Burdizzo castration, pinhole castration and orchidectomy induced haematological alterations in Red Sokoto Bucks

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Abstract Castration of bucks is a management practice that is essential for breed improvement and market-oriented buck production. This study assessed the haematological alterations induced by Burdizzo castration, pinhole castration and orchidectomy in red Sokoto bucks. A total of 16 red Sokoto bucks, aged six months to one-year and weighing between 11kg to 12 kg, were randomly and equally assigned into 4 groups (A, B, C and D. Bucks in groups A, B and C were castrated by Burdizzo, pinhole castration and orchidectomy techniques while the group D animals were not castrated (control). Blood samples were collected pre-castration, immediately after castration and at 4, 8, 12, 16, 20, 24, 32, 48 and 72 hours post-castration (HPC), and processed for haematology. Results revealed non-significant decrease (P>0.05) in packed cell volume, haemoglobin concentration and total red blood cell count at 4 HPC and a return to normal range values by 12 hours HPC with non-significant fluctuations thereafter in groups A, B and C. There were significant increases (P<0.05) in the total white blood cells and neutrophil count in all castrated bucks at immediate PC period with maximum increase recorded following the orchidectomy. No significant difference (P>0.05) in the lymphocyte count was observed in all bucks for up to 72 HPC. Burdizzo castration and pinhole castration induced less haematological alterations compared to orchidectomy in the red Sokoto bucks.

Keywords: castration, haematology, red Sokoto bucks

1. Introduction

Castration of male animals is the removal or rendering of the testicles nonfunctional either by crushing or transecting the blood vessels within the spermatic cord, by vaccinating the animal or by raising the temperature of the testes obliterating the blood supply to the testes (Abid and Al-Baghddy, 2013; Hassan et al., 2016). This procedure is used to prevent unwanted mating and mounting, treat testicular pathology, and make the animal docile for easier management (Price et al., 2005; Hasan et al., 2016). The castration of food animals such as goats can improve chevon quality, feed efficiency, and reduce goaty odour in the meat (Merkel and Dawson, 2008).

The methods of castration can be classified into Surgical, chemical, and hormonal (Coetzee et al., 2010; Munahi and Abid, 2017). The surgical methods include Burdizzo castration, Pinhole castration, and orchidectomy amongst others (Stafford and Mellor, 2005).

Burdizzo castration involves the use of a Burdizzo castrator to crush the spermatic cord (Munahi and Abid, 2017). In-situ spermatic cord ligation popularly known as Pinhole castration is minimally invasive and involves the ligation of the spermatic cord without incising the scrotum (Ponvijay, 2007; Okwee-Acai et al., 2008). Orchidectomy involves the surgical removal of the testes (Coetzee et al., 2010). These commonly used surgical castration methods in goats elicit stress, and alterations in the haematological indices (Olaifa and Opara, 2011). Although there are few reports related to the haematological changes following physical castration in goats (Olaifa and Opara, 2011; Olaifa, 2018), but no such data is available regarding the red Sokoto breed. In this study, the haematological alterations induced by Burdizzo castration, Pinhole castration, and orchidectomy in red Sokoto bucks were evaluated.

2. Materials and Methods
A total of sixteen (n=16) Sokoto red bucks purchased from Giwa market, in Giwa Local Government Area, Kaduna State, were used in this study. The bucks were 6 months to 1 year old and each weighed 11kg-12 kg. The bucks, on arrival, were acclimatized and fed a balanced diet for 2 weeks Also, routine examination and clinical evaluations were performed on each buck. The bucks were fed with groundnut hay, bean husks, and maize offal, and water was provided ad libitum.

2.1. Grouping of bucks

The bucks were randomly and equally assigned into four groups (A, B, C, and D) of four animals each. Bucks in group A were castrated using Burdizzo (Olaifa and Opara, 2011), B by in-situ spermatic cord ligation (Ponvijay, 2007), and C by orchidectomy (Malbrue and Zorilla 2018) while D was not castrated. Blood sample (3 mL) was collected from each buck via jugular venipuncture pre-castration, immediately after castration (0 hour), 4, 8, 12, 16, 20, 24-, 32-, 48- and 72-hours post-castration. and processed for haematology. Packed cell volume (PCV) was determined using the haematocrit method. Haemoglobin concentration was estimated using the cyanomethaemoglobin method. Red blood cell count was determined by the haematocytometry method (Jain and Schalms, 1986). Total white blood cell (WBC) and differential leucocyte counts (DLC) were estimated according to Coles (1986).

Data obtained were presented using charts as the mean and standard error of the mean (mean ± SEM). The data were subjected to one-way analysis of variance (ANOVA) with Tukey’s posthoc test, using Graph pad prism version 5.0 (San Diego California, USA). Values of P≤0.05 was considered significant.

3. Results

The packed cell volume (PCV) showed no significant (P>0.05) difference in bucks of all the groups at any time interval and was non-significantly (P>0.05) lower at 8 and 24 HPC in bucks in group C bucks. (27.25 ± 1.65%; 26.50 ± 1.44%) than group A (28.00 ± 1.73%; 28.00 ± 1.22), group B (28.25 ± 0.85%; 29.25 ± 1.31%) animals (Figure 1). There was a significant (P<0.05) decrease in the values at 20 HPC in bucks of group C (4.13 ± 0.29 × 10^3/μL). Thereafter non-significant (P>0.05) fluctuations in the values were noticed in all the groups. (Figure 5).

