

SCIENCE

Pain-free way to test health of blood vessels

Researchers at Nanyang Poly and TTSH developing non-invasive device to measure blood flow

Cheryl Teh

When he learnt how currency-counting machines use sensors and magnetic signals to identify bank notes, Dr Phua Chee Teck had a eureka moment.

Could a similar system be used to detect how blood vessels are working, he wondered.

Using a blood-pulse measurement device which uses magnets, Dr Phua, who is deputy director of sustainability engineering at Nanyang Polytechnic's (NYP's) School of Engineering, realised he could assess the blood flow rate from the radial artery, where the pulse is normally taken.

Researchers at NYP and Tan Tock Seng Hospital (TTSH) have since joined hands to develop a prototype device which can test whether blood vessels can cope with reduced blood flow. It is the first of its kind to allow for endothelial dys-

function (deficiencies in a person's blood vessel system) to be detected in a non-invasive way.

"The whole device is connected wirelessly, and the data will be analysed after the 20-minute process is completed," Dr Phua said.

The device holds some promise for cardiovascular patients. In 2017, one in three deaths in Singapore was due to heart disease or stroke.

Early detection can save lives. One way is to measure if a patient's blood vessels are working well. Current methods for testing endothelial dysfunctions are invasive, and often time-consuming.

The prototype device analyses if there is damage to the small and large blood vessels, which is common in diabetic patients.

Large blood vessel damage is commonly associated with stroke and heart disease, while small blood vessel damage often results in issues with the eyes, kidneys and nerves.

The procedure is simple and requires the device's two clamps to be attached to the patient's wrists for 20 minutes.

The patient's resting pulse and blood flow are measured first before the blood flow is temporarily re-



Nanyang Polytechnic's Dr Phua Chee Teck and Tan Tock Seng Hospital's Dr Rinkoo Dalan showing how their device works. PHOTO: NANYANG POLYTECHNIC

stricted from the patient's left arm and subsequently released.

The machine will then measure the intensity at which the blood flows back into the left arm to assess if the patient's vessels are working at their optimum levels.

It took a year for the researchers to design and develop the device, and come up with an algorithm to analyse patients' results. The team also conducted clinical trials. The prototype device was developed in partnership with Dr Rinkoo Dalan, a senior consultant in endocrinology and diabetes at TTSH.

The effort is supported by the National Health Innovation Centre and the National Healthcare Group's Centre for Medical Technologies and Innovations.

"We want to measure the elasticity of blood vessels. When blood flow is restricted and then released, blood vessels are supposed to dilate to their full size. If it is stiff, it will not dilate as much, in comparison

to flexible blood vessels," said Dr Dalan.

She said the device is also intended to be a good way of predicting whether someone is suffering from diabetes. It can differentiate between patients with severe and early diabetes. Tests of diabetic patients tend to reveal unnatural readings, which suggest that the blood vessels are inelastic.

The researchers are now looking to make the device easier for any healthcare professional to use.

They will also examine how it can be made cost-effective for widespread use. The plan is for the team to work with a local industry partner to introduce this device into the regular body check-up process at clinics.

Dr Phua and Dr Dalan are now more than three months into designing the new prototype, which will be ready in 2021.

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New award to recognise lab technicians

They are the often-overlooked workers who keep the cogs turning in every laboratory. Now, a new award aims to celebrate the work of lab technicians.

Lab technicians are a fixture in every laboratory, and help to keep labs safe, while helping researchers with their projects. They have various responsibilities – from organising lab tools and equipment to helping to record data, and ensuring accuracy while scientific research is conducted, for example.

The Asian Scientist Lab Tech of the Year 2019 competition will be launched on Monday.

An initiative of Asian Scientist Magazine, it aims to honour the valuable contributions of laboratory technicians across Singapore. It is the first of its kind here.

Prizes will be given to individuals with heartwarming and inspiring stories of their struggles and sacrifices.

"Since Asian Scientist was founded in 2011, we have tried to feature the best scientists in Asia – inevitably, the Nobel laureates, chief executive officers and founders," said Dr Juliana Chan, CEO of Wildtype Media Group and editor-in-chief of Asian Scientist Magazine.

"So in 2019, we decided to flip it around, and find a way to honour these unsung heroes who have made great contributions to successful scientific research."

Prizes of \$500 in cash will be awarded to 10 winners from Britain-based sponsor Abcam, along with a certificate of recognition, and a goody bag of books and magazines for each winning lab tech. The top prize is a three-day, two-night stay at the Banyan Tree Bintan, donated by Mr Ho Kwon Ping, executive chairman of Banyan Tree Holdings.

Supervisors of the winning lab techs will also win \$500 in book vouchers for their lab, to act as an incentive for them to nominate their lab techs.

The competition will run from Jan 14 to March 15. Readers can submit stories of their favourite lab technicians at Asianscientist.com/labtech.

Cheryl Teh

Why humpbacks sing – and change their tunes too

Sometimes a whale just wants to change its tune.

That's one of the things researchers have learned recently by eavesdropping on whales in several parts of the world and listening for changes in their pattern and pitch. Together, the new studies suggest that whales are not just whistling in the water, but constantly evolving a form of communication that we are only beginning to understand.

