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MURMURS

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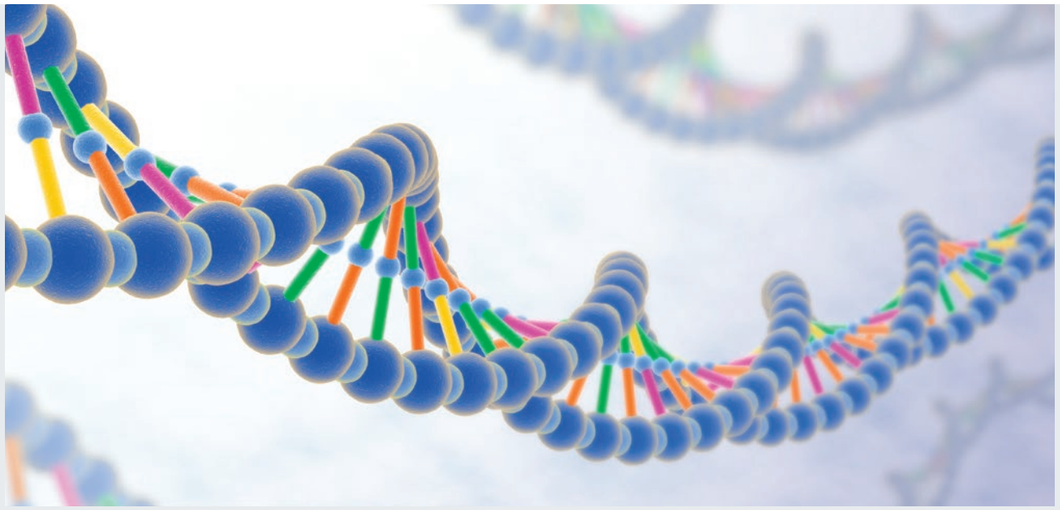
NHCS RESEARCHERS DEVELOP SAFE METHOD TO STUDY COMPLEX INHERITED HEART DISEASE



Researchers at the National Heart Centre Singapore (NHCS) have created a human heart cell model of an inherited heart muscle disorder known as arrhythmogenic right ventricular cardiomyopathy (ARVC). The team discovered that key characteristics of the disease, such as abnormal "fatty changes" and altered distribution of proteins involved in cell-cell connections, are reproduced in the heart cells. This novel cellular model allows for in-depth study of ARVC safely in a petri dish and the possibility of testing for new treatments.

The heart cell model was developed using the induced pluripotent stem cell (iPSC) technology, first developed by Professor Shinya Yamanaka who won the 2012 Nobel Prize in Physiology/Medicine for his work on this. The NHCS research team has taken a step further by developing a key clinical application of the iPSC technology. The landmark study was published in the European Heart Journal, a prestigious international peer-reviewed medical journal on cardiology, in July 2012.

For patients with ARVC, vigorous exercise places the heart under great stress and may result in heart muscle damage.

What is ARVC?

ARVC is an inherited heart muscle disorder which predisposes one to a high risk of developing life-threatening arrhythmias and sudden cardiac death.

While it is a rare condition found in an estimated 0.02 to 0.05 per cent of the population, ARVC is more commonly detected and lethal among young men in their 20s to 30s, with added risk if they have a family history of sudden cardiac death.

The low statistical incidence may be due to under-reporting as the clinical manifestations of the disease are not well known. Furthermore, symptoms may not present in the early stages, with the condition being revealed only during autopsies or after a close shave with sudden cardiac death. Symptoms, if they occur, include palpitations, giddiness and fainting.

At the cellular level, genetic mutations in ARVC disrupt the function of desmosomes, structures that bind heart cells to one another, provide strength to the heart muscle and allow electrical signals to pass between neighbouring cells. Impaired desmosomes result in damage to the heart muscle, particularly when a person with ARVC performs vigorous exercise and places his heart under great stress. This manifests as dangerous arrhythmia and sudden cardiac death when fat and scar tissue gradually replace the damaged heart muscle, affecting the electrical signals that control the heartbeat.

A challenge to diagnose, until now

Common diagnostic tests used to pick up ARVC include the electrocardiogram, cardiac MRI (magnetic resonance imaging), and a heart biopsy. However, these may not be foolproof and there may be risks involved, particularly for the heart biopsy.

All that may change with the new heart cell model developed by the NHCS research team.

"For the first time, we have created a 'crystal ball' of the disease outside the body to look into the patient's detailed genetic makeup and its relationship to the manifestation of disease," said Associate Professor Philip Wong, Director, Research and Development Unit, NHCS.

