Short-term Stress Can Affect Learning and Memory

Science Daily (Mar. 13, 2008) — Short-term stress lasting as little as a few hours can impair brain-cell communication in areas associated with learning and memory, University of California, Irvine researchers have found.

It has been known that severe stress lasting weeks or months can impair cell communication in the brain's learning and memory region, but this study provides the first evidence that short-term stress has the same effect.

"Stress is a constant in our lives and cannot be avoided," said Dr. Tallie Z. Baram, the Danette Shepard Chair in Neurological Sciences in the UC Irvine School of Medicine and study leader. "Our findings can play an important role in the current development of drugs that might prevent these undesirable effects and offer insights into why some people are forgetful or have difficulty retaining information during stressful situations."

In their study, Baram and her UC Irvine colleagues identified a novel process by which stress caused these effects. They found that rather than involving the widely known stress hormone cortisol, which circulates throughout the body, acute stress activated selective molecules called corticotropin releasing hormones, which disrupted the process by which the brain collects and stores memories.

Learning and memory take place at synapses, which are junctions through which brain cells communicate. These synapses reside on specialized branchlike protrusions on neurons called dendritic spines.

In rat and mouse studies, Baram's group saw that the release of CRH in the hippocampus, the brain's primary learning and memory center, led to the rapid disintegration of these dendritic spines, which in turn limited the ability of synapses to collect and store memories.

The researchers discovered that blocking the CRH molecules' interaction with their receptor molecules eliminated stress damage to dendritic spines in the hippocampal cells involved with learning and memory.

In addition, the authors replicated the effects of stress on dendritic spines by administering low levels of synthetic CRH, and watching how the spines retracted over minutes. "Fortunately, once we removed the CRH, the spines seemed to grow back," Baram said.

Baram also noted that there are compounds under development that show the ability to block CRH receptors, and that this study can play a role in the creation of therapies based on these compounds to address stress-related learning and memory loss.

The study appears in the March 12 edition of the Journal of Neuroscience. Yuncai Chen, Celine Dubé and Courtney Burgdorff of UC Irvine also participated in the study, which was supported by the National Institutes of Health.

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