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Original Research Article

Comparison in haematological and biochemical changes in normal, acute and chronically castrated West African Dwarf goats

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ABSTRACT

Background: Castration is one of the frequent management practices in large animal husbandry and burdizzo castration has been shown to produce fewer long-term behavioral signs of pain and distress than banding. Castration is known to reduce virility and aggression due to the elimination of testicular androgens.
Methods: This is a comparative study of hematological and biochemical parameters in intact, acute and chronically castrated West African dwarf goats. Twelve adult West African Dwarf bucks weighing between 8 to 14 kg randomly divided into 3 groups of intact, acute and chronic castrated. They were castrated using burdizzo castrator. Hematological and biochemical parameters were estimated by standard laboratory procedures.
Results: There were significant decreases ($P<0.05$) in the PCV, Hb, RBC, WBC and MCH of acute and chronically castrated goat compared to the control group. The MCV and platelets increased significantly in acute and chronically castrated goat; while the neutrophil and lymphocyte showed no significant changes. The result also showed no significant changes in Na^+, Cl^-, K^+, Ca^{2+}, Cu^{2+}, AST and Creatinine. Mg^{2+} and ALT significantly increased in chronically castrated goats compared with the acutely castrated goats while Zinc increased significantly ($P<0.05$) in acute castrated compared with the control goats.
Conclusions: Therefore, from this study, either acute or chronic castration in goats have no detrimental effect on blood electrolytes, but mainly deter the hematopoietic process in the animal owing to testosterone and androgen depletion in castrate animals.

Keywords: Acute, Chronic, Castration, Erythopoiesis, WAD goats

INTRODUCTION

Testosterone, the principal androgen, secreted by Leydig cells, exerts both 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 and also affects the hemogram of animals.[1,2] Testosterone is involved in regulating the oxidative phase of carbohydrate metabolism[1] and also improves the lipid metabolism.[3] Several non-genetic factors including castration (removal of testis, the source of testosterone) affecting haematological parameters of farm animals have been observed.[4, 5]

Castration means a process which stops the functions of the testes leading to sterilization.[6] The indications for castration are different according to reasons of castration such as to stop the production of male hormones and sperms, prevent mating after age of puberty, produce animal to be easier to handle with less aggressiveness, avoid unwanted pregnancies and mating of young females before they are of adequate body size and age for pregnancy and parturition and reduce goaty smell in males.[7] Castration is one of the management activities practiced in different parts of the country as castration in goats has an advantage of eliminating the strong maleodor present in bucks. Un-castrated and sexually mature goats are difficult to sell or they may have low

market price because of their strong male taint. Castrations also affect growth and carcass composition.[8]

Two prevalent castration techniques including the application of rubber rings or tightened latex bands referred to as banding; and use of a burdizzo instrument to crush the testicular cords (referred to as burdizzo).[9-11] Burdizzo procedure requires the male to be restrained as the burdizzo device is clamped on the spermatic cord above the testicles. Torsion of the spermatic cord causes strangulation of gonadal blood supply with subsequent testicular necrosis and atrophy, and results in diminished fertility in experimental animals.[12,13] Burdizzo castration has been shown to have no effects on most of feedlot performance traits and blood metabolites.[14]

Higher peak cortisol concentration following surgical and banding castration was earlier observed.[15] Castration has been shown to elicit physiological stress, inflammatory reactions (indicated by acute phase proteins), pain-associated behaviour, suppression of immune function, and a reduction in performance to varying degrees.[16,17] Earlier studies on acute effects of burdizzo castration on hematological and biochemical parameters in goats have been reported.[18,19]

Examining blood for their constituents is used to monitor and evaluate health and nutritional status of animals.[3] Though, various studies have been carried out on castrated WAD goats but information is scanty on the current study which compares the changes in the reproductive hormone and hemato-biochemical parameters. Also reference values will be available to surgeons and other clinicians.

METHODS

Experimental animals

Twelve adult West African Dwarf bucks weighing between 8 to 14 kg randomly divided into 3 groups of intact, acute and chronic castrated were acclimatized for one week before commencement of this study. The individual pens were cleaned and disinfected prior to the arrival of the animals. Upon arrival, they were clinically 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 and fed daily on a 12% protein ration, fresh grass and water ad libitum.

