Acute Hormonal and Blood Biochemistry Responses of Calves to Open Castration In Sokoto Gudali Breed of Cattle.

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ABSTRACT

Castration of cattle is common in modern veterinary practice with different motives and reasons. Castration has been observed to cause alterations in body system parameters with accompanying stress under various methods in farm animals. This study was aimed at evaluating the hormonal, hematological and biochemical responses to open castration in Sokoto gudali calves . Six calves were castrated using an open method using a sterile scalpel. Blood was collected at 30minutes interval for 2hours and assayed for hematological, biochemical and hormonal analyses. The present study showed that castration of calves caused a transient increase in packed cell volume, red blood cell count, white blood cell count, platelets, hemoglobin concentration and neutrophil at 30minutes post-castration and later decreased to nearly the initial levels. It decreased significantly (P<0.05) at 90min when compared with the 30min value. There were fluctuations in the estrogen, testosterone and cortisol levels while no significant changes in the electrolytes level was observed. The fluctuations in these parameters could be as a result of the disruption in the testosterone production owing to the castration. It could therefore be concluded that open castration in calves using sterile scapel is safe and not detrimental to the physiology of the animals under study.

Keywords: Castration, physiology, Sokoto gudali calves, Hormones.

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1. INTRODUCTION

Castration defines a process which stops the function of the testes leading to sterilization (Fisher et al., 2001). Castration of cattle is a common practice in modern veterinary practice, most especially for medical reasons as in removal of cancerous and ruptured testes. Benefits of castration include a reduction in aggression and mounting behavior of males causing fewer injuries in confinement operations and reduced dark-cutting beef. Also, farm animals have been castrated to eliminate breeding and reduce aggressive behavior (Stafford, 2007). Castration also prevents physically or genetically inferior males from reproducing and prevents pregnancy in commingled pubescent groups (Stafford and Mellor, 2005). Although the benefits of castration are widely accepted in most countries, all methods of castration have been demonstrated to produce physiological, neuroendocrine, and behavioral changes indicative of pain and distress (Currah et al., 2009; Gonzalez et al., 2010). Methods of castration are typically associated with physical, chemical or hormonal damage to the testicles (Stafford and Mellor, 2005). In most production settings, physical castration methods are the most common. Castration procedures involve surgical removal of the testes, by interruption of the blood supply using a castration clamp (Burdizzo castration), rubber ring or latex band (American Veterinary Medical Association, 2009).

Several non-genetic factors including castration (removal of testis, the source of testosterone) affecting haematological parameters of farm animals have been observed (Carlson, 1996; Svoboda et al., 2005). Testosterone, the principal androgen, secreted by Leydig cells, exerts androgenic effects involving growth stimulation and functional maintenance of the male reproductive tract and anabolic effects involving growth stimulation of non reproductive organs, such as muscle, kidney and liver (Barbara et al., 2006) and also affects the hemogram of animals (Aydilek and Aksakal, 2005). Earlier studies on acute and chronic effects of burdizzo castration on hematological and biochemical parameters in goats have been reported (Olaifa and Opara, 2011; Olaifa and Akpan, 2017, Olaifa, 2018). However, there is dearth of information on the biochemical and physiological responses to castration in calves of our indigenous species which necessitated this study.

2. MATERIALS AND METHOD

Experimental animals

Six Sokoto gudali calves (2months old) were acclimatized for one week before commencement of this study at the University of Ibadan Teaching and Research Farm. The individual pens were cleaned and disinfected prior to the arrival of the animals. Upon arrival, they were examined and dewormed using Levamisole® and de-ticked using Asuntol®, an organophosphate compound. They were also placed on antibiotic therapy for 5 days by intramuscular administration to therapeutically foreclose any bacterial subclinical infection and fed daily on a 12% protein ration, fresh grass and water ad libitum. All physiological parameters were within normal range.

Castration Procedure

The open method of castration was used in this study. Each calf was restrained in dorsal recumbency, the scrotal area washed with soap and water and later disinfected with methylated spirit. 1 ml of 2% lignocaine hydrochloride solution, a local anesthetic, was injected through the tense scrotal skin into each testicle to be removed. The scrotal skin had been earlier desensitized by local subcutaneous infiltration of the local anesthetic around the neck of scrotum (Hall, 1979). Each testicle was then held tightly against the scrotal skin to open up the scrotum. The incision which was about 1 cm wide penetrated the tunica vaginalis which was then retracted to allow the testicles to come out. Its attachment to the scrotal wall via the gubernaculums at the cauda epididymal end was severed together with the spermatic cord. A three-pronged ligature and clamping technique was employed to ensure hemostasis. 1 ml of a combination of antibiotic containing penicillin and streptomycin was then given parenterally and also infused into the scrotal tissue.

