The Effect of the Stress Hormone Corticosterone and ACTH Concentrations Swimming and Surgery in Mature Male Sprague-Dawley Rats

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ABSTRACT

Introduction: The number of stress hormones and neurotransmitter systems of the body and cause activation of the pituitary - adrenal (HPA) and the sympathetic system in the body. Corticosterone, glucocorticoid in the rat adrenal cortical secretion in part is influenced by stress. ACTH-secreting pituitary adrenal also found that the stress concentration changes can affect the secretion of corticosterone. This study compared the effects of chronic stress hormone ACTH and corticosterone swimming and surgery in male rats. Methods: in this experimental study, 40 adult male rats of Sprague-Dawley rats were used. Animals were randomly divided into 4 groups as follows: Control, stress, swimming, surgery stress swimming for 7 consecutive days, each day for 10 minutes in water at 25 °C were swimming. In the surgical group, a length of one centimeter incision in the back and the lumbar vertebrae 5-3 were created. The results of the statistical software SPSS version 18 and the surface P ≤ 0.05 was LSD test was used for comparisons between groups. Results: Swim stress alone caused a significant increase in ACTH. Chronic stress caused a significant increase in the concentration of corticosterone was swimming with surgery. Discussion: Swimming chronic stress may increase ACTH and corticosterone by the HPA axis is activated.

Key words: Swim stress, surgical stress, ACTH, corticosterone.

Introduction

The main glucocorticoid in species such as rats, corticosterone and cortisol in humans and that the steroid hormones are synthesized from cholesterol [1]. This hormone is secreted by the adrenal cortical Fasciculata section [2]. All nucleated body tissue with glucocorticoid receptors in the cytoplasm [1]. Secretory pattern of cortisol and corticosterone is very complicated and almost entirely by ACTH hormone is controlled. Steroidogenic response to ACTH stimulation of adrenal gland growth in the glands. By stimulating the secretion of corticotropin–releasing hormone called ACTH, a CRH is secreted Hypothalamus [3]. In addition, CRH, stress, surgery, trauma, infection, hypoxia, hypoglycemia, anxiety, daily rhythms, alpha-and beta-adrenergic agonists, glucocorticoid hormones, and excess ACTH on ACTH regulate affect [4,5,6]. Cortisol is a stress hormone and is an essential component of the stress response. Response to stress is mediated through the central nervous system. Besides the stress of anti-diuretic hormone (ADH) increases the stimulatory effect of the hormone on hypothalamic CRH is secreted. CRH and ACTH and cortisol secretion rate in humans during the early morning and early evening is low [7]. Stress activates the hypothalamic - pituitary - adrenal (axis HPA) is also [8,9]. In one study it was found that adrenalectomy performed in non-stress conditions increased plasma ACTH and corticosterone levels are reduced.

However, in this study, control rats injected with corticosterone to ACTH was significantly reduced. Also found that intravenous injection of 30 mg dexamethasone on ACTH and corticosterone plasma concentrations kilogram of body weight loss is rapid [10]. Franssisca Gomez and colleagues found that injections of dexamethasone 0.05 mg / kg and 0.02 mg / kg inhibits ACTH and corticosterone concentrations in the rat race all (Boron Norway) BN, (Fischer344) F344, (Wistar - Kyoto) WKY, (Lewis) LEW and (Spontaneously hypertensive rate)
SHR but tail shock induced by acute stress induces an increase in ACTH concentration is only in the first race [11]. Research N.Kain and colleagues found that two hours after hysterectomy increases the amount of cortisol concentration to 48 hours following surgery is stable. In addition, another study by the same group on heart disease found during surgical stress increases cortisol levels after 24 h [12]. The present study investigated the effects of stress hormones corticosterone and ACTH concentrations in adult male rats.

**Methods:**

A prospective study of 40 adult male Wistar rats, Sprague - Daweley weighing 200-250 g were used. Animals at standard conditions of 12 hours light and 12 hours darkness and temperatures of 2 ± 2 ° C were maintained. The animals were randomly divided into 4 groups as follows:

2. Second group of healthy male rats with swim stress.

The induction of chronic swimming stress:

Animals for seven consecutive days for 10 minutes each day (between 10 am to 12 am) in the swimming pool with a temperature of 25 ° C were placed.