Castration procedure

The bucks were restrained with the hind limbs apart and scrotal area exposed for correct application of the Burdizzo castrator. The instrument was applied laterally onto the scrotal neck of the goat. The cord was held laterally in the scrotal neck by first finger and thumb, with the second hand directing the position of the jaws slowly, until they were about 8-10mm apart to grip the skin and cord firmly. Rapid closure was ordered and maintained for 15-30 seconds, during which the cord was correctly crushed.[18]

Collection of blood samples

A 2.5ml of blood was collected by jugular venipuncture using a sterile needle and syringe both for hematology and serum analyses. The blood samples for acute castration were collected 24 hours after castration and the chronic were collected five weeks post castration.

The experimental samples were collected in the morning 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 haematology were evaluated for packed cell volume (PCV) using the haematocrit method.[20] Haemoglobin concentration was evaluated using the cyanomethaemoglobin method.[21] Red blood cell count was determined by the haematocytometry method.[20]

Total white blood cell (WBC) counts and differential leucocyte counts were estimated according to Coles (1989). Serum urea and Creatinine levels was determined using photoelectric colorimeter.[22] Aspartate aminotransferase (AST) and alanine aminotransferase (ALT) activities were measured using a colorimetric method.[23] The serum electrolyte levels were evaluated using flame photometry.

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.

RESULTS

There was a significant ($P<0.05$) decrease in PCV, Hb, RBC, WBC and MCH of acute and chronic castrated goat compared to control group. The MCV and platelets increased significantly in acute and chronic castrated goat; while neutrophil and lymphocyte showed no significant changes (Table 1).

The result showed no significant changes in Na^+, Cl^-, K^+, Ca^{2+}, Cu^{2+}, AST and Creatinine. Mg^{2+} and ALT significantly increased in chronic castrated goats compared with acute castrated goats while Zinc increased significantly in acute castrated compared with control goats (Table 2).

Table 1: Hematological values of control and experimental goats.

Parameter	Control	Castrated	
		Acute	Chronic
PCV (%)	46±0.51	42.72±0.55	22±0.4*
Hb (gm/l)	16.95±0.45	13.63±0.17	7.25±0.10*
MCV (fL)	53.08±1.19	57.09±1.01*	71.02±1.64*
MCH (Pg)	17.76±0.73	18.67±0.42	23.42±0.74*
MCHC (g/dL)	33.41±0.66	32.63±0.27	33.39±0.79
WBC (cell/mm^3)	10000±185.1	13210±385	4590±44.9
RBC (cell/mm^3)	9136±178.7	7965±251	3102±55.5
Platelet(cell/mm^3)	585000±6449	840000±21983	118750±3944
Neutrophils (%)	68.22±0.85	55.75±1.8	63.5±0.64
Lymphocytes (%)	31.0±0.65	46.5±2.02	34±1.68

*P<0.05 compared with control. PCV-Packed cell volume, Hb-Hemoglobin, RBC-Red blood cell, WBC-White blood cell, MCH-Mean corpuscular volume, MCV-Mean corpuscular volume, MCHC-Mean corpuscular hemoglobin concentration

Table 2: Biochemical and electrolyte indices of control and experimental (acute and chronic castrates) goats.

Parameters	Control	Castrated	
		Acute	Chronic
Na^+ (mmol/L)	132±1.77	133±1.09	136±1.49
Cl^- (mmol/L)	95.5±1.44	93.15±2.39	100±2.1
K^+ (mmol/L)	3.27±0.10	3.29±0.07	3.52±0.15
Ca^{2+} (mg/dl)	6.7±0.29	5.65±0.35	6.5±0.04
Cu^{2+} (mg/dl)	3.65±0.65	3.65±0.50	5.25±0.06
Zinc (mg/dl)	2.80±0.51	4.55±0.29*	3.35±0.1
Mg^{2+} (mg/dl)	5.45±0.49	4.05±0.25	6.05±0.06#
Creatinine	0.51±0.05	0.42±0.04	0.55±0.06
AST	11.55±0.79	10.95±0.49	11.5±0.64
ALT	7.90±0.58	7.55±0.49	9.25±0.48#
Testosterone	3.47±0.27	4.73±0.14	2.1±0.3
Estrogen	0.75±0.15	1.23±0.08	1.3±0.11
Cortisol	5.25±0.75	13±1.22	8.47±2.56

