

## **STRESS INDUCED STRAUB TAIL ELEVATION FURTHER BEHAVIORAL EVIDENCE IN RATS FOR THE INVOLVEMENT OF ENDORPHINS IN STRESS**

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### **SUMMARY**

Adult male Sprague-Dawley rats briefly immersed in cold water and forced to swim showed Straub tail elevation, a typical sign of opiate stimulation, upon removal. The presence of Straub tail was a function of degree of immersion and was reversed by naloxone. This suggests the Straub tail response may be a novel behavioral index of stress-induced endorphin release.

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Stressful manipulations of many sorts have been shown to affect behavior through the release of endogenous opioid peptides. Akil et al. [2] reported the induction of analgesia after shock, which correlated with increased opiate-like activity and which was reversible in part by naloxone. Cold water stress produces a similar syndrome (e.g., ref. 3). Other forms of stress including centrifugal rotation and the injection of hypertonic saline solution may also induce related analgesic states although these may have primarily non-narcotic mediation [4].

In addition to anaesthesia, a further typical sign of opiate stimulation in rodents is the Straub tail response. This response consists of tail extension, rigidity and elevation subsequent to a variety of opiate treatments [1,5,6]. The response is opiate specific, naloxone reversible and subject to modification by manipulation of biogenic amines [1].

To further characterize stress as a behavioral syndrome with a possible relation to endorphins, stress-induced Straub tail response in the rat was examined in the present experiment.

Twenty-four adult male Sprague-Dawley rats (Charles River, Portage, MI) 80–130 days of age and weighing an average of 405 g (range = 300–520) at the start of testing were individually maintained with food (Teklad 4.0% fat rodent diet) and tap water continuously available. Normal 12-h/12-h

light/dark cycles (lights on = 07:00–19:00 h) were maintained by automatically programmed artificial lighting.

Subjects were habituated to handling through daily exposures during the week preceding testing. This was necessary to assure control procedures would not themselves be stressful.

The stress procedure consisted of placing the rat individually in a 25 × 37 × 38 cm plastic container 75% filled with an ice-water mixture maintained at 4°C. Ice was added as required to maintain temperature. The rat was removed after 0.5, 1.6 or 5.0 min of exposure and placed upon a table for observation. The rat's hindquarters were placed over the edge of the table without support. Light manual pressure was applied to the back to maintain the animal in an immobile position. Straub tail was scored upon a presence/absence scale with criteria for presence being tail rigidity and extension directed either in an upwards direction or level with the body (note that the tail extended past the testing table and was not supported). If the tail was pointing in a downwards direction Straub tail was considered to be absent. Straub tail is generally scored based upon visual observations and these criteria are in accord with typically employed criteria (e.g., ref. 6). Rats were tested on two occasions separated by 7 days each and order of treatments was counterbalanced. Using the rating criteria and procedures of the present experiments we have not found tolerance to the stress induced effect in rats matched for age and strain (unpublished). Three swim durations were examined with respect to control (no swim): these were 0.5, 1.6 and 5.0 min. In addition three doses of the opiate blocker naloxone were administered to the 5 min stress group to evaluate the effects of receptor blockade. Naloxone HCl (Endo Laboratories) was administered intraperitoneally 1 ml/kg in doses of 0.2, 2.0 and 20.0 mg/kg approx. 15 min prior to testing. Results are presented as percentage positive scores per condition. In all cases 6 rats were used for each experimental cell.

Straub tail was induced by swimming in ice water. This was a naloxone reversible effect. Both of these effects were essentially monotonic, as may be seen in Table I. The increase in tail elevation is significant for both 1.6 and 5.0 min compared to control (by the Fisher exact test;  $P < 0.05$ ). In addition both 2.0 and 20.0 mg/kg of naloxone reduce the normal elevation ( $P < 0.05$  Fisher exact test).

Straub tail elevation in the stressed rat may be a functional marker for the normal activity of endogenous opioid systems. Since activation of endorphins by stress has been defined through limited behavioral means this is a potentially useful extension of its behavioral characterization. These results suggest stress-induced changes are not restricted to analgesia, but may be measured through another typically used index of opiate stimulation.

While no direct measurements of endogenous opioid activity were taken, naloxone reversal supports the present findings as opiate specific. The highest dose (20 mg/kg) is generally regarded as non-specific but the intermediate dose has been used as a specific opiate blocker. The present findings

TABLE I

EFFECTS OF SWIMMING IN COLD WATER (4°C) AND NALOXONE UPON STRAUB TAIL ELEVATION IN THE RAT

## A. Straub tail produced by cold water swimming in the rat

Time swimming (min)	% of rats with positive response <sup>a</sup>
0	0
0.5	0
1.6	33
5.0	100

## B. The antagonism of the Straub tail by intraperitoneal naloxone

Dose naloxone <sup>b</sup> (mg/kg)	% of rats with positive response
0	100
0.2	100
2.0	16
20.0	0

<sup>a</sup>In all cases % positive represents the percentage of rats of a given group of six showing either rigid extended or elevated tail response as further defined in the text.

<sup>b</sup>Dose administered 15 min prior to test.

therefore may represent true opiate mediated effects which are not dependent upon non-specific sedation.

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