PROCEEDINGS OF THE SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE, 179, 546-548 (1985)

PROLACTIN RESPONSES TO CHRONIC EXERCISE IN MALES

KAUFMAN, F.L.*, D.E. MILLS**, R.L. HUGHSON*, G.T. PEAKE***

*Depts. of Kinesiology and **Health Studies,
University of Waterloo, Waterloo, Ont., Canada N2L 3G1

**Depts. of Medicine, University of New Mexico,
School of Medicine, Albuquerque, N.M. 87131

ABSTRACT: Chronic, as well as acute, exercise increases circulating PRL in females. The response of males to repeated exercise, however, is unknown. The purpose of the present study was to examine the effects of acute and chronic exercise on plasma PRL levels in untrained males. Eight male subjects performed cycle ergometer exercise at 50% of their maximal oxygen uptake on 10 consecutive days. The subjects exercised in an environmental chamber maintained at 39°C and 30% relative humidity. PRL levels were measured on days 1, 5, and 10 before exercise, and after 20 and 45 minutes of exercise. Acute exercise increased PRL levels. However, plasma levels did not significantly increase during exercise on days 5 and 10. This suggests a similarity in the PRL response to acute exercise in males and females, but a sex difference in the response to chronic exercise.

It has been suggested that alterations in prolactin (PRL) secretion may be responsible for reproductive disturbances in females athletes (1). For this reason, a considerable amount of attention has been focussed on PRL regulation during acute and chronic exercise in these individuals. Many of these studies have demonstrated a significant increase in circulating PRL concentrations during both acute and chronic exercise (2-7). In addition, trained female runners have been reported to exhibit elevated 24 hour mean PRL levels in comparison to non-exercising controls (8).

Much less attention, however, has been directed toward the effects of exercise on PRL in males. Although acute exercise has been shown to increase circulating PRL in these individuals (9-11), there are no studies which describe the response to chronic exercise.

The purpose of the present study was to investigate the PRL responses to acute and repeated bouts of exercise in males.

MATERIALS AND METHODS

This study was conducted in conjunction with research into the involvement of PRL in heat acclimatization. Therefore certain unrelated aspects of the study were not included in this report.

Eight healthy male subjects, age 21-26 years (24±1, $\bar{x} \pm$ S.E.) participated in the study. Before testing began, each subject signed a consent form approved by the Office of Human Research at the University of Waterloo. Although none of the subjects were trained athletes, all participated in recreational sports. In the study, each subject performed cycle ergometer exercise, at 50% of his maximal oxygen uptake, on 10 consecutive days in an environmental chamber maintained at 39°C and 30% relative humidity. Workloads were determined from a maximal oxygen consumption test prior to the study. On exercise days 1, 5, and 10, designated as test days, the exercise was 45 minutes in duration. On the remaining days subjects exercised for 90 minutes.

On each test day a catheter was inserted into a dorsal hand vein 30

0037-9727/85 $1.50

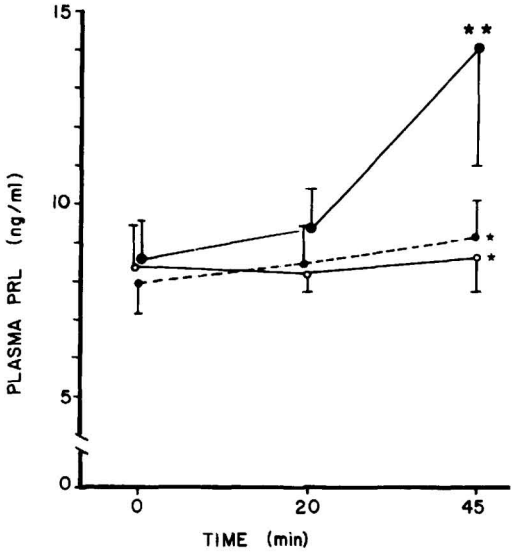

Figure 1. Plasma PRL responses of 8 men ($\bar{x}$ ± S.E.M.) to 45 minutes to cycle ergometer exercise at 50% Vo_2 max on days 1 (●-●), 5 (●-●), and 10 (0-0) of the study. On days 2-4 and 6-9, subjects cycled for 90 min at 50% Vo_2 max. $p<0.05$ vs. day 1
** $p<0.025$ vs. Time 0

minutes prior to exercise. Heparinized blood samples were drawn at times T=0 (pre-exercise), and 20 and 45 minutes after the start of exercise. Plasma was stored at -80°C and analyzed for PRL by radioimmunoassay kit (Diagnostic Products Corp.). All samples were assayed together. The sensitivity of the assay was 3.7 ng/ml.

RESULTS

Pre-exercise plasma PRL levels on day 1 were within the normal range reported for healthy men (12) and did not change significantly from this value on either days 5 or 10 of exercise.

Acute exercise on day 1 significantly increased plasma PRL (Figure 1) from 8.6 ± 1.1 ng/ml to 14.1 ± 3.0 ng/ml ($p<0.025$). However, chronic exercise at a similar workload failed to elicit PRL increases on subsequent test days, so that the day 1 PRL response was

DISCUSSION

Acute exercise is known to stimulate PRL secretion in females (2-7). The findings of the present study confirm reports that acute exercise also increases circulating PRL in males (9-11).

However, unlike females, the results of the present study suggest that with repeated exercise at a constant intensity, the plasma PRL response attenuates within 5 days. Previous studies in the literature have suggested that the PRL response is maintained over time in chronically exercising males. The variation between the current and previous observations may result from the presence of confounding variables in the earlier studies.

