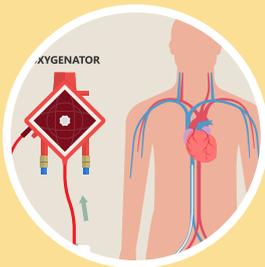


MURMURS®

A publication of
National Heart Centre
Singapore (NHCS)



**ECMO –
LIFE-SUPPORT
OPTION**



**NEW DEDICATED
CARDIOGENETICS
SERVICE LAUNCHED**



**A SMALL INCISION -
MINIMALLY INVASIVE
CARDIAC SURGERY**



TELEMEDICINE: PROVIDING REMOTE HEART CARE



National Heart
Centre Singapore
SingHealth

PATIENTS. AT THE HEART OF ALL WE DO.®

TELEMEDICINE: PROVIDING REMOTE HEART CARE

In face of the Covid-19 pandemic, telemedicine is a safer and effective alternative offered to patients so that they continue to receive care remotely without the need to get out of their homes. Find out the latest telemedicine consultation and care services provided by NHCS.

Telehealth refers to a broad array of communication technologies used to deliver healthcare.

While Singapore is increasingly digital, the advances in telehealth has been relatively slower as healthcare delivery in Singapore is predominantly physical, that is face-to-face. The emergence of COVID-19 (Coronavirus Disease 2019), however, has been a catalyst for the adoption of telehealth technologies and driving the launch of many telemedicine services in healthcare. A typical telemedicine consultation uses conferencing technology, to allow patients to remotely receive consultations and medical advice from a physician or care team.

Caring for Patients Remotely

At NHCS, several clinical departments jumped on the telehealth wagon last year; offering various telemedicine services to continue to provide care to patients remotely, so that patients can minimise unnecessary travelling and reduce exposure risk to infection. This also allows patients and their caregivers to save time and money from commuting. Since April 2020, NHCS has successfully launched a myriad of telemedicine services such as doctor consultations, nurse counselling and post-surgery care advice. As of February 2021, more than 800 telephone and video consultations were conducted for patients in NHCS.

NHCS provides a wide range of telemedicine services, including:

- **Self-Testing and Monitoring INR (International Normalised Ratio) at Home**
- **Physiotherapy Telehealth Service**
- **Cardiac Rehabilitation Tele-Consultation**
- **Intravenous Epoprostenol Therapy Nursing Video Consult**
- **Cardiothoracic Surgery Video/ Phone Consultation for Cardiology Patients at Sengkang Hospital**

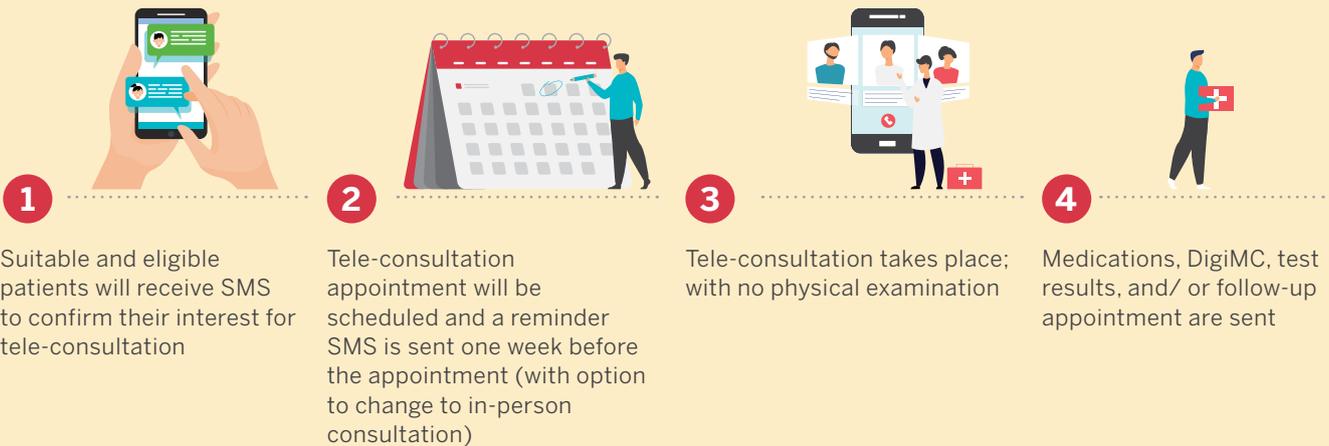
Selection Criteria and Eligibility for NHCS Telemedicine Services

