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Evaluation of Nylon Cable Ties as an Alternative Method of Preventive Hemostasis for Bovine Orchiectomy

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Abstract

Objective: The castration of male beef cattle is a routine practice in many bovine herds, but this procedure is stressful and affects profitability by reducing average of weight daily gain and increasing susceptibility to diseases. The aim of this study was to evaluate the effectiveness and security of nylon cable ties of electric usage as an alternative method for hemostasis in bovine orchiectomy.

Methods: For the study, 22 animals were randomly divided into 2 groups according to the hemostasis method: Control-Group (CG, n=11) using Chromic Catgut; and Nylon Cable Ties Group (CTG, n=11). For the evaluation of the hemostasis was considered the healing time, incidence of postoperative complications and the results of hematological exams performed on days 0 (D0), 2 (D2) and 7 (D7) from the postoperative period.

Results: Differences were not observed when comparing the hematocrit, total protein and plasma fibrinogen of animals castrated with nylon cable ties or Catgut in any of the evaluated moments (P>0.05). CG or CTG animals did not show alterations in any of the hematological variables serially evaluated between the moments D0 and D7 (P>0.05), except for the leukocytes count which presented significant increase, regardless of the experimental group (CG, P=0.0125; CTG, P=0.0080), event related to the transitory inflammatory process as a result of surgical procedure. Conclusion: It was concluded that the use of nylon cable ties represents an economic and effective alternative for hemostasis in bovine orchiectomy.

Keywords: Orchiectomy; Bovine; Castration; Hemostasis; Nylon cable ties; Catgut

Introduction

The orchiectomy or castration corresponds to one of the most widespread management practices used in the different animal production systems all over the world. Castrated bovine are more prepared to suit the consumer market as it is considered a better quality product [1]. From the perspective of animal origin products technology, the entire animal carcass presents a fat cover deficiency, which can bring to a darkening of the extern area of the muscles during the cooling [2] what harms its aspect and depreciates its commercial value and acceptance by the main international buying markets. As a management strategy, the orchiectomy reduces the problems related to aggressiveness and sexual behavior [3] as it happens with the fights and sodomy, which represents frequent causes and great economic impact to the bovine livestock, especially when confined.

Among the main techniques used for orchiectomy, the use of emasculator, application of constriction with rubber band and surgical ablation [2] can be highlighted, the last one representing the most used procedure in extensive cattle production systems [4]. Although being fast and easy-to-apply, several complications may occur after the surgical castration, such as edema, myiasis, blood clot retention, granuloma formation [5] and hemorrhage, which corresponds to the most common complication and that may occur in intra-and postoperative moments. For that reason, the use of preventive methods of hemostasis becomes imperative, especially when castrating adult animals [4].

The selection of materials for hemostasis in surgical procedures must be based on the patient's biological characteristics and the type and complexity of the procedure to be performed. Regarding the several studies reporting the benefits of using artificial materials for reproductive surgeries in human [6] and veterinary medicine [7], the Chromic Catgut still remains as the main material chosen by many surgeons.

Because of the necessity of allying low cost, facility of acquisition, rapidity and security, previous studies were developed to evaluate the use of nylon cable ties of electric usage for hemostasis in surgical procedures involving bovine [8], equine [7] and canine [9] species. However, only a few studies evaluated the tissue reactivity and postoperative inflammatory response of castrated bovine with the

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utilization of nylon cable ties. For that reason, the objective of this study was to evaluate the efficacy and security of nylon cable ties when used in preventive hemostasis for bovine orchiectomy through monitoring of inflammatory response and the production of acute-phase proteins of inflammation during the immediate postoperative period.

Material and Methods

For the study 22 half-blood Nellore/Holstein bovine belonging to a single farm located in the municipality of Vassouras, RJ, Brazil (Latitude: -22.4044, Longitude: -43.6633) were selected. Health animals aged 12 to 15 months old and weighing an average of 250 kg were submitted to the same pasture management of *Braquiaria brizantha*, having free access to water and mineral salt. The methodology used in this study was previously approved by the Ethics Committee in Animal Experimentation of the Severino Sombra University, Vassouras, RJ, Brazil.

