

DERMAL ANESTHESIA IN THE WHITE RHINOCEROS (*CERATOTHERIUM SIMUM SIMUM*) USING A EUTECTIC MIXTURE OF LIDOCAINE AND PRILOCAINE

Christian Walzer, D.M.V.

Abstract: Various methods have been used to obtain blood samples from unrestrained rhinoceros. Without extensive prior training, the results are generally poor due to pain avoidance reactions. However a new dermal anesthesia technique previously used in humans, an eutectic mixture of lidocaine and prilocaine, made it possible to obtain blood samples from the ear veins of one male and two female white rhinoceros (*Ceratotherium simum simum*) and five full-thickness skin punch biopsies and subsequent suturing on unrestrained rhinoceros. In all animals, the procedures elucidated neither limb withdrawal nor head shake and were regarded as painless.

Key words: White rhinoceros, *Ceratotherium simum simum*, dermal anesthesia, venipuncture, biopsy.

INTRODUCTION

Mucous membranes generally have a minimal penetration barrier to topical application of lidocaine (Xylocain spray, Astra Ges.m.b.H. Linz A-4020, Austria) and oxybuprocaine (Benoxitat-Lsg, Agepha, A-1150 Vienna, Austria), and anaesthesia is achieved within minutes. Intact cornified skin, however, is very resistant to the penetration of medications.⁸ However, in the medical management of pain in children a eutectic mixture of lidocaine and prilocaine (EMLA®, Eutectic Mixture of Local Anesthetics, Astra Ges.m.b.H. Linz and Astra USA, Westborough, Massachusetts, USA) effectively anesthetizes the skin after topical application. A eutectic mixture is the combination of specific solid constituents in such quantities as to yield the lowest possible melting point.

Only highly lipophilic and hydrophilic drugs can enter and transverse intact skin. Both lidocaine and prilocaine are only relatively hydrophilic and lipophilic by themselves and are crystalline solids at room temperature. In combination, these properties are enhanced, and the mixture also forms a liquid at room temperature. The addition of this eutectic mixture to the proper oil and water emulsion provides the ideal conditions for good penetration through intact skin: a high concentration gradient (80% concentration of local anesthetics compared with 20% in similar single drug medications),⁷ microdroplet size of 1 μ m, and slow release.⁸ Penetration is further enhanced by placing the resulting cream under an occlusive tape or using an EMLA® patch (a single unit dose package of 1 g of EMLA® using foam medical tape as an adhesive).

In extensive tests, this mixture provided effective skin anesthesia in children and adults.^{3,6–8,10–12} The

use of topical local anesthetics in veterinary medicine is far less common. In a pilot study, the use of EMLA® prior to venipuncture was examined in dogs, cats, rats, and rabbits.⁴

Various methods have been used to obtain blood samples from unrestrained rhinoceros. The most successful procedures involve special training programs to allow venipuncture of the medial metacarpal vein from laterally recumbent animals.⁹ The application of local anesthetics to the ear has also been attempted. In Rotterdam Zoo, lidocaine (Xylocain, Astra Ges.m.b.H), and dimethyl sulfoxide (Merck Ges.m.b.H, Ges.m.b.H, Vienna A-1147, Austria) failed to provide sufficient anesthesia for ear vein phlebotomy (W. Schaftenaar, 1996, pers. comm.). The feasibility of using EMLA® patches for venipuncture and punch biopsies in white rhinoceros (*Ceratotherium simum simum*) was studied, and the results are presented here.

MATERIAL AND METHODS

Venipuncture

Various methods have been used in the past 3 yr to obtain weekly blood samples from two female white rhinoceros at the Salzburg Zoo for steroid hormone analysis. These rhinoceros had been habituated to manipulations of the ear during a previous study.¹³ However, pain associated with the initial venipuncture, with subsequent limb withdrawal and head shake, made the routine collection of blood samples difficult.