*P<0.05 compared with control, #P<0.05 compared with acute. Na+-Sodium ion, Cl-Chloride ion, K+-Potassium ion, Ca2+-Calcium ion, Cu2+-Copper ion, Mg2+-Magnesium ion, AST-Aspartate Transferase, ALT-Alanine Transferase

DISCUSSION

Castration is one of the frequent management practices in large animal husbandry. Some of the indications include prevention of breeding and enhancing the growth rate of the goats.[24,25] A method is known as Burdizzo clamping, which involves using a tool to crush the spermatic cords from outside the scrotum, with the aim to remove the blood vessels feeding the testes.[26]

Although it is related to the banding method, Burdizzo castration has been shown to produce fewer long-term behavioral signs of pain and distress than banding.[27] Castration is known to reduce virility and aggression due to the elimination of testicular androgens.[28]

Chronic castration of goats in this study significantly (P<0.05) reduced packed cell volume (PCV), red blood cell (RBC), hemoglobin concentration (Hb); a significant (P<0.05) increase in mean corpuscular volume (MCV) and mean corpuscular hemoglobin (MCH).These findings corroborate the report by Kelani and Durotoye, Hassan, Zha et al, and Gofur et al.[29-32] Reduction of normal serum testosterone levels as in castrated animals is associated with suppression of erythropoiesis. The values of MCV and MCH significantly increased and have clinical implications of anemia and also serve a useful index of the capacity of the bone marrow to produce red blood cells.[33] Testosterone has the ability to increase erythropoiesis (red blood corpuscles production) in the kidneys, and a higher red blood corpuscles (RBCs) count may improve iron kinetic studies.[33] It is possible that testosterone stimulates erythropoiesis by directly affecting the bone marrow hematopoietic stem cells. This direct effect is mediated through the induction of insulin-like growth factor (IGF-1) of the androgen-receptor mediated mechanism.[34] In the available literature, there is evidence that testosterone enhances the absorption of iron, its incorporation into red blood cells and hemoglobin synthesis.[35] Testosterone-induced increase in hematocrit and hemoglobin is associated with elevated erythropoietin levels, but this is also accompanied by other mechanisms, such as reduced hepcidin (the iron-regulatory peptide) and ferritin.[36] Anemia is partially associated with reduced levels of circulating androgens.[37]

The testosterone levels in chronically castrated goats decreased insignificantly (P>0.05) and it increased insignificantly (P>0.05) in the acute castrated animals. The upsurge during the acute castration could have been due to a compensatory mechanism in order to regulate the serum testosterone within the physiological range. The Platelets increased insignificantly in the acute castrated goats compared with intact goats. The causes of thrombocytosis are classified as primary (clonal) or

secondary (reactive). The clonal thrombocytosis is observed in chronic myeloproliferative diseases such as essential thrombocythemia or in some myelodysplastic syndromes.[38] Reactive thrombocytosis may occur in various conditions such as infections, surgery, malignancies, inflammatory diseases, trauma, asplenic states, and iron deficiency anemia (IDA).[39,40] This could have been precipitated as a result of anemia observed in this study. Acute and chronic castration is not harmful to the kidney as the creatinine levels show no significant change. Creatinine is removed from the blood chiefly by the kidneys, primarily by glomerular filtration, but also by proximal tubular secretion. Serum creatinine is the most commonly used indicator (but not direct measure) of renal function.

The hematological findings in this study have opened a new gateway into the clinical understanding of the altered body physiology of castrated West African Dwarf goats. Though, these findings need further investigations in other mammals which will further strengthen and establish them as new research discovery. We can therefore conclude from this study that either acute or chronic castration in goats have no detrimental effects on blood electrolytes but only mainly inflict negativity on the hematopoietic process in the animal owing to testosterone and androgen depletion in the castrate animals. The castrated animals showed clinical macrocytic anemia (increased MCV) which will make them to be more susceptible to severe anemia than intact goats which might prove fatal thereafter.