In the present study the intensity of the exercise was constant, with only the duration varying on the test days. In addition, environmental conditions were held constant throughout the study. In previous studies, the presence of stressful stimuli were not completely eliminated thus providing a stimulus to PRL secretion above that of the chronic exercise. For example, Moretti et al.(10) reported a 13.4 ng/ml rise in plasma PRL in professional athletes following 20 minutes of cycle ergometer exercise at 80% of their maximal heart rate. This intensity and duration of exercise is very stressful, even for trained individuals, and was more demanding than the regular exercise program of the subjects. Thus, the stress of an unusually intensive exercise session may have accounted for the PRL response in this study. Similarly, in a study by Rogol et al (13) examining post-exercise serum PRL levels in male marathon runners, PRL tended to be higher post-exercise than in untrained controls ($p<0.08$). Two of 5 subjects in the test group demonstrated no post-exercise increase and the 3/5 that did respond were those who had exercised by running at a fast pace in adverse weather (-29°C). The environmental stress, rather than the chronic exercise per se, was most likely responsible for any PRL changes.

Brisson et al (17) recently suggested that the PRL response to exercise is closely associated with rectal temperature during the exercise bout. In the present study the mean post-exercise rectal temperature on day 1 was 37.9 ± 0.1°C. This did not significantly change on either day 5 or 10, suggesting that body temperature was not a factor in the observed attenuation of the PRL response.

The findings of this study suggest that there is a sex difference in the

PRL response to repeated exercise, and that the male PRL response to chronic exercise attenuates within days unless accompanied by additional stressors. The sex difference in the PRL response to repeated exercise may be the result of estrogen sensitization of the PRL secretory pathways in the female. Estrogen has been shown to increase basal PRL secretion (14), as well as increase the sensitivity and magnitude of the PRL response to stimuli (15, 16).

ACKNOWLEDGEMENTS

This work was supported by grants from the Heart and Stroke Foundation of Ontario and Natural Sciences and Engineering Research Council.

The authors would like to thank R. Ward for his expert technical assistance, and E. Bruce for her patient secretarial assistance.

REFERENCES

1. Boyden TW, Pamenter RW, Grosso D, Stanforth P, Rotkis T, Wilmore HR. Prolactin responses, menstrual cycles, and body composition of women runners. J Clin Endocrinol Metab 54:711-714, 1982.
2. Brisson GR, Volle MA, DeCarufel D, Desharnais M, Tanaka M. Exercise-induced dissociation of the blood prolactin response in young women according to their sports habits. Horm Metab Res 12:201-205, 1980.
3. Loucks AB, Horvath SM. Exercise-induced stress responses of amenorrheic and eumenorrheic runners. J Clin Endocrinol Metab 59:1109-1120, 1984.
4. Russell JB, Mitchell D, Musey PI, Collins DC. The relationship of exercise to anovulatory cycles in female athletes: hormonal and physical characteristics. Obstet Gynecol 63:452-456, 1984.
5. Cavanaugh DJ, Fox EL, Bartels RL, Malarkey WB, Hecker A, MacVicar MG. Acute and chronic effects of exercise on prolactin levels in running and non-running women, age 18-37. Med Sc Sports Ex 15:96, 1983.
6. Baker ER, Mathur RS, Kirk RF, Landgrebe SC, Moody LO, Williamson HO. Plasma gonadotropins, prolactin, and steroid hormone concentrations in female runners immediately after a long distance run. Fert Steril 38:38-41, 1982.
7. Shangold MM, Gatz ML, Thysen B. Acute effects of exercise on plasma concentrations of prolactin and testosterone in recreational women runners. Fert Steril 35:699-702, 1981.
8. Cavanaugh DJ, Fox EL, Malarkey WB. Twenty-four hour mean prolactin profiles of female long distance runners compared to non-runners. Med Sci Sports Ex 16:119, 1984.
9. Gawel MJ, Alaghband-Zadeh H, Park DM, Rose FC. Exercise and hormonal secretion. Post Grad Med J 55:373-376, 1979.
10. Moretti C, Fabbri A, Gnessi L, Cappa M, Calzolari A, Fraioli F, Grossman A, Besser GM. Naloxone inhibits exercise-induced release of PRL and GH in athletes. Clin Endocrinol 18:135-138, 1983.
11. Mayer G, Wessel J, Kobberling J. Failure of naloxone to alter exercise-induced growth hormone and prolactin release in normal men. Clin Endocrinol 13:413-416, 1980.
12. Frantz AG. Prolactin. N Engl J Med 298:201-207, 1978.
13. Rogol AD, Veldhuis JD, Williams FA, Johnson ML. Pulsatile secretion of gonadotrophins and prolactin in male marathon runners. J Androl 5:21-27, 1984.
14. Frantz AG, Kleinberg DL, Noel GL. Studies on prolactin in man. Recent Progr Hormone Res 28:527-573.
15. Buckman MT, Peake GT. Estrogen potentation of phenothiazine-induced prolactin. J Clin Endocrinol Metab 36:977-980, 1973.
16. Carlson HE, Jacobs LS, Daughaday WH. Growth hormone, thyrotropin and prolactin responses to thyrotropin-releasing hormone following diethylstilbestrol pretreatment. J Clin Endocrinol Metab 37:488-490, 1973.
17. Brisson GR, Ledoux M, Massicotte D, Pellerin-Massicotte J, Peronnet F, Rajotte D, Thibault G. Blood prolactin response during exercise in trained male subjects could result from a thermal stress. Can J Appli Sports Sci 9:25P, 1984.

Received April 25, 1985.
P.S.E.B.M., Vol. 179, 1985.
Accepted May 17, 1985.