Indexed, Abstracted and Cited: Index Copernicus International (Poland), ISRA Journal Impact Factor, International Impact Factor Services (IIFS), Directory of Research Journals Indexing (DRJI), International Institute of Organized Research and Scientific Indexing Services, Cosmos Science Foundation (South-East Asia), International Innovative Journal Impact Factor, Einstein Institute for Scientific Information {EISI}, Directory of Open Access Scholarly Resources, Science Indexing Library (UAE), Swedish Scientific Publication (Sweden), citefactor.org journals indexing, Directory Indexing of International Research Journals

World Journal of Biology and Medical Sciences

Published by Society for Advancement of Science®

ISSN 2349-0063 (Online/Electronic)

Volume 4, Issue-4, 62-68 October-December, 2017

Journal Impact Factor: 4.197

WJBMS 04/04/0028/2017

www.sasjournals.com

A Double Blind Peer Reviewed Journal / Refereed Journal **wjbmedsc@gmail.com/wjbms.lko@gmail.com**

REVIEW ARTICLE

Received: 28/11/2017 **Revised: 28/12/2017** **Accepted: 29/12/2017**

Wound Healing in Castrate and Non-Castrate West African Dwarf (Wad) Goats

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ABSTRACT

Castration has been shown to elicit physiological stress, inflammatory reactions (indicated by acute phase proteins), suppression of immune function, and a reduction in performance to varying degrees; which could also impair or accelerate wound healing. This study compares the rate wound healing contraction in castrate and intact West African Dwarf (WAD) goats. Epidermal wounds of dimension 1cm by 1cm was created on the trunk of four burdizzo castrated goats and four intact goats. Each wound was measured (in cm^2) daily with the aid of a vernier caliper while blood was collected by jugular venopuncture for hematological and hormonal analyses. The castrate wound contract faster than the non-castrate starting from the 5th day and healed faster. The Packed cell volume (PCV) and Lymphocyte significantly ($P<0.05$) decreased when compared with the non-castrate while the Heamoglobin concentration (Hb), platelet, Neutrophil and White blood cell also decreased insignificantly. Hair and skin distribution of copper and zinc showed no significant changes between the groups. Estrogen and Cortisol level was higher while the testosterone level was lower in castrate as compared with the intact goats. This study concludes that wound healed faster in castrate animals owning to the reduced testosterone level.

Keywords: Wound Contraction, Castration and Wound.

INTRODUCTION

Once the protective barrier is broken, the normal (physiologic) process of wound healing is immediately set in motion. (Theoret 2008, Nguyen *et al*, 2009, Rieger *et al*, 2014). Normal wound healing is a dynamic and complex process having a series of coordinated events. These include bleeding, coagulation, acute inflammatory response, regeneration, migration and proliferation of connective tissue and parenchyma cells; synthesis of extracellular matrix proteins, remodeling of new parenchyma, connective tissue and collagen deposition. Increasing the wound strength occurs in an ordered manner and results in the repair of severed tissues (Labler *et al*., 2006; Rivera and Spencer, 2007; Strecker-McGraw *et al.*, 2007).Wound healing begins at the moment of injury as wound is a disruption to the anatomic structure and the functional continuity of living tissues (Robson *et al*, 2001) and involves both resident and migratory cell populations, extracellular matrix and the action of soluble mediators.

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 male odor 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 (Solomon *et al.,* 1991). Castration means a process which stops the function of the testes leading to sterilization (Fisher *et al.,* 2001). The indication of 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 size and age for pregnancy and parturition and reduce goaty smell in males (Burciage *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. Earlier studies on acute effects of burdizzo castration on hematological and biochemical parameters in goats have been reported (Olaifa and Opara, 2011; Olaifa and Akpan, 2017).

Goats are one of the oldest domesticated species, and have been used for their milk, meat, hair, and skins over much of the world. In 2011, there were more than 924 million live goats around the world, according to the UN Food and Agriculture Organization. West African dwarf goat is the most prevalent species in south-west Nigeria. They are hardy, small, early maturing, prolific, non-seasonal breeders (Oppon-Anane *et al*., 2010), plump, measuring less than 50cm in height, weighing between 20 –25kgand are trypano-tolerant. West African dwarf goats possess the widest margin for adaptation amongst the ruminants (Oni, 2003) and have quite specific physiological properties that have made them acclimatize in the tropics easily.

