An Appraisal of Naloxone Hydrochloride as a Narcotic Antagonist in the Capture and Release of Wild Herbivores

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SUMMARY

Naloxone hydrochloride was used as the narcotic antagonist during capture operations conducted on 84 specimens of 11 game species in the Kruger National Park, South Africa. It was found that 10 mg of naloxone was sufficient to antagonize wide dosage ranges of etorphine hydrochloride or fentanyl, used in combination with a variety of tranquilizers. The absence of undesirable side effects and the fact that naloxone can be administered without fear of overdosage make it a unique and valuable drug in the capture and release of wild animals.

ALTHOUGH the respiratory and circulatory effects of the 2 conventional narcotic antagonists, nalorphine hydrobromide and levallorphan tartrate, have not been studied to any extent when used as narcotic antagonists in the capture of free-roaming wild animals, these undesirable effects have received considerable attention in the field of human anesthesiology.[3] Nalorphine itself is a potent analgesic[8] and, as is the case with levallorphan, has been found to cause respiratory depression when given without prior administration of a narcotic.[6] Other undesirable effects of these drugs in man include myosis, depression of certain reflexes, neurophysiologic changes,[8] and often alarming mental effects.[4]

Because of the shortcomings of the conventional narcotic antagonists, the search continued for a better antagonist—one that would be not only more potent but also devoid of undesirable side effects. This search culminated in the development of naloxone hydrochloride.[a]

Inasmuch as large and often unpractical volumes of nalorphine are required to antagonize the effects of etorphine hydrochloride in immobilized elephants and rhinoceroses, it was decided to evaluate naloxone as the narcotic antagonist in these and a number of other species.

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[a] Narcan, Endo Laboratories, Inc, Garden City, NY.

Materials and Methods

Naloxone hydrochloride, also called naloxone (N-allylnoroxymorphone), is a potent narcotic antagonist synthesized from oxymorphone hydrochloride, a narcotic analgesic.

Either etorphine hydrochloride[b] or fentanyl[c] was used as the immobilizing drug.

Depending on the species, one of the following tranquilizers was used: xylazine hydrochloride,[d] azaperone,[e] or acetylpromazine.[f]

Capture procedures and delivery of the immobilizing drugs by dart syringes were similar to those described earlier.[11] In a few immobilized specimens an additional 1 to 2 mg of etorphine was administered intravenously and, after a time lapse of 10 minutes, the experimental dose of naloxone was injected intravenously. Intramuscular injections were also given, particularly in semitractable specimens and in the small steenbok (body mass = 10 to 12 kg), in which veins are relatively difficult to locate.

Results

The narcotic-tranquilizer combinations and the naloxone dosage ranges used on 84 individual wild game animals are given (Table 1).

Discussion

Inasmuch as naloxone was available in a standard experimental concentration of 10 mg/ml, the general procedure was to use between ½ and 1 ml (5 to 10 mg) to antagonize any amount of narcotic used. In a number of cases, however, considerably less was used and in the larger species it was found that 1 mg injected intravenously was sufficient to antagonize 1 mg of etorphine or 10 mg of fentanyl. In this respect it compared favorably with the specific etorphine antagonist, cyprenorphine.[2,9,12,g] When given intramuscularly, however, these small dosages resulted in too slow a recovery, which could be avoided by administering greater amounts (5 to 20 mg). Particularly encouraging results were obtained from subadult (3,000 kg) bull elephants (Fig 1). In these elephants an intravenous injection of 10 mg was sufficient to antagonize 8 mg of etorphine with good recovery reaction and return to ambulation. In fully grown (5,000 kg) bulls, however, 10 mg was insufficient and a minimum of 15 mg was required to get them to their feet. Once standing, these

[b] M.99, Reckitt & Sons Ltd, Hull, England.

[c] R 4263-citrate, Janssen Pharmaceutica, Beerse, Belgium.

[d] Rompun, Bayer, Germany.