The lymphocyte counts showed no significant (P>0.05) differences in all the groups of bucks up to the last recorded period and were non-significantly (P>0.05) lower at 12 HPC to 20 HPC in group C (6.70 ± 0.45 × 10^3/μL; 6.62 ± 0.46 × 10^3/μL) than group A (7.59 ± 0.29 × 10^3/μL; 8.01 ± 0.57 × 10^3/μL) and group B (6.89 ± 0.26 × 10^3/μL; 7.85 ± 0.29 × 10^3/μL) animals (Figure 6).
Figure 2 Haemoglobin concentration of goats before and after bilateral castration using the Burdizzo method, Pinhole castration, and orchidectomy.

Figure 3 Total red blood cells of goats before and after bilateral castration using the Burdizzo method, Pinhole castration, and orchidectomy.

Figure 4 Total white blood cells count of goats before and after bilateral castration using the Burdizzo method, Pinhole castration, and orchidectomy. Values with different alphabets in the same hour differ significantly at P<0.05.
Figure 5  Neutrophil count of goats before and after bilateral castration using the Burdizzo method, Pinhole castration, and orchidectomy. Values with different alphabets in the same hour differ significantly at $P<0.05$.

Figure 6  Lymphocyte count of goats before and after bilateral castration using the Burdizzo method, Pinhole castration, and orchidectomy.

4. Discussion

The practice of castrating goats routinely is aimed to produce higher carcass yields for the local market (ESGPIP, 2008; Zamiri et al., 2012). As such the consumption and rearing of goats have necessitated the assessment of haematological profiles in a quest to cater to their well-being since blood plays a significant role in the transport of several substances in the body (Garraud and Tissot, 2018). The results of this study indicate that the (PCV), haemoglobin concentration, and (RBC) in this study were non-significantly decreased in all the castrated goats (groups A, B, and C) compared to those in the control group D. However, this decrease was more in goats subjected to the orchidectomy (group C). These findings contrast with the study of Olaifa (2018), who reported a significant decrease in these erythrocytic parameters in castrated West African dwarf
goats. Differences in the breed of goats might be responsible for the disparity in the outcomes as the red Sokoto breed of goats was used in the present study.

Reports have shown that stress-inducing events could cause reduced PCV in several animal species including goats (Al-Qarawi and Ali, 2005; Gupta and Mondal, 2019). The decrease in erythrocytic parameters following the castration of goats might be associated with the stress induced by the castration procedure. This might also be due to the destruction of mature RBC and/or reduced erythropoiesis rate possibly as a result of the reduction of normal serum testosterone levels in the castrated goats (Olaifa, 2018). The least value in erythrocytic parameters in goats in group C in this study suggests that orchidectomy induced more stress compared to Burdizzo and Pinhole castration. Also, blood loss during orchidectomy might be another possible reason for the decreased erythrocytic parameter values obtained in group C animals.

The significant increase in total white blood cells (TWBC) in all castrated goats in this study was due to increased neutrophil count and this increase was marked in goats castrated by orchidectomy. This observation is consistent with the findings of Olaifa and Opara (2011), who reported increased TWBC and neutrophil counts in goats following Burdizzo castration. Since neutrophils were reported to play a critical role in the phagocytosis of tissue debris (Coles, 1986), their increase in this study suggests possible tissue destruction resulting from the castration. However, the marked increase observed in group C thus suggests that orchidectomy caused marked tissue destruction than Pinhole castration and Burdizzo. Reactive leukocytosis and stress associated with the procedures might be another possible mechanism for the increased TWBC and neutrophil count. This might have resulted from the trauma induced by the castration procedure. The inflammatory stimulus led to the chemotaxis of neutrophils and their regression from the bone marrow into the general circulation pool to recruit phagocytes in the injured tissue (Kovtun et al., 2018). Hence, orchidectomy induced more trauma in this study and this was evident by the significantly increased neutrophil count observed in group C compared to groups A and B.

The decrease in lymphocyte count in all the castrated goats might be attributed to the release of excess endogenous glucocorticoid-induced by stress from the procedures (Sapolsky et al., 2000; Smith and Cidlowski, 2012). Glucocorticoid was suggested to induce lymphocytic apoptosis via a combination of genomic and cytoplasmic signaling events (Smith and Cidlowski, 2012). Thus, the decreased lymphocyte count observed in castrated goats in this study might be due to this apoptosis. Furthermore, the migration of lymphocytes from the general circulation pool into tissues induced by the principal stress hormones (norepinephrine, epinephrine, and corticosterone) (Dhabhar et al., 2012) might be another possible mechanism responsible for the decreased lymphocyte count in castrated goats. Therefore, the significant decrease in lymphocyte count in group C animals suggests that the release of endogenous glucocorticoid and principal stress hormones was more after orchidectomy than Burdizzo and Pinhole castration in the goats.

In conclusion, this study demonstrated that Orchidectomy results in more severe alterations in hematological parameters than Burdizzo castration and Pinhole castration in red Sokoto goats.

Ethical Considerations

Approval for this study was obtained from the Ahmadu Bello University Committee on Animal Care and Use (ABUCAUC/2022/047), A.B.U. Zaria.

Conflict of Interest

The authors declare no potential conflict of interest.

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