Collection of blood samples

2.5ml of blood was collected by jugular venipuncture using a sterile needle and syringe both for hematology and serum analyses. The blood samples were collected before castration and 30minutes interval post castration for 2hours. The experimental samples were collected in the morning (9.00 a.m.) when the animals were calm and the ambient temperature was low so as to reduce stress- related consequences. Thereafter, the samples were immediately taken to the laboratory for analyses after proper storage in an ice pack.

Analyses of blood samples

The blood samples collected for haematologic were evaluated for packed cell volume (PCV) using the hematocrit method (Jain and Schalm, 1986). Hemoglobin concentration was evaluated using the cyanomethaemoglobin method (Schalm et al., 1975). Red blood cell count was determined by the haematocytometry method (Jain and Schalm, 1986). Total white blood cell (WBC) counts and differential leucocyte counts were estimated according to Coles (1989). Serum urea and Creatinine levels were determined using photoelectric colorimeter (Coles, 1989). The serum electrolyte levels were evaluated using flame photometry. Hormonal assay was done spectrophotometrically using a commercially available kit.
Statistical analysis

Data collected were subjected to statistical analyses using ANOVA, followed by Turkey's multiple comparison. Values of $P<0.05$ were considered statistical significant and were presented as Mean ± standard error of mean.

3. RESULTS

Table 1: The hematological response of calves to castration at different time intervals

	PCV	RBC	WBC	PLT	Hb	N	L
Before	40±1.15	8897±209	7500±208.2	476667±66916	13.1±0.42	56.33±4.25	43.67±4.25
30min	45.33±2.18	9567±636	7683±462.2	586667±60645	14.23±1.08	68±2.5	28±4.35#
60min	39±0.57	8303±199	6700±115.5	403333±14530	12.47±0.08	62±0.57	38±0.57
90min	37.33±0.88*	7633±145*	6883±44.1	406667±44096	11.77±0.2	66±1.15	33.33±1.76
120min	41.33±2.02	9083±420.6	7583±277.4	406667±31798	13.4±0.79	65±4.04	34.67±3.75

*P<0.05 when compared with 30minutes #P<0.05 when compared with before castration.
PCV-Packed cell volume, RBC-Red blood cell, WBC-White blood cell, Hb-Haemoglobin, PLT-platelets, N-Neutrophils, L-Lymphocytes

The PCV and RBC increased after 30minutes and then decreased which was significant at 90minutes when compared with at 30minutes. The WBC and PLT also increased initially and later decreased though not significantly. No significant changes in Hb and N levels were observed. At 30mintes, the lymphocytes decreased significantly ($P<0.05$) when compared with the pre-castration value.

Table 2: The serum biochemistry response of calves to castration at different time intervals

	Na	K	Cl	HCO_3	Urea	Cr	Cu	Zn
Before	139.3±0.88	3.8±0.1	106.7±1.67	22±0.58	25.67±2.6	0.7±0.05	5.23±0.38	4.2±0.32
30min	138.7±2.02	3.8±0.2	105±2.88	22.33±1.85	24.33±3.18	0.63±0.08	5.73±0.34	4.06±0.08
60min	139.3±0.67	3.9±0	103.3±1.67	23.33±0.88	28±0.58	0.7±0	6.1±0.72	4.43±0.71
90min	138±0.58	3.9±0.1	102.7±1.45	25.67±0.88	27±0.58	0.6±0.05	6.06±0.03	4.76±0.03
120min	140.3±0.33	3.9±0.1	107.3±1.45	22.67±0.88	29±0.58	0.7±0.05	6.23±0.26	5.23±0.2

Na-Sodium, K-Potassium, Cl-Chloride, HCO_3-Bicarbonate, Cr-Creatinine, Cu-Copper, Zn-Zinc
There were no any significant changes in the values of Na, K, Cl, HCO_3, Urea, Cr, Cu and Zn across the time intervals.

