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Is the Thoroughbred race-horse under chronic stress?

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Abstract

Thoroughbred fillies were divided into three groups according to age: group 1, 7 fillies aged 1 to 2 years (G1) starting the training program; group 2, 9 fillies aged 2 to 3 years (G2) in a full training program; group 3, 8 older fillies 3 to 4 years of age (G3) training and racing. Blood samples were collected weekly from July to December. Cortisol was quantified using a solid phase DPC kit. The intra- and interassay coefficients of variation were 12.5% and 15.65% and sensitivity was 1.9 ± 0.2 nmol/l. The semester average of cortisol levels varied between groups: G1 = 148.8 ± 6.7, G2 = 125.7 ± 5.8, G3 = 101.1 ± 5.4 nmol/l, with G3 differing statistically from the other groups. The lower cortisol levels observed in the older fillies leads us to propose that the stress stimulus, when maintained over a long period of time, may become chronic and result in a reduction of hypophyseal corticotropin-releasing hormone receptors. The secretion of endogenous opioids may also lead to low serum cortisol levels.

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Key words
- Horses
- Cortisol
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- Chronic stress

Exercise is stressful to all animals, but the magnitude of the stress response depends on its intensity and duration and on animal fitness (1-3). In fact, exercise is the best example of "normal stress" to which an animal can be exposed, and is a high-intensity natural stressor (4). The physiologic elevation of cortisol can occur secondary to exercise, hypoglycemia or stress (5). Acute exercise and training may influence circulating endogenous opioid (EO) levels (6). In addition to having an effect on exercise performance, EO may play a role in various hormonal changes. Cortisol levels increase at the beginning of training and this increase is attributed to adaptation to conditioning (7).

The study was conducted on 24 Thoroughbred fillies born and raised at Equilia Stud farm, Avaré, SP, Brazil. The animals were divided into three groups: group 1 (G1) consisted of 7 fillies aged 1 to 2 years that were starting the riding and training program; group 2 (G2) consisted of 9 fillies aged 2 to 3 years already used to riding and running; group 3 (G3) consisted of 8 fillies aged 3 to 4 years running and competing at the Jockey Club of São Paulo. Blood was collected weekly by venipuncture always at the same time to avoid circadian cortisol fluctuation (8) over a 6-month period from July to December. Serum was frozen at -20ºC until the time for cortisol determina-

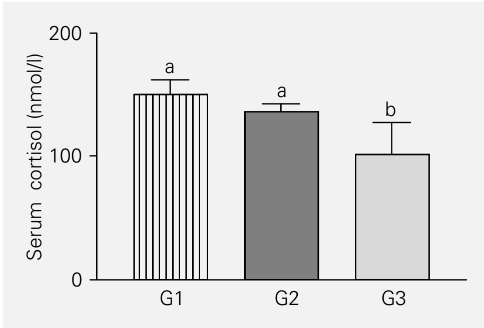

Figure 1 - Serum cortisol during a 6-month period from July to December in three groups of Thoroughbred fillies of different ages and submitted to different periods of training: G1 (1 to 2 years of age, N = 7), G2 (2 to 3 years of age, N = 9), and G3 (3 to 4 years of age, N = 8). Samples were collected weekly at the same time of day for the determination of cortisol levels. Data are reported as means ± SEM. Means are different at the 0.05 level if they do not share a common letter (Kruskal-Wallis test).

tion, which was carried out at VRA-FMVZ-USP using a solid phase DPC (Coat-a-Count) kit. The intra- and interassay coefficients of variation were 12.5% and 15.65%, respectively, and sensitivity was 1.9 ± 0.2 nmol/l. Data were analyzed statistically by the Kruskal-Wallis and Friedman tests, with the level of significance set at $P<0.05$. Data are reported as means ± SEM.

Mean serum cortisol levels varied both within and between groups during the semester (Figure 1) and were higher in G1 and G2. Although not significant, there was a positive correlation between cortisol levels and month of the year in G1 ($r = 0.7143$) but the correlation coefficient was negative for G2 and G3 fillies ($r = -0.65$ and $r = -0.20$, respectively). Table 1 shows that cortisol levels increased in G1 and decreased in G2 and G3.

In horses, cortisol secretion is controlled by pituitary ACTH whose secretion is influenced not only by independent actions of secretagogues such as CRH and AVP, or inhibitors such as cortisol, but also by a complex interaction of these factors with one another (9). Exercise is stressful to horses, resulting in an increase in plasma cortisol levels (10). The older fillies, which were submitted to more intense training, showed lower cortisol levels (mean values) during the semester and also a tendency to decreased serum cortisol levels reflected by a negative correlation with months. The older fillies may be under some influences that can diminish cortisol levels since they are subjected to a heavier workload and have been training for a longer period of time compared to younger animals. The younger fillies showed a positive correlation of cortisol levels during the semester, indicating that the stress situation may be increasing in the animals of this group, in agreement with data reported by McCarthy et al. (11) and Freestone et al. (7).

Another possibility is that the G3 fillies are under chronic stress (12). It has been shown that the administration of an opioid antagonist increases cortisol secretion in horses (13). There are two hypotheses that can explain the difference within groups: either the animals are under chronic stress or they are becoming used to exercise. During chronic stress the relationship between CRH secretion and pituitary responsiveness to CRH becomes disturbed, indicating the existence of an ACTH-release inhibiting factor

Table 1 - Comparison of monthly mean cortisol levels for three groups of Thoroughbred fillies of different ages and submitted to different periods of training.

Group 1 (1-2 years of age, N = 7), group 2 (2-3 years of age, N = 9), and group 3 (3-4 years of age, N = 8) during the 6-month breeding season. Blood was collected weekly at the same time of day. Data are reported as means ± SEM as nmol/l. Means are different at the 0.05 level if they do not share a common letter (Kruskal-Wallis test).

	July	August	September	October	November	December
Group 1	145.3 ± 10[a]	120.6 ± 9[a]	150.9 ± 17[a]	135.3 ± 12[a]	163.4 ± 12[a]	167.07 ± 12[a]
Group 2	131.5 ± 14[a]	155.7 ± 7[b]	151.5 ± 10[a]	138.5 ± 9[a]	122.5 ± 8[b]	111.4 ± 12[b]
Group 3	118.5 ± 13[a]	95.7 ± 7[a]	101.0 ± 12[b]	102.5 ± 10[a]	76.6 ± 9[c]	104.4 ± 16[b]

(14). In fact, exhausting exercise decreases the cortisol peak (15). The increased impact of the opioid system during chronic stress may prevent excessive hypothalamic-pituitary-adrenocortical activation and thus may be of adaptive value (16). We conclude that these fillies may be under chronic stress or may be better accustomed to the work imposed on them, or both.

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