HAEMOGLOBIN MASS STABILITY OVER 100 DAYS

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The mass of haemoglobin in the blood is one of the factors limiting oxygen transport in endurance exercise. In a recent meta-analysis, haemoglobin mass appeared to be more variable as time between measurements increased from days to months. Such variability could have implications for athletic performance and for testing for abuse of erythropoietin. PURPOSE: To characterise the extent of random variation and any systematic linear or periodic trends in multiple serial measurements of haemoglobin mass over several months. METHODS: The carbon monoxide rebreathing method was used to measure haemoglobin mass of six active men every 1-6 d for 100-114 d. Measurement error for each individual’s series was estimated effectively uncontaminated by systematic trends from the standard deviation of consecutive pairwise changes and compared with his total error (standard deviation of all values). Linear trends in each series were analysed by regression. Periodicities in each series were quantified by spectral analysis. Series with known random error and periodicities were also simulated and analysed. RESULTS: The range in the pairwise error for the six men was 1.4–2.7% (90% confidence limits for each estimate, 1.20). This range is unlikely to be due entirely to sampling error and presumably reflects differences between subjects in variability of storage of blood in the spleen. For 5 men there was little difference between the total error (range 1.6-2.7%) and the pairwise error; their mean ratio (1.06, 90% confidence limits 0.96 to 1.17) was probably less than ratios for simulated series with random error of 2%, sinusoidal periodicities of amplitude 2%, and periods of 20-100 d (ratios 1.13-1.21). Spectral analysis clearly revealed such periodicities in simulated series but not in the series of these subjects. The linear trend in these men over 100 d ranged from -0.6% to 2.3% (90% confidence limits, ±1.3% to ±2.3%), which could be consistent with small cyclic variation over a longer term (e.g., annual). The sixth man, who had donated blood 12 d before entering the study, showed a gradual restoration of haemoglobin mass that in analyses of errors and spectra was consistent with a quarter cycle of amplitude 15% and period 400 d. CONCLUSION: The carbon monoxide method showed little change in error of measurement of haemoglobin mass in active men over 100 d. The method is suitable for long-term monitoring of small changes in haemoglobin mass that might occur with training or EPO abuse in athletes, but differences between athletes in error of measurement and small differences in systematic trends may need to be taken into account.

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