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BETA-ENDORPHIN LEVELS IN BLOOD FROM SELECTED ALASKAN MAMMALS

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Abstract: Blood samples were analyzed for beta-endorphin from 43 non-torpid black bear *(Ursus americanus)*, 8 torpid black bear, 3 non-torpid brown bear *(Ursus arctos)*, 14 moose *(Alces alces)*, 6 mountain goats *(Oreamnus americanus)* and 30 Steller sea lions *(Eumetopias jubatus)*. Beta-endorphin levels were detected in all species sampled and there were no significant differences in levels among non-torpid black bear, brown bear and sea lions. Also, no differences were detected between moose and mountain goats, but all other comparisons were significantly different ($P<0.001$). Torpid black bear had higher levels than all other groups. Moose and mountain goats had the lowest levels. The possibility of beta-endorphin influencing behavior and physiology of mammals is discussed.

INTRODUCTION

Discovery of morphine-like peptides (endorphins) from brain and pituitary tissue of mammals in the mid-1970's[4,9,10,14,15,16] stimulated a flurry of research on their pharmacology and physiological effects. The analgesic property of beta endorphin[1,3,12] was of particular interest to us for its potential influence on the behavior and physiology of wild animals. Endorphins have a profound behavioral effect in rats and were suggested as new etiologic factors in human mental illness.[2] Some of the physiologic characteristics of hibernation which may be induced by morphine or morphine-like substances include: reduction of blood pressure, respiration, body temperature, and total metabolism.[13]

The possibility of beta-endorphin influencing the physiology and behavior of wild mammals should not be ignored. The first step in ascertaining this possibility is to determine the presence and levels of beta-endorphin in a variety of mammals. This paper reports the findings of blood levels of beta-endorphin in Alaskan black bear *(Ursus americanus)*, brown bear *(Ursus arctos)*, moose *(Alces alces)*, mountain goats *(Oreamnus americanus)*, and Steller sea lions *(Eumetopias jubatus)*.

The terms torpid and winter lethargy are used in this paper to reflect data which suggest that bear are physiologically intermediate between hibernators and non-hibernators.[6]

MATERIALS AND METHODS

All species, except sea lions, were sampled during Alaska Department of Fish and Game studies on the Kenai, Peninsula, Alaska, from spring 1978 through spring 1980. Sea lions were sampled during Outer Continental Shelf studies at various coastal locations in the Gulf of Alaska from January, 1976 to April, 1978. Sea lions were shot either at

"haul out" areas or in the water. Blood generally was collected from the shot wound or from the extradural intervertebral venous sinus[6] when it was not possible to collect from the wound. Torpid black bear were immobilized with minimum disturbance in their dens using phencyclidine hydrochloride[1] and promazine hydrochloride.[2] When black bear were not denned, baited barrel traps were used to capture them for subsequent immobilization. Brown bear were captured using a helicopter as a vehicle from which to fire a projectile syringe[3] loaded with phencyclidine hydrochloride and promazine hydrochloride. Moose sampled were from the Moose Research Center (MRC) enclosures and were captured using traps[11] then immobilized using etorphine hydrochloride[4] and xylazine hydrochloride[5] mixture.[7] Mountain goats were captured using a helicopter as a vehicle from which to fire a projectile syringe loaded with etorphine hydrochloride.

Blood samples were collected from captured animals using standard vena puncture techniques. Sera were obtained by centrifuging the samples and drawing the sera which was frozen and stored until analyzed. Beta-endorphin analyses were done by the Cleveland Clinic Foundation, Cleveland, Ohio using radioimmunoassay techniques.[8] The radioimmunoassay kit[6] utilized a rabbit anti-beta-endorphin serum. The antiserum shows 100% cross-reactivity with human sera for beta-endorphin.

The species selected for beta-endorphin analysis represented the greatest diversity of species from which we could obtain samples during ongoing studies. Black and brown bear experience winter lethargy and are omnivorous monogastrics; moose are large ungulates inhabiting the boreal forest; mountain goats are small ungulates and inhabitants of the alpine; and sea lions are carnivorous, monogastric, marine mammals.

RESULTS

One hundred four blood samples were analyzed for levels of beta-endorphin (43 non-torpid black bear, 8 torpid black bear, 3 non-torpid brown bear, 14 moose, 6 mountain goats, and 30 sea lions). Beta-endorphine levels were detected in all samples. Means and standard deviations (pg/ml) were; non-torpid black bear 38.86 $\pm$ 7.79, torpid black bear 56.24 $\pm$ 10.52, non-torpid brown bear 37.00 $\pm$ 3.83, moose 23.49 $\pm$ 3.62, mountain goats 24.83 $\pm$ 2.54, and sea lions 44.74 $\pm$ 6.03 (Table 1).

There were no significant differences ($P<0.001$) among beta-endorphin levels of non-torpid black bear, non-torpid brown bear and sea lions. Also, no differences were detected between moose and mountain goats, but all other comparisons were significantly different (Table 1). Torpid black bear levels were significantly higher than all other groups. Ungulates (moose and mountain goats) had the lowest beta-endorphin levels.

DISCUSSION

The presence of beta-endorphin and the variability between certain species and groups furnished additional reason to speculate on the potential role of

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[1] Sernylan®, Bio-ceutic Laboratories Inc. St. Joseph, Missouri 65502 USA.

[2] Sparine®, Wyeth Laboratories, Philadelphia, Pennsylvania 19101 USA.

[3] Cap-Chur®, Palmer Chemical Co., Douglas, Georgia 30134 USA.

[4] M-99®, Lemmon Co., Rockville, Maryland 20850 USA.

[5] Rompun®, Haver-Lockhart, Shawnee, Kansas 62201 USA.

[6] B-Endorphin [^{125}I] New England Nuclear, Boston, Massachusetts 02118, USA.

TABLE 1. Beta-endorphin blood levels of selected Alaskan mammals (pg/ml).

	N	Mean*	SD
Black bear (non-torpid)	43	38.86a	7.79
Black bear (torpid)	8	56.24	10.52
Brown bear (non-torpid)	3	37.00a	3.83
Moose	14	23.49b	3.62
Mountain goats	6	24.83b	2.54
Sea lions	30	44.74a	6.03

*Any two means followed by a common letter are not significantly different ($P<0.001$).

endorphins in animal physiology and behavior, but provides no conclusive relationship. The only conclusions from this study are: (1) beta-endorphin was detected in the five species sampled and; (2) there was variation between some species and groups. No other conclusions can be drawn due to the nature of the collections. For example, we cannot determine the influence different capture techniques may have on beta-endorphin blood levels. Using the same capture methods on different species may result in a different physiologic response, thereby potentially influencing beta-endorphin blood levels.

A further complicating factor, limiting discussions of beta-endorphin blood levels between species, is the potential difference of antigenic cross-reactivity between species. The percent cross-reaction that may occur with the species we tested is not known. It is known that between rabbits and humans 100% cross-reactivity of beta-endorphin is experienced with the test we used.

Nevertheless, the relatively low standard deviations of beta-endorphin within species suggests that we may speculate about changes in levels if we limit our discussions to within-species considerations. For example, the significantly higher levels of beta-endorphin in torpid compared to non-torpid black bear suggests that beta-endorphin may play a role in winter lethargy. Conversely, the differences noted between carnivores and ungulates may not deserve further speculation at this time.

This paper provides some base-line beta-endorphin blood levels for some Alaskan mammals and, hopefully, provides a stimulus for continued research into the role of beta-endorphin in the physiology and behavior of wild animals.

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