Surgery:

After the animals were anesthetized with ketamine (50 mg/kg) and xylazine (20 mg/kg) and removing the hair back, a vertical incision in the back between the lumbar vertebrae during a 3-5 cm meters will be given. The skin and muscle tissue is pushed aside and went on with needle and suture 4, back skin was sutured. Tetracycline ophthalmic ointment was applied to prevent infection, which was rubbed on the skin.

**Plasma Method of preparation:**

After a seven-day period ending stress (the eighth day after the onset of stress) directly from the heart to help pet syringe 5 ml blood was taken directly from the animal's heart.

After preparation of plasma samples obtained at a temperature of - 20 ° C were maintained. To determine the concentration of corticosterone ELISA kit manufactured by IDS-UK (LOT: 60056) and to determine the concentration of ACTH ELISA kit manufactured by Biomerica-Germany (REF: 7023) was used.

**Statistical Analysis:**

For data analysis software SPSS version 16 statistical test for comparison of groups was performed using ANOVA and LSD test.

**Results:**

Swim stress alone caused significant increases in ACTH concentrations compared to the control group (P = 0.03).

Surgical stress alone reduced ACTH concentrations compared to the control group was significant (P = 0.15).

Surgical stress associated with swimming stress increased ACTH concentrations compared to the control group was no significant (P = 0.09).

Swim stress alone increased plasma corticosterone concentrations significant compared to control group was (P = 0.14).

Surgical stress alone increased plasma corticosterone compared to controls was significant (P = 0.06).

Surgical stress associated with swimming stress significantly increased plasma corticosterone compared to controls was (P <0.004).

**Table 1:** Comparison of groups of hormone concentration.

<table>
<thead>
<tr>
<th></th>
<th>Surgical stress</th>
<th>Normal stress</th>
<th>Normal</th>
<th>ACTH (pg/ml)</th>
<th>Corticosterone (ng/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stress</td>
<td>Normal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACTH</td>
<td>14.12± 2.36</td>
<td>12.26 ± 1.51</td>
<td>15.92 ± 1.74 *</td>
<td>13.1 ± 1.93</td>
<td></td>
</tr>
<tr>
<td>Corticosterone</td>
<td>23.48 ± 1.37 *</td>
<td>21.23 ± 2.64</td>
<td>20.06 ± 3.54</td>
<td>19.12 ± 4.14</td>
<td>23.48 ± 1.37 *</td>
</tr>
</tbody>
</table>

* Asterisk indicates a significant difference between groups at the 5% level.

**Discussion:**

Effect of surgical stress on plasma ACTH concentration chronic swim stress significantly increased plasma ACTH concentrations were examined in groups. ACTH concentrations reflect increased activity of the HPA axis stress types [4,5,6,13]. The increased activity of the HPA axis, ACTH release from the pituitary is high that Stress causes the release of CRH from the hypothalamus, this mean that the hormone ACTH secretion into the peripheral blood circulation is increased [14]. It may also arginine vasopressin (AVP) secretion from the hypothalamus stimulates the release of CRH and ACTH induced stress is involved [14,15]. Moreover sympathetic locus ceruleus - nor epinephrine, which is activated by stress influence CRH-secreting neurons in the nucleus of the hypothalamus gland adjacent ventricular CRH secretion, is increased [4,5,6,14].