For patient safety, there are sets of guidelines and criteria on the eligibility of patients for the respective telemedicine services. Patients will be assessed by their care team (which may include physician, nurse clinician, physiotherapist and more) on their suitability such as existing health condition, medication compliance and IT competency.

The table provides a general criteria for patient enrolment into telemedicine services:

✓ Suitable	✗ Not Suitable
<p>Patients</p> <ol style="list-style-type: none"> 1. With stable cardiac conditions or low cardiac risk who do not require physical examination 2. Who have sufficient medication supply for at least one week from date of virtual consultation 3. Who are comfortable with the use of technology 4. Whose monitoring of vital signs is not crucial during their consultation 	<p>Patients</p> <ol style="list-style-type: none"> 1. With high cardiac risk 2. Who are newly referred to NHCS for a consultation or treatment 3. Who have not had face-to-face consultation in the last one year 4. Who have communication barriers

HOW IT WORKS



A look at two types of our telemedicine services

Tele-consultation for patients with stable and/or low cardiac risk

The tele-consultation service allows our doctors to follow up with existing patients with stable and/or low cardiac risk. Tele-consultation serves to be equivalent to in-person consultation.

Patients are pre-identified for their suitability for enrolment to the tele-consultation based on the criteria as outlined in table above.

Tele-counselling for patients with post-cardiac event/ procedure

The tele-counselling service allows the nurses to assess and provide health education to patients who have been discharged within one to two weeks after a cardiac event, procedure or surgery. This helps reduce the risk of post-surgery complications. As of

November 2020, over 120 sessions were conducted.

NHCS Cardiac Rehabilitation Unit will identify patients who require medical management after a cardiac event such as acute coronary syndrome, cardiac procedures like angioplasty and cardiac surgery like coronary artery bypass grafting. During the tele-counselling session which takes approximately 45 minutes, the nurses will provide patients with information and advice pertaining to cardiac risk factors, behavioural lifestyle modifications such as smoking cessation and exercise regime, and reinforce the importance of chronic disease management.

The overall response to the telemedicine services had been positive. Many patients shared that such services had helped save travelling time and were convenient. In particular, patients shared that the rehabilitation tele-counselling was a good alternate route of communication, during the nation's Circuit Breaker period when commuting

was restricted. Although some still prefer a face-to-face counselling, they felt that the tele-counselling was a good way for patients to ensure compliance on healthy eating and regular exercise.

- NHCS telemedicine services are optional and not all conditions are suitable for tele-consultation. Please consult your doctor for more information.
- This service is not suitable for you if you are feeling unwell and/or a physical examination is required. Do not wait for a telephone or video consultation if you are feeling unwell. Please proceed to your nearest polyclinic, GP clinic or Emergency Department.
- For appointment matters, please email central.appt@nhcs.com.sg or call 6704 2000.



Samantha Ng, Senior Physiotherapist, Department of Physiotherapy, meeting a patient over a video consultation and demonstrating exercises.



FOR PHYSICIANS

ECMO – LIFE-SUPPORT OPTION

By Asst Prof Jose Chakaramakkil Mathew, Consultant,
Department of Cardiothoracic Surgery

