Social isolation worsens cardiac arrest effects on heart regulation

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A new study in mice shows how social support can help minimize some of the worst physical damages to the brain caused by a heart attack.

From cell death to depressive symptoms to regulation of the heart, mice that lived with a partner after a heart attack suffered less damage than did similar mice that were housed alone.

"The results really get at the profound influence that the social environment can have on health after cardiac arrest," said Greg Norman, lead author of the study and doctoral student in psychology at Ohio State University.

One of the key findings of the research, published this week in the online early edition of the Proceedings of the National Academy of Sciences, is that social interaction helps protect against some of the negative effects of a heart attack on neural regulation of the heart.

Mice in the study showed damages to the regulation of their heart rate within 24 hours of cardiac arrest. But those mice that lived with a partner showed significantly less damage, and had more normal control of heart rate variability.

"This is another way that social interaction is able to improve health functioning after a heart attack," said Norman.

That finding is important because, in humans, heart rate variability after

a heart attack is strongly related to survival, said Courtney DeVries, co-author of the study and associate professor of psychology and neuroscience at Ohio State and a member of the university's Institute for Behavioral Medicine Research.

"We only followed the mice for seven days after the heart attack, but if these results are confirmed it could suggest that social isolation may have a negative impact on survival in heart attack victims," DeVries said.

For the study, male mice were either housed alone or with a female mouse for two weeks. Mice were implanted with a device, similar to an ECG in humans, that transmitted data on heart rate variability and other heart functions.

After two weeks, some of the mice underwent a surgically induced heart attack, while others were placed in a control group that did not undergo cardiac arrest.

The mice that had the heart attack were resuscitated. These mice were then tested 24 hours, three days or seven days after the heart attack on various measures of health.

On nearly every measure, mice that lived with a partner showed less damage after the heart attack than did those that lived alone.

For example, mice that lived alone showed more than twice as much neuronal cell death in the hippocampus area of the brain as did the mice that lived with a partner.

"The only difference in those groups was the living arrangements," Norman said. "Something as simple as living with another mouse can cut in half the amount of cell death in the brain as a result of cardiac arrest."

Other measures showed similar results.

In one test, socially housed mice showed less depressive-like symptoms than did mice that lived alone. Mice with a partner spent more time swimming when placed in water, while socially isolated mice spent much more time floating, which is seen as a depressive symptom.

"Cardiac arrest, even among mice in good social conditions, is inducing some depressive-like behaviors," DeVries said. "But depressive symptoms are more pronounced for mice that lived alone."

The results also showed evidence that socially isolated mice had more activity in the brain associated with the creation of pro-inflammatory chemicals, such as tumor necrosis factor alpha (TNF-a). TNF-a is one of a large family of proteins called cytokines -- chemical messengers that are mobilized when the body is injured or has an infection. These cytokines cause inflammation in their effort to repair an injured or infected area of the body.

All the mice that had a cardiac arrest showed more evidence of pro-inflammatory activity, but the effect was heightened in socially isolated mice.

This study and others have documented the damage that inflammation can cause have a heart attack, particularly in socially isolated animals, according to DeVries.

"There seems to be this residual inflammation in the brain that lasts long after the heart attack is over," she said. "We believe this inflammation may be related to many of the problems that victims have after a heart attack, including psychological consequences, such as depression."

In addition, within three days after the heart attack, socially isolated

mice had significantly higher levels of corticosterone, a stress hormone found in mice. This pattern remained seven days after the heart attack.

When the results are considered together, the picture is clear, Norman said.

"Social isolation hits cardiac arrest victims from multiple angles. It is involved in results for cell death, inflammation, and a variety of behavioral and physiological measures," he said.

"You really see the ability of social interaction to influence recovery."

Provided by The Ohio State University