DIURNAL VARIATION OF PLASMA TESTOSTERONE AND CORTISOL

R. M. ROSE*, L. E. KREUZ, J. W. HOLADAY, K. J. SULAK AND C. E. JOHNSON

Department of Psychiatry, Division of Neuropsychiatry, Walter Reed Army Institute of Research, Walter Reed Army Medical Center, Washington, D.C. 20021, U.S.A.

(Received 20 March 1972)

Recent reports have demonstrated that plasma testosterone shows a significant diurnal variation, with an early morning peak (Resko & Eik-Nes, 1966; Faiman & Winter, 1971; Okamoto, Setaishi, Nakagawa, Horiuchi, Moriya & Itoh, 1971). Testosterone has also been reported to fluctuate during sleep, possibly associated with rapid eye movement episodes (Evans, MacLean, Ismail & Love, 1971). Thus testosterone, like cortisol (Hellman, Nakada, Curti, Weitzman, Kream, Roffwarg, Ellman, Fukushima & Gallagher, 1970; Krieger, Allen, Rizzo & Krieger, 1971) may be secreted episodically.

In a recent study of ten young men, aged 19–23 yr, who were closely observed while participating in their usual daily routines, plasma samples were drawn approximately every 90 min during the day and night from indwelling catheters. Cortisol was analysed in all samples by the method of Murphy (1968), and testosterone was analysed in all men every 6 h by a modification of the method of Mayes & Nugent (1968). In addition, testosterone was analysed in all the samples from five men.

The mean plasma testosterone upon awakening (06.00 h) was 788 ng/100 ml, and the mean of all samples 596 ng/100 ml, which is similar to that reported by others for men in this age group (Resko & Eik-Nes, 1966; Faiman & Winter, 1971; Kreuz & Rose, 1972). Figure 1 shows the deviation from the mean over 24 h for testosterone and cortisol for the five men. Although samples were not collected with sufficient frequency to show all possible cortisol secretory episodes, peaks at 12.00 and 16.00 h and the early morning rise are clearly evident. These peaks during the day were also those most frequently observed in subjects studied by Krieger et al. (1971). No such peaks were evident in plasma testosterone levels. More frequent sample collection might detect such peaks, especially during sleep, but they are likely to be of a smaller magnitude than those observed for cortisol. Although consistent, the magnitude of diurnal change in testosterone levels was significantly less than that observed for cortisol. Testosterone fell an average of 42 % from awakening (06.00 h) to 23.00 h, compared with 92 % for cortisol during this period.

Analysis of variance of plasma testosterone levels for all men studied is shown in Table 1. By far the largest source of variance is the effect of time (diurnal change), with a small amount of variability shown over different days.

* Present address: Department of Psychosomatic Medicine, Boston University School of Medicine, 720 Harrison Avenue, Boston, Massachusetts 02118, U.S.A.
Fig. 1. Per cent deviation from the mean for plasma testosterone and cortisol concentration analysed approximately every 90 min for five men (vertical lines indicate ± s.e.m.).

Table 1. Summary of an analysis of variance of estimates of plasma testosterone analysed every 6 h in ten men studied for 3 days each

<table>
<thead>
<tr>
<th>Source</th>
<th>Mean square</th>
<th>d.f.</th>
<th>F ratio</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between subjects</td>
<td>253428-9</td>
<td>9</td>
<td>7-22</td>
<td>&lt; 0-001</td>
</tr>
<tr>
<td>Within subjects:</td>
<td>35099-1</td>
<td>140</td>
<td>65-74</td>
<td>&lt; 0-001</td>
</tr>
<tr>
<td>Time</td>
<td>784770-0</td>
<td>4</td>
<td>4-23</td>
<td>&lt; 0-025</td>
</tr>
<tr>
<td>Day</td>
<td>50530-7</td>
<td>2</td>
<td>1-78</td>
<td>NS</td>
</tr>
<tr>
<td>Time x day</td>
<td>21192-9</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within error</td>
<td>11938-0</td>
<td>126</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NS = not significant.

These data suggest that plasma testosterone is relatively stable in individuals, shows a relatively small but very consistent diurnal change, and that if other fluctuations or peaks occur during the day, they are less consistent and less striking than that observed in plasma cortisol.

REFERENCES