The results obtained are consistent with the research results:
ACTH levels in male F344 rats, 6 months and 20 months of age were at increased risk of new chronic stress [16]. Manipulated mice than in the control group had higher ACTH levels [11]. Sedentary rats with chronic stress exposure for 14 consecutive days significantly increased plasma ACTH levels [17]. Restraint stress induces HPA axis for two hours, and plasma ACTH concentrations were C57BL male rats [18]. In male rats exposed for 1 to 21 days of chronic stress increased plasma ACTH levels were unpredictable [19]. Djordjevic J. And colleagues showed that acute cold stress and lack of exercise (two hours) increased ACTH levels in SHR and WKY rats are male. Isolation of chronic stress (21 days) increased ACTH levels in these mice were [20]. Another study by Francisca Gomez and colleagues found that chronic immobilization stress increased ACTH concentrations in rat strains LEW, SHR and WKY was (Gomez, et al., 1996). Francisca Gomez, another study showed that acute stress increased ACTH (tail shock in male rats BN, F344 and WKY is [11]. In the present study, ACTH concentrations decreased following surgery, but the difference was not significant. It seems like stress, such as surgery, immobilization stress and stress before puberty and is bound to act. The stress or ACTH secretion is reduced or had no effect on the concentration of the hormone [11,21,22]. Following adrenalectomy, ACTH levels increased, but this change was not statistically significant. Adrenalectomy in adrenal glands have been removed because of glucocorticoid negative feedback on the HPA axis does not exist (in this case the stress intensity than is observed with adrenalectomy), so there is potential to increase plasma ACTH concentrations [23]. This result is consistent with the following research:

A study on adult male rats Sprague - Dawley showed that adrenalectomy increased plasma ACTH was after 7 days [10]. Yukimura Y, and colleagues studied on very obese Zucker rats (genetic) and demonstrated that lean, if this seems adrenalectomized rats subjected to surgery after the end of the recovery period, plasma ACTH levels are increased [24].

Effect of surgical stress on plasma corticosterone concentrations:

Swim stress increased corticosterone concentration, but this increase is not statistically significant. Many previous studies have shown that chronic stress does not cause significant changes in corticosterone levels: Apply to variable chronic stress on male rats for 6 consecutive weeks [25], Chronic immobilization stress in male rats LEW [11], foot shock stress for 14 days in mice [17], stress-foot shock to 23 days in rats [26], chronic stress, shock - escape for 6 consecutive months in male Fischer rats [16], chronic social stress for 7 days (once a day) in rats [27] and psychological stress (Sociological) for 18 days (day 30 min) in European starlings does not affect corticosterone concentrations [28].

In the group with surgical stress, swim stress significantly increased corticosterone levels, which is probably due together with these two stress and increasing stress intensity by rats, could be excessive secretion of corticosterone. This result is consistent with the studies. Chronic stress immobility in rats of Brown Norway, Fischer, SHR and Wistar Kyoto [11], chronic stress noise for 30, 60 and 90 days in rats, albino [29], and stress community 30 days in mice of male rats [30] were significantly increased corticosterone concentrations.

Concentration of corticosterone in this study (not significant) and similar studies may be due to a phenomenon called adaptation or repetition of the stressor is Adaptation [3,4,5,6,14]. In contrast, other studies contradict this conclusion are: The study found that chronic stress Alvin Bordish and Mauricio Oido a shock - escape to 6 months on the young Fisher 344 rats aged 6 and 20 months of age, plasma corticosterone levels are increased [16]. Acute restraint stress for two hours on a C57BL male rats increased plasma corticosterone [18]. Adrenalectomy caused a significant decrease in corticosterone levels were that this is due to the removal of the adrenal glands and the synthesis of corticosteroids. The stress in this group had no effect on corticosterone levels. Eduardo Spinedi and RoLF C Gaillard research also showed that the rats of Wistar Sprague - Dawley underwent adrenalectomy seems, after 7 days, they have very little hormone corticosterone in blood flow is observed [10].

Conclusions:

The aim of this study was to investigate the possible effects of swim stress and chronic stress hormones ACTH and corticosterone concentrations surgery in male rats Sprague - Dawley. Chronic swim stress was significantly increased ACTH that this is probably due to an increase in the HPA axis and AVP secretion is increased ACTH concentrations did not change, but the effect of surgical stress. Swim stress alone had no significant effect on plasma corticosterone but swimming with surgical stress significantly increased corticosterone concentrations that it is probably due to stimulation of adrenal cells. The present study suggests that the overall effect of chronic stress, chronic stress, surgery is more intense than swimming. Appreciation and Thanks

That means all those who assisted us in this research, is appreciated and thanks.

References


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