Autonomic Nervous System in Old Age
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11 figures and 9 tables, 2004
Contents

VII Preface

1 Age-Related Sympathetic Autonomic Neuropathology.
   Human Studies and Experimental Animal Models
   Schmidt, R.E. (St. Louis, Mo.)

24 Clinical and Therapeutic Implications of Aging Changes in
   Autonomic Function
   Ford, G.A. (Newcastle upon Tyne)

32 Normal and Pathological Changes in Cardiovascular
   Autonomic Function with Age
   Attavar, P.; Silverman, D.I. (Farmington, Conn.)

45 The Autonomic Nervous System and Blood Pressure
   Regulation in the Elderly
   Bourke, E. (Brooklyn, N.Y.); Sowers, J.R. (Columbia, Mo.)

53 Aging, Carbohydrate Metabolism and the Autonomic
   Nervous System
   Madden, K.M.; Meneilly, G.S. (Vancouver)

67 Aging and the Gastrointestinal Tract
   Pilotto, A. (San Giovanni Rotondo); Franceschi, M. (Schio);
   Orsitto, G.; Cascavilla, L. (San Giovanni Rotondo)

78 Structure and Function of the Aged Bladder
   Tannenbaum, C. (Montréal); Zhu, Q.; Ritchie, J.; Kuchel, G.A. (Farmington, Conn.)
94 Impact of Aging on Reproduction and Sexual Function
   Beshay, E.; Rehman, K.-u.; Carrier, S. (Montreal)

107 Aging of the Autonomic Nervous System. Pain Perception
   Lussier, D. (Montreal); Cruciani, R.A. (New York, N.Y.)

120 Aging and Thermoregulation
   McDonald, R.B.; Gabaldón, A.M.; Horwitz, B.A. (Davis, Calif.)

134 Author Index

135 Subject Index
In recent years, all western industrialized countries, and to a growing extent even many developed and developing Asian nations, have witnessed a remarkable growth in numbers of older people [1]. Future projections anticipate continued increases, particularly in numbers of individuals who are 85 years and older [1]. Although US statistics have indicated recent declines in disability trends [2], overall numbers of older individuals living with disability and functional dependence are likely to increase given projected increases in life expectancy [3]. For example, average life expectancy for women born today in the United States is nearly 80; for men, it is nearly 75 [1]. With these considerations in mind, many investigators have begun to pay increasing attention to identifying factors which may predict the transition from health and independence to disability and dependence in older individuals, eventually providing useful targets for interventions [3, 4].

Neurodegenerative disorders such as Alzheimer’s and Parkinson’s diseases are both common and important causes of cognitive and motor deficits in later life. Moreover, the presence of cognitive and motor deficits resulting from these disorders represents a major risk for the development of disability, dependence and need for institutionalization among older individuals [1]. Thus, it is not at all surprising that the central nervous system has received far more research attention than has the peripheral nervous system. Nevertheless, age-related changes and diseases involving the peripheral nervous system, particularly its autonomic elements, do frequently play determining roles in late life health and functional independence.

Homeostasis, the need for the body to maintain a constant internal milieu, was first defined by Claude Bernard in the mid 19th century [5]. In a 1932 book,
Walter B. Cannon clearly recognized that as the body ages its ability to maintain normal homeostasis in response to common challenges is altered [6]. In fact, many of the physiologic parameters discussed by Cannon – temperature, blood sugar and blood pressure – are all closely regulated by autonomic function and are discussed in some detail in this book. However, our understanding of autonomic system aging and its role in human health and disability has increased a great deal since the time of Bernard and Cannon.

Above all, modern clinical investigators typically study autonomic aging in healthy older individuals and are thus able to dissect the contribution being made by aging from that caused by disease. Such studies clearly indicate that while basal sympathetic activity increases with normative aging, there is evidence of considerable dysregulation in terms of the ability of the aging sympathetic nervous system to respond to a variety of challenges. Moreover, markers of elevated sympathetic activity appear to predict increased mortality among ill [7, 8], as well as community dwelling independent older individuals [9, 10].

Although many questions remain unanswered, recent conceptual and technological advances have provided both the clinician and investigator with much new information drawn from clinical, as well as basic research. In the following pages, investigators from several different disciplines discuss aging of the autonomic nervous system from a variety of perspectives. Given the fact that aging of the parasympathetic elements of the autonomic nervous system is not nearly as well understood as that of its sympathetic portions, greater emphasis has been placed on the latter. Some authors are basic scientists, while others are clinical investigators, yet efforts have been made by all to begin bridging the barriers between the two perspectives in a fashion that is meaningful to both.

In the first chapter, Dr. Schmidt discusses the major neuropathological and cellular changes that have been described during autonomic aging in both animal and human studies. Dr. Ford addresses the impact of physiologic changes involving the autonomic nervous system, but does so from the point of view of a clinical pharmacologist and clinician in describing the impact of age-related changes in autonomic function on responses to common medications. In Chapter 3, Drs. Attavar and Silverman discuss the impact of autonomic aging on cardiac performance and the management of common cardiac conditions. Drs. Bourke and Sowers focus their discussion on autonomic mechanisms involved in the regulation of blood pressure and the impact of age-related changes on the management of both hypertension and hypotension in older individuals. Aging is associated with specific deficits in the body’s capacity to handle glucose and the role of autonomic aging in these changes is addressed by Drs. Madden and Meneilly. Many aspects of gastrointestinal function, particularly motility, are closely influenced by autonomic function. Drs. Pilotto, Franceschi, Orsitto and Cascavilla discuss the role of autonomic changes on
gastrointestinal performance in late life. Urinary incontinence is a major cause of morbidity and disability in older individuals. Drs. Tannenbaum, Zhu, Ritchie and Kuchel provide an overview of age-related changes in the autonomic elements that closely regulate bladder performance and discuss their potential roles in maintaining continence in older women and men. As discussed by Drs. Beshay, Rehman and Carrier, both reproductive function and sexual performance decline in advanced age, with autonomic changes providing a contribution to both. The management of pain is a crucial element in improving the quality of life older patients and, as discussed by Drs. Lussier and Cruciani, autonomic changes are among the many important considerations needed to be brought into the assessment of an older individual in pain. Finally, the inability of many older individuals to appropriately regulate their body temperatures in response to both high and low extremes of environmental temperature is a major risk factor for death. Drs. McDonald, Gabaldón and Horwitz provide an excellent overview addressing a number of clinically important questions by highlighting key clinical and basic research studies.

Clearly, the years since Claude Bernard’s first presentation of the concept of homeostasis and Cannon’s comments regarding the influence of aging on these mechanisms have witnessed a tremendous growth in our knowledge. At the same time, the coming decade should lead to an even better understanding of this area. This will take place as more ambitious and well-defined clinical studies are undertaken and as the power of basic research is harnessed, particularly in terms of using genetically modified animals, with real efforts made to move or translate knowledge between the two fields.

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References