policy, which is fully supported by management and accompanied by cessation classes, was followed by apparent increases in smoking cessation by employees[8].

Finally, it should be emphasized that in addition to skill building, nicotine replacement therapy, prescribing bupropion and social support one should realize that tobacco places an enormous burden on public health and society as a whole. A comprehensive strategy aiming at a smoking free society is necessary, including regulatory activities, protection of non- or ex-smokers at work and during leisure time activities (restaurants, public places, transport), de-legitimization of tobacco use and de-normalization of the tobacco industry. Physicians and cardiologists should be at the forefront—leading the implementation of smoking cessation programmes in clinical practice.

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Heart rate variability: a telltale of health or disease

See page 475 for the article to which this Editorial refers

Heart rate variations have puzzled medical doctors ever since they began to feel their patients’ pulse. Even today heated scientific debates are devoted to interpretation of (non-pathological) heart rate variability[1–3]. However, without bothering too much about the physiological background, in clinical cardiology the predictive value of (absence of) heart rate variations is now an acknowledged risk factor, strongly associated with long-term outcome of disease in cardiac patients. In the present issue Galinier and colleagues[4] present the results of a well-controlled prospective study in chronic heart failure. One hundred and ninety patients with chronic heart failure in sinus rhythm were enrolled; after an average follow-up of 2 years 55 had died. One of the independent predictors for all-cause mortality was a low standard deviation of normal RR intervals (<67 ms) and for sudden death a daytime low-frequency power below 3.3 ln (ms²).

In this study, time and frequency domain measures have been deduced from 24-h Holter recordings. The usual short- and long-term averages for heart rate and accompanying standard deviations were computed. The problem of 24-h spectral analysis was reduced to Fourier analysis of consecutive 2-min periods and averaging the spectra. In doing so one generally can only distinguish low frequency (0.04 to 0.15 Hz) and high frequency (0.15 to 0.40 Hz) variations. Variability in heart rate in both these frequency bands is mainly vagally mediated, as has been shown by atropine blocking experiments[5]. To reliably observe frequencies lower than 0.04 Hz (variations lasting longer than 25 s) one needs periods longer than 2 min to compute the spectrum.

The conclusion from the Galinier study[4], then, would be that heart rate variations in one way or another prove a favourable pattern in response in the
autonomic nervous system; their absence announces problems. In particular the absence of low frequency power, i.e. vagal activity to the heart, reveals an impending risk of sudden death. This statement seems at variance with much of the literature where it is claimed that the low frequency band in heart rate variability represents the activity of the sympathetic nervous system, as opposed to the high frequency band that would exclusively represent vagal activity to the heart in the respiratory rhythm[6]. This view would appear to be contradictory: low low-frequency power would imply low sympathetic activity, and yet this is not as healthy as one would expect for the compromised heart.

As always the explanation is simple. Normally, sympathetic outflow related to blood pressure regulation is revealed in heart beat related bursts. Due to baroreflex control of the circulation, more bursts occur if blood pressure is below a setpoint, until blood pressure is sufficiently raised above the setpoint again and sympathetic bursts are switched off. This will induce an oscillation in overall sympathetic activity and blood pressure in the low frequency band (about one oscillation in 10 s). However, if cardiac function is very much impaired due to a multitude of alarming afferent stimuli, the sympathetic activity will be activated almost continuously, without clear-cut on-off periods. This is exactly what has been observed in directly recorded sympathetic nerve activity in chronic heart failure patients[7] (although the authors of that study came to a different conclusion).

Low-frequency oscillations in sympathetic outflow are transmitted to the sinus node as well and should, therefore, appear as heart rate variations. However, they will not lead to appreciable heart rate-oscillations if the oscillation frequency is above some 0.03-0.04 Hz[6.9]. We need the vagus nerve to translate the underlying sympathetic oscillations via blood pressure and the baroreflex into heart rate oscillations, even in the low frequency band. This, again, underlines the importance of vagal activity for heart rate variability in both the low and high frequency bands.

Returning to the clinical issue after this digression into physiology, the interpretation of low-frequency variability in chronic heart failure patients is paradoxical: it actually indicates increased sympathetic activity (cf. [10])! There are no other outstanding independent risk factors in the present study indicating patients that are prone to sudden death. Mean heart rate might have been a telltale sign, when looking for signs of sympathetic over-activity, but it was not. Heart rate did not differ significantly between survivors and those who died in the present study, nor between those who died of sudden cardiac death and other non-survivors. This might be due to the general increase in sympathetic levels in chronic heart failure, which may lead to downregulation of beta-receptors, as has been shown in hypertrophic cardiomyopathy with or without chronic heart failure[11].

In a recent review Stein and Kleiger[12] give an overview of clinical studies where Holter recordings were used for heart rate variability analysis, looking for the predictive value for mortality in healthy adults and cardiac patients (myocardial infarction or chronic heart failure). Their review was restricted to studies that used classical time- and frequency domain measures, as in the Galinier study[6]. The unanimous conclusion is that vagal modulation of heart rate is a sign of good condition when it arises due to a natural cause. Pharmacological means to increase vagal activity directly were not beneficial, but exercise to improve physical condition was. In this respect we can consider heart rate variability to be an indicator of good health, and one wonders why cardiac monitors in our hospitals only present mean heart rate prominently, but do not take heart rate variations into account. This latter method might help to highlight individuals in greater need of attention than others, even if other cardiac conditions seem equally impaired.

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