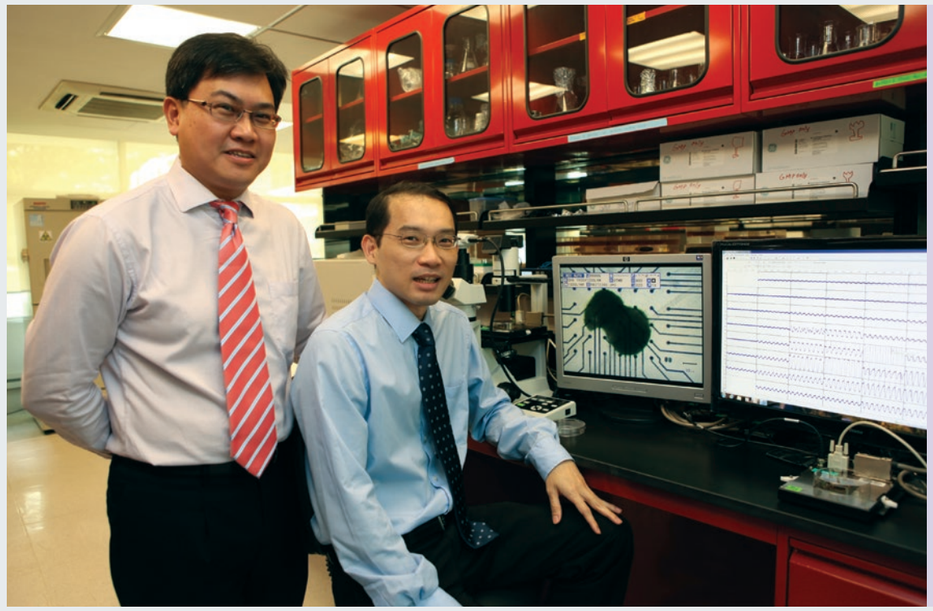
By sampling the skin cells of a 30-year-old male patient clinically diagnosed with ARVC, the team found hallmark features of ARVC replicated in the beating heart cells created from the patient's skin. There is also potential to use the novel heart cell model for drug testing where the individuals' responses to the drugs can be known before they are actually used on the patients.

"What this means for medicine down the road is personalised care. We will be able to tailor the medicine to specific patients for it to be more effective," said A/Prof Wong.

iPSC: A gift of time

Heart cells obtained from a biopsy are studied under the microscope immediately as they cannot be kept for long. On the other hand, iPSC derived from skin can be grown, frozen and stored for a longer period of time, and retrieved for laboratory use any time. This allows researchers more time to study the condition in detail.

The 10-member research team comprises six research scientists, two clinician scientists and two staff from the Electron Microscopy Unit, Yong Loo Lin School of Medicine, National University of Singapore. The three-year project, which started in 2010, was supported with a research grant from Goh Foundation and administered through Duke-NUS. The team is moving onto the next stage of using the ARVC model to unravel the secrets of the disease and stratify affected patients who are at risk of heart arrhythmias.



From the Research and Development Unit (RDU) at NHCS, A/Prof Philip Wong (left), Director, RDU and Dr Winston Shim, Scientific Director, RDU demonstrating the use of the patient's stem cells outside the body to test their response to drugs and to study the mechanisms of the inherited heart disease.

NUCLEAR CARDIOLOGY

IMAGING PROCEDURES FOR BETTER CARDIAC DIAGNOSIS AND TREATMENT

New technological improvements at NHCS allow for further reduction of radiation where minute doses of radiotracers can be used without compromising the accuracy of diagnoses.

Since the inception of the nuclear cardiology service at the National Heart Centre Singapore (NHCS) in 1995, the patient load for nuclear imaging procedures has grown exponentially to over 9,000 patients in 2012. These procedures include myocardial perfusion imaging (MPI) and rest equilibrium blood pool imaging.

Assessing treatment adequacy with perfusion scans

MPI is the most common nuclear cardiology procedure performed at NHCS. The indications for this test are diverse. These include the detection of haemodynamically significant coronary artery disease (CAD) in subjects without previous known disease, or the assessment of myocardial ischaemia and viability in patients with known CAD who are under medical therapy, following percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG).

For CAD patients, the test is used to assess the adequacy of current treatment. The amount of ischaemia and myocardial viability is paramount in determining the mode of therapy for these patients. The simultaneous accurate objective assessment of left ventricular (LV) systolic function, LV volume and wall motion detection is an added value for the test.

Another large group of patients who have these tests performed are those scheduled for major non-cardiac surgeries, whose risk of cardiac morbidity and mortality is considered moderate to high. Others who require MPI include post-heart transplant patients and those with non-ischaemic dilated cardiomyopathy contemplating an implantable cardioverter defibrillator or cardiac resynchronisation therapy.