Animals

All the calves were submitted to 24 hours of solid-food fast before the orchiectomy realization. The animals received the same anesthetic protocol based on a live-weight of 0.1 mg/kg of xylazine chloride and local anesthetic block using 10ml of lidocaine 1% directly applied on each spermatic cord area. The animals were positioned in left lateral decubitus and contained with the help of ropes in the corral. After contention, the scrotum and inguinal region antisepsis was accomplished through application of polyvinylpyrrolidone-iodine solution. All the animals were submitted to the same open technique of orchiectomy, through longitudinal incision on the scrotal sac apex using scalpel.

Treatments

At the castration moment, the animals were randomly allocated into 2 groups according to the surgical hemostasis technique to be accomplished: Control Group (CG), usage of absorbable Chromic Catgut n.2; Nylon Cable Ties Group (CTG): nylon cable tie of electric usage having the dimension of 10mm length and 2.5mm height, presenting gear rack on its caudal extremity (Figure 1). All the nylon cable ties were previously autoclave-sterilized at 121°C for 30 minutes, according to previous study [1].

After the application of the hemostatic methods, the resection of both testicles was accomplished with the help of a scalpel. The postoperative cares were identic in both groups, including the application of fly repellent for topical use and single dose of antibiotic association based on Penicillin and non-steroidal anti-inflammatory diclofenac sodium, respectively with doses of 20.000 UI/kg and 1.0mg/kg, intramuscularly.

Postoperative Clinical Evaluations

All the animals were daily evaluated during 7 days from the postoperative period regarding the body temperature, presence of hemorrhagic focuses, and inflammatory edema on the incision area and myiasis occurrence.

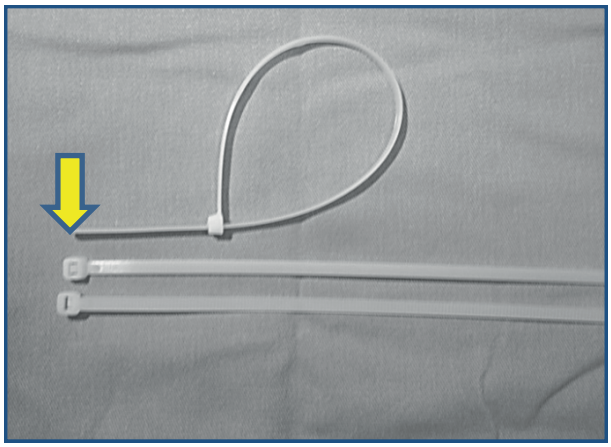

Figure 1: Nylon cable ties of electric usage, presenting gear rack on its caudal extremity (arrow) that represents a locking mechanism to guarantee the blood vessels closure during operative procedures.

Blood Collection and Hematological Evaluations

The calves were submitted to three serial blood collections, initiated on the days 0 (moment immediately before the orchiectomy), day 2 (two days after the procedure) and day 7 (seven days after the castration) through jugular venipuncture using closed system of blood collection. All the samples were kept under refrigeration in Styrofoam boxes at 5°C before the laboratory process.

The hematocrit determination was accomplished according to Thrall [10], through the filling of 80 to 90% of micro-hematocrit capillary with total blood. Glass capillaries were sealed at one of its extremities through application of heat produced by Bunsen burner and centrifuged in a micro-centrifuge at 10,000 rpm for 5 minutes. After the hematocrit measurement, the plasma column located on the front surface of the micro-hematocrit capillary was used for determination of the concentration of total plasma protein through refractometer.

The refractometry technique described by Jain [11] was used for fibrinogen measurement, obtaining the fibrinogen concentration through the difference between the measurement of plasma protein results before and after the thermal precipitation in water-bath at 56ºC for 3 minutes.

The total leukocyte count was manually accomplished in a hematological Neubauer chamber through dilution of 20 µl of total blood in 380 µl of hemolizing diluent solution (Türk's solution). After homogenization, the samples were incubated for 8 minutes before and then was performed the count of cells present in four quadrants of the Neubauer chamber with 10x objective lens, multiplying the final result by the dilution factor = 50 [11].

Statistical analysis

The results were evaluated with GraphPad Instat 5.0 (San Diego, CA, USA) and expressed as mean and standard deviation. The hematological parameters were compared across the hemostasis methods (Chromic Catgut or nylon cable ties) using Friedman variance analysis and Mann-Whitney test. Differences were considered significant when $P<0.05$.

