Happiness lowers blood pressure, study says

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(Medical Xpress)—A synthetic gene module controlled by the happiness hormone dopamine produces an agent that lowers blood pressure. This opens up new avenues for therapies that are remote-controlled via the subsconscious.

The endogenous hormone dopamine triggers feelings of happiness. While its release is induced, among other things, by the "feel-good"

classics sex, drugs or food, the brain does not content itself with a kick; it remembers the state of happiness and keeps wanting to achieve it again. Dopamine enables us to make the "right" decisions in order to experience even more moments of happiness.

Biological components reconnected

Now a team of researchers headed by ETH-Zurich professor Martin Fussenegger from the Department of Biosystems Science and Engineering (D-BSSE) in Basel has discovered a way to use the body's dopamine system therapeutically. The researchers have created a new genetic module that can be controlled via dopamine. The feel-good messenger molecule activates the module depending on the dosage. In response to an increase in the dopamine level in the blood, the module produces the desired active agent.

The module consists of several biological components of the human organism, which are interconnected to form a synthetic signalling cascade. Dopamine receptors are found at the beginning of the cascade as sensors. A particular agent is produced as an end product: either a model protein called SEAP or ANP, a powerful vasodilator lowering blood pressure. The researchers placed these signal cascades in human cells, so-called HEK cells, around 100,000 of which were in turn inserted into capsules. These were then implanted in the abdomens of mice.

Contact with females activates module

These animals were subsequently exposed to situations that corresponded to their central reward system, such as sexual arousal, which a female mouse triggered in males, the injection of the drug methamphetamine or the drinking of golden syrup. In each case, the mouse brain responded

with a "state of happiness", the formation of dopamine and its release into the blood via the peripheral nervous system. In mice which received different concentrations of golden syrup, the "state of happiness" varied: the more the sugar was diluted, the smaller the amount of dopamine and thus the active agent that circulated in the blood. "This shows that dopamine does not merely switch our module on and off, but also that it responds based on the concentration of the happiness hormone," says Fussenegger.

In another step, the scientists linked the dopamine sensor module to the production of the antihypertensive agent ANP and implanted the customised cells in the abdomens of hypertensive male mice. Contact with a female mouse triggered such feelings of happiness in the males that the dopamine-induced ANP production corrected the hypertension and the blood pressure even reached a normal level.

Serum dopamine linked to brain

Based on their experiments, the researchers were also able to demonstrate that dopamine is not only formed in the brain in corresponding feel-good situations, but also in nerves in the vegetative system, the so-called sympathetic nervous system, which are closely knit around blood vessels. The brain is interlinked with the rest of the body via the sympathetic nervous system, despite the fact that the brain is unable to release "its" dopamine directly into the circulation due to the blood-brain barrier. Dopamine receptors have also been known to exist in body tissue such as the kidneys, adrenalin glands or on blood vessels, as well as in the brain.

Dopamine, which circulates in the blood serum, regulates the breathing and the blood sugar balance. For a long time, it was thus assumed that the activities of brain and serum dopamine were connected. The fact that the ETH-Zurich researchers in Basel have now managed to demonstrate

this connection deepens our understanding of the body's reward system.

Eating as therapeutic input

Martin Fussenegger says that eating, for instance, can be seen as therapeutic input thanks to this module. "Using the gene network, we link up with the normal reward system," he explains. Good food triggers feelings of happiness, which activate the module and intervene in a process that is normally only controlled by the subconscious. As a result, daily activities could be used for therapeutic interventions.

For the time being, however, the dopamine hypertension model is only a prototype. With their work, the scientists have proved that they can intervene in the body's reward system as a result. Nonetheless, it is more than merely an idea or experiment in living cells. "It works in a mouse model that simulates a human disease and the components we used to produce the module also came from humans." When and whether a treatment based on the happiness hormone will hit the market, however, remains uncertain. The development of prototypes into a marketable product takes years or even decades.

More information: Rössger K, Charpin-El-Hamri G & Fussenegger M. Reward-based hypertension control by a synthetic brain-dopamine interface, *PNAS* Early Edition, online 14th Oct. 2013.

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