

## USE OF CIANOACRILATE GLUE ON CUTANEOUS WOUNDS OF DONKEYS

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### ABSTRACT

We evaluated the use of adhesive cyanoacrylate ester in the synthesis of skin wounds of donkeys by analyzing the duration of surgery and healing process. For this, we used five clinically healthy, male donkeys, weighing  $103 \pm 8.5$  kg, in which we performed a 10 cm skin incision in the dorsal-ventral direction, in the thoraco-lateral region, ventral to the scapula and caudal to the withers on both sides. The adjacent tissues were joined with 2-0 simple catgut and the skin with nylon

on one side (Control Group) and with adhesive on the other side (Treatment Group). We clinically assessed the wounds daily and by light microscopy after 10, 20 and 30 days. The cyanoacrylate glue proved to be a viable alternative for cutaneous synthesis of donkeys, for reducing the time of surgical procedure in 35.3%, and for allowing a good coaptation of the edges of the wound, without interfering with the healing process.

KEYWORDS: cutaneous adhesive; skin suture; equine.

## EMPREGO DA COLA DE CIANOACRILATO EM FERIDAS CUTÂNEAS DE ASININOS

### RESUMO

Avaliou-se o emprego do adesivo de éster de cianoacrilato na síntese de feridas cutâneas de asininos, a partir da análise do tempo de duração do procedimento cirúrgico e do processo cicatricial. Para tanto, foram utilizados cinco asininos clinicamente saudáveis, machos, adultos, pesando  $103 \pm 8,5$  kg, nos quais foi realizada uma incisão cutânea de 10 cm, em sentido dorso-ventral, na região tóraco-lateral, caudal à escápula e ventral à cernelha, em ambos os lados. Realizou-se a aproximação dos tecidos adjacentes com categute simples 2-0 e a aproximação da pele, de um

lado com fio de náilon (Grupo Controle) e no lado oposto com o adesivo (Grupo Tratamento). Foram realizadas, diariamente, avaliações clínicas das feridas e por meio de microscopia de luz decorridos 10, 20 e 30 dias. A cola de cianoacrilato demonstrou ser uma alternativa viável para a síntese cutânea de asininos, por ter reduzido o tempo de realização do procedimento cirúrgico em 35,3% e por permitir boa coaptação dos bordos da ferida, sem interferir com o processo cicatricial.

PALAVRAS-CHAVE: adesivo cutâneo; dermorrafia; equídeo.

### INTRODUCTION

Donkey breeding in the Northeast region of Brazil accounts for almost 91% of the national herd (IBGE, 2006). Strength, hardiness and

resistance, mainly to hot weather and food scarcity, characterize donkeys. This species shows great value for work in semi-arid region, where it is used to transport food and water, to prepare the soil and to transport people, among others.

Most donkey breeders belong to the class of Family Farmers. Thus, the procedures of donkey breeding should be the least expensive as possible, minimizing the expenses with the animals, in order to make the agricultural activity profitable.

In Veterinary Medicine, cyanoacrylates have been used in many surgical specialties. The beginning of its clinical and surgical use occurred in 1959, when its adhesive properties were found, making it the target of several experimental studies in the 1960s (MATSUMOTO et al., 1969). Currently, it is the adhesive most widely used in surgical routine.

The adhesives, when in contact with the tissue, are converted from liquid to solid state by polymerization, and are catalyzed by low humidity. The settling time varies from two to sixty seconds, depending on the presence and quantity of body fluids, pellicle thickness, and the length of the alkyl radical molecule (SLATTER et al. 2007). The physical, chemical and biological properties vary according to the size of the carbon chain of the radical (PAPATHEOFANIS, 1989; TSENGET et al., 1990).

Cyanoacrylates can have toxic effects, probably due to the products resulting from their degradation, such as formaldehyde (TSENGET et al., 1990), characterized by granulomatous inflammation. On the other hand, long chain cyanoacrylates present lower toxicity and lower stickiness, without jeopardizing the adhesive effect (BORBA, 2000). The slower the degradation, the lower the toxic effect because the slow release of products allows a more effective metabolism, leading to a less severe inflammatory reaction (GUEIROS et al. 2001).