Results

Hemorrhagic episodes were not observed in any of the animals after orchiectomy, demonstrating the efficiency of both hemostatic methods. Pronounced edema was evidenced on the scrotal sac in the immediate postoperative period in 6 animals of each group (54.55% of the orchiectomies), presenting, however, spontaneous resolution until D2. There were not observed postoperative hyperthermia in none castrated bull. Differences were not observed when comparing the hematocrit, the total protein and fibrinogen of the animals castrated with nylon cable ties or Catgut in any of the three moments evaluated ($P>0.05$). The total leukocyte count presented significant increase between the moments D0 and D7, regardless of the experimental group (CG, $p=0.0125$; CTG, $p= 0.0080$; Table 1).

Discussion

Over the centuries, advancements in surgical techniques, sterilization methods, chemical contention and analgesia have permitted the use of synthetic materials in many ways. In this study we described the use of a low cost synthetic nylon cable ties conventionally used for electrical and electronic purposes for bovine orchiectomy in field conditions. Independent of the preventive hemostasis method used, the castration procedure induced a pronounced local edema in half of the orchiectomized animals, but this effect was of short duration and lasted for 24 h after surgery. Similar alterations were observed by Pang [12] which reported the presence of inflammatory edema after bovine castration using burdizzo or rubber band, interpreted as transitory and local inflammatory response.

Differences were not observed when comparing the hematocrit and the total protein of the animals castrated with Nylon cable ties or Catgut in any of the evaluated moments ($P>0.05$). According to Early and Crowe [2], the castration makes limited effect on hematological parameters in bovine not being observed differences concerning the hematocrit, differential leucocyte count, mean corpuscular volume, hemoglobin concentration and platelet count after orchiectomy. Similar results were reported by Martins [13] that observed no differences in hematologic parameters including red blood cells count, packed cell volume, mean corpuscular volume, mean corpuscular hemoglobin concentration among water buffaloes castrated or not. Besides, constant values on the hematocrit before and after castration in both experimental groups contributed to the conclusion that both hemostatic techniques were efficient in prevention of hemorrhagic episodes.

The total leukocyte count presented significant increase between the moments D0 and D7, regardless of the experimental group (CG, $P=0.0125$; CTG, $P= 0.0080$; Table 1). Regardless of the material used for hemostasis, every surgical procedure stimulates the instauration of inflammatory process characterized by mono-nucleated cells infiltration, tissue destruction and repair characterized by the production of connective tissue, neovascularization and fibrosis [14]. The leukocytosis in the acute inflammatory process has its origin in the plasma cortisol level increase [2] that stimulates the neutrophil transendothelial migration resulting in neutrophilia and increase of global leukocyte count [12]. Fisher [15] reported similar results, indicating the increase of global leucometry associated to a neutrophilia in bovine submitted to orchiectomy.

Although the fibrinogen represents one of the main proteins of the acute inflammatory phase, being produced by hepatocytes from the stimulus of interleukins and tumor necrosis factor released in the beginning of the inflammatory processes [11], in our study, fibrinogen increase was not observed when CG and CTG were compared in any of the experimental moments evaluated; besides, the fibrinogen concentrations kept stable ($P>0.05$) for both groups throughout the seven days of clinical postoperative evaluation.

In previous study [2] it was observed that castration inducted the increase of plasma fibrinogen levels; according to the authors, this effect may be reverted through the use of non-steroidal anti-inflammatories. In our study we used only one single dose of diclofenac sodium, drug of short plasma half-life and that does not have significant effects on the hemogram and plasma biochemical profile, according to previous study conducted in rats [16]. According to Qui [17], the concentration of plasma fibrinogen presents increase on the first 24 hours after stress, presenting spontaneous decrease before 72 hours after the stress episode. Considering the diclofenac sodium plasma half-life and the profile of fibrinogen release, small variations on plasma concentrations of this protein of the acute period could only be masked by the non-steroidal anti-inflammatory on the first