[e] R 1929, Janssen Pharmaceutica, Beerse, Belgium.

[f] Acetylpromazine, Boots Pure Drug Company Ltd, Nottingham, England.

[g] M. 285, Reckitt & Sons Ltd, Hull, England.

TABLE 1—Doses for 11 Species of Game Animals Captured in the Kruger National Park, Using Naloxone Hydrochloride as the Narcotic Antagonist

Species	Number ♂	Number ♀	Age class	Narcotic (mg)* Etorphine HCl	Narcotic (mg)* Fentanyl	Tranquilizer (mg) Xylazine HCl	Tranquilizer (mg) Azaperone	Tranquilizer (mg) Acetylpromazine	Antagonist (mg) Naloxone hydrochloride
Elephant *(Loxodonta africana)*	9	15	Adult bulls and calves	2–8*	40–70*	....	....	5–40	5–50 IV
Square-lipped rhinoceros *(Ceratotherium simum)*	1	....	Subadult	2	....	....	....	40	10 IV
Warthog *(Phacochoerus aethiopicus)*	5	9	Adults and subadults	2–4	....	....	....	10–20	5–10 IV or IM
Brindled gnu *(Connochaetes taurinus)*	2	....	Adults	3*	20*	....	100	....	2–5 IV
African buffalo *(Syncerus caffer)*	1	....	Adult	5	....	....	200	....	2 IV and 3 IM
Sassaby *(Damaliscus lunatus)*	1	1	Adults	2	....	....	50–100	....	5 IV or IM
Bushbuck *(Tragelaphus scriptus)*	....	1	Subadult	0.25	....	30	....	....	6 IV
Greater kudu *(Tragelaphus strepsiceros)*	2	1	Adults	3	....	200	....	....	2–5 IV
Steenbok *(Raphicerus campestris)*	10	6	Adults	....	5	10–20	....	....	5 IM
Sable antelope *(Hippotragus niger)*	2	....	Adults	3	....	30–40	....	....	5 IM
Roan antelope *(Hippotragus equinus)*	10	8	Adults and subadults	2–3*	40*	10–50	....	....	5–10 IV or IM
Total	43	41							

* Either etorphine or fentanyl was used.
IV = Intravenously; IM = intramuscularly.

elephants appeared lethargic and relatively nonresponsive to noise and movements—even in the absence of a tranquilizer. This response indicated incomplete antagonistic effect, resulting in reluctance to move away. Thirty to 50 mg of naloxone was later found to achieve rapid and complete antagonistic effect, with the elephant rising and running off within a few minutes.

Subjective evaluation of recovery times when using naloxone intravenously revealed comparable and more rapid antagonistic effect than had been obtained with nalorphine in previous experiments.[10,11]

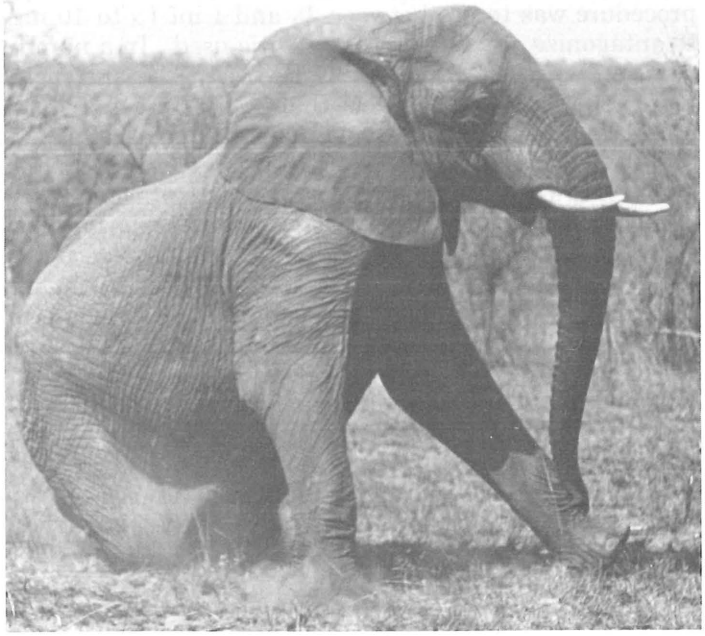

Fig 1—A young adult bull elephant rises 3 minutes after having received an intravenous dose of 10 mg of naloxone hydrochloride. Capture mixture was 8 mg of etorphine plus 40 mg of acetylpromazine.