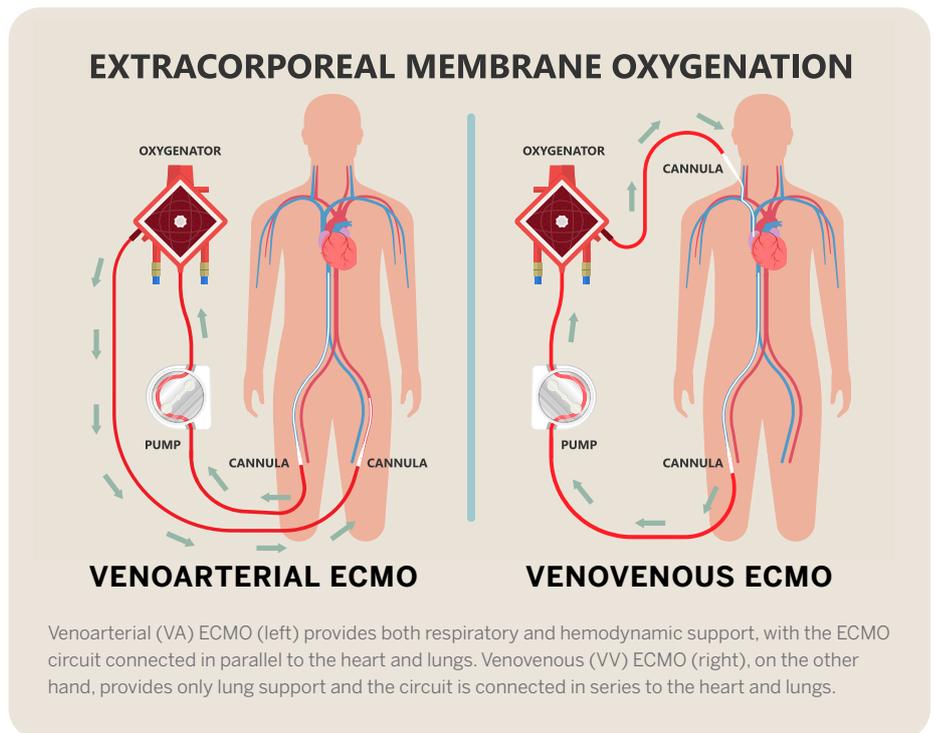
Extracorporeal Membrane Oxygenation (ECMO) is a treatment that uses artificial heart and lung to support the body when a patient's heart and/or lung have failed. It can provide the cardiac and respiratory support for up to a few weeks, allowing time for the heart and/or lung to be treated and recover. ECMO may be an option only after all other conventional treatments have failed.

ECMO uses a modified “heart-lung machine” that is routinely used for open-heart surgery.

It involves the use of a centrifugal pump (artificial heart) which takes over the work of the heart and an oxygenator (artificial lung) which takes over the work of the lungs. Large bore cannula is placed in a large vein to draw venous blood out into the ECMO circuit. This venous blood is oxygenated and decarboxylated by the oxygenator in the circuit. The treated blood is warmed up using a heat-exchanger in the circuit and pumped back into the patient using the centrifugal pump.

There are two types of ECMO - Venousarterial (VA) ECMO, which provides the heart and lung support, and venovenous (VV) ECMO, which provides only lung support.

VA ECMO supports the function of the patient's heart and lungs by diverting most of a person's blood to the ECMO circuit without the blood flowing through the patient's heart and lungs. VA ECMO draws out blood from a large vein and into the ECMO circuit. The venous blood in the ECMO circuit is oxygenated and returned into a large artery, allowing oxygen-rich blood to circulate through the body. In adults, VA ECMO is commonly used in conditions causing cardiac arrest and cardiogenic shock such as heart attack, myocarditis,



cardiomyopathy, pulmonary embolism and primary graft failure after heart transplant. It is also used in conditions like poisoning, endocrine emergencies, sepsis, trauma, and organ donation. Most commonly, patients are on VA ECMO for 5-10 days.

VV ECMO supports the function of patient's lungs only, hence a persons'

heart must still function well to meet the body's needs. It draws most of the patient's venous blood out of a large vein and into the ECMO circuit. The venous blood in the ECMO circuit is oxygenated and returned to the right atrium and the patient's own heart pumps the blood throughout the body. It is therefore important the patient's heart is strong enough to pump the



oxygenated blood in the right atrium, through the non-functioning lungs, to the rest of the body. In adults, common indications for VV ECMO is lung failure due to pneumonia and adult respiratory distress syndrome. It is also used in aspiration, drowning, respiratory burns, lung trauma, airway obstruction, and post lung transplantation. Most commonly, patients are on VV ECMO for 10-14 days.