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REFERENCES

1. Attardi BJ, Hild SA, Reel JR. Dimethandrolone undecanoate: a new potent orally active androgen with progestational activity. Endocrinol. 2006;147(6):3016-26.
2. Aydilek N, Aksakal M. Effects of testosterone on lipid peroxidation, lipid profiles and some coagulation parameters in rabbits. J Vet Med Physiol Pathol Clin Med. 2005;52(9):436-9.
3. Gupta V, Bhasin S, Guo W, Singh R, Miki R, Chauhan P, et al. Effects of dihydrotestosterone on differentiation and proliferation of human mesenchymal stem cells and preadipocytes. Molecular cellular endocrinology. 2008;296(1-2):32-40.
4. Carlson GP. Clinical chemistry tests. In BP Smith (Ed.), Large Animal Internal Medicine. 2nd Ed. Mosby Publisher. USA;1996.
5. Svoboda M, Eichlerova K, Horak V, Hradecký J. Development of haematological indices in melanoma-bearing Liběchov minipigs. Acta Veterinaria Brno. 2005;74(4):603-11.
6. Fisher AD, Knight TW, Cosgrove GP, Death AF, Anderson CB, Duganzich DM, et al. Effects of surgical or banding castration on stress responses and behaviour of bulls. Australian veterinary J. 2001;79(4):279-84.
7. Burciage RL, Step DL, Holland BP, McCurdy MP, Krehbiel CR. Castration in goats: Technique and animal welfare issues. Compend. Cont Educ Pract Veterinarian. 2006;24(9):512-5.
8. Solomon G, Fletcner I, Gizaw K, Yibrah Y. Effects of castration and supplementary feeding on growth, carcass characteristics, and market value of Adal goats'. In: IAR Proceedings of the Fourth National Livestock Improvement Conference, Addis Ababa, Ethiopia. 1991;159-164.
9. Fell LR, Wells R, Shutt DA. Stress in calves castrated surgically or by the application of rubber rings. Australian veterinary J. 1986 ;63(1):16-8.
10. Chase Jr CC, Larsen RE, Randel RD, Hammond AC, Adams EL. Plasma cortisol and white blood cell responses in different breeds of bulls: a comparison of two methods of castration. J animal science. 1995;73(4):975-80.
11. Robertson IS, Kent JE, Molony V. Effect of different methods of castration on behaviour and plasma cortisol in calves of three ages. Research in veterinary science. 1994;56(1):8-17.
12. Vigueras RM, Reyes G, Rojas-Castaneda J, Rojas P, Hernandez R. Testicular torsion and its effects on the spermatogenic cycle in the contralateral testis of the rat. Laboratory animals. 2004;38(3):313-20.
13. Callewaert PR, Van Kerrebroeck P. New insights into perinatal testicular torsion. Euro J Pediatrics. 2010;169(6):705-12.
14. Nasr AI, Atta M, Elmahi MI, Mohammed AO. Effect of castration on feedlot performance and some serum metabolites of Nubian male kids. Res Opi Anim Veter Sci. 2011;1(2):98-101.
15. Earley B, Crowe MA. Effects of ketoprofen alone or in combination with local anesthesia during the castration of bull calves on plasma cortisol, immunological, and inflammatory responses. J Animal Science. 2002;80(4):1044-52.
16. Fisher AD, Crowe MA, OÓNualláin EÓ, Monaghan ML, Prendiville DJ, O'Kiely P, et al. Effects of suppressing cortisol following castration of bull calves on adrenocorticotropic hormone, in vitro interferon-γ production, leukocytes, acute-phase proteins, growth, and feed intake. J animal science. 1997;75(7):1899-908.
17. Ahmed SA, Ahmed EA. Behavioral responses of castrated buck kids at different ages by using different methods of castration. J Am Sci. 2011;7(5):200-9.
18. Olaifa AK, Opara MN. Haematological and Biochemical parameters of West African Dwarf bucks castrated by the Burdizzo method. Vet Arhiv 2011;81:743-50.
19. Kayode OA, Obot AM. Acute biochemical and Hematological responses to Bur dizzo castration in

