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Biological Aspects of Suicidal Behavior

Volume Editors

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According to a definition of the Institute of Medicine of the National Academies of the USA [1], suicide is 'a fatal self-inflicted destructive act with explicit or inferred intent to die'. Globally, year by year, approximately one million people die by suicide, which corresponds to a rate of 16 per 100,000. In the year 2012, suicide accounted for 1.4% of all deaths worldwide, making it the fifteenth leading cause of death throughout the lifespan and the second leading cause of death among 15- to 29-year-olds [2]. In Germany, the suicide rate as of 2013 is almost twice as high as the death rate from traffic accidents [3]. Therefore, effective and evidence-based interventions should be implemented at population, subpopulation, and individual levels to prevent suicides and suicide attempts. However, the reliable assessment of suicide risk in an individual person is a major scientific challenge. Although apparently relevant, psychological, psychosocial, and cultural factors offer merely weak predictive power with regard to suicidal behaviour, and even the clinical history of a patient, though extremely valuable, can be non-specific. It is generally accepted that mental disorders per se represent a risk factor for suicidal behaviour, but there appear to exist other causative factors – environmental as well as dispositional – which are independent of psychiatric diseases. During recent years, an increasing amount of research has been dedicated to the analysis of the neurobiological basis of suicide, enabling the development of neuro-psycho-biological models which may help to improve our understanding of this complex behaviour. This book provides a comprehensive overview on the epidemiological, neurobiological, and psychopharmacological aspects of suicide and suicide attempts throughout the lifespan.

Värnik and Wasserman present a meticulous review of the worldwide epidemiology of completed and attempted suicide. Mainly based on data from the World Health Organization, they draw our attention to the broad spectrum of factors influencing suicide rates, among which age and gender are only the most prominent ones. In addition, among others, societal, cultural, socioeconomic, and geographic effects have been identified. Methodological problems involved in the recording of suicide and attempted suicide rates are also discussed.

The important issue of suicidal ideation, suicide attempts, and completed suicide in adolescents is dealt with in the chapter by Sarchiapone, D’Aulerio and Iosue, with...
special emphasis on neurobiological aspects. The authors review alterations in major neurotransmitter and signalling systems found to be related to suicidal behaviour. Most interestingly, different results have been obtained in a number of parameters when groups of adolescents and adults were compared. In many cases, the biological significance of these differences has yet to be revealed.

A great number of clinical as well as post-mortem brain studies have shown neurobiological abnormalities associated with suicidal behaviour. Many of these were pointed out to be related to the serotonergic and noradrenergic neurotransmitter systems. The role of these systems, their intracellular signalling pathways and downstream effector molecules and their effects on the regulation of target genes in suicidal behaviour are discussed in the chapter by Dwivedi.

Among neurotransmitter systems, special attention has focused on the role of GABA in depression and suicide. Pabba and Sibille review the current evidence – mainly from post-mortem studies – suggesting a dysfunction of GABAergic systems in suicide victims having suffered from major depressive disorder (MDD-related suicides) compared to those not having suffered from major depression (MDD-unrelated suicides).

Giegling and Rujescu focus on the genetic part of suicidal behaviour. Beside medical, psychological, psychosocial, social, cultural, and socioeconomic parameters, biological factors, especially genetic variants, were also shown to be risk factors for suicidal behaviour. The heritability is about 55% assuming a polygenic risk model. The chapter gives an overview on first-candidate gene studies focusing mainly on the serotonergic system. Additionally, newly started genome-wide association studies are discussed.

The relative contributions of heritable versus environmental risk factors to suicidal behaviour have become a more and more challenging question. In their chapter, Mandelli and Serretti provide a comprehensive overview on studies regarding the interaction between genes modulating brain functions and stressful life events in the aetiology of suicide.

A great number of studies have confirmed an association between early-life adversity and increased suicide risk. Turecki describes how epigenetic mechanisms induced by early-life adversity are able to mediate altered behavioural development, resulting in increased vulnerability toward psychopathology in general and suicidal behaviour in particular.

In an analysis of what might predispose individuals to make a suicide attempt or completed suicide, neurocognitive processes appear to play a crucial role. Richard-Devantoy and Courtet review evidence from the current literature showing that, in addition to impulsive aggression and persistent hopelessness, impairments in cognitive domains may increase the vulnerability to suicidal behaviour.

Clinical electrophysiology, although mostly neglected in earlier reviews, has also contributed to our knowledge on the neurobiological basis of suicide. For example, it was shown that the habituation of P300, an event-related potential, differed between patients with MDD and a history of suicidal behaviour and MDD patients without...
such a history. Hodgkinson, Steyer, Kaschka, and Jandl summarize recent electrophysiological studies and discuss their implications for suicide risk assessment and suicide prophylaxis.

The rapid development of neuroimaging techniques during the last decades has provided us with tools that allow the investigation of suicidal behaviour in vivo. Results obtained using the different methods of structural and functional neuroimaging are reviewed by Jollant. Derived from the data presented in the context of the current literature, the author proposes a neurocognitive model of suicidal behaviour which could stimulate the development of interventions for the prevention of suicide.

In recent years, evidence has accumulated indicating that inflammatory processes and alterations within the immune system may contribute to the pathophysiology not only of depression but also of suicidal behaviour. Postolache, Manalai, Brenner, and Brundin give a comprehensive overview of the available data and delineate novel strategies of intervention, targeting immune dysregulation and aiming at the improvement of suicide risk assessment and suicide prevention.

The topic of pharmacological influences on suicidal ideation and behaviour is addressed by Müller-Oerlinghausen and Lewitzka. Whereas a large variety of pharmacologically different compounds is able to induce depressive states, suicidal ideation and suicidal behaviour, pharmaceutical agents that effectively counteract suicidality are surprisingly rare. Over the years, satisfactory evidence of an antisuicidal efficacy has been presented for lithium salts and clozapine only. The authors provide a comprehensive review of the literature, also covering the question of possible mechanisms of action. As for lithium, in addition to studies based on the use of lithium salts as pharmaceutical drugs, some studies have been published on the potential antisuicidal effects of lithium as a trace element in drinking water. These are also critically discussed.

Rujescu, Kaschka and Kaschka outline possible further directions of research which might be promising to improve our understanding of the neurobiological foundations of suicidal behaviour. It is suggested that biological parameters should be integrated into algorithms for the assessment of suicide risk in individual persons. Thereby, neurobiological research can be expected to make a significant contribution to personalized medicine in general and to suicide prevention in particular.

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1 The Institute of Medicine of the National Academies of the USA. http://www.nap.edu/author/IOM/institute-of-medicine (accessed March 10, 2015).