

Full length research paper

# Acute biochemical and Hematological responses to Burdizzo castration in West African Dwarf bucks

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Accepted 10 January, 2017

Castration has been shown to elicit physiological stress, inflammatory reactions, pain-associated behaviour, suppression of immune function, and a reduction in performance to varying degrees. The responses to castration using Burdizzo were investigated in four male West African Dwarf (WAD) goats hourly over a period of 3 hours. The bucks were castrated with Burdizzo clamp, blood samples were collected by jugular venipuncture for biochemical, hematological and hormonal analyses. The hematological values showed significant decreases ( $P<0.05$ ) in PCV, Hb, Rbc, neutrophil throughout the period, while the White blood cell count decreased significantly 1 hour post castration. Respiratory rate increased significantly ( $P<0.05$ ) throughout the post castration period of study, while the rectal temperature significantly increasing ( $P<0.05$ ) for just an hour post castration. Cortisol level rose significantly ( $P<0.05$ ) throughout the study period. Testosterone and estrogen levels fell after an hour though non-significantly ( $P>0.05$ ) but later rose significantly ( $P<0.05$ ) during the second and third hour post castration. The serum biochemistry changes observed include a significant rise ( $P<0.05$ ) in AST, ALT, urea and Creatinine after 1 hour upon castration, but the values later significantly decreased ( $P<0.05$ ) after the 2nd and 3rd hours. The serum electrolytes increased significantly ( $P<0.05$ ) an hour post castration when compared with the pre castration values and later decreased significantly ( $P<0.05$ ) at the 2nd and 3 hours post castration in comparison to the 1st hour value. There was a non-significant ( $P>0.05$ ) increase in heart rate 1 hour post castration before returning to the pre castration value. This study concluded that the effects of three hours post burdizzo castration on hematological and biochemical profile fluctuated significantly in all the values under study and this calls for clinical surveillance among surgeons when such animals are brought for surgery during the acute period of castration. Also, this study will make information available for clinicians and researchers.

**Keywords:** Burdizzo, Castration, Hematology, Biochemistry, Serum

## Introduction

Goats are one of the most essential food-producing animal species in developing countries and an integral part of a traditional crop livestock production (Seyoum, 2002).

Castration means a process which stops or reduces the function of the testes leading to sterilization (Fisher and Knight, 2001). The castration of male goats is a routine practice in many countries aimed at stopping the production of male hormones and sperms, preventing mating after age of puberty, producing animal to be easier to handle with less aggressiveness and improving meat quality (Molony *et al.*, 1995). Also to avoid

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unwanted pregnancies and mating of young females before they are of adequate size and age for pregnancy and parturition and reduce goaty smell in males (Burciage *et al.*, 2006).

The common techniques used for castration are Burdizzo, elastration, ligation of spermatic cord and chemical castration (Coetzee *et al.*, 2010). Burdizzo procedure requires the buck to be restrained as the burdizzo device is clamped on the spermatic cord above the testicles. Each spermatic cord is crushed separately. This action severs the blood supply to the testicles causing them to degenerate. Post-castration discomfort or pain from the use of the burdizzo is comparable with other castration methods (Robertson *et al.*, 1994). 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 (Fisher *et al.*, 1997; Ahmed and Ahmed, 2011) to varying degrees. Castrations also affect growth and carcass composition as it alters metabolism (Solomon *et al.*, 1991). The chronic effects of burdizzo castration on hematological and biochemical parameters in goats after 4 weeks have been earlier reported (Olaifa and Opara, 2011). Burdizzo castration has been shown to have no effect on most of feedlot performance traits and blood metabolites (Nasr *et al.*, 2011). Previous reports showed an increase in two acute-phase proteins (APP) at an earlier time (days 1, 3, and 7 post-castration) in younger animals (Earley and Crowe, 2002; Ting *et al.*, 2003; Pang *et al.*, 2006). The effect of castration on average daily weight gain in goats has not been consistent. Daily weight gains of castrated goats were either lower (Allan and Holst, 1989), higher (Mackenzie, 1970) or unchanged (Koyuncu *et al.*, 2007), compared to intact goats.

Hitherto, there is dearth of information on short or immediate term effects of bloodless burdizzo castration on hematological, biochemical and serum electrolytes in West African Dwarf goats. Hence, the need to study these effects within the first three hours post castration since such animals can be presented for surgical intervention within such hours post castration. Also, this study will make information available for clinicians and researchers for reference purposes.

