

Brain–Heart Interactions are More Diverse than Anticipated

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Sir,

With interest, we read the interesting review article by Prasad Hrishu et al. about brain–heart interactions (BHIs) and the effect on the heart in general.¹ The review is important since BHIs are still poorly acknowledged. However, the article has a number of shortcomings.

Generally, BHIs do not only result in ventricular arrhythmias and Takotsubo cardiomyopathy (TTC) but also in a number of other direct or indirect disturbances of heart function. For example, heart function can be primarily affected by cerebral hormones or secondarily affected by involvement of the pressure arterioles or the volume load.² It should also be discussed that drugs given for a cerebral pathology may have a direct or indirect effect on cardiac functions.

The authors do not discuss the phenomenon of sudden unexpected death in epilepsy (SUDEP) extensively.³ The cause of SUDEP is largely unknown, but a number of speculations have been raised during previous years to explain the phenomenon.³ One of these speculations is that generalized seizures trigger ventricular arrhythmias and that the patient dies from torsades de pointes, ventricular fibrillation, or sinus arrest. Another speculation suggests that the epilepsy patient experiences TTC due to seizures and dies from intractable global-type TTC. A third speculation is that it is not a direct brain–heart problem but rather an intoxication inducing ventricular arrhythmias. This speculation relies on the fact that SUDEP predominantly occurs in patients with poorly controlled seizures and that these patients usually take more anti-seizure drugs (ASDs) than epilepsy patients with well-controlled epilepsy. Other mechanisms discussed are postictal apnea or laryngospasms and consecutive cerebral hypoxia.⁴

Another phenomenon that is not addressed in the review is sudden unexpected death in Parkinson's disease (SUDPAR). As in SUDEP, the pathomechanism of SUDPAR is also unknown, but there are speculations that disturbances of the autonomic nervous system, frequently affected in parkinsonism, or the antiparkinsonian medication may play a causative role.⁵

Another shortcoming is the missing discussion that BHIs may be mediated not only via neural structures but also a humorally. It has to be mentioned that the brain is also a hormone and cytokine-producing organ. Particularly, the pituitary gland produces a number of substances that have either a direct or an indirect effect on heart functions. Hormones of the anterior lobe of the pituitary gland affect the hypothalamic–pituitary adrenal axis, and hormones from the posterior lobe affect the heart indirectly via the regulation of the blood volume.

Another shortcoming is that there may not be an interaction with the “heart” in general but with specific structures of the heart. These include the myocardium, the cardiac conduction system, the coronary arteries, cardiac veins, the pericardium, endocardium, and the autonomic innervation. There should be a discussion

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about which of these structures are predominantly affected in the various different BHIs.

Unaddressed in the review is that direct or indirect lesions of the vagal nerve may have a strong impact on the autonomic innervation of the heart.⁶ Overstimulation of the vagal nerve may result from brain stem lesions or lesions in the extra-cerebral but intracranial course of the vagal nerve.

Unaddressed remain neurological patients who have implanted microelectrodes in their brain. Particularly, from stimulators used for deep brain stimulation of the thalamus, globus pallidus, or the subthalamic areas (tremor, Parkinson, dystonia, and epilepsy), it is known that they may affect the vagal nerve as a side-effect.⁷

Finally, the brain should not be only regarded as topically organized but also organized in network structures that interact with each other or with various other humoral or neural systems in the body, a perspective that should be included in the discussion about BHIs.

In summary, the important issue of BHIs needs to be more extensively discussed, and topics, such as SUDEP, SUDPAR, neuronal networks, endocrine cerebral functions, drugs affecting the brain, and cerebral microelectrodes, should be addressed. Widening the spectrum of BHIs is important, as the issue is still poorly understood and still not widely recognized.

AUTHOR CONTRIBUTION

Josef Finsterer contributed in design, literature search, discussion, first draft, critical comments.

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