ECMO treatment is a high-risk procedure with significant complications including bleeding, stroke, sepsis and limb ischemia, and should only be used when all other conventional treatments such as mechanical ventilation (breathing machine), inotropes (medications that help with heart's contractions), intraaortic balloon pump (device that helps the heart pump more blood), have failed. In this group of critically ill patients, ECMO can save approximately, 60% with respiratory failure, 40% with cardiogenic shock and 30% with cardiac arrest.

NHCS has been performing ECMO since 2001 and is the largest ECMO centre in Singapore; performing about 75 procedures per year. NHCS has a mobile unit that can be activated to initiate ECMO at peripheral hospitals and bring the patient back to NHCS for management.

Eligibility Criteria for Adult ECMO

ECMO is generally contraindicated if patient is/has:

- Age > 65-70 years old
- Presence of advanced multi-organ failure
- Severe chronic organ failure (e.g. kidney, liver, lung)
- Advanced malignancy
- Severe brain injury
- Pre-existing 'DO NOT RESUSCITATE' order
- Uncontrolled bleeding

Nonetheless, decisions on ECMO initiation are made based on the risks and benefits it could bring to individual case. When a patient is identified to be requiring ECMO, the referring physician will discuss with the ECMO centre on the treatment plan.

Venoarterial ECMO (VA ECMO) for medically refractory cardiogenic shock

In addition to the conditions listed above, factors which may influence the decision to provide VA ECMO include whether the patient:

- is a transplant and/or ventricular assist device candidate
- has severe peripheral vascular disease
- has severe thrombocytopenia

Contraindications:

- Aortic dissection
- Moderate to severe aortic valve eurgitation

Venovenous ECMO (VV ECMO) for acute respiratory failure

VV ECMO should be reserved for patients who are at a high risk of death despite maximal conventional therapy, including those with:

- Severe hypoxaemia (eg. $\text{PaO}_2/\text{FiO}_2 < 80$ on $\text{FiO}_2 > 90\%$) despite optimal positive end-expiratory pressure, oxygen, and adjunct therapies (e.g. paralysis, prone positioning)
- Severe hypercapnic respiratory acidosis ($\text{pH} < 7.15$)
- Inability to achieve lung protective ventilation (e.g. tidal volume $\leq 6\text{ml/kg}$, plateau pressure $\leq 30\text{cmH}_2\text{O}$)
- Significant air leak/barotrauma

Triggers for VV ECMO activation should take into account the trajectory of illness (e.g. rate of deterioration) and safety of the hospital transfer (time and logistics).

General contraindications for VV ECMO in acute respiratory failure:

- Immediately following cardiac arrest
- Patients with chronic immunosuppression
- Invasive mechanical ventilation for ≥ 7 days prior to referral



NEW DEDICATED CARDIOGENETICS SERVICE LAUNCHED

Launched in November 2020, the NHCS Cardiogenetics Clinic provides care for patients and their families who have been diagnosed, or are suspected to have, an inherited cardiac condition.

Formed under the stewardship of the SingHealth Duke-NUS Genomic Medicine Centre (SDGMC), the Clinic is the first specialty genetic service at NHCS to help patients with genetic disorders or conditions with a suspected genetic basis.

Helmed by Dr Saumya Shekhar Jamuar, Head of SDGMC and Senior Consultant, Paediatrics, Genetics Service from KK Women's and Children's Hospital and a team of genetic counsellors, the Clinic currently sees the following types of patients:

- Individuals with a family history of an inherited cardiac condition, sudden death, and/or a known causative genetic variant;
- Individuals with an established clinical diagnosis who would like to understand why they developed a cardiac condition and/or the risk to family members or future children
- Individuals whose aetiology and associated cardiac condition is not clear;

"The identification of an underlying genetics basis for many cardiovascular conditions has evolved in the past decade and recognised to have significant implications for patient management. Many cardiology practice guidelines incorporate genetic data in the recommendations for diagnosis and clinical management. Genetic testing can help in establishing a definitive, aetiologically based diagnosis," explained Dr Saumya on why there is a need to set up a dedicated service at NHCS.

