves were castrated by incising the scrotum with a Newberry knife, leaving an anterior and posterior flap. Testes were exposed and spermatic cords were crimped and severed with an emasculator.

Sampling and Analysis

Shrunk body weight (BW) were obtained on d 0, 14, and 84. In addition, full BW were recorded on d 7, 28, 42, 56, and 70. All cattle were weighed in the morning and at approximately 0700 h for each weigh date. On days that shrunk BW were recorded, access to feed and water was removed by 1900 h the previous evening.

Feed intake and water intake were recorded using the GrowSafe® system. Trips to the feed bunk and head down feeding events were also recorded by utilizing radio frequency identification tags.

Blood samples were collected from a sub-sample ($n = 45$) of the cattle at the beginning of the experiment to investigate the acute phase response resulting from castration. Three pens (15 calves/pen) were sampled by blood collection via jugular venipuncture on d 0, 2, 6, 9, 12 and 15. Plasma was extracted from blood samples and analyzed for concentrations of ceruloplasmin and haptoglobin.

The MIXED procedure of SAS was utilized to perform statistical analyses. The model included the main effects of treatment, pen, and day or week when necessary. Animal within pen was the random variable. Least square means are reported with standard errors, means were separated for comparison by PDIF. All two-way interactions found to be significant at

$P < 0.10$ for a particular variable were included in the model for that variable.

Results

Average Daily Gain

Castration of calves reduced ($P = 0.06$) average daily gain (ADG) by an average of 76 percent during the post castration period (day 0-14) regardless of method utilized (Table 1). All castrated calves gained less ($P < 0.05$) than CON with BULL being intermediate and similar ($P = 0.23$) to all other treatments.

Average daily gain over the entire experiment (d 0 to 84) was similar (mean = 1.94 lb/d; $P = 0.42$) for all treatment groups indicating that castrated calves were able to compensate and recover from castration regardless of castration method.

Average daily gain was evaluated by period from d 7 to 70 (data not shown). Banded calves suffered a 50 percent reduction ($P < 0.05$) in ADG compared to all other treatments. However, ADG d 28 to 42, d 42 to 56, and d 56 to 70 was similar regardless of castration method, indicating that at some point after d 28 and before d 42 all treatments began to gain similarly. Ratcliff et al. (2005) reported that weaned beef calves (462 ± 32 lb) castrated surgically tend to gain more ($P < 0.10$) than banded calves in the 50 d after castration, however no controls were present. Our results indicate that all methods of castration reduce ADG compared to control steers during the first 14 days after castration but by d 84 ADG was similar regardless of castration technique. These results imply that method of castration may not impact ADG long term when castrating single source weaned calves weighing around 500 lbs.

Feed and Water Intake

Daily feed intake from d 0 to 14 (post-castration period) was similar (mean = 12.98; $P = 0.80$) for treatment groups (Table 1).

Feed intake over the entire experiment (d 0 to 84) was analyzed by week (12 wk). Mean DFI by wk (wk 1 to 12) was not impacted by treatment ($P = 0.92$; Table 1). Fisher et al. (1997) reported that castrated calves tend to eat less ($P < 0.05$) than intact male calves early

post-castration and eat similar amounts 28 d post-castration.

Feeding behavior was not impacted ($P = 0.34$) by treatment early post-castration (Figure 1). All treatments had decreased trips to the bunk on d -1 and 0. This is attributed to the shrink period on d -1 and the time spent out of the pen while being processed on d 0. On d -1, 0, 1, and 2 all treatments had similar number of trips to the feed bunk. These results indicate that not only was DFI by week not altered by castration method, but feeding behavior was not impacted by the stress of castration early post-castration.

Daily water intake was similar (mean = 9.6 gal/d; $P > 0.10$) among treatment groups from d 0 to 14 and d 0 – 84 (mean = 8.2 gal/d; Table 1). These results indicate that the short term stress of castration did not suppress water intake.

Feed Efficiency

Gain to feed ratio was similar among treatments d 0 to 14 (mean = 0.03; $P = 0.28$; Table 1) and d 0 to 84 (mean = 0.09; $P = 0.32$). Residual feed intake tended to be affected ($P = 0.10$) by treatment during the post-castration period (d 0 to 14; Table 1). Control steers and BULL were similar ($P > 0.10$) in RFI value, but lower ($P < 0.05$) than SUR. Calves that were castrated by BAN and HEN were intermediate and similar ($P > 0.10$) to CON, BULL, and SUR. These results indicate that castration did induce a change in efficiency, measured by RFI early post-castration. There is a clear trend showing that castration increased RFI, but the magnitude is small and short in duration. Over the 84-d experiment, RFI did not differ ($P = 0.75$) among treatments, suggesting that in the long term, castration does not negatively impact efficiency as measured by RFI.