## Materials and Methods

### Experimental animals

Four intact adult West African Dwarf bucks weighing between 8 to 14 kg 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 examined and dewormed using Levamisole<sup>®</sup> 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 held apart and scrotal area exposed for correct application of the Burdizzo castrator. The instrument was applied laterally onto the scrotal neck behind 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 8-10 mm 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 (Olaifa and Opara, 2011).

### 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 first set of blood samples were collected prior to castration and then hourly for 3 hours after castration. The 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 (Jain and Schalm, 1986). Haemoglobin 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 was determined using photoelectric colorimeter (Coles, 1989). Aspartate aminotransferase (AST) and alanine aminotransferase (ALT) activities were measured using a colorimetric method (Reitman and Frankel 1957). The serum electrolyte levels were evaluated using flame photometry (Jones, 1995).

### Statistical analysis

Data collected were subjected to statistical analysis using ANOVA, followed by Turkey's multiple comparison.

**Table 1:** Hematological values of WAD bucks before and after Burdizzo castration

Parameter	Pre-castration	Post castration		
		1 hour	2 hours	3 hours
PCV (%)	48±0.41 <sup>ab</sup>	46.25±0.48 <sup>a</sup>	44.25±0.48 <sup>a</sup>	44.75±0.75 <sup>a</sup>
Hb (gm/l)	16.05±0.44 <sup>ab</sup>	14.83±0.08 <sup>a</sup>	14.6±0.23 <sup>a</sup>	14.63±0.17 <sup>a</sup>
Wbc (cell/mm <sup>3</sup> )	10000±187.1 <sup>ab</sup>	11150±64.55 <sup>ac</sup>	12625±225 <sup>a</sup>	13188±390.7 <sup>a</sup>
Rbc (cell/mm <sup>3</sup> )	9063±174.9 <sup>ab</sup>	8450±64.55 <sup>ab</sup>	7830±47.08 <sup>a</sup>	7875±253.7 <sup>a</sup>
Platelet(cell/mm <sup>3</sup> )	595000±6455 <sup>bc</sup>	635000±6455 <sup>bc</sup>	683750±14913 <sup>b</sup>	850000±21985 <sup>b</sup>
Neutrophils (%)	69.25±0.75 <sup>ac</sup>	58.25±0.48 <sup>bc</sup>	62.25±0.75 <sup>bc</sup>	53.75±1.60 <sup>a</sup>
Leucocytes (%)	30.5±0.65 <sup>c</sup>	41.5±0.29 <sup>bc</sup>	37.75±0.75 <sup>bc</sup>	45.5±2.02 <sup>b</sup>

Values are mean ± standard error of mean. Means on the same row with different superscripts are significantly different (P<0.05).

**Table 2:** Serum biochemistry of WAD buck before and after Burdizzo castration

Parameters	Pre-castration	Post-castration		
		1 hour	2 hours	3 hours
AST (iu/L)	11.25±0.75b	14±0.41ba	11.74±0.75b	10.75±0.48bc
ALT (iu/L)	7.75±0.48b	10.5±0.29ab	9.25±0.48a	7.25±0.48b
Urea (mg/dl)	15.25±1.60ab	20.25±0.48a	14.5±1.19b	13.75±1.03c
Creatinine (mg/dl)	0.53±0.05ab	0.75±0.06a	0.48±0.05b	0.43±0.05c

Values are mean ± standard error of mean. Means on the same row with different superscripts are significantly different (P<0.05).  
AST- Aspartate Transaminase ALT- Alanine Transaminase

**Table 3:** Serum electrolytes of WAD bucks before and after Burdizzo castration

Parameters	Pre-castration	Post-castration		
		1 hour	2 hours	3 hours
Na <sup>+</sup> (mmol/L)	134±1.78ab	140±0.41a	133.8±0.85b	131.8±1.03c
Cl <sup>-</sup> (mmol/L)	97.5±1.44ab	108±1.08a	95±2.0b	93.75±2.4c
K <sup>+</sup> (mmol/L)	3.23±0.10ab	3.93±0.08a	3.23±0.07b	3.28±0.07c
Ca <sup>2+</sup> (mg/dl)	6.5±0.29a	6.5±0.29a	6.0±0.40a	5.75±0.25a
Cu <sup>2+</sup> (mg/dl)	3.75±0.75a	6.0±0.41a	4.0±0.58a	3.75±0.48a
Zinc (mg/dl)	2.75±0.48a	3.5±0.29a	3.25±0.25a	4.5±0.29ab
Mg <sup>2+</sup> (mg/dl)	5.25±0.48a	6.5±0.29a	4.75±0.25ab	4.25±0.25bc

Values are mean ± standard error of mean. Means on the same row with different superscripts are significantly different (P<0.05)

Values of P<0.05 were considered statistical significant and were presented as Mean ± standard error of mean.

