Acute stress alters control of gene activity

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Acute stress alters the methylation of the DNA and thus the activity of certain genes. This is reported by researchers at the Ruhr-Universität Bochum together with colleagues from Basel, Trier and London for the first time in the journal *Translational Psychiatry*.

"The results provide evidence how stress could be related to a higher risk of mental or physical illness", says Prof. Dr. Gunther Meinlschmidt from the Clinic of Psychosomatic Medicine and Psychotherapy at the LWL University Hospital of the RUB. The team looked at gene segments which are relevant to biological stress regulation.

Epigenetics - the "second code" - regulates gene activity

Our genetic material, the DNA, provides the construction manual for the proteins that our bodies need. Which proteins a cell produces depends on the cell type and the environment. So-termed epigenetic information determines which genes are read, acting quasi as a biological switch. An example of such a switch is provided by methyl (CH3) groups that attach to specific sections of the DNA and can remain there for a long time - even when the cell divides. Previous studies have shown that stressful experiences and psychological trauma in early life are associated with long-term altered DNA methylation. Whether the DNA methylation also changes after acute psychosocial stress, was, however, previously unknown.

Two genes tested

To clarify this issue, the research group examined two genes in particular: the gene for the oxytocin receptor, i.e. the docking site for the neurotransmitter oxytocin, which has become known as the "trust hormone" or "anti-stress hormone"; and the gene for the nerve growth factor Brain-Derived Neurotrophic Factor (BDNF), which is mainly responsible for the development and cross-linking of brain cells. The researchers tested 76 people who had to participate in a fictitious job interview and solve arithmetic problems under observation - a proven means for inducing acute stress in an experiment. For the analysis of the DNA methylation, they took blood samples from the subjects before the test as well as ten and ninety minutes afterwards.

DNA methylation changes under acute psychosocial stress

Stress had no effect on the methylation of the BDNF gene. In a section of the oxytocin receptor gene, however, methylation already increased within the first ten minutes of the stressful situation. This suggests that the cells formed less oxytocin receptors. Ninety minutes after the stress test, the methylation dropped below the original level before the test. This suggests that the receptor production was excessively stimulated.

Possible link between stress and disease

Stress increases the risk of physical or mental illness. The stress-related costs in Germany alone amount to many billions of Euros every year. In recent years, there have been indications that epigenetic processes are involved in the development of various chronic diseases such as cancer or depression.

"Epigenetic changes may well be an important link between stress and chronic diseases" says Prof. Meinlschmidt, Head of the Research Department of Psychobiology, Psychosomatics and Psychotherapy at the LWL University Hospital. "We hope to identify more complex epigenetic stress patterns in future and thus to be able to determine the associated risk of disease. This could provide information on new approaches to treatment and prevention". The work originated within the framework of an interdisciplinary research consortium with the University of Trier, the University of Basel and King's College London. The German Research Foundation and the Swiss National Science Foundation supported the study.

More information: E. Unternaehrer, P. Luers, J. Mill, E. Dempster, A.H. Meyer, S. Staehli, R. Lieb, D.H. Hellhammer, G. Meinlschmidt (2012): Dynamic changes in DNA methylation of stress associated genes (OXTR, BDNF) after acute psychosocial stress, *Translational Psychiatry*, doi: 10.1038/tp.2012.77