By Dr Felix Keng
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Department of Cardiology
Director
Nuclear Cardiology
National Heart Centre Singapore

MYOCARDIAL PERFUSION IMAGING IS THE MOST COMMON NUCLEAR CARDIOLOGY PROCEDURE PERFORMED AT NHCS.

The procedure of MPI is simple. After a thorough explanation and obtaining consent, the patient will be asked to either perform physical exercise, or undergo pharmacologic stress (via dipyridamole, adenosine or dobutamine) if the patient is unable to achieve an adequate heart rate or exercise at all. At the peak of the exercise or induced stress, a radiotracer (sestamibi, tetrofosmin or thallium) is injected. This radiotracer perfuses the myocardium proportional to the amount of blood flow to the myocardium at peak stress, thus offering a snapshot of the perfusion, or blood flow, of the myocardium. This image is usually compared to a "resting" picture, in which another radionuclide injection may be injected to assess the perfusion in the myocardium in the resting state. Comparison of the two sets of snapshots allows for assessment of the amount of ischaemia and viability of the myocardium, important considerations in guiding treatment for CAD. As caffeine may interfere with the action of pharmacologic stress agents, all patients are advised to avoid caffeinated food and drinks for six to 24 hours before the test.

The amount of radiation which the patient is subjected to is minimal and well within the maximal daily radiation dose recommended for patients. New technological improvements at NHCS allow for further reduction of radiation where minute doses of radiotracers can be used without compromising the accuracy of diagnoses.

The test may take as short as one hour (for stress imaging only), or up to six hours if both stress and rest imaging are required. With the new generation gamma cameras acquired by NHCS in 2010, the imaging process itself may only take three to five minutes to complete.

Assessing ejection fraction with gated blood pool scans

Rest equilibrium blood pool imaging, also known as equilibrium radionuclide angiocardiography (ERNA), is also performed at the nuclear cardiology laboratory at NHCS. The majority of patients undergo this procedure for serial assessment of LV function in varying situations, such as pre-and post-treatment for CAD, and pre-and post-chemotherapy for a variety of oncologic malignancies. This technique offers objective LV ejection fraction assessment which is independent of operator subjectivity, unlike other techniques.

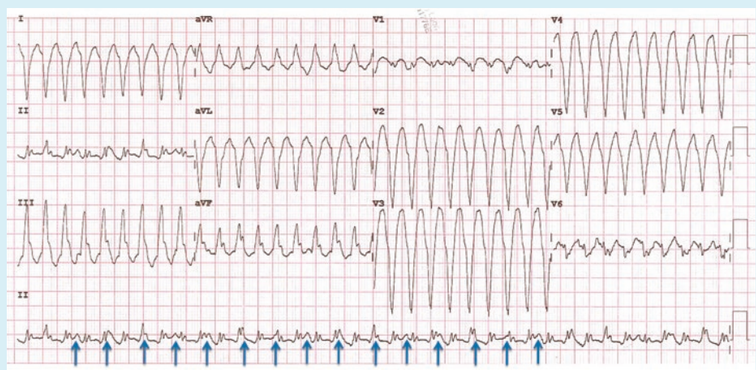
ERNA is a simple procedure. A resting radiotracer (free technetium) is introduced after prior injection of Stannous Chloride. The patient then rests for 15 to 20 minutes before a rest imaging is performed for about 10 minutes.

Conclusion

The nuclear cardiology subspecialty at NHCS has expanded to accommodate the rapid increase in demand for imaging procedures. The advent of new software and equipment has reduced imaging time and radiation risk to patients, while enhancing diagnostic accuracy and patient comfort. The tests are cost-effective as they act as a gatekeeper to coronary intervention and bypass surgery, clearly identifying patients who will benefit most from such procedures.

ANALYSE THIS

A 39-year-old gentleman presented to the emergency department and complained of four hours of palpitations. He described the onset as sudden, which woke him up at 2am in the morning and this was associated with dizziness and diaphoresis. He managed to drive himself to the emergency department. On arrival, he was noted to be in distress, and was cold and clammy with a blood pressure of 94/65mmHg and a regular heart rate of 200bpm. He had no significant history of note and no family history of sudden cardiac death.



WHAT ECG ABNORMALITY DID THIS PATIENT HAVE?

Refer to page 10 for the answer.

AMERICAN HEART ASSOCIATION SCIENTIFIC SESSIONS 2012

FOCUS ON LATE BREAKING CLINICAL TRIALS

The recent American Heart Association (AHA) Scientific Sessions 2012 held from 3 to 7 November in Los Angeles, USA, was a huge success with more than 800 scientific sessions conducted and about 27 Late Breaking Clinical Trials (LBCT) presented. It was attended by a large number of attendees from 100 countries as the AHA Scientific Sessions offered the best of cardiovascular science from around the globe that may change our day-to-day clinical practice in cardiology.