Some advantages of using the adhesive are the easy application, reduced surgery time, and, therefore, the duration of anesthesia. In addition, in cases of reduction of small extent traumatic wounds, its application does not require the use of surgical materials or local anesthesia. Studies show that adhesives also possess antibacterial activities, which increase with the reduction of the radical chain, and immediate haemostatic action (MATTHEWS, 1993; AZEVEDO, 2000). Its effectiveness has been proved when used on the skin or mucosa surface as a replacement for conventional suture (BORGES et al., 1993; FREITAS-JUNIOR et al., 2008).

The adhesive cyanoacrylate ester is a product which can be easily purchased on the market and has a reduced cost; according to the literature, however, it has not yet been used in the dermal suture of donkeys. Thus, this study aimed

to evaluate the use of the adhesive on the cutaneous synthesis of donkeys, analyzing the duration of the surgical procedure and the healing process.

## MATERIAL AND METHODS

The experiment was performed at the Veterinary Hospital of the Federal University of Campina Grande (VH / UFCG), in Patos, State of Paraíba, in the period of March 3<sup>rd</sup> to June 30<sup>th</sup> 2008, and it was approved by the Research Ethics Committee of UFCG, under the number 87/2008.

We used five adult donkeys. The animals were healthy, uncastrated and of undefined breed, and weighed  $103 \pm 8.5$  kg. The animals were housed in a pen at the VH / UFCG and fed throughout the experimental period, with hay, elephant grass and water *ad libitum*. There was an adaptation period of 15 days before the start of the experiment.

After fasting for 12 hours, each animal was sedated with acepromazine maleate<sup>1</sup>. Trichotomy of left and right thoracic regions was performed on an area of 20 x 30 cm, ventral to the dorsal line and caudal to the scapula. Then, we carried out infiltrative anesthesia subcutaneously under the incision site, with lidocaine hydrochloride 2% with vaso-constrictor<sup>2</sup>, diluted to 1% with double-distilled water at a dose of 30 ml in each hemithorax, and antisepsis with chlorhexidine gluconate<sup>3</sup>.

We made a 10.0 cm skin and subcutaneous incision in the dorsal-ventral direction; then we carried out hemostasis by compression, followed by reduction of subcutaneous adjacent tissue with simple catgut, number 2-0, in zigzag pattern. The cutaneous synthesis was performed in the control group with monofilament nylon thread number 0 in simple pattern separately (Figure 1) and in the group treated with the cyanoacrylate ester adhesive<sup>4</sup> (Figure 2).

<sup>1</sup>Acepran 1% - Univet S/A Indústria Veterinária. São Paulo, SP

<sup>2</sup>Anestésico Bravet - Bravet Indústrias Químicas e Farmacêuticas. São Paulo, SP

<sup>3</sup>Riohex 0.5% - Indústrias Farmacêuticas Rioquímica. São José do Rio Preto, SP

<sup>4</sup>Superbonder. Loctite do Brasil



Figure 1. Photography showing the synthesis of donkey's skin with separated simple stitches with nylon thread, after surgery.



Figure 2. Photography showing the joining of donkey's skin with cyanoacrylate glue after surgery.

The choice of which side would receive the thread or the adhesive was at random for the first animal and on alternate sides for the other animals, so that animals 1, 3 and 5 received the adhesive on the right side, and animals 2 and 4 received it on the left side.

In the control group, the skin suture was performed using nine stitches in separated simple pattern, with one centimeter between each other. In the treatment group, the adhesive application was made through dripping, without letting the package be in contact with the wound. We used nine drops of adhesive placed discontinuously over the incision, separated one centimeter from each other, after digital joining of the edges. The trans-operative time was measured in both surgeries, for all animals.

After surgery, the animals were treated with a single dose of benzathine benzylpenicillin, procaine, potassium and streptomycin<sup>5</sup>, 20,000 IU/kg. Around the incision, we applied sulfadiazine silver, aluminum and cypermethrin<sup>6</sup> due to its repellent action, but we avoided contact of these substances with the incision line.

We assessed the animals daily for ten days, measuring heart and respiratory rates, and body temperature; we also observed the type and amount of secretion, edema and dehiscence. We performed the same kind of dressings after surgery and every day until the tenth day, when we removed the sutures from the skin of animals in control group.

We performed skin biopsies at 10 (T10), 20 (T20) and 30 (T30) days after surgery for histological evaluation of the healing process in both groups. The biopsy was performed in the dorsal portion of the surgical wound on T10, in the center on T20 and in the ventral portion on T30.

