

CHRONOMICS: INSTRUMENTATION FOR MONITORING OF PEAK EXPIRATORY FLOW

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Abstract

A cost-effective instrument for the self-monitoring of peak expiratory flow (PEF) was used to map the time structure or chronome of this variable, with circadian to circadecennian rhythms. Self-measurements may detect changes in PEF associated with changes in personal health and/or air quality. For basic and applied purposes, a reduction in size of the measurement tool will be important until automatic instrumentation is developed.

Key words

Peak expiratory flow, Self-monitoring, Circadian rhythm

INTRODUCTION

Peak expiratory flow in man is a measure that shows biological changes around the clock. Peak expiratory flow (PEF) has a circadian rhythm, peaking usually in the afternoon (1–10). A circadian rhythm has been reported in clinical health as well as in patients with asthma and other respiratory disorders (3, 5). Smoking, chronic obstructive pulmonary disease and interstitial lung disease are associated with alterations of the circadian pattern of PEF (3, 9).

Population studies, based on transverse sampling with each subject usually providing only a single measurement, indicate that PEF increases during adolescence (2, 11).

A cost-effective instrument for the self-monitoring of peak expiratory flow (PEF) to map the time structure or chronome of this variable, with circadian to circadecennian rhythms already demonstrated, can serve for broad purposes of personal and environmental care. Until automatic instruments become available, self-measurements may detect changes in PEF associated with changes in personal health and/or air quality.

MATERIALS AND METHODS

A 53-year-old, clinically healthy man, with more than 33 years of experience in monitoring his own PEF 3 to 9 times daily, collected PEF data for one month using four different PEF instruments in order to compare circadian rhythm characteristics and the ease of their use. The instruments included two full-sized Wright Peak Flow meters, a Wright Mini-meter and a Hildebrandt Pneumometer. Each data series was analysed by the least-squares fit of models consisting of cosine curves with periods of 24 or of 24 and 12 hours. Circadian rhythm characteristics (MESOR, amplitude, acrophase) were compared by parameter tests.

RESULTS

A statistically significant circadian rhythm was found in PEF measured by each instrument, with highest values found in the afternoon. The overall highest readings were identical in the Wright Mini-meter and one of the full-sized Wright meters, making the smaller meter an ideal instrument to use because of its reliability and light weight.

DISCUSSION

When monitoring PEF, multiple readings throughout the day are preferred since PEF is characterised by a high-amplitude circadian rhythm. The use of a light-weight PEF meter, such as Wright Mini-meter, is appropriate for use by subjects serving as biomonitors of the environment as well as for exercising their own chest and lungs. Self-measurement of PEF during waking hours can only serve to monitor the main features of PEF circadian rhythm in healthy subjects as well as in patients (1, 3 –12).

Several PEF measurements each day over decades seem to have averted, in the subject investigated, the well-documented population evidence-based PEF decline with age. Apart from personal benefit, as a basic scientific dividend, the decades-long monitoring with the Wright peak flow meter has revealed a circadecennian rhythm with a period of 11.74 years and a 95% confidence interval (CI) extending from 10.36 to 13.11 years; this has an amplitude twice as large as that of an about-yearly rhythm (of 3.84 with CI from 1.78 to 5.90, vs. 1.86 with CI from 0 to 3.77). Any reduction in size of the measurement tool will be important, for basic and applied purposes, until automatic instrumentation is developed.

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CHRONÓMY: PŘÍSTROJE PRO MONITOROVÁNÍ VRCHOLOVÉ VÝDECHOVÉ RYCHLOSTI

S o u h r n

Levný přístroj pro samoměření vrcholové výdechové rychlosti (PEF) byl použit pro mapování časové struktury chronomu výdechové rychlosti s cirkadiánní a cirkaseptánní periodicitou. Vlastní měření má detekovat změny PEF spojené se změnami zdraví a kvality života měřeného jedince. Pro základní a aplikované výsledky měření je nezbytné zmenšit velikost přístroje až do doby, než budou vyvinuty automatické přístroje.

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