In the initial EMLA® trial with these two female rhinoceros, following a dry scrub of the skin, approximately 2 g of 5% EMLA® cream was applied to the dorsal or ventral aspects of the ear depending on the local dilation of the available veins. The application site was then covered with a self-adhesive transparent occlusive dressing (Tegaderm, 3M, Heiland CFB, Vienna A-1037, Austria). The dressing

From the Salzburg Zoo Hellbrunn, A-5081 Anif, Austria.

was left in place for 60–90 min.^{2,7,8,12} In subsequent trials, EMLA® patches a single unit dose package of 1 g of EMLA® using foam medical tape as an adhesive were used. As in the initial trials, these patches were also applied for 60–100 min.

The dressings were removed and the cream was wiped off. The venipuncture site was examined for signs of possible skin reactions, cleaned with a dry swab, and disinfected with isopropyl alcohol swabs (Alkomed B. Braun Ges.m.b.H, Maria Enzersdorf A-2344, Austria). After the alcohol had evaporated, a 20-ga needle was inserted into the vein, and blood was collected by means of a pediatric low-vacuum vacutainer (SST 2.5 ml, Becton Dickinson Vacutainer Systems Europe, B.P37-38241 Meylan Cedex, France).

Numerous attempts were made to obtain blood samples from the unanesthetized contralateral ear veins or from the same ear at another time period. Though the procedures were carried out in an identical fashion (same time of the day, Tegaderm, same blood collection material) to the procedures using EMLA®, it was never possible to obtain a blood sample because of immediate head shake and withdrawal following needle insertion attempts.

Punch biopsies

EMLA patches were applied laterally to the neck region of one male and two female white rhinoceros as described for venipuncture. After removal of the patches, an 8-mm biopsy punch (Stiefel, Heiland CFB, Vienna A-1037, Austria) was used to obtain full thickness skin samples. The biopsy sites were each closed with one suture (PDS 2/0 Ethicon, Norderstedt D-22851, Germany).

RESULTS AND DISCUSSION

To date, it has been possible to obtain 10 blood samples from the ear veins of three rhinoceros using the EMLA cream and 40 blood samples using the EMLA patch. In all cases, the needle insertion produced neither limb withdrawal nor head shake. Weekly sampling has been well tolerated by the animals and is ongoing at the present time. Although the rhinoceros became accustomed to the collection procedure, it has not been possible to obtain a blood sample without EMLA.

Five full-thickness skin punch biopsies and subsequent suturing were also carried out on unrestrained rhinoceros without avoidance reactions. Using the definition of pain and pain response provided by the Association of Veterinary Teachers and Research Workers, these venipuncture and biopsy methods can be considered practically painless.¹

The onset of the analgesic effect, which is dependent on rate of absorption, may vary with the application site. Local blood flow, dermal thickness, and the condition of the skin may affect the onset.² Because of the wide range of anatomical dermal variations encountered within the many zoo species, the location that will permit optimum onset of anesthetic action will need to be determined for each species.

In human and laboratory animals, mild transient local skin reactions have occurred in approximately half of the patients treated with EMLA. The majority of the reactions consist of pallor or blanching of the skin and erythema.^{2,6} Rabbits in one study showed blanching or reddening of the skin, but these changes did not interfere with venipuncture.⁴ No visible local reactions to the rhinoceros skin were noted in our study. Following an initial trial with EMLA® cream, we chose to use the single-unit EMLA patches because of the greater ease of application. As reported in the medical literature, no difference in efficacy could be established between the two methods of application.¹²

Two metabolites of prilocaine are able to induce methemoglobinemia. Studies in human infants have demonstrated that the application of EMLA induces a two-fold increase of methemoglobin levels.^{2,3,5} Eutectic prilocaine–lidocaine mixtures are therefore contraindicated in children younger than 3 mo of age. Similar considerations should apply to the use of these mixtures in young animals, particularly animals that are already receiving medications that may induce methemoglobinemia (e.g., chloramphenicol, sulfonamides) and thus induce an additive effect or species prone to hemolytic crises (e.g., black rhinoceros).

Based on this study, the eutectic mixture of prilocaine and lidocaine is a valuable additional tool for selected diagnostic and therapeutic procedures in the white rhinoceros. The use of EMLA in other species and procedures has yet to be evaluated, but considering the many different uses of EMLA® in human medicine, there seems to be great potential.

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