He added that establishing an inherited cardiac condition is a multi-stage process, involving the collection of family history, recognition of phenotypes associated with inherited cardiac conditions, facilitation of relevant genetic testing and the interpretation of the genetic test results.

If a genetic cause for an inherited cardiac condition is indeed established, testing can be offered to asymptomatic family members for preclinical diagnosis and management. For example, a family member who has been found to have inherited the familial genetic variant will require regular cardiac follow-up as compared to a family member who does not have the genetic variant.

Prof Terrance Chua, Medical Director shared, "This service is a significant milestone for us. By working closely with NHCS cardiologists, the Clinic can provide cardiovascular evaluation, genetic counselling and testing for our patients with, or who are at risk of, inherited cardiac conditions to improve our clinical management and patient care."

Positive impact on cardiac patients and their families

Dr Yan Limin, Associate Consultant from the Department of Cardiology recently referred a patient with early onset aortic dissection whose height was suggestive of Marfan syndrome, an inherited congenital disorder affecting the connective tissue of the heart, eye, bone and other organs, "The patient didn't meet the full criteria of Marfan syndrome and could also be associated with other systemic aortopathies such as Loeys-Dietz or Ehlers Danlos syndrome, which are also inherited disorders. Genetic testing will allow us to confirm his diagnosis and understand the impact on his family."

For another pair of patients, a couple whose child was diagnosed with Tetralogy of Fallot, a birth defect that affects



The NHCS Cardiogenetics Clinic is helmed by Dr Saumya Shekhar Jamuar, Head of SDGMC and Senior Consultant, Paediatrics, Genetics Service from KK Women's and Children's Hospital and a team of genetic counsellors.

blood flow through the heart, and had undergone exome sequencing, the Clinic will return the results to the couple, which will not only help the couple to understand the results but also implications for future children.

Ms Yasmin Bylstra, Principal Genetic Counsellor, said, "Patients will receive education and support regarding their diagnosis or cardiac family history, and information regarding how the condition is inherited in the family." Indeed, the service hopes to offer patients a deeper understanding of the genetics behind their inherited cardiac condition, as well as the risks for themselves and their family members.

REFER A PATIENT

If you have a patient with a suspected inherited cardiovascular disease, you may refer them to the NHCS Cardiogenetics Clinic by the following contacts:

Tel: 6704 2222

Fax: 6222 9258

Email: central.appt@nhcs.com.sg

The types of conditions that can be seen in the clinic include:

- Channelopathies e.g. Long QT Syndrome
- Cardiomyopathies e.g. Hypertrophic cardiomyopathy, Dilated cardiomyopathy
- Systemic aortopathies e.g. Marfan syndrome
- Non-systemic aortopathies e.g. Familial thoracic aortic aneurysm and dissection
- Connective tissue disorder e.g. Ehlers Danlos syndrome
- Familial hypercholesterolemia
- Sudden unexplained death in the family
- Congenital heart disease syndromes
- Other cardiovascular conditions deemed to benefit from genetic testing by the specialist

CONTACT US



National Heart
Centre Singapore
SingHealth

GP PATIENT REFERRALS

Tel (65) 6704 2222

NHCS CALL CENTRE

Tel (65) 6704 2000

Fax (65) 6222 9258

central.appt@nhcs.com.sg

GENERAL ENQUIRIES

Tel (65) 6704 8000

Fax (65) 6844 9030

nhcs@nhcs.com.sg

ADULT CONGENITAL HEART DISEASE (ACHD) PROGRAMME

Congenital heart disease is a heterogeneous condition with a wide spectrum of varying complexity and severity. ACHD patients, with the exception of those with mild isolated valvular heart disease or those with repaired patent ductus arteriosus, ventricular septal defect and atrial septal defect, should be followed up in a specialised ACHD clinic with a dedicated multi-disciplinary team who can anticipate the various issues particular to each individual. At NHCS, we have the experience and expertise in managing patients ranging from those with simple congenital heart lesions to patients with complex congenital heart defects such as those with post-Fontan surgery, univentricular heart, cyanotic complex and congenital heart lesions.