Most whales and dolphins vocalise, but dolphins and toothed whales mostly make clicking and whistling sounds. Humpbacks, and possibly bowheads, sing complex songs with repeated patterns, said Associate Professor Michael Noad of the Cetacean Ecology and Acoustics Laboratory at the University of Queensland in Australia.

Birds may broadcast their social hierarchy among song-sharing populations by allowing the dominant bird to pick the playlist and patterns. But how and why whales pass song fragments across hundreds of miles, and to thousands of animals, is far more mysterious.

The biggest question is why whales sing at all.

"The thing that always gets me out of bed in the morning is the function of the song," Prof Noad said. "I find humpback song fascinating from the point of view of how it's evolved." The leading hypothesis is that male humpbacks – only the males sing – are trying to attract females. But they may also switch tunes when another male is nearby, apparently to assess a rival's size and fitness, said Prof Noad, the senior author of one of four new papers on whale songs.

Why the humpbacks' musical patterns tend to be more complex than those of other whales is also a bit murky. Prof Noad suggested that the development may be the result of "runaway selection". Early humpbacks with complex songs were so much more successful at mating that they gained a substantial evolutionary advantage over their brethren with simpler vocalisations. This led to some very large, sometimes very noisy animals.

In one of the new studies, led by scientists at the New York-based Wildlife Conservation Society, researchers tracked humpbacks singing along the east and west coasts of Africa, comparing songs sung by those off the coast of Gabon to those near Madagascar.

The study, published in the journal Royal Society Open Science, confirmed that the two populations interact, noting overlap in their vo-



A new study has found an unexpected singing pattern among humpbacks: Once their songs reach a certain level of complexity, they drop that tune entirely and pick up a new, simpler one. PHOTO: AGENCE FRANCE-PRESSE

calisations. The researchers recorded songs annually from 2001 to 2005 using hand-held hydrophones aboard boats.

"Male humpback whales within a population tend to sing the same song type, but it's continuously changing and evolving over time," said Dr Melinda Rekdahl, the study's first author and a marine conservation scientist with the wildlife society. "It's thought to be one of the best examples of cultural evolution in the animal kingdom."

The idea of using songs to look at population mixing and connectivity is relatively new, she said, and has been proven valuable only in the past few years.

Some animals repeat sounds more than others, some sing "aberrant" tunes, and juveniles may hum jingles altogether different from the adults. Humpbacks also alter their tunes over time.

One reason might be novelty – for themselves or nearby females. "If I was swimming up with 15,000 whales and all the males were

VARIATIONS ON A THEME

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DR MELINDA REKDAHL, a marine conservation scientist at the New York-based Wildlife Conservation Society.

singing the same song, it would drive me crazy," Dr Rekdahl said. Maybe the "females are just, like, give me a new song!" she said.

Two additional recent studies examined how the songs change, sea-

sonally and across years.

In one paper, Dr Jenny Allen, who was a doctoral student with Prof Noad, found an unexpected pattern among humpbacks. Once their songs reach a certain level of complexity, humpbacks drop that tune entirely and pick up a new, simpler one. Her study, the first to quantify the complexity of the songs, was published in Proceedings Of The Royal Society B: Biological Sciences. "That clear oscillating pattern was something we didn't really expect," said Dr Allen, now a postdoctoral researcher at the University of Queensland and a lecturer at Griffith University in Australia.

Assuming that the songs are meant to attract females, "it might be that a brand-new song is a bit sexier than continuing to sing the complicated version of the old song", she said. But because it's hard to memorise a whole new song, "they're simplifying it to make it easy to learn so much new material all at once". Humpback songs have a lot of repeating patterns, which

might make them easier to remember, just as rhymes at the end of poetry lines aid memorisation, Dr Allen said. She also found a lot of predictability in the patterns, and compared them to pop songs based on the same four chords.

In another new paper, researchers at the University of Brest in France found that the pitch of Antarctic blue whale, pygmy blue whale and fin whale vocalisations fell from 2007 to 2016 at various recording sites in the southern Indian Ocean.

Because of a whale's anatomy, a louder call is higher in pitch, and a quieter one is lower. Essentially, the whales have gotten slightly quieter, said Ms Emmanuelle Leroy, now a research fellow at the University of New South Wales and an author of the new research.

"Blue whales are mostly solitary, so to communicate across large distance, they need to produce really low-frequency and high-intensity calls," she said. "The calls are really loud and will propagate over a few hundreds of kilometres." Her team

has two hypotheses to explain the drop in pitch across years. With the populations rebounding since the end of commercial whaling, perhaps the whales don't need their calls to carry as far to be heard by others.

Or perhaps with oceans acidifying because of climate change, the calls are naturally carrying farther, allowing the whales to reduce their volume. The team does not believe the change in pitch is tied directly to human activity.

Their research, published in the Journal of Geophysical Research: Oceans, also showed that the call pitch of the Antarctic blue whales varies across seasons, with pitches increasing 0.1 hertz during the spring and summer and dropping at other times.

That might be the whales' response to the loud cleaving of icebergs in the spring and summer. These extremely loud sounds – like the cracking of ice in a glass – make it harder for the whales to hear one another, so they crank up the volume, Ms Leroy said. NYTIMES