Table 3: The hormonal response of calves to castration at different time intervals

	Estrogen	Testosterone	Cortisol
Before	14±2.65	2.83±0.4	10.03±1.7
30min	16.33±8.33	2.9±0.64	7.1±0.42
60min	22.67±3.84	3.4±0.28	9.36±1.36
90min	21±3.78	3.16±0.03	11.03±1.12
120min	21.33±5.48	3.2±0.14	11.97±1.12

The estrogen and testosterone levels increased from the pre-castration levels though not significant while the cortisol decreased at 30minutes and later increased at other time intervals of the study.

4. DISCUSSION

Castration has been shown to elicit physiological stress, inflammatory reactions, pain–associated behavior, suppression of immune function, and a reduction in performance to varying degrees (Hassan, 2010). The present study showed that castration of calves caused an increase in packed cell volume, red blood cell, white blood cell, platelets, hemoglobin concentration and neutrophil at 30minutes post-castration, a situation which could be attributed to splenic contraction and later decrease to return to nearly the basal level. The fluctuations in the hematological parameters could not be unconnected to the disruption in testosterone (Androgen) production due to the castration. This is similar to our findings in goats (Olaifa, 2018; Olaifa and Akpan, 2017) and also to findings of Hassan, 2010; Zha et al., 2013 and Gofur et al., 2014.

The exact mechanisms by which androgens regulate erythropoiesis have not been fully elucidated (Shahani et al., 2009), but there is evidence for both a direct stimulatory action on bone marrow erythroid progenitor cells via the androgen receptor as well as for indirect mechanisms involving erythropoietin (Shahani et al., 2009) and the master iron regulatory protein, hepcidin (Bachman et al., 2010; Grossmann and Zajac, 2012). Reduction of normal serum testosterone levels is associated with suppression of erythropoiesis.
It has been found in most experimental and case-control studies of testosterone treatment in elderly men that it stimulates erythropoiesis and increases hematocrit 3% - 5% above the normal range (Delev et al., 2013). The increase at 30minutes post castration could be a quick response to the castration causing a removal of blood from splenic reservoir into the circulation. Vasoconstriction occurs in the organs having reservoir function like spleen. Blood from this organ is directed into the systemic circulation so as to compensate for the slight reduction in blood volume (Sembulingam and Sembulingam, 2012).

There were no significant changes in the blood electrolytes as also observed in burdizzo -castrated goats (Olaifa, 2018). This indicates that castration in calves has no detrimental effects on electrolyte homeostasis and organ functions. Serum level of different electrolytes is an important indicator of the physiological status of the animal as they are involved in most of the body functions; such as muscle contraction, nerve conduction, body fluid homeostasis and maintenance of blood pH (Ashis, 2005).

The slight increase in the level of plasma testosterone observed at the other time intervals when compared with the pre-castration level may have been due to the production of testosterone by the adrenal cortical cells of the adrenal gland as a compensatory mechanism. Mingqiu and his colleagues also observed a compensatory function of adrenal glands by increasing the secretion of androgen precursors and producing a remarkable increase in androgen levels in rats (Mingqiu et al., 2008).

This study has shown that open castration in calves does not have an immense negative effect on the hematology, serum biochemistry and hormonal parameters which makes the procedure safe. These findings will serve as reference point for surgeons doing research on castration in calves and domestic animals. There is also need to further this research to determine the long term effects of this procedure.

