

Good night's sleep keeps blood cells young and healthy

Under normal conditions, many of the different types of tissue-specific adult stem cells, including hematopoietic stem cells, exist in a state of dormancy where they rarely divide and have very low energy demands. "Our theory was that this state of dormancy protected hematopoietic stem cells from DNA damage and therefore protects them from premature aging," says Dr. Michael Milsom, leader of the study.

However, under conditions of stress, such as during chronic blood loss or infection, hematopoietic stem cells are driven into a state of rapid cell division in order to produce new blood cells and repair the damaged tissue. "It's like forcing you out of your bed in the middle of the night and then putting you into a sports car and asking you to drive as fast as you can around a race circuit while you are still half asleep," explains Milsom. "The stem cells go from a state of rest to very high activity within a short space of time, requiring them to rapidly increase their metabolic rate, synthesize new DNA and coordinate cell division. Suddenly having to simultaneously execute these complicated functions dramatically increases the likelihood that something will go wrong."

Indeed, experiments described in the study show that the increased energy demands of the stem cells during stress result in elevated production of reactive metabolites that can directly damage DNA. If this happens at the same time that the cell is trying to replicate its DNA, then this can cause either the death of the stem cell, or potentially the acquisition of mutations that may cause cancer.

Normal stem cells can repair the majority of this stress-induced DNA damage, but the more times you are exposed to stress, the more likely it is that a given stem cell will inefficiently repair the damage and then die or become mutated and act as a seed in the development of leukemia. "We believe that this model perfectly explains the gradual accumulation of DNA damage in stem cells with age and the associated reduction in the ability of a tissue to maintain and repair itself as you get older," Milsom adds.

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