Two LBCTs that attracted my interest were the FREEDOM (Future Revascularisation Evaluation in Patients with Diabetes Mellitus: Optimal Management of Multivessel Disease) and dal-OUTCOME trials. These trials are significant as they offer important insights into how we treat patients with coronary artery disease (CAD).

FREEDOM

This new trial further supports previous literature on coronary artery bypass surgery (CABG) as being significantly more effective than percutaneous coronary intervention (PCI) with drug-eluting stents (DES) in patients with diabetes and multivessel CAD. This LBCT was presented by Professor Valentin Fuster, Director of Mount Sinai Heart at The Mount Sinai Medical Centre in New York, USA.

FREEDOM is a randomised trial involving 1,900 diabetes patients with multivessel CAD from 140 international centres. These patients, recruited between 2005 and 2010, were randomly assigned to receive either CABG or PCI with DES.

Mean age was 63±9.1 years. Of the group, 29 per cent were women and 83 per cent had triple vessel disease. The primary outcome was composite of all-cause mortality or non-fatal myocardial infarction (MI) or stroke.

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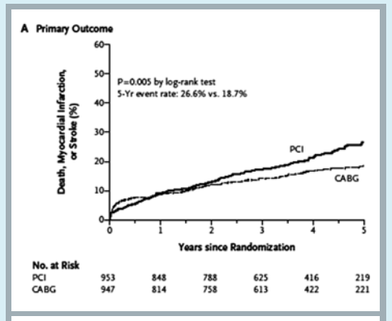
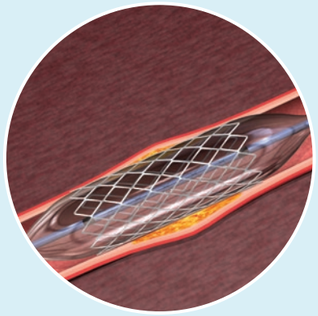


Figure 1: Kaplan Meier Estimate of the Composite Primary Outcome and Death (FREEDOM Trial)



Secondary outcomes included major adverse cardiac events such as death, MI, stroke or repeat revascularisation. Patients were followed up for a minimum of two years, with a mean of 4.37 years.

Figure 1 clearly demonstrates that the composite primary outcome at five years occurred more frequently in the PCI group compared with the CABG group (26.6 per cent versus 18.7 per cent, p=0.005). The benefit of CABG was driven by a difference in rates of both MI (p<0.001) and death from any cause (p=0.049). Stroke was more frequent in the CABG group, with a five-year rate of 2.4 per cent in the PCI group versus 5.2 per cent in the CABG group (p=0.03). Though the number of stroke cases was higher in the CABG group (37 versus 22 in the PCI group), it was not enough to negate the net significant benefits of fewer deaths and MIs in the CABG group.

In summary, this trial emphasised that for diabetes patients with multivessel CAD, CABG was superior to PCI in reducing rates of death and MI with a slightly higher stroke rate.

A subsequent cost effectiveness study of the FREEDOM trial showed that at five years post-surgery, CABG provided improved long-term clinical outcomes while increasing total costs by about US$3,600 per patient. In the long run, the initial higher costs of CABG were partially offset by lower costs associated with repeat revascularisation in PCI patients and, to a lesser extent, the cost of cardiac medications.

dal-OUTCOME

This was an important cholesteryl ester transfer protein (CETP) inhibitor trial designed to study the effectiveness of dalcetrapib, a CETP inhibitor, versus placebo in reducing cardiovascular events in patients with recent acute coronary syndrome (ACS).

In 2007, the phase 3 trial of the first CETP inhibitor, Torcetrapib, had to be terminated due to off-target adverse events. In the previous phase 2 trial, dalcetrapib was shown to increase high density lipoprotein cholesterol (HDL-C) by 30 per cent without any off-target effect in blood pressure. It was hoped that in the dal-OUTCOME randomised, double-blind phase 3 study, dalcetrapib would provide a clinical benefit in raising HDL-C.

In this trial, 15,871 patients who had a recent ACS event were randomly assigned to receive dalcetrapib 600mg daily (7,938 patients) or a placebo (7,933 patients). Patients in the study were required to have low density lipoprotein cholesterol at target levels with evidence-based therapies. There were no entry level criteria for HDL-C levels. Patients with high triglycerides (>400mg/dL) were excluded from the study.

The primary efficacy measures were time to first occurrence of coronary heart disease death, non-fatal MI, ischaemic stroke, hospitalisation for unstable angina or resuscitated cardiac arrest.

