Study investigates light, biological clocks, estrogen receptor expression in the breast

April 3 2016

Researchers are exploring one possible physiologic explanation of why prior studies have demonstrated a higher risk of breast cancer in women who experience high levels of illumination at night. Their study results in an animal model will be presented Saturday at the Endocrine Society's 98th annual meeting in Boston.

The mammary gland in the female appears to be sensitive to changes in light exposure, initially reacting to excess nighttime light in ways that might lead to tumor development, a research team from Oregon State University in Corvallis discovered.

"The medical research community is beginning to recognize that multiple environmental factors likely contribute to the development of hormone-dependent breast cancer through processes that can change normal patterns of gene expression or hormone responsiveness," said lead researcher Rebecca Veitch, MS, a graduate student at the university.

Among the environmental factors that scientists are exploring are chemicals and, less often, society's increasing exposure to nighttime illumination, such as streetlights and digital technology. Most Americans—95 percent, according to a 2011 poll from the National Sleep Foundation—report using an electronic device in the hour before bedtime at least a few nights a week.

Light is the main cue for setting the body's biological clock and circadian rhythms, which affect the release of hormones, sleep-wake

cycles, metabolism and other important functions. This internal clock, Veitch explained, regulates the timing and expression of so-called clock genes that are necessary for many cellular functions, such as cell growth, cell proliferation and DNA repair. The Per2 clock gene is thought to be a tumor suppressor gene, she said.

Extended exposure to light, Veitch and her co-workers theorized, could disrupt normal cellular behaviors and gene expression, particularly in hormone-dependent tissues like the breast. Most aggressive forms of breast cancer stop responding to signals from the hormones estrogen and progesterone, she pointed out.

For three weeks, the investigators exposed one group of female mice to an extended light cycle of 18 hours of light and six hours of darkness, and another group of mice to 12 hours each of light and dark. The mice exposed to longer light exhibited significantly slowed cycling, or fluctuation, of the Per2 clock gene—from normal 24-hour cycling to approximately 42 hours—in mammary tissues but, to the investigators' surprise, there was no change in other peripheral tissues outside the brain. Slower cycling could indicate that cellular functions regulated by the biological clock are not working at the right times, Veitch said.

In other cohorts of mice exposed the same two light-dark cycles, only the extended light cycle group had substantially decreased expression of the genes that encode, or supply the genetic code for, estrogen receptors alpha and beta. Estrogen receptors are proteins that bind to DNA and can act as on-off switches for cell responses. An abundance of estrogen receptor beta is often associated with decreased spread of breast cancer and lower death rates due to breast cancer, Veitch noted. The expression of estrogen receptors alpha and beta was especially low in the mammary gland of the mice exposed to the extended light cycle.

"Our study provides new avenues of exploration for determining what

might initiate breast cancer growth," Veitch commented. "This study also raises awareness of potential consequences of inappropriate nighttime light as a suspected mechanism of breast cancer."

Provided by The Endocrine Society