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; which could also impair or accelerate wound healing. Therefore, investigating the wound healing rate in castrated West African (WAD) goats is of great necessity as it will provide scientific information for veterinary surgeons and clinicians.

MATERIALS AND METHODS

Experimental animals

Eight adult West African Dwarf goats grouped into castrate and non-castrate of four animals each were put in stalls. The animals were housed in individual pens three weeks for stabilization before commencement of the experiment. Well-balanced diet consisting of concentrate, grass and cassava peels were fed to the animals and water provided *adlibitum*. The animals were dewormed with levamisole (10%) I/M at the dose rate of 10mg/kg body weight and also given penicillin-streptomycin premptively to take care of possible bacterial infections.

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 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).

Epidermal wound creation

Using a square stencil of dimension 1cm by 1cm, the portion of the epidermis to be surgically removed which is the right lateral side of the animal just ventral to the vertebrae column was marked using an ink marker. Three mg/kg of 2% lignocaine was used in caudal epidural block and local infiltration (inverted L-Block) to desensitize the skin in order to ensure complete desensitization of nerves that might escape epidural block and provide the required anaesthesia. Booster injections of up to one-half of the initial dose were administered as needed in order to ensure that the goats were pain-free during the skin excision procedure. Each marked portion was blocked individually before surgery was done. Epidermal wounds were created on the trunk of all the goats. A sharp sterilized scalpel was used and bleeding reduced by the use of pressure gauze and shortening of surgery duration. The full thickness of the skin within the incision was then carefully stripped away by sharp dissection from its underlying muscle. All excisions were made using a scalpel blade and forceps; with particular care taken that wound edges were sharply defined (Olaifa, 2016)

Measurement of wound contraction

Each wound was measured (in centimetre2) daily using the length of the mid-horizontal and mid-vertical sides of the wound with the aid of a vernier calliper. Error due to parallax was reduced by ensuring that wounds were measured under adequate illumination using the same blind observer all through the experiment. The length (L) and breadth (B) were then used to calculate the wound area in cm^2 (Olaifa, 2016).

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 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 hematology were evaluated for packed cell volume (PCV) using the haematocrit method (Jain and Schalm, 1986). Hemoglobin concentration was evaluated using the cyanomet haemoglobin 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).

RESULTS

The castrate wound contract faster than the non-castrate starting from the 5th day and healed faster as shown in the figure below.

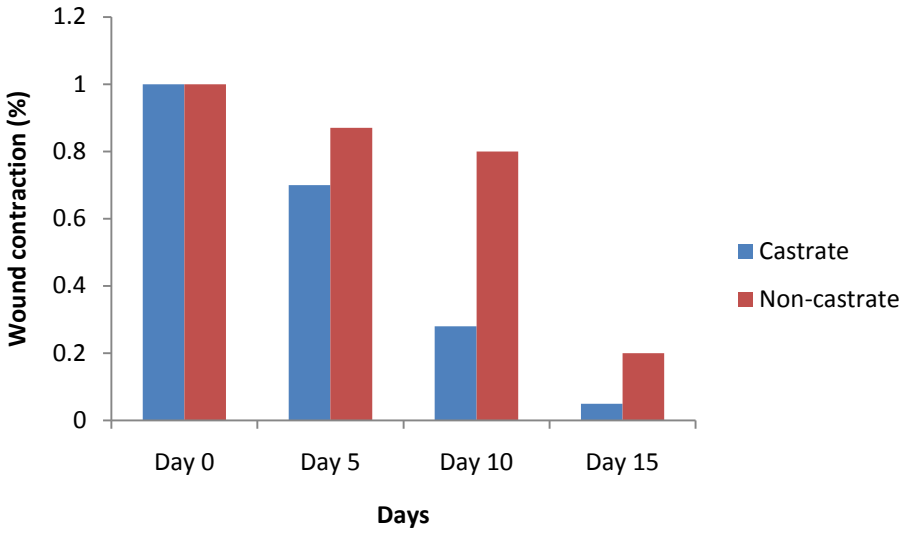

Figure 1. Wound contraction rate of castrate and non-castrate.