Patients were followed up for a median of 31 months. It was observed that dalcetrapib did not alter the risk of primary end point (cumulative event rate 8 per cent and 8.3 per cent for dalcetrapib and the placebo respectively; hazard ratio with dalcetrapib, 1.04, p=0.52), and neither did it have a significant effect on any component of the primary endpoint or total mortality. Median C-reactive protein level was 0.2mg/L higher and mean systolic blood pressure was 0.6mmHg higher with dalcetrapib relative to placebo (p<0.001). The trial was terminated early for futility on the recommendation of independent data and safety monitoring board.

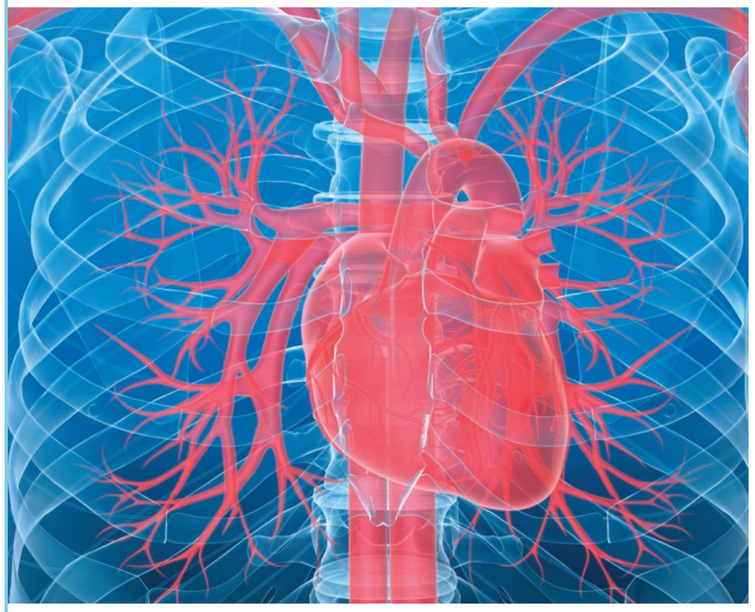
In short, dalcetrapib increased the HDL-C levels but did not reduce the risk of recurrent cardiovascular events in patients who had recent ACS.

But why did dalcetrapib fail to improve clinical outcome despite raising the HDL-C in ACS patients? One possible explanation is that moderate HDL elevation has no impact on cardiovascular events in patients who have already been optimally treated with statins and other agents. In this trial, 97 per cent of patients were on statins, 97 per cent on aspirin, 89 per cent on clopidogrel, ticlopidine or prasugrel and 88 per cent on beta blockers. Other trials such as JUPITER and AIM HIGH had shown a lack of relationship of HDL-C levels to clinical outcomes.

Another explanation is that CETP inhibition may produce a form of HDL that is dysfunctional. In addition, the benefits of raising HDL-C with dalcetrapib may be offset by its modest but significant elevation in systolic blood pressure. A partial CETP inhibitor such as dalcetrapib may be insufficiently potent. Trials on more potent CETP inhibitors involving anacetrapib and evacetrapib are on-going, and their clinical efficacy in reducing atherosclerotic risk will be made known in the near future.

In conclusion, the recent AHA Scientific Sessions yielded tremendous new scientific information to guide us in our day-to-day clinical practice in cardiology. Some trial results will definitely be incorporated in future AHA guidelines in managing the wide spectrum of cardiovascular diseases. I would encourage all medical practitioners managing cardiac patients in their day-to-day clinical practice to attend this useful meeting to keep in pace with advances in clinical cardiology.

THE SIGNIFICANCE OF HYPERTROPHIC CARDIOMYOPATHY



Hypertrophic cardiomyopathy (HCM) is defined by the presence of increased ventricular wall thickness or mass in the absence of loading conditions such as hypertension or valvular condition that is sufficient to cause the observed abnormality. About one in 500 of the general population has this condition, making HCM the most common hereditary cardiovascular condition.

By Dr Tang Hak Chiaw
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Department of Cardiology
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Risks and complications