## Results

The Packed cell volume (PCV), Hemoglobin concentration (Hb) and red blood cell count (RBC) decreased significantly (P<0.05) post castration compared with pre castration value. The white blood cell (WBC), platelets and leucocytes increased significantly (P<0.05) after 2, 3hours castration as compared with pre castration (Table 1).The serum biochemistry changes observed includes a significant rise in AST, ALT, urea and Creatinine after 1 hour upon castration, but the values later significantly decreases after 2 and 3 hours as

compared with 1 hour post castration (Table 2). Sodium ion (Na<sup>+</sup>), Chloride ion (Cl<sup>-</sup>), potassium ion (K<sup>+</sup>) and magnesium ion (Mg<sup>2+</sup>) increased significantly 1hour post castration as compared with pre castration value and decreased significantly 2 and 3 hours post castration as compared with 1 hour post castration. No significant changes in Calcium ion (Ca<sup>2+</sup>) and copper ion (Cu<sup>2+</sup>) but there was a non-significant increase in Cu<sup>2+</sup> 1 hour post castration. Zinc ion (Zn<sup>2+</sup>) showed a significant increase 3 hours post castration compared with pre castration value (Table 3). There was a non-significant increase (P>0.05) in heart rate 1 hour post castration which later returned to the pre castration level. Respiratory rate increased significantly (P<0.05) throughout the post castration period while the rectal temperature significantly increased

**Table 4:** Heart rate, respiratory rate and rectal temperature of WAD bucks before and after Burdizzo castration

Parameters	Pre-castration	Post-castration		
		1 hour	2 hours	3 hours
Heart rate(Beats/min)	112±1.83a	114.5±0.65a	107±3.03a	112±1.83a
Resp rate(Breaths/min)	49.75±0.85bc	81.75±0.85a	81.75±0.85a	72.75±1.25ab
Rect. Temp (0 C)	38.83±0.14ab	39.9±0.28a	39.43±0.15ab	39.05±0.19ab

Values are mean ± standard error of mean. Means on the same row with different superscripts are significantly different (P<0.05)

**Table 5:** Hormones level of WAD bucks before and after castration

Parameters	Pre-castration	Post-castration		
		1 hour	2 hours	3 hours
Testosterone (iu/L)	1.48±0.28 <sup>b</sup>	0.93±0.05 <sup>ba</sup>	1.89±0.23 <sup>b</sup>	2.73±0.14 <sup>bc</sup>
Estrogen (iu/L)	0.75±0.16 <sup>b</sup>	0.33±0.05 <sup>ab</sup>	0.73±0.13 <sup>a</sup>	1.23±0.08 <sup>b</sup>
Cortisol (iu/L)	5.25±0.75 <sup>ab</sup>	8.25±0.25 <sup>a</sup>	8.75±1.03 <sup>a</sup>	13±1.23 <sup>c</sup>

Values are mean ± standard error of mean. Means on the same row with different superscripts are significantly different (P<0.05)

an hour post castration (Table 4). The testosterone and estrogen levels decreased at the 1<sup>st</sup> hour but later increased significantly at the 3<sup>rd</sup> hour. The cortisol level significantly (P<0.05) rises throughout the hour of the study (Table 5).

## Discussion

Castration is any procedure that removes the testicles surgically, damaging them irreparably or causing them to atrophy by stricture of the blood supply (Currah *et al.*, 2009). There are various castration methods used in animals, which include physical, chemical and hormonal methods (Rajkumar, 2013). Haematological parameters are good indicators of the physiological status of animals (Khan and Zafar, 2005). Several non-genetic factors including castration affecting haematological parameters of farm animals have been observed (Svoboda *et al.*, 2005; Xie *et al.*, 2013). PCV, Hemoglobin concentration (Hb) and RBC were significantly reduced at 1, 2 and 3 hours as compared to pre-castration level in this study. These findings corroborate the findings reported by Kelani and Durotoye, 2002; Hassan, 2010; Zha *et al.*, 2013 and Gofur *et al.*, 2014. Testosterone has the ability to increase erythropoiesis (red blood corpuscles production) in the kidneys, and a higher red blood corpuscles (RBCs) count (Hassan, 2010). Therefore, acute deficiency of testosterone of the goats might have caused the significant decrease in RBC and PCV and Hb since the testis is the major producer of testosterone.