Table 1. Haematology, hormonal and Elemental results of castrate and non-castrate.

Parameters	Castrate	Non- castrate
PCV (%)	47±0.91*	48±0.41
Hb (gm/L)	15.93±0.23	16.05±0.44
Lymphocyte (%)	34.5±0.65*	30.5±0.65
Platelet(cell/mm^3)	380000±9128.71	595000±6454.97
Neutrophil (%)	67.5±1.11	69.25±0.75
Rbc (cell/mm^3)	9500±389.44	9000±174.85
Wbc (cell/mm^3)	9400±85.39	10000±187.08
Copper Skin (µg/L)	0.95±0.065	1.15±0.065
Copper Hair (µg/L)	0.75±0.065	0.8±0.041
Zinc Skin (µg/L)	0.75±0.065	1.0±0.041
Zinc Hair (µg/L)	0.75±0.065	0.75±0.065
Estrogen (iu/L)	1.43±0.085	0.75±0.155
Testosterone (iu/L)	1.03±0.33	2.45±0.26
Cortisol (iu/L)	11.5±0.65	4.67±0.67

The Packed cell volume (PCV) and Lymphocyte significantly ($P<0.05$) decreased when compared with the non-castrate while the Heamoglobin concentration (Hb), platelet, Neutrophil and White blood cell also decreased insignificantly. Hair and skin distribution of copper and zinc showed no significant changes between the groups. Estrogen and cortisol

level was higher while the testosterone level was lower in castrate as compared with the intact goats.

DISCUSSION

In the skin, estrogens and androgens are involved in the proliferation and differentiation of epithelial cells and the activity of fibroblasts and skin immune cells and they play important roles in wound healing (Strudwick *et al.,* 2006).

There was a faster progression of wound contraction in castrate than in non-castrated goats making their wound to heal faster (fig 1). Also the estrogen and testosterone level increased and decreased respectively in castrate as compared with the non-castrate. This agrees with a study where accelerated healing in castrated mice is associated with increased local levels of matrix collagen compared with intact control (Ashcroft and mills, 2002). All available evidence suggests that, whilst estrogens have a positive effect on wound healing by reducing inflammation and accelerating wound closure, testosterone appears to have a detrimental effect (Gilliver *et al.,* 2003). Elderly males heal wounds more slowly than elderly females and have reduced matrix deposition and an increased inflammatory response. In a study on a group of elderly males, increasing testosterone levels were linked to delay wound healing. Androgen receptor expression is localised to keratinocytes, inflammatory cells and fibroblasts during wound healing, suggesting that androgens may be involved in the regulation of inflammation and/or repair (Ashcroft *et al.,* 1999). Recent studies have suggested that, intriguingly, endogenous testosterone inhibits wound healing and promotes inflammation (Ashcroft and Mills, 2002). Castrated male mice exhibit accelerated cutaneous wound healing compared to sham-operated controls accompanied by an attenuated inflammatory response, reduced macrophage invasion and increased matrix collagen deposition. Systemic treatment with the androgen receptor antagonist flutamide also significantly accelerates wound healing and reduces inflammation; moreover, the injury invoked inflammatory response is dampened in castrated animals; macrophage influx and TNF-α production are reduced (Ashcroft *et al.,* 1999). These findings strongly suggest that natural androgens act to increase local inflammation and hinder repair and, indeed, systemic administration of the active androgen precursor androstenedione to castrated mice impairs healing (Ashcroft *et al.,* 2003). The anti-inflammatory activities of estrogens were also highlighted by the observation that 17b-estradiol limits the local accumulation of granulocytes and monocytes/macrophages following vascular injury (Xing *et al.,* 2004).

Therefore, it could be concluded from this study that wound healed faster in castrate goats than non-castrate goats and this will give veterinary surgeons working on castrate animals a better hope of faster surgical wound healing.

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