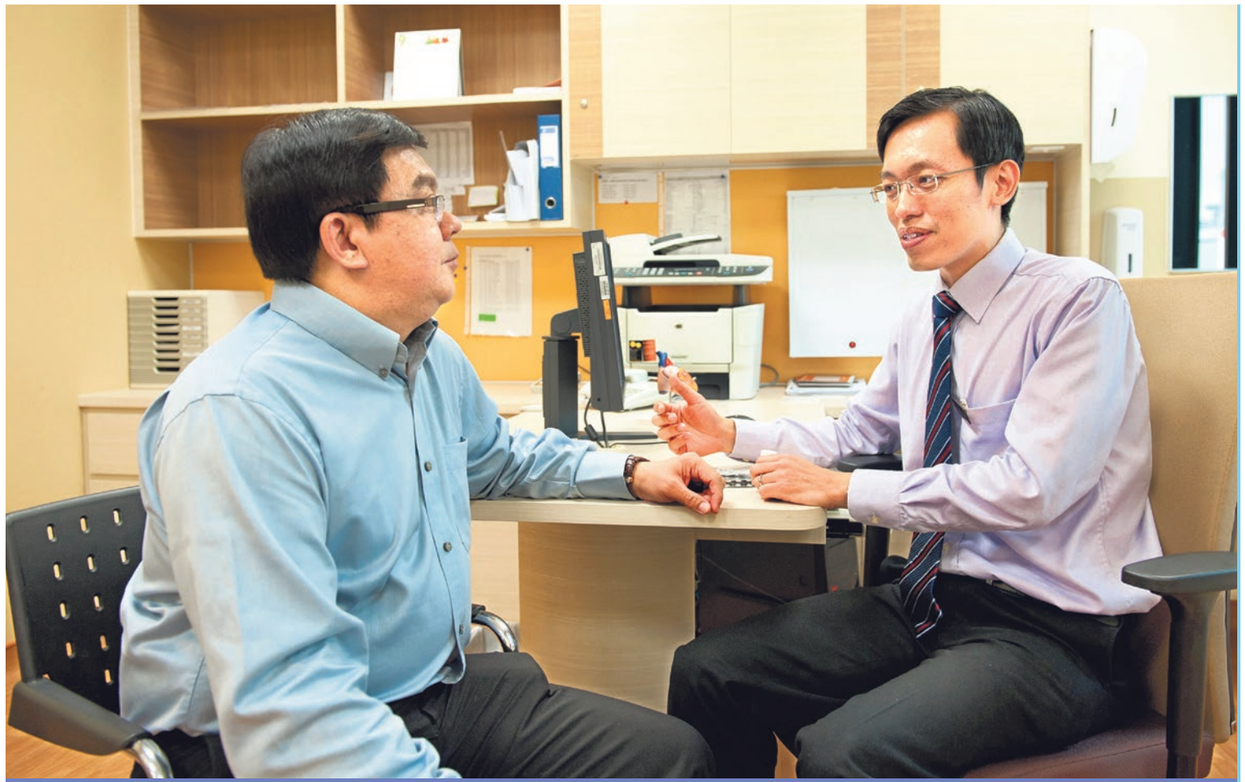
While HCM is documented as a major cause of sudden cardiac death (SCD) in younger patients, its incidence is really quite low at less than one per cent a year. In addition, individual HCM patients are not at equal risk. Factors such as family history of sudden death, history of ventricular arrhythmia or recent experience of unexplained fainting episodes have been shown to increase the risk of SCD. Patients deemed to be at a higher risk of SCD may be implanted with an implantable cardioverter defibrillator. There is no proven medication to prevent sudden cardiac death.

Atrial fibrillation is a more common, and worrying, complication faced by HCM patients. Atrial fibrillation, a condition of irregular heartbeat, is more prevalent among older patients and it increases their chances of getting a stroke. Left ventricular dysfunction and congestive heart failure are two other possible complications of HCM.

Symptoms and screening

HCM follows an autosomal inheritance pattern, where HCM patients have a 50 per cent likelihood of passing the abnormal gene(s) to their children. Genetic mutation may at times result in a patient becoming the first in the family to get HCM. Although genetic testing is currently available commercially for detecting known culprit mutations, the modest yield, high cost and low availability prevent it from becoming more widespread.

Most HCM patients are asymptomatic and will achieve normal life expectancy. Some, however, will experience symptoms such as chest discomfort, breathlessness on exertion, fainting spells or palpitations. Medications like beta-blockers, dihydropyridine calcium channel blockers and disopyramide are effective in alleviating, even abolishing, symptoms in majority of HCM patients.



Dedicated cardiomyopathy clinic sessions help doctors to better treat and manage HCM patients. PHOTO: SINGAPORE HEALTH

An individual typically undergoes a physical examination, ECG and echocardiogram when being screened for HCM. The recommended ECG and echocardiogram screening strategy from published guidelines is shown below.

AGE GROUP	RECOMMENDED SCREENING
<12 years old	If the patient: • Has a family history of young onset of disease or young sudden cardiac death; • Experiences an onset of symptoms suggestive of disease; • Participates in competitive sports.
12-21 years old	As the onset of myocardial thickening occurs during the growth spurt coinciding with adolescence, young patients should be screened every 12-18 months.
>21 years old	Screen at least once every five years or when suggestive symptoms appear. Patients with a family history of late onset of HCM should be screened even more frequently.

Treatment and long-term care

National Heart Centre Singapore runs a weekly Cardiomyopathy Clinic to better manage and treat HCM patients.