Stress Response

An interaction ($P = 0.02$) was detected between treatment and day for plasma ceruloplasmin concentration post-castration (Figure 2). All treatments had similar ($P > 0.10$) plasma ceruloplasmin concentrations on d 0. CON had decreased ($P < 0.05$) plasma ceruloplasmin concentrations compared to BULL and HEN on

d 2; BULL, HEN, and SUR on d 6 and 9; and tended ($P < 0.10$) to be lower than BULL, HEN, and SUR on d 12; and BULL, BAN, and SUR on d 15. The delayed increase in plasma ceruloplasmin concentrations in BAN compared to CON suggests that BAN induced a delayed inflammation response compared to surgical methods of castration. The increased plasma ceruloplasmin concentrations HEN and SUR exhibited compared to CON indicates that there is an acute inflammatory response early post-castration in surgically castrated calves, however it is decreased over time. HEN and SUR were similar ($P > 0.10$) post-castration indicating that neither surgical method was better at minimizing a stress response.

An interaction ($P = 0.0002$) was detected between treatment and day for plasma haptoglobin concentration post-castration (Figure 3). These data indicate that plasma haptoglobin concentrations were greater in the surgical methods early post-castration but were not different from CON steers by d 9. Calves that were BAN responded like CON until d 15 when BAN had greater plasma haptoglobin concentration than CON and calves castrated surgically, indicating the delayed inflammatory response associated with banding calves. The causative agent for increased plasma haptoglobin concentration observed in intact male calves in the current study remains to be elucidated.

No one method induced a greater inflammatory response early post-castration, these results may be important from an animal welfare standpoint. There are minimal differences in concentration of plasma ceruloplasmin and haptoglobin among castration methods and only slight numerical differences compared to CON.

Literature Cited

- Brazle. 1992. Kansas State Univ. Rep. of Prog. 651, Agric. Exp. Station.
- Chase et al. 1995. J. Anim. Sci. 73:975.
- Faulkner et al. 1992. J. Anim. Sci. 70:2970.
- Fisher et al. 1996. J. Anim. Sci. 74:2336.
- Fisher et al. 1997. J. Anim. Sci. 75:1041.
- Ratcliff et al. 2005. Arkansas Animal Science Research Report. Fayetteville, AR. P 115.
- Stafford et al. 2002. Research in Veterinary Science 73:61.
- Ting et al. 2003. J. Anim. Sci. 81:1281.
- Zweiacher et al. 1979. J. Anim. Sci. 49:5.

Table 1. Effect of castration technique on measures of performance, and intake in beef calves

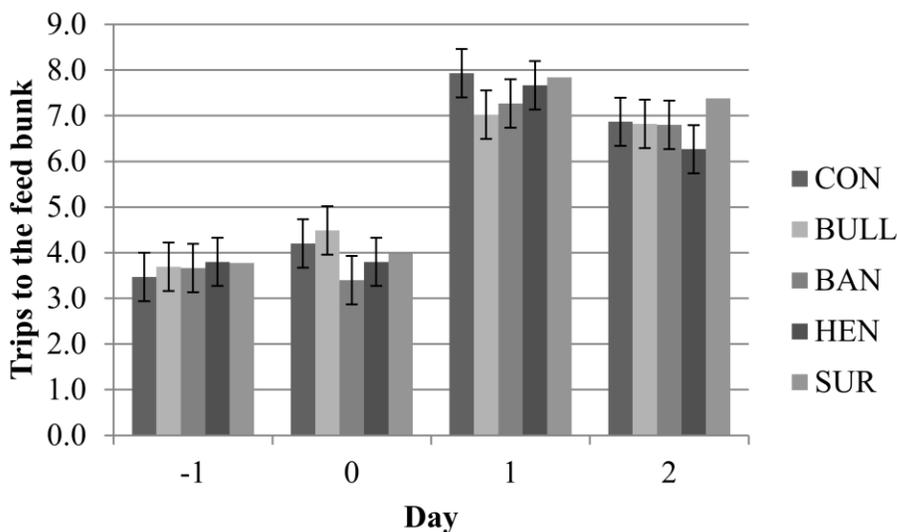
| Item | Treatments ¹ | | | | | S. E. ² | P-value |
|---------------------------|-------------------------|--------------------|--------------------|---------------------|-------------------|--------------------|---------|
| ADG, lb/d | CON | BULL | BAN | HEN | SUR | | |
| d 0 to 14 | 1.60 ^a | 1.10 ^{ab} | 0.33 ^b | 0.53 ^b | 0.57 ^b | 0.33 | 0.06 |
| d 0 to 84 | 2.0 | 2.1 | 1.8 | 1.9 | 1.9 | 0.13 | 0.42 |
| Daily Feed Intake, lb/d | | | | | | | |
| d 0 to 14 | 13.6 | 12.5 | 12.8 | 12.1 | 13.9 | 1.2 | 0.80 |
| d 0 to 84 ³ | 20.9 | 20.9 | 20.0 | 20.9 | 21.1 | 0.95 | 0.92 |
| Daily Water Intake, gal/d | | | | | | | |
| d 0 to 14 | 10.67 | 8.74 | 9.61 | 9.16 | 9.66 | 0.87 | 0.61 |
| d 0 to 84 ³ | 8.63 | 8.37 | 7.74 | 8.37 | 8.13 | 0.48 | 0.71 |
| Gain:Feed | | | | | | | |
| d 0 to 14 | 0.10 | 0.06 | -0.06 | 0.03 | 0.02 | 0.05 | 0.29 |
| d 0 to 84 | 0.10 | 0.10 | 0.09 | 0.09 | 0.09 | 0.005 | 0.39 |
| Residual Feed Intake | | | | | | | |
| d 0 to 14 | -0.92 ^a | -0.88 ^a | 0.66 ^{ab} | -0.04 ^{ab} | 1.20 ^b | 0.66 | 0.09 |
| d 0 to 84 | -0.29 | -0.48 | -0.11 | 0.57 | 0.31 | 0.66 | 0.75 |

