Cardiac autonomic regulation and hormonal responses during a two-week military training.

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Introduction. A soldier's physical fitness continues to play a key role on the battlefield. Heart rate variability (HRV) measurements are used to monitor physical exertion and recovery. It can be used to indicate the stress level from psychological and physiological factors. HRV has been widely studied in athletes, but it has been used less often to monitor soldiers' exertion. Much of the research on soldiers' exertion has been carried out based on serum hormonal measurements. The present study aimed to monitore the training load of conscripts during both garrison and field service and to evaluate recovery during 3 days after the training.

Methods. The test group included 20 young (20±1 yrs.), fit (12 min running test: 2980±267 m) conscripts from the Reconnaissance Course of the Light Infantry Company at the Reserve Officer School. The study period consisted of 4 days of garrison training (days 1-4) and 7 days of military field training (days 5-12) followed by a 3 day recovery period (days 13-15). Heart rate variability was recorded with heart rate monitors (Polar Electron S801I) during an orthostatic test in the morning straight after awakening at 5:45 am. Orthostatic test included 5 minutes lying in supine position followed by 5 minutes in standing position. Heart rate variability was analyzed from 4 minute segment in the supine and standing positions (Firstbeat Technologies 3.1.1.0). The baseline value for HRV was executed by combining 2 succesfull measurements from the all four possible measurements during the garrison training. Serum hormone concentrations [testosterone (TES), cortisol (COR), sex-hormone binding globulin (SHBG)] were assessed at day 1 (D1), day 5 (D5), day 8 (D8), day 12 (D12) and day 15 (D15).

Results. The low-frequency power (LF) indicating sympatho-vagal activity decreased in the orthostatic test from baseline to the several days of the field training. The decrease from baseline was statistically significant when compared to the 3rd, 5th and 6th days of the field training in the supine position as well as in the standing position ($p<0.05$). The indicator of parasympathetic regulation, high-frequency power (HF), remained virtually unchanged during the supine position but it increased during the standing position, where the change from baseline to the 3rd, 4th and 7th days of the field training was statistically significant ($p<0.05$). The LF/HF -ratio, which indicates the balance of the autonomic nervous system, decreased in the standing position when compared to baseline and 4th, 5th, 6th and 7th days of the field training (p 0.05). The measurements after the recovery period (days 13-15) showed an increase in all heart rate variability parameters when compared to field training ($p<0.05$).

Testosterone decreased ($p<0.05$-0.001) throughout the training period but recovered during the recovery period (Day 1: 18.2±3.9, D5: 16.2±4.0, Day 8: 10.2±3.6, D12: 7.0±4.1, Day 15: 19.9±5.3 nmol/l), while sex-hormone binding globulin increased by 24% from Day 1 to Day 12. In addition, cortisol decreased ($p<0.05$) between day 8 and day 12 (D8: 583 ± 146 nmol/l; D12: 388 ± 109 nmol/l).

Discussion. Autonomic nervous system regulation decreased during the field training. The decreasing hormone values indicate that the field training involved more exertion than the period in garrison conditions. However, the magnitude of the changes in the autonomic nervous system regulating cardiac and circulation systems were not as significant as the dramatic hormone changes. The hormone responses and changes in the autonomic nervous function occurring from the field training to the measurements after the recovery period indicates a physical recovery from the training. The hormones even increased above the baseline measurement levels, which may indicate a state of super compensation.

Conclusion. The planning of military training, as far as this training period is concerned, was successful, as the results show a positive trend in exertion after the recovery period. The present findings indicate that the stress is largely caused by the military field training, which should be taken into account in the planning of more prolonged military exercises and training.