West African Dwarf bucks. EJMR. 2017;6(1):006-11.
20. Jain NC. Schalms Veterinary haematology 4th ed. Lea and Febiger, Philadelphia, USA. 1986;1168.
21. Schalm OW, Jain NC, Carrol E. Veterinary Haematology 3rd Ed. Lea and Febiger, Philadephia USA;1975:160-21.
22. Coles EH. Veterinary Clinical Pathology, 4th Ed. W.B. Saunders Co., USA;1989.
23. Reitman AG, Frankel S. A colorimetric method for the determination of serum glutamic transaoxalecetic and glutamic pyruvic transaminases. Am J Clinical Pathology. 1957;28:56-63.
24. Venogopalan A. Castration of bull. In: Essentials of Veterinary Surgery. Oxford and IBH Publishing Co. PVT. Ltd, India; 8th Ed. 2000:491.
25. O'Connor JJ. Castration of the goat. In: Dollar's Veterinary Surgery. CBS Publishers and Distributors, India. 4th Ed. 2005:381.
26. Anderson N. Fact Sheet: Castration of Calves. Ontario Ministry of Agriculture, Food and Rural Affairs. 2007;07-029:420-6.
27. Melches S, Mellema SC, Doherr MG, Wechsler B, Steiner A. Castration of lambs: a welfare comparison of different castration techniques in lambs over 10 weeks of age. Veterinary J. 2007;173:477.
28. Edwards DA. Early androgen stimulation and aggressive behavior in male and female mice. Physiol Behav. 1996;14:333-8.
29. Kelani OL, Durotoye LA. Haematological responses of the African giant rat (Cricetomisgambianus) to castration and androgen replacement. Vetreinarski Arhiv. 2002;72(1):39-49.
30. Hassan AA. Effect of castration on some physiological aspect in rats: Effect of testosterone hormone. J Edu Sci. 2010;23(3):28-39.
31. Zha C, Moon DG, Park JK. Effect of testosterone undecanoate on hematological profiles, blood lipid and viscosity and plasma testosterone level in castrated rabbits. Can Urol Assoc J. 2013;7(3-4):E221-5.
32. Gofur MR, Hossain KM, Khaton RM, Hasan MR. Effect of Testosterone on Physio-Biochemical Parameters and Male Accessory Sex Glands of Black Bengal Goat International J Emerging Technology Advanced Engineering. 2014;4(9):456-65
33. Njidda AA, Shuai'bu AA, Isidahomen CE. Haematological and Serum Biochemical Indices of Sheep in Semi-Arid Environment of Northern Nigeria. Global J Sci Frontier Res. 2104;14(2):49-55.
34. Hero M, Wickman S, Hanhijärvi R, Siimes MA, Dunkel L. Pubertal up regulation of erythropoiesis in boys is determined primarily by androgen. J Pediatr. 2005;146(2):245-52.
35. Kim SW, Hwang JH, Cheon JM, Park NS, Park SE, Park SJ, et al. Direct and indirect effects of androgens on hematopoietic cells in vitro. J Korean Med Sci. 2005;20:409-16.
36. Bachman E, Travison TG, Basaria S, Davda MN, Guo W, Li M, et al. Testosterone induces erythrocytosis via increased erythropoietin and suppressed hepcidin: evidence for a new erythropoietin/hemoglobin set point. J Gerontol Biol Sci Med Sci. 2014;69(6):725-35.
37. Ferrucci M, Maggio S, Bandinelli S, Basaria S, Lauretani F, Ble A, et al. Low testosterone levels and the risk of anemia in older men and women. Arch Intern Med. 2006;166:1380-8.
38. Dan K. Thrombocytosis in iron deficiency anemia. Intern Med. 2005;44:1025-6.
39. Aydogan T, Kanbay M, Alici O, Kosar A. Incidence and etiology of thrombocytosis in an adult Turkish population. Platelets. 2006;17:328-31.
40. Kadikoylu G, Yavasoglu I, Bolaman Z, Senturk T. Platelet parameters in women with iron deficiency anemia. J Natl Med Assoc. 2006;98:398-402.

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