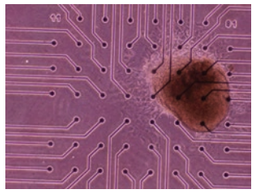
When medication is inadequate in controlling the symptoms of HCM, interventional procedures such as alcohol septal ablation and myectomy may be carried out. Alcohol septal ablation is an invasive procedure which thins a certain part of the heart muscle through a controlled heart attack. Myectomy, on the other hand, achieves the same outcome via open heart surgery.

As strenuous physical activity increases the risk of sudden cardiac death in HCM patients, competitive sports are strongly discouraged. Recreational aerobic exercises such as jogging, brisk walking and cycling are preferred for HCM patients.

RESEARCH HIGHLIGHT

Eur Heart J. 2012 Jul 13. [Epub ahead of print]

Generation of patient-specific induced pluripotent stem cell-derived cardiomyocytes as a cellular model of arrhythmogenic right ventricular cardiomyopathy.



Ma D, Wei H, Lu J, Ho S, Zhang G, Sun X, Oh Y, Tan SH, Ng ML, Shim W, Wong P, Liew R.

SOURCE: Research and Development Unit (RDU), National Heart Centre Singapore, 17 Third Hospital Avenue, Singapore 168752, Singapore.

ABSTRACT

AIMS: Arrhythmogenic right ventricular cardiomyopathy (ARVC) is a primary heart muscle disorder associated with sudden cardiac death. Its pathophysiology is still poorly understood. We aimed to produce an in vitro cellular model of ARVC using patient-specific induced pluripotent stem cell (iPSC)-derived cardiomyocytes and determine whether the model could recapitulate key features of the disease phenotype.

METHODS AND RESULTS: Dermal fibroblasts were obtained from a 30-year-old man with a clinical diagnosis of ARVC, harbouring a plakophilin 2 (PKP2) gene mutation. Four stable iPSC lines were generated using retroviral reprogramming, and functional cardiomyocytes were derived. Gene expression levels of desmosomal proteins (PKP2 and plakoglobin) in cardiomyocytes from ARVC-iPSCs were significantly lower compared with cardiomyocytes from control iPSCs ($P < 0.01$); there were no significant differences in the expression of desmoplakin, N-cadherin, and connexin 43 between the two groups. Cardiomyocytes derived from ARVC-iPSCs exhibited markedly reduced immunofluorescence signals when stained for PKP2 and plakoglobin, but similar levels of staining for desmoplakin, N-cadherin, and connexin 43 compared with control cardiomyocytes. Transmission electron microscopy showed that ARVC-iPSC cardiomyocytes were larger and contained darker lipid droplets compared with control cardiomyocytes. After two weeks of cell exposure to adiopgenic differentiation medium, ARVC-iPSC cardiomyocytes were found to contain a significantly greater amount of lipid, calculated using Oil Red O staining, compared with controls (734 ± 35.6 vs. 8.1 ± 0.49 a.u., respectively; $n = 7$, $P = 0.001$).

CONCLUSION: Patient-specific iPSC-derived cardiomyocytes display key features of ARVC, including reduced cell surface localisation of desmosomal proteins and a more adipogenic phenotype.

For the full list of NHCS publications, please refer to ***www.nhcs.com.sg****.*

ANALYSE THAT

Continued from page 5.

Initial ECG as shown on page 5 showed a broad complex tachycardia. A diagnosis of pulsed VT was made. Attempts at pharmacological cardioversion with amiodarone were unsuccessful and the patient was eventually externally cardioverted with an external biphasic shock. There is clear VA dissociation, as indicated by the blue arrows (refer to page 5).

The patient was subsequently diagnosed with borderline Arrhythmogenic Right Ventricular Dysplasia/Cardiomyopathy (ARVD/C), based on the Task Force of the Working Group on Myocardial and Pericardial Disease of the European Society of Cardiology and the Scientific Council on Cadiomyopathies of the International Society and Federation of Cardiology Criteria (TFC) for ARVD.

SHE LOOKS INTO YOUR HEART

A/Prof Ding performing an echocardiography scan on a patient.

"One must be passionate about the work and bear in mind that we are not dealing with machines."

Murmurs **gets up-close and personal in an interview with Associate Professor Ding Zee Pin, Senior Consultant, Department of Cardiology and Director, Echocardiography at the National Heart Centre Singapore (NHCS). A veteran cardiologist, A/Prof Ding has been with NHCS since 1986 when the centre was a department at SGH. This year, she was presented with the National Day Awards Long Service Medal.**

What analogy would you use to describe your work?

Echocardiography is like a window to the heart. It is quite fascinating that almost the whole spectrum of heart disease can be seen using ultrasound. In fact, echocardiography is the gold standard in evaluating heart valve disease, and whether a patient requires surgery or not will be based on what we see in the scans. The only part of the heart we cannot see is the coronary arteries. Even though the proximal portion is still visible from the scans, it is not always easy to get a good scan. For some patients, such as those with severe lung disease or wounds all over their chest, we are unable to scan them from the chest like we normally do.