For the biopsies, we carried out trichotomy around and on the surgical wound, and antiseptis with chlorhexidine<sup>4</sup>, performing a block with subcutaneous infiltration of local anesthesia with 10 mL of 2% lidocaine with vasoconstrictor<sup>3</sup>, diluted to 1% with double-distilled water. After that, we collected the material using a trephine punch for skin biopsy with six millimeters in diameter. The skin fragments were preserved in 10% formalin and sent to histological processing. After being fixed, the samples were cleaved, cleared and embedded in paraffin to be cut by a microtome, at four or five micron-thick. We stained the sections with hematoxylin and eosin and read the slides with the aid of an optical microscopy. We evaluated each fragment for the presence of crusts, epidermal thickening, epidermis retraction, fibrosis, inflammation, necrosis and foreign body reaction.

For statistical analysis of the duration of the surgical procedure, we used the Student *t* test for independent samples, with Welch's correction, at 5% significance, using the program GraphpadInstat.

## RESULTS AND DISCUSSION

The polymerization of cyanoacrylate ester, observed by the color change from colorless to off-white, occurred at about 30 seconds after the

<sup>5</sup>PencivetPlusforte. Akzo Nobel. Cruzeiro, SP

<sup>6</sup>Bactrovet Spray Prata. König do Brasil. São Paulo - SP

application, showing the rapidity with which the adhesive fixes the borders and starts the healing process. This polymerization period was similar to that reported by GUEIROS et al. (2001), who used the adhesive in dogs and cats.

The duration of the surgical procedure in the control group was  $31.2 \pm 4.3$  minutes and in the treatment group,  $21.2 \pm 3.7$  minutes, with a difference of 10 minutes between the means, which corresponds to a statistically significant reduction in the order of 35.3% for the total duration of the procedure, making it one of the strengths of using adhesives, since the period of exposure of the surgical wound to external agents is related to postoperative contamination. GUEIROS et al. (2001) SHIMIZU et al. (2003) and FREITAS-JÚNIOR et al. (2008), who fixed the skin of rats using cyanoacrylate glue, also reported this reduction.

One of the animals in the treatment group showed dehiscence of the surgical wound, on the second day after surgery. It appeared agitated during surgery, hence it needed supplemental sedation, and such behavior may have influenced the excessive amount of blood on the borders of the wound at the time of application of the adhesive, which may have

reduced binding capacity. This finding contrasts with the reports by SILVER (1976) and AZEVEDO (2000) that cyanoacrylates have immediate hemostatic action. The wound was treated by second intention, and it healed within 20 days.

We found no significant change in the vital parameters measured, revealing that the inflammatory response was localized; all parameters remained within physiological limits for the species, according to FEITOSA (2004).

The microscopic analysis showed a slight edema in all wounds until the third day after surgery, corresponding to the initial stages of the inflammatory response (SLATTER et al., 2007). All animals in both treatments showed progress in the healing process without secretion.

On T10, the treatment group presented a thinner and more linear scar, with better cosmetic results compared to the control group, also observed by GUEIROS et al. (2001) and FREITAS-JÚNIOR et al. (2008). On T20 and T30 we observed complete re-epithelization and wound repair (Figures 3 and 4) in both groups. The treatment group presented better cosmetic result of the surgical scar than the control group (Figures 5 and 6).



Figure 3 - Photography showing the cutaneous healing on the 20<sup>th</sup> day after surgery, observing the separated simple pattern scar. Control Group.



Figure 4 - Photography showing the cutaneous healing on the 20<sup>th</sup> day after surgery, observing the scar line of the surgical borders. Treatment Group.



Figure 5. Photography showing the cutaneous healing on the 30<sup>th</sup> day after surgery, observing the separated simple pattern scar. Control Group.



Figure 6. Photography showing the cutaneous healing at the 30<sup>th</sup> day after surgery, observing the scar line of the surgical borders Treatment Group.

Histological analysis of the healing process, on T10, revealed no significant differences between groups: both showed moderate hyperkeratosis, thickening of the epidermis with slight vacuolization of keratinocytes, neovascularization, mononuclear inflammatory reaction, with the presence of

lymphocytes and plasma cells around vessels, and moderate fibrosis (Figure 7).