¹CON = calves castrated pre-trial; BULL = intact male calves; BAN = calves banded on d 0; HEN = calves surgically castrated with Henderson castration tool on d 0; SUR = calves surgically castrated with emasculators on d 0.

²Standard Error

³Data reported as average daily intake by week

^{a, b} Means within same row with different superscripts differ $P < 0.05$.

**Figure 1.** Effect of castration method on feeding behavior early post-castration.

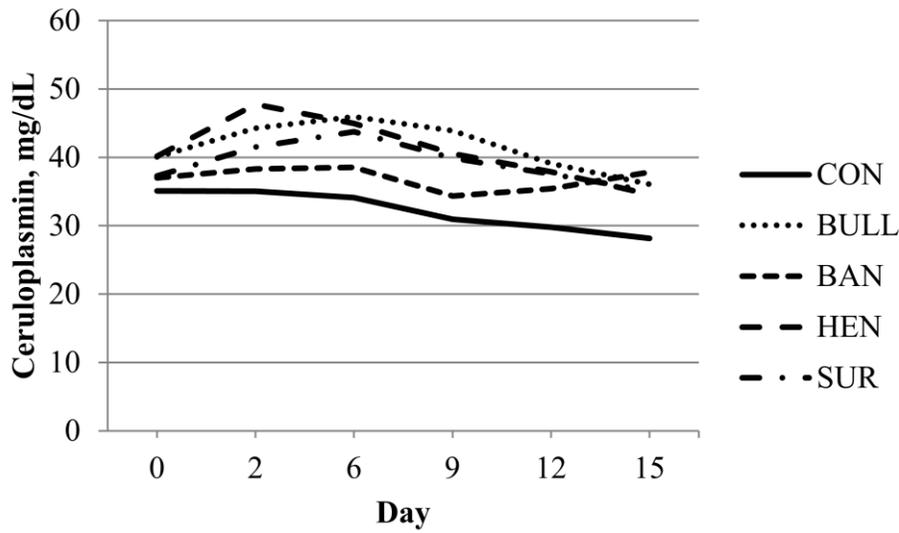


Figure 2. Effect of the castration method x day interaction on plasma ceruloplasmin concentration post-castration. Treatment x day: $P = 0.02$.

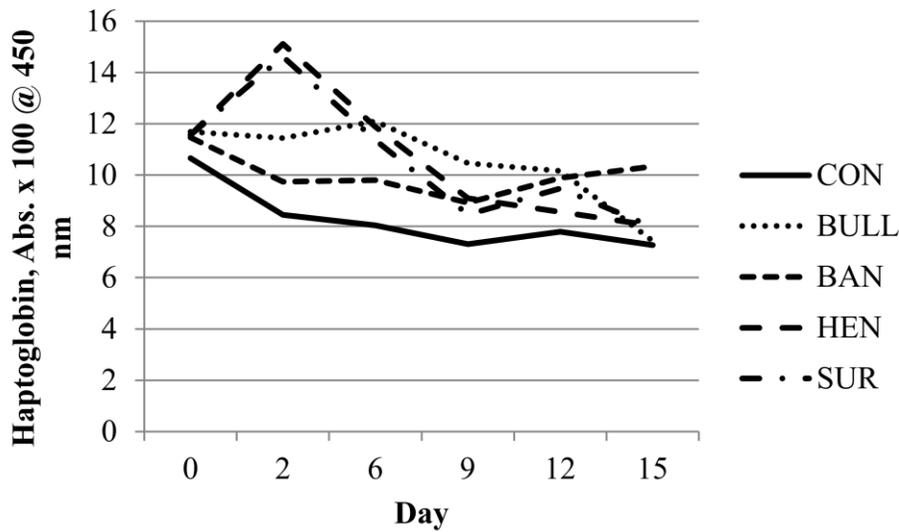


Figure 3. Effect of the castration method x day interaction on plasma haptoglobin concentration post-castration. Treatment x day: $P = 0.0002$.