

The heart and the brain: an intimate and underestimated relation

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The entire field of neurocardiology can be divided into three categories: 1) the brain's effects on the heart (such as Takotsubo cardiomyopathy), 2) neurocardiac syndromes such as hypertrophic cardiomyopathy in Friedreich ataxia and 3) the heart's effects on the brain, such as the cardiac origin of embolic stroke [1].

The broken-heart syndrome or Takotsubo cardiomyopathy is a perfect example of the intimate relation between the brain and the heart as it mimics an acute coronary syndrome and can even result in sudden unexpected death [2]. It is an example of major cardiac pathologies seen in emotional and neurological catastrophes, such as subarachnoid bleeding and cocaine-related death, and is due to severe overactivity of the sympathetic limb of the autonomic nervous system leading to cardiac myofibrillar degeneration [1]. The central role of the autonomic nervous system in the regulation of cardiac function has also resulted in the introduction of neuromodulation to effectively improve cardiac function.

A relatively underestimated example of the heart's effects on the brain is the link between dysfunction of the heart and the brain. This may become a very important health care problem in the near future, as both cardiac dysfunction and progressive loss of cognitive functioning are prominent features of ageing. The apparent lack of appreciation of the link between cardiac and brain (dys)function is probably due to the monodisciplinary approach by cardiologists and neurologists and by the reductionist approach of modern medical research. Yet it is time for a more integrative view to the heart-brain connection as recent data indicate that cardiovascular conditions contribute to cognitive impairment [3]. Pioneers in the field recognised the importance of this link and organised the successful first international conference on the Heart & Brain

in Paris in March 2012. This conference aimed to 'consolidate the hybrid field of neurocardiology or cardioneurology: the strokologist will teach the cardiologist about the brain and the neurologist will learn how the heart is affecting the brain' (see website Heart & Brain Conference, 1–3 March 2012, Paris). Neurologists and neuropsychologists also increasingly appreciate the importance of vascular risk factors and cardiovascular diseases on cognitive function. In a preface to a recent special issue on vascular risk factors and Alzheimer's disease in the *Journal of Alzheimer's Disease*, Jack de La Torre stated that: 'the significant association between cardiovascular diseases and an increased risk of Alzheimer's disease offers the possibility to markedly reduce incident dementia by early identification and appropriate medical management of cardiovascular risk factors and diseases and could be a monumental step forward in reducing the worldwide prevalence of dementia, which will rise from a current 35 million to 60 million people in 2030' [4].

Thus this special issue of the *Netherlands Heart Journal* is very timely by providing different perspectives into the intriguing, intimate and clinically increasingly important relations between the brain and the heart. It describes the important role of the autonomic nervous system in ventricular arrhythmias [5, 6] and in psychological distress [7] and its potential role in the treatment of cardiovascular diseases, either by electrical neuromodulation [8], vagal stimulation [9], denervation [10] or music [11]. It also provides insights on the reduction of cognitive functions after major forms of cardiac surgery, on cardiovascular risk factors that affect cognitive functions in the brain [12] and on the effects of exercise training on cardiac and cognitive function [13]. It highlights the importance of the baroreflex in the heart-brain connection [14, 15], and potential pathophysiological and molecular mechanisms of the effects of cerebral hypoperfusion and cognitive function [16].

This special issue of the *Netherlands Heart Journal* thus provides some unique insights into the integrative world of

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cardioneurology or neurocardiology in which cardiologists, neurologists and neuropsychologists join forces to better understand, diagnose and treat cardiovascular diseases and cognitive dysfunction, acknowledging the intimate and underestimated relation between the heart and the brain and offering new possibilities to treat cardiovascular diseases by modulating the activity of the autonomic nervous system and to treat cognitive dysfunction by reducing the cardiovascular risk and disease burden.

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