ELSEVIER

Comparative Biochemistry and Physiology Part A 124 (1999) 367–368

CBP

www.elsevier.com/locate/cbpa

Introduction

Introduction: on the significance of cardiac rhythms

The heart is one of the most significant 'inventions' of the animal kingdom. The internal circulation of body fluids, propelled by a heart (or series of hearts), was a major factor in the continuing evolution of animals. No longer dependent on the very slow process of diffusion of oxygen, carbon dioxide, nutrients and wastes to, from and within tissues, the efficiency of a convective blood supply permitted the evolution of larger animals with higher metabolic rates. Freed from the bounds of diffusion, these animals could proliferate and expand into formerly unoccupied environments

Cardiac rhythm is the most obvious of the manifestations of the heart's pumping action. Because blood pumping is so intimately linked to all aspects of animal metabolism, the heart beat can serve as a reliable indicator of many physiological facets of life. Indeed, from time immemorial health care practitioners from a wide variety of cultures have made assessment of the heart rate a routine component of any physical exam. While in part the ubiquitous nature of 'taking the pulse' is as a result of the fact that the heart beat can be easily monitored in humans without sophisticated instrumentation, it is also true that the nature of the pulse — its strength, rate and pattern of change — provides a uniquely valuable, non-invasive view into the state of physiological health of a patient. This century, and in particular the last few decades, has seen a proliferation of wondrous techniques for measuring cardiovascular performance, e.g. pulsed Doppler blood velocity measurement, imaging techniques for blood flow distribution, etc. While our ability to document a variety of cardiovascular parameters using new non-invasive techniques has exploded of late, the simple measurement of heart rate still remains as a prime determinant in clinical settings.

Given the ubiquitous nature of heart rate in a clinical setting, it is hardly surprising to find that data on heart rate is central to basic research studies in comparative physiology. Indeed, observations of the beating heart rate of the bird embryo have been recorded by Socrates, Aristotle, Vesalius and Galileo. While measurement of heart rate in comparative studies is certainly a stalwart of such studies, there is currently a renewed focus on gleaning new information from *patterns* of heart rate. Heart rate changes over a time span ranging from a couple of minutes to the life of the individual organism. Changes over minutes reflect subtle but significant influences of cardiac control systems revealed by mathematical dissection of the heart rate signal. Changes over a life span represent the development, maturation and senescence of the cardiac regulatory systems.

Against a time-honored backdrop of heart rate measurement, this symposium was convened around the central theme of *heart rate* — how to measure it, what it tells us, and what future advances can be made based upon it. While at first glance this might seem like an unduly specialized topic for an international conference, the ubiquitous presence of heart rate measurement in both clinical and basic studies commands attention now more than ever. Consequently, an international group of investigators with backgrounds in comparative physiology, clinical and veterinary medicine, and engineering met at the Muroran Institute of Technology in Muroran, Japan in late March, 1998. Approximately 40 papers were presented in nine different sessions including Mechanisms of Regulation and Cardiac Reflexes, Physiological State and Cardiac Activity, Cardiac Development and Allometry, and Analysis, Models and Techniques. In addition, specific sessions focused on cardiac rhythms in a wide variety of animal taxa. To our knowledge this is the first international symposium convened on this particular theme.

As evident from scanning the titles in this volume, this symposium on 'Cardiac Rhythms in Animals' was organized around a combination of both process and taxonomy. Data were presented on species ranging from insects to humans, with a heavy focus on non-mammalian vertebrates. Thus, 'Comparative Biochemistry and Physiology' makes a highly appropriate outlet for the publication of this symposium, especially because innumerable studies reporting on heart rate have been published throughout the existence of CBP.

1095-6433/99/$ - see front matter
PII: S1095-6433(99)00128-2

What emerges very clearly from this symposium is the fact that the measurement of this seemingly simple and single parameter of heart beat is in fact providing investigators with new insights into not only cardiovascular physiology, but also into processes in development and genetic regulation of physiology generally. Analysis of heart rate pattern is also revealing new information about environmental influences on physiological process, and so contributes to our understanding of ecological and even evolutionary biology! Although the act of measuring heart rate is often straightforward, its conceptual reach is far, indeed. We predict that, even as the ways of measuring and analyzing all physiological parameters constantly change and improve, heart rate measurement will remain a central component of physiological investigation. Heart rate still has many secrets to reveal to the physiologist.

September 21, 1998

Hiroshi Tazawa
Muroran, *Japan*
E-mail: tazawa@muroran-it.ac.jp

Warren W. Burggren
Denton, *TX*, *USA*
E-mail: burggren@unt.edu

Amos Ar
Tel Aviv, *Israel*
E-mail: aamar@ccsg.tau.ac.il