The practical advantages of naloxone relative to nalorphine may be summarized as follows:

1) Greater potency—Depending on the narcotic used, naloxone has been found to have a relative potency rating between 30 and 58 times greater than nalorphine.[1] At the narcotic dosages used (Table 1) it would have been possible to use a standard naloxone dose of 5 mg on all animals except subadult and adult bull elephants. In the bull elephants, 20 to 40 mg is suggested. In the case of an adult rhinoceros, on the other hand, 250 to 500 mg of nalorphine (up to 25 ml) would be required to antagonize 2 mg of etorphine.[5,10] The larger volume could be disadvantageous—especially when a divided dose must be administered into the ear vein of a partially ambulant specimen. The same applies in the case of subadult and adult elephants (1,500 to 4,000 mg required[10]). In the case of the square-lipped rhinoceros, 10 mg of naloxone (1 ml) appears to be sufficient to antagonize the normal dose of etorphine (Table 1).

2) No chance of overdosage—In the absence of narcotics, naloxone appears to have no demonstrable pharmacologic activity.[7] Because of its greater potency without overdosage problems, naloxone can be administered intramuscularly at high doses with good results. This is particularly valuable in the case of small antelope species (e.g., the steenbok, Table 1) and semitractable but dangerous ungulates.

3) Reduced chance of undesirable side effects.[3]

4) Counteracts the most widely used narcotics.[8]

Conclusions

Naloxone is the preferred antidote for use in the capture and release of free-roaming wild animals, the only possible disadvantage being its high price. Ten milliliter multidose vials (0.4 mg/ml) used in the medical field presently retail at $5.00 each.

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Dermatophilosis in Two Polar Bears

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SUMMARY

Dermatophilosis was diagnosed in 2 of 13 captive polar bears *(Thalarctos maritimus)*, causing generalized dermatitis of 3 years' and 6 months' duration, respectively. Progressive clinical signs included yellowing and darkening of the hair, pruritus, encrustation of skin, and reluctance to bathe. Dramatic resolution of lesions occurred during 8 weeks of twice-weekly intramuscular treatment with long-acting penicillin.

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DERMATITIS caused by the actinomycete *Dermatophilus congolensis* was first described in 1915 as a disease of cattle in the former Belgian Congo.[30] Dermatophilosis has since been reported in cattle,[5,8,12,13,24,29] sheep,[2,6,17] horses,[4,8,11,14,20,21] goats,[10] seals,[9] owl monkeys,[15,18] deer,[7,16] cats,[3,19] hares,[17] hedgehogs,[17] a cottontail rabbit,[23] gerbils,[17] a lizard,[25] polar bears,[26] and human beings.[7] Dermatophilosis in chamois, zebras, donkeys, wild elands, foxes, giraffes, Thompson's gazelles, and ground squirrels has also been reported.[1] The disease was first described in the United States in 1961, affecting cattle,[5] deer,[7] horses,[4] and human beings.[7]

In this report we describe the occurrence and successful treatment of dermatophilosis in 2 polar bears *(Thalarctos maritimus)* at the Detroit Zoological Park.

Clinical History

The polar bear exhibit at the Detroit Zoological Park is 47 years old and presently contains 13 bears. It is constructed of concrete blocks reinforced with steel rods and wire mesh covered by unpainted concrete. The pools, which comprise one-fourth of the exhibit area, are periodically emptied and cleaned with a sodium hypochlorite solution. While the exhibit is being cleaned, the bears are placed in a concrete-lined den area behind