

'Broken heart syndrome' protects the heart from adrenaline overload

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A condition that temporarily causes heart failure in people who experience severe stress might actually protect the heart from very high levels of adrenaline, according to a new study published in the journal *Circulation*. The research provides the first physiological explanation for Takotsubo cardiomyopathy, also called "broken heart syndrome" because it affects people who suffer severe emotional stress after bereavement, and suggests guidance for treatment.

Around 1-2% of people who are initially suspected of having a [heart attack](#) are finally discovered to have this increasingly recognised syndrome.

The Imperial College London study, which simulated the condition in an [animal model](#), suggests that the body changes its response to [adrenaline](#) by switching from its usual role in stimulating the heart to reducing its pumping power. Although this results in [acute heart failure](#), most patients make a full recovery within days or weeks.

The researchers propose that the switch in the heart's response to adrenaline might have evolved to protect the heart from being overstimulated by the particularly high doses of adrenaline that the body releases during stress.

Patients with Takotsubo cardiomyopathy, most often older women, experience symptoms that resemble a heart attack, but heart tests reveal no blockage in the coronary arteries; instead the heart has a balloon-like

appearance caused by the bottom of the heart not contracting properly. The same condition is sometimes seen in people who are injected with adrenaline to treat severe [allergic reactions](#).

In this new research, the authors simulated the condition by injecting high doses of adrenaline in anaesthetised rats. In these rats, as in Takotsubo patients, heart [muscle contraction](#) was suppressed towards the bottom of the heart. The researchers found that these rats were protected from an otherwise fatal [overstimulation](#) of the heart, indicating that adrenaline acts through a different pathway from usual, and that this switch protects the heart from toxic levels of adrenaline.

The study also examined drugs that might be useful for treating Takotsubo cardiomyopathy. Some beta blockers, used to treat high blood pressure, angina and heart failure, reproduced or enhanced the features of Takotsubo, giving new insights into the protective effects of these drugs. Levosimendan, a different type of drug given in [heart failure](#) to stimulate the heart without going through the adrenaline receptor pathways, had a beneficial effect.

"Adrenaline's stimulatory effect on the heart is important for helping us get more oxygen around the body in stressful situations, but it can be damaging if it goes on for too long," said Professor Sian Harding, from the National Heart and Lung Institute (NHLI) at Imperial College London, who led the study. "In patients with Takotsubo cardiomyopathy, adrenaline works in a different way and shuts down the heart instead. This seems to protect the heart from being overstimulated."

Study co-author Dr Alexander Lyon, also from the NHLI at Imperial, and consultant cardiologist at Royal Brompton Hospital, set up one of the first specialist services in the UK to look after people who have experienced Takotsubo cardiomyopathy. "Currently it is not fully known how to treat these patients," he said. "Insights from this work show that

the illness may be protecting them from more serious harm. We've identified a drug treatment that might be helpful, but the most important thing is to recognise the condition, and not to make it worse by giving patients with Takotsubo cardiomyopathy more adrenaline or adrenaline-like medications."

"At the Royal Brompton Hospital and Imperial College London we are leading a European initiative to bring together experts to understand this recently recognised cardiac syndrome, and we hope the findings from this work will lead to new treatment strategies for these patients during the acute phase of their illness, and to prevent recurrence".

The study was funded by the British Heart Foundation (BHF), the Wellcome Trust, the Biotechnology and Biological Sciences Research Council (BBSRC) and the Academy of Medical Sciences.

Dr Shannon Amoils, Research Advisor at the BHF, said:

"This is a fascinating study which presents a possible explanation for the signs of Takotsubo [cardiomyopathy](#), a rare condition that's usually preceded by intense emotional or physical stress. Patients usually have symptoms that resemble those of a heart attack but nearly all fully recover after a short time.

"The study also provides new insights into how the heart may protect itself from stress, which opens up exciting avenues of exploration for research. We must remember though that this is a study in rats, and the findings need to be confirmed in people before we can be sure of their relevance to patients."

More information: H Paur et al. 'High levels of circulating epinephrine trigger apical cardiodepression in a β 2-1 adrenoceptor/Gi-dependent manner: a new model of Takotsubo Cardiomyopathy'

Circulation, published online 25 June 2012.

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