Blood pressure variability and cardiovascular control mechanisms in hypertension

ABSTRACT

Blood pressure variability is the result of a complex interaction between external stimulation and several cardiovascular control mechanisms and is enhanced in all those conditions characterized by an impaired autonomic regulation of circulation. In particular, blood pressure variability is enhanced in hypertension over 24 h and may independently contribute to the cardiovascular complications of this condition. The paper by Mussalo and co-workers in this issue of Clinical Science offers additional information in this field by suggesting that different forms of hypertension are characterized by different patterns of blood pressure variability, and that these differences may reflect variations in the underlying autonomic regulation of the heart and blood vessels.

The occurrence of blood pressure fluctuations is an intrinsic characteristic of the cardiovascular system and represents a physiological phenomenon [1,2]. Blood pressure variability usually increases in response to physical exercise or when coping with external challenges, whereas it is less pronounced in resting conditions and during sleep. Blood pressure variability is also the result of a complex interplay between multiple cardiovascular control mechanisms, being importantly affected by central neural influences, sympathetic vascular modulation, arterial baroreflexes and other cardiovascular reflexes, mechanical factors (e.g. respiration) and humoral influences (e.g. plasma catecholamines, renin–angiotensin system, vasopressin and endothelial factors) [1,3–5].

It is therefore not surprising that the degree of blood pressure variations has been found to be enhanced in all those conditions characterized by alterations in cardiovascular regulation, either of primary nature (e.g. pure autonomic failure) or secondary to aging, and to a number of diseases (e.g. the autonomic impairment characterizing diabetes mellitus, renal failure, obstructive sleep apnea syndrome and arterial hypertension) [1–3,6–12].

The interest raised over the last 30 years towards the analysis of blood pressure variability is also due to the evidence provided by a number of studies that an enhanced blood pressure variability independently contributes to the target organ damage and the cardiovascular complications of hypertension [13–23], and might therefore represent a suitable target for antihypertensive treatment.

The paper by Mussalo and co-workers [24] in this issue of Clinical Science provides us with additional interesting information on this stimulating issue. The aim of this paper was to investigate whether there is any difference in the features of short-term blood pressure variability between patients with different severity and/or different forms of chronic treated arterial hypertension. This issue was addressed by performing non-invasive continuous finger blood pressure recordings at rest in different groups of patients with either renovascular hypertension (RVHT) or essential hypertension of severe (SEHT) and mild (MEHT) degree. A group of age-matched control subjects was also included in the study [24]. Short-term blood pressure variability was quantified by spectral analysis of 10 min continuous finger blood pressure recordings. The results show that, indeed, blood pressure variability is characterized by different features in different groups of hypertensive patients. SEHT patients showed a higher blood pressure variability (mainly for diastolic blood pressure) than control subjects, whereas RVHT and MEHT patients were characterized by a reduced overall blood pressure variability and lower low-frequency (LF) powers than the control group, again mostly for diastolic blood pressure.

The authors [24] concluded that both the aetiology and the severity of hypertension have a significant influence on short-term blood pressure variability as assessed at rest in a laboratory environment. These differences in blood pressure variability patterns are interpreted as to suggest that different hypertensive groups are characterized by different features of cardiovascular regulation.

Key words: arterial baroreflex, arterial hypertension, blood pressure variability, sympathetic nervous system, secondary hypertension, target organ damage.
These data are intriguing, as it emphasizes further the possible importance of blood pressure variability as a tool to explore cardiovascular regulation [5,25] in a way that does not require any external intervention on the subject under evaluation. Thanks to the availability of techniques for non-invasive continuous blood pressure monitoring [26–28], this is now possible also without need of intra-arterial catheters [29].

The results in the paper by Mussalo et al. [24] are also in agreement with previous findings that the sympathetic activation that characterizes essential hypertension in its severe form is not a feature of milder forms of this condition nor of secondary forms of hypertension, such as renovascular hypertension [30], a finding that has not only pathophysiological, but also clinical and possibly therapeutic, implications.

In spite of the interest of these findings, however, the paper by Mussalo et al. [24] is not immune to limitations. First of all, the study includes a relatively small number of patients assigned unevenly to the three hypertensive groups. This limitation is emphasized by the inability to discontinue treatment in the most severely hypertensive patients for obvious ethical reasons. As a result of this limited sample size, a type-2 error cannot be completely excluded, and this might contribute to explain some inconsistencies of the results, such as the inability to find significant differences in systolic blood pressure powers between groups, whereas a difference was found for diastolic blood pressure powers. Secondly, the range of frequencies over which the LF blood pressure powers were computed is narrower than recommended (0.07–0.15 Hz rather than 0.04–0.14 Hz). This might have prevented proper quantification of the LF power in some patients given the known variability in the LF range of frequencies, in particular in patients with alterations of autonomic cardiovascular control, in whom LF oscillations often have a period closer to 15 min than to 10 min.

Notwithstanding these limits, however, the study by Mussalo et al. [24] represents a further step towards a deeper understanding of the possible different features of autonomic cardiovascular regulation in different forms of hypertension. It also underlines once more the usefulness of computer analysis of short-term blood pressure variability, which may offer a deeper insight into cardiovascular control mechanisms, provided that sufficient care is given to the quality of beat-by-beat blood pressure recordings and to the selection of the most suitable analysis approaches as a function of the local study conditions [5,31–33].

GIANFRANCO PARATI
Department of Clinical Medicine, Prevention and Health Biotechnologies, University of Milano-Bicocca, Milan, Italy and Cardiology II, S. Luca Hospital, Istituto Auxologico Italiano, Milan, Italy
(ON BEHALF OF THE EDITORIAL BOARD)

REFERENCES


Received 31 July 2003; accepted 4 August 2003
Published as Immediate Publication 4 August 2003, DOI 10.1042/CS20030256

© 2003 The Biochemical Society