On T20 we verified decrease in the epidermis, proliferation of fibrous tissue in the dermis and neovascularization accompanied by inflammatory infiltration around the vessels, in all animals from both treatments (Figure 8).

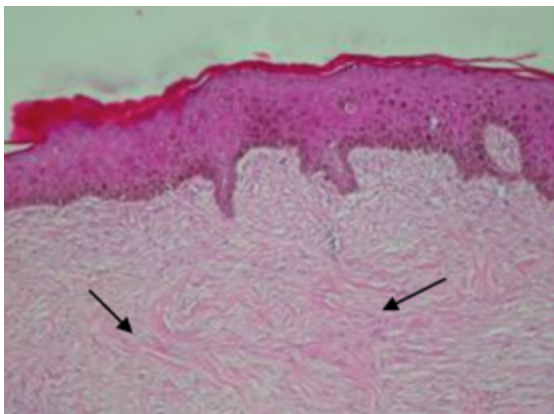


Figure 7. Photomicrography showing the histological analysis on the 10<sup>th</sup> day after surgery, observing the epidermis thickening and neovascularization. Treatment Group.

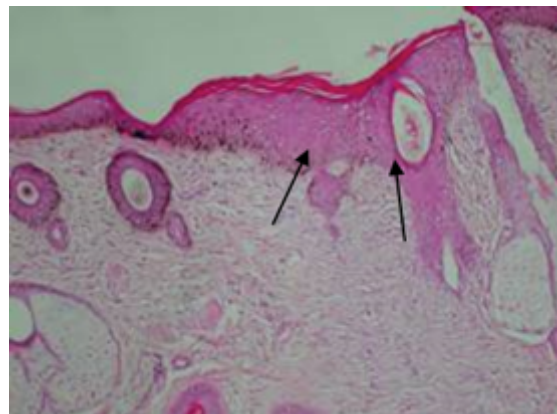


Figure 8. Photomicrography showing the histological analysis on the 20<sup>th</sup> day after surgery, observing the proliferation of fibrous tissue. Treatment Group.

We observed no differences on T30 between the skin sutures used, showing only

epidermal thickening, focal area with proliferation of fibrous tissue forming irregular projections into

the dermis and proliferation of connective tissue in the deep dermis (Figure 9).

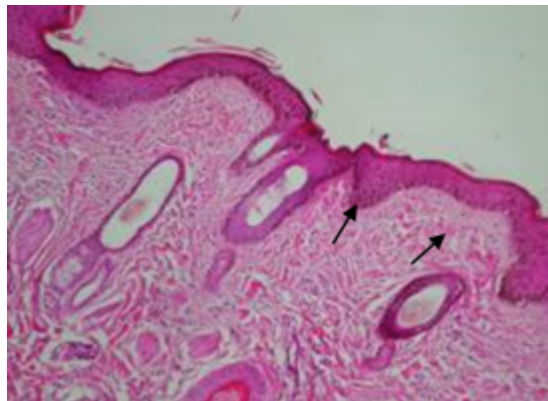


Figure 9. Photomicrography showing the histological analysis on the 30<sup>th</sup> day after surgery, observing the epidermis thickening and proliferation of connective tissue. Treatment Group

Histological examination revealed that, in donkeys, the cyanoacrylate ester adhesive caused very few tissue reactions, since the phenomena observed on the 10<sup>th</sup>, 20<sup>th</sup> and 30<sup>th</sup> days after surgery showed no histotoxic reactions. On the other hand, SHIMIZU et al. (2003), applying the N-butyl cyanoacrylate adhesive on the inside edges of the wounds, observed a foreign body granulomatous reaction around the glue in one animal.

The reactions observed suggest an initial inflammatory response, on the 10<sup>th</sup> day and, from 20 days on, the recovery phenomena, as dermal fibroplasia and neovascularization, which were also described by GUEIROS et al. (2001) and FREITAS-JÚNIOR et al. (2008).

## CONCLUSIONS

The use of cyanoacrylate ester adhesive significantly reduces the duration of the surgical procedure, without interfering in the healing process of the cutaneous surgery wound. Cosmetically, healing promoted by cutaneous synthesis by the adhesive is superior to that produced by conventional suturing. The cyanoacrylate ester glue in the synthesis of skin wounds in donkeys does not produce histotoxic effects.

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