The total WBC, Platelets and leucocytes increased significantly in the post castration values as compared to pre castration values. This profound effects on leucocytes indices is in agreement with the findings of AL-Zghoul *et*

*al.*, 2008; Hassan, 2010. Castration has been shown to elicit physiological stress, anti-inflammatory reactions (indicated by acute phase proteins), pain-associated behaviour, suppression of immune function, and a reduction in performance (Ahmed and Ahmed, 2011; Fisher *et al.*, 1997; Molony *et al.*, 1995) to varying degrees. The acute phase response (APR) is a nonspecific component of innate immunity, which may respond to infection, inflammation, tissue damage, or stress (Fisher *et al.*, 2001; Hughes *et al.*, 2014). Biological responses associated with the APR include fever, production of acute phase proteins by hepatocytes, and increases in circulating WBC (Carroll and Forsberg, 2007).

The castration procedure has been reported to elicit varying degrees of pain in animals (Udegbunam *et al.*, 2013). Pain in animals is associated with changes in physiological and biochemical parameters, as a result of changes in plasma levels of catecholamines (Molony and Kent, 1997). Painful stimulations have been associated with increased heart and respiratory rates as a result of increased activities of the sympathetic nervous system (Molony and Kent, 1997; Udegbunam *et al.*, 2013). This might probably explain the significant rise in heart rate, respiratory rate and rectal temperature observed in this study in post castration values when compared with the pre castration values.

Testosterone and estrogen levels dropped 1 hour post castration and later increased significantly (P<0.05) 2, 3 hours post castration, this might be due to compensatory response of the body as part of homeostatic control while cortisol increase significantly post castration. Fundamentally, severe pain, whether it is acute or chronic, is a severe stressor that activates the hypothalamic–pituitary–adrenal–thyroid–gonadal

(HPATG) system, which is the major stress control mechanism of the body (Cutolo *et al.*, 1999; Tennant, 2000). The critical pain-control hormones that are produced in glands outside the central nervous system are cortisol, pregnenolone, dehydroepiandrosterone (DHEA), progesterone, testosterone, estrogen, and thyroid (Pednekar and Mulgaonker, 1995; Jain *et al.*, 1991; Aloisi and Bonifazi, 2006). Therefore pain stimulation of the hormone system that might be due to the burdizzo castration causes these adrenal and gonad hormone levels to elevate in the serum. The persistent increase in cortisol values seen in this study follows what was reported by Murata, 1997, and Courboulay *et al.*, 2010. 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 acute increase in serum electrolytes values is in agreement with the results obtained by Mamman *et al.*, (2014) where they observed an increase in sodium and potassium values in surgically castrated Red Sokoto bucks which later returned to normal values and further decreased to values lower than the normal range values in bucks. This may be due to reactive changes associated with stress during and few hours after castration.

The Urea concentration increased significantly after 1 hour and later decreases significantly 2, 3 hours post castration. This was similar to reports of Nasr *et al.*, 2001 who reported a higher blood urea level for intact than that of castrated animal. This may be due to the fact that the usual quantity of testosterone hormone secreted by the testes during active sexual life increased the digestion efficiency of protein resulting in increased blood urea level (Lee *et al.*, 1990) and acute testosterone decline decreases the protein digestion efficiency resulting in decreased urea level. The increased level of urea observed following an hour post castration could apparently be due to elevated cortisol concentration as established by several authors (Stull and Rodiek, 2000; Kannan *et al.*, 2000; Odore *et al.*, 2004). Stress is known to cause an increase in plasma urea, which indicates an increase in protein and nucleic acids breakdown in the muscles, due to increase in cortisol concentration and during stressful conditions (Packer *et al.*, 2007; Guardia *et al.*, 2009).

The ALT, AST, and creatinine concentrations were similar to the findings of Mohammad *et al.*, 2008 following castration Awassi lambs. These changes are likely due to increased catabolic breakdown of tissue and dehydration as a result of post-operative stress. It could be concluded from these findings that acute response to burdizzo castration elicit pain which reduces the hematology, increase the white blood cell, increase stress hormone and fluctuates serum electrolytes and this calls for clinical surveillance among surgeons when such animals are

brought for surgery during the acute phase. And values obtained from this study will serve as reference data to researchers in related areas of study.

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