REFERENCES

1. American Veterinary Medical Association (2009). Welfare implications of castration of cattle (June 26, 2009).http://www.avma.org/reference/ backgrounders/castration_cattle_bgnd.pdf, Accessed Aug 19, 2009.
2. Ashis B. (2005). Clinical Physiology. Cambridge University Press, New York, 2005.
3. Aydilek, N. and Aksakal, M. (2005). Effects of testosterone on lipid peroxidation, lipid profiles and some coagulation parameters in rabbits. Journal of Veterinary Medicine. A Physiology Pathology, Clinical Medicine, 52(9): 436-9.
4. Bachman, E., Feng, R., Travison, T., Li, M., Olbina, G. et al (2010). Testosterone suppresses hepcidin in men: a potential mechanism for testosterone-induced erythrocytosis. Journal of Clinical Endocrinology Metabolism, 2010; 95: 4743–7.
5. Barbara, J., Sheri, A., Hild, A. and Reel, J.R. 2006. A new potent orally active androgen with progestational activity. Endocrinology, 147(6): 3016-3026.
6. Carlson, G.P. 1996. Clinical chemistry tests. In: B. P. Smith (Ed.), Large Animal Internal Medicine. 2nd Ed. Mosby Publisher. USA.
7. Coles, E.H. (1989). Veterinary Clinical Pathology, 4th edition (W.B. Saunders Co., USA, 1989).
8. Currah J.M., Hendrick, S.H., Stookey, J.M (2009). The behavioral assessment and alleviation of pain associated with castration in beef calves treated with flunixin meglumine and caudal lidocaine epidural anesthesia with epinephrine. 2009, 50(4):375-382.
9. Delev, D.P., Delyana, P., Davcheva, Ilia D., Kostadinov, Ivanka I. Kostadinova (2013) Effect of Testosterone Propionate On Erythropoiesis After Experimental Orchidectomy. Folia Medica; 55(2): 51-57
10. Fisher, A. D., Knight, W. and Cosgrov, G. P. (2001). Effect of surgical or banding castration on stress responses and behavior of bulls. Australian Veterinary Journal, 79: 279-284.
11. Gonzalez, L. A., Schwartzkopf-Genswein, K.S., Caulkett, N. A., Janzen, E., McAllister, T.A., Fierheller, E., Schaefer, A. L., Haley, D. B., Stookey, J. M., Hendrick, S. (2010). Pain mitigation following band castration of beef calves and its effects on performance, behavior, E. coli, and salivary cortisol, 88:802-810.
12. Hall, L.W. (1979). Wright's Veterinary Anesthesia and Analgesia. 7th ed. ELBS and Balliere Tindeall, p. 95.
13. Jain, N. C., Schalm, O.W. (1986). Veterinary Haematology, 4th edn. (Lea and Febiger, USA).
14. Grossmann, M. and Zajac, J. D. (2012). Hematological changes during androgen deprivation therapy. Asian Journal of Andrology (2012) 14, 187–192.
15. Mingqiu, H., Dianqi, X., Jun, C., Guofeng, S., Yiming, W. & Yanqun, N. (2008). Changes in the androgen levels in the ventral prostate of spontaneously hypertensive rats after castration. BJU International; 1 0 4: 4 0 6 – 411.
16. Olaifa, A.K. (2018). Comparison in haematological and biochemical changes in normal, acute and chronically castrated West African Dwarf goats. International Journal of Research in Medical Sciences, 6 (5): 1623-1627.
17. Olaifa, A. K, Opara, M.N. (2011). Haematological and biochemical parameters of West African dwarf Goats (WAD) bucks castrated by the burdizzo method. Veterinary arhiv, 81, 743-750.
18. Olaifa A. K., Akpan M. O. (2017). Acute biochemical and haematological responses to burdizzo castration in West African dwarf bucks. E3 Journal of Medical Research; 6(1): 006-011.
19. Schalm, O.W., Jain, N.C. and Carrol, E. (1975). Veterinary Haematology 3rd Edition Lea and Febiger, Philadephia USA, 160-21.
20. Sembulingam, K, & Sembulingam, P. (2012). Essentials of Medical Physiology. J.P. Medical Ltd. Pg. 652
21. Shahani, S., Braga-Basaria, M., Maggio, M., Basaria, S. (2009). Androgens and erythropoiesis: past and present. Journal of Endocrinological Investigation, 32: 704–16.
22. Stafford, K. J. (2005). Alleviating the pain caused by the castration of cattle. Veterinary Journal, 173: 333-342 (2007).

23. Stafford, K. J., Mellor, D. J. (2005). The welfare significance of the castration of cattle: a review. New Zealand Veterinary Journal, 53: 271-278.
24. Svoboda, M., Eichlerova, K., Horak, V. and Hradecky, J. (2005). Development of haematological indices in melanoma-bearing liběchov minipigs. Acta Veterinaria Brno., 74(4): 603-611.
25. Zha, C., Moon, D.G., Park, J.K. (2013). Effect of testosterone undecanoate on haematological profiles, blood lipid and viscosity and viscosity and plasma testosterone level in castrated rabbits. Can. Urol. Assoc. J., 7 (3-4):E221-225.
26. Hassan, A.A. (2010). Effect of castration on some physiological aspect in rats: Effect of testosterone hormone. J.Edu. Sci., 23 (3): 28-39.
27. Gofur, M. R., Hossain K.M.M., Khaton, R. and Hasan, M. R. (2014). Effect of testosterone on physio-chemical parameters and male accessory sex glands of black Bengal goat. International Journal of Emerging Technology and Advanced. Engineering, 4:456- 465