What is your role as the Director of Echocardiography?

My role is to ensure that the highest standard of imaging is maintained in the laboratory. To achieve that, all echocardiography scans must be done accurately as the information will be used by the other cardiologists to manage their patients. We are also very committed to engaging our allied health professionals in continuous training, by sending them for in-house lectures and overseas meetings to upgrade themselves. A well trained team makes the system much more efficient and reduces the wait time for patients who need their scans done.

Aside from training our people and standardising our imaging planes, measurements and reports, we introduce new technology into the laboratory to maintain our standards. An example is the 3-D echocardiography equipment we brought in, which produces more accurate images of conditions such as mitral valve prolapse and regurgitation in patients.

What are some things about echocardiography that most people may not know of?

Contrary to what some might believe, echocardiography scans are not dangerous and do not involve any sort of radiation. It is the same type of ultrasound used on pregnant women during their scans. Also, our imaging equipment is actually very portable. At NHCS, we have two machines which we can wheel to the patients' bedside for those who cannot come to the laboratory. For most cases, we are able to tell the attending doctor how sick the patient is upon doing the scan at the bedside and deduce if emergency surgery is necessary.

In addition, it is not necessary to expose the entire chest during the scan. At NHCS, it is our practice to ensure that female patients have their chest covered during the scan to protect their modesty. We also make it a point to ensure that patients are lying down comfortably before scanning, or else they will have to endure being in an awkward position for 45 minutes. These are two key aspects we emphasise for patients getting a scan here – comfort and privacy.

What keeps you going?

I enjoy my work in imaging and the camaraderie among the people here. Sometimes at the end of a stressful day, it is very pleasant to sit together and talk with the people in the laboratory and have a good laugh. It is the people here at NHCS that make the difference.

TOP INTERNATIONAL CLINICIAN SCIENTIST JOINS NHCS

PHOTO: TOMORROW'S MEDICINE, SINGHEALTH

National Heart Centre Singapore warmly welcomed Professor Stuart Alexander Cook to the family on 26 September 2012 as our Distinguished Clinician Scientist, Senior Consultant in Clinical and Molecular Cardiology and Senior Research Advisor with the Department of Cardiology at the National Heart Centre Singapore. In recognition and support of his stellar qualifications in translational and clinical research, Prof Cook recently received the prestigious Singapore Translational Research Investigator (STaR) Award at the National Medical Research Council Awards Ceremony held on 31 October 2012. The overall aim of Prof Cook's research is to identify new ways of preventing, diagnosing, stratifying and treating patients with cardiovascular disease, such as cardiac arrhythmias and sudden cardiac death.

APPOINTMENT WITH DUKE-NUS GRADUATE MEDICAL SCHOOL

A/PROF LIM CHONG HEE
Adjunct Associate Professor
Office of Education

PROMOTION

DR JACK TAN
Senior Consultant
Department of Cardiology

Sub-specialty interest: Interventional Cardiology

NHCS nurses win 6th Tan Chin Tuan Nursing Award

Congratulations to NHCS Principal Enrolled Nurses Ms Khatijah Binte Kassim (right) and Ms Norazlinda Binte Abdul Malek, from Wards 44 and 56 respectively, for winning the 6th Tan Chin Tuan Nursing Award. They were among the top nine nurses to receive the award from Minister for Health, Mr Gan Kim Yong, during the ceremony on 20 November 2012. Established by the D. S. Lee Foundation in 2006, the Tan Chin Tuan Nursing Award is the highest accolade dedicated to Enrolled Nurses in Singapore.

NHCS bags double awards

NHCS' efforts in driving work-life harmony and workplace health were once again reaffirmed with two biennial awards.

Ms June Tay, Assistant Manager, Human Resource Department, NHCS, receiving the Work-Life Excellence Award from Mr Tan Chuan-Jin, Acting Minister for Manpower and Senior Minister of State for National Development, during the Gala Dinner on 12 October 2012. NHCS has been an award recipient since 2004.

Mr Lucas Chow, Chairman of the Health Promotion Board, presenting the Gold Award for the Singapore HEALTH (Helping Employees Achieve Life-Time Health) Award to Ms Lim Suh Fen, Deputy Director, Nursing, NHCS, during the award ceremony on 30 November 2012. This is the fourth time NHCS is receiving the award since 2006.

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MEDICAL EDITOR Dr Ewe See Hooi
EDITORIAL TEAM Yvonne Then, Jessica Koh, Lim Peizhen

We value your feedback. For comments or queries on Murmurs, please email us at ***nhcs@nhcs.com.sg****.*