Parameters	Treatment	Day 0	Day 2	Day 7
Hematocrit (%)	Catgut	31.73 ± 1.4^{Aa}	31.27 ± 1.9^{aA}	31.27 ± 1.3^{Aa}
	CTG	31.45 ± 2.2^{Aa}	31.45 ± 2.3^{Aa}	30.64 ± 1.9^{Aa}
Total Leukocytes (x 10^3 cells/mL)	Catgut	9.36 ± 1.6^{Aa}	10.97 ± 1.8^{Aab}	13.78 ± 2.1^{Ab}
	CTG	10.15 ± 1.2^{Aa}	14.09 ± 2.2^{Aab}	15.69 ± 1.8^{Ab}
Fibrinogen (mg/dL)	Catgut	254.55 ± 57.8^{Aa}	345.45 ± 47.4^{Aa}	363.64 ± 52.7^{Aa}
	CTG	345.45 ± 59.3^{Aa}	281.82 ± 51.6^{Aa}	327.27 ± 71.5^{Aa}
Plasmatic Protein (g/dL)	Catgut	7.18 ± 0.2^{Aa}	6.98 ± 0.2^{Aa}	6.95 ± 0.3^{Aa}
	CTG	7.15 ± 0.2^{Aa}	7.15 ± 0.3^{Aa}	6.95 ± 0.3^{Aa}

[a,b] Lowercase letters on the same line compare the hematological parameters throughout the 7 days of postoperative period, according to hemostasic material used. [A,B]Uppercase letters letters on the same column indicate differences between treatments for each evaluated hematological variable for each time point. Differences were considered when $P < 0.05$.

Table 1: Average values (±SD) for the different hematological variables evaluated in the pre (D0) and postoperative moments (Days 2 and 7) of castrated bovine using Catgut or Nylon Cable Ties (CTG) for surgical hemostasis.

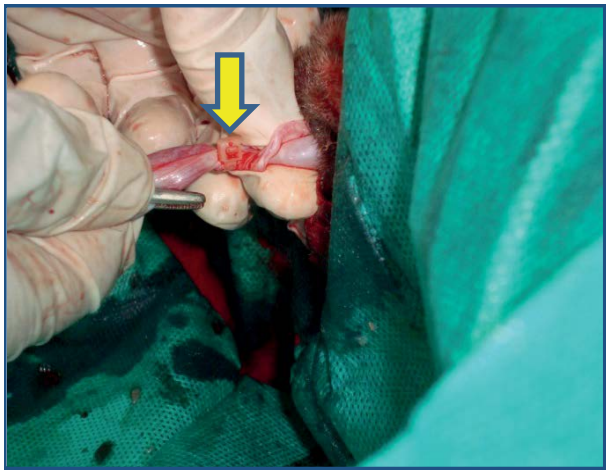

Figure 2: The spermatic cord of an anesthetized bovine ligated with the nylon cable tie device (arrow). The photo shows the hemostasis halo under the nylon cable tie position, permitting a security resection of testicules.

hours after the administration. In this way, the stability on fibrinogen concentrations until D7 of the experiment may be justified by the low tissue reactivity performed by both used materials for surgical hemostasis.

In most of bovine livestock farms, the orchiectomy methods are still being practiced not scientifically by unprofessional people, without attention to hygiene and preventive hemostasis of the vessels from the spermatic cord, which may results in death and inevitably economic loss. In this sense, in addition to low cost, a good suture material for preventive hemostasis should be easy and quick to apply, minimizing the perioperative bleeding or hematomas. In our study we observed that the loop formed by the nylon cable tie around the spermatic cord could be tightened with only one hand, leaving the surgeon's other hand free for cleaning and for inspection of the surgical area. Considering the hemostasic materials, ease of use is an important factor for the safety, convenience and speed of surgery [18]. In this sense, with the nylon cable ties the complete hemostasis of spermatic cord could be made in seconds. The devices were securely locked into the tissue, i.e. at the applied traction no sliding along the vessels was observed (Figure 2).

Conclusion

Due to the similarity of clinical and hematological response between both studied groups it is possible to conclude that preventive hemostasis using nylon cable ties presented similar results to those obtained with Chromic Catgut, representing an economic, practical, quick and effective alternative for bovine orchiectomy.

Author Contributions

Project conception and experimental analysis: CSF, AFSC, APMA, FS and AMC; Data and statistical analysis: KCP and AMC; literature review and manuscript preparation: CFS, AFSC, APF and AMC; Project supervision, manuscript review: GMG and AMC.

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