SERVICES

- Adult Congenital Heart Disease Clinic
- Cardiac Pregnancy Clinic (Joint clinic with Obstetricians from Singapore General Hospital)
- Congenital Echocardiography
- Congenital Heart Catheterisation
- Congenital Heart Intervention (e.g. Atrial Septal Defect Device Closure, Patent Foramen Ovale Device Closure, Patent Ductus Arteriosus Device Closure, Pulmonary Valvuloplasty, etc.)
- Pulmonary Hypertension
- Right/Left Heart Catheterisation and Pulmonary Vasoreactivity Studies
- Screening for Marfan Syndrome

OUR SPECIALISTS

Assoc Prof Tan Ju Le

Director, Adult Congenital Heart
Disease and Senior Consultant

Asst Prof Foo Jie Sheng

Consultant

Asst Prof Lee Phong Teck

Consultant

**For the full list of NHCS services and specialists,
please visit www.nhcs.com.sg.**

A SMALL INCISION

MINIMALLY INVASIVE CARDIAC SURGERY

Traditionally, cardiac surgery is carried out through making a cut in the middle of the breastbone to gain access to the heart for maximal exposure. With technology advancement, minimally invasive cardiac surgery (MICS) can be carried out through a small incision (thoracotomy) on the side of the chest between ribs, without splitting the breastbone.

Peter Tan* is the sole breadwinner in his family.

When he was first diagnosed with mitral valve disease, he was concerned that his condition would affect his work and was hesitant to undergo an open-heart surgery, as full recovery may take up to three months. Upon assessing Peter's condition, Asst Prof Chua Kim Chai, Consultant from the Department of Cardiothoracic Surgery

recommended minimally invasive mitral valve repair procedure where the recovery time is shorter. Peter underwent the procedure and was able to go back to work a few weeks after his surgery. He was happy that he had a short recovery time, and his symptoms have improved.

"Compared to conventional cardiac surgery carried out through sternotomy, MICS has shown multiple benefits to patients such as minimising the need for blood transfusion, reducing the length of hospitalisation, hence saving medical costs. It also allows faster recovery and better cosmetic result due to less visible surgical scars," shared Asst Prof Chua.

NHCS performed an average of 20 minimally invasive coronary bypass annually and had also just started performing minimally invasive mitral repair/replacement for suitable patients. Since October 2020, there had been 10 minimally invasive mitral repair/replacement and the number is expected to increase with time. Each minimally invasive cardiac surgery depended on surgeon's careful pre-operative

planning and mastery of using long instruments, aided by using endoscope for visual improvement, to carry out the procedure. Prior to operation, patients also had to go through multiple pre-operation investigations such as CT chest scan and lung function test.

Who are suitable for MICS?

MICS may not necessarily be an appropriate treatment option for every patient. Patients with serious medical condition such as lung disease or peripheral vascular disease, abnormal rib cage anatomy (severe kyphosis or pectus chest) and those require additional cardiac procedures, are not suitable to go for MICS. MICS is also generally not performed for complex cases that require multiple surgeries such as a combined valve and coronary artery bypass graft (CABG) surgery. MICS will bring greater benefit to patients who have an active lifestyle such as those who are into sporting activities, or those who are likely to have delayed chest bone healing if bone splitting was performed (osteoporosis or chronic steroid use).



Wound healing is a much smoother and swift process with MICS.

It is important for patients to discuss with their doctors on the suitability for any treatment options, and undergo thorough assessment to determine the appropriate treatment option to achieve the best health outcome.

Selective Procedures Done Through MICS

Nowadays, selected coronary artery bypass graft (CABG) and valvular surgery can be done via minimally invasive approach. For CABG, a single graft bypass is most commonly performed on left anterior descending artery stenosis – minimally invasive direct coronary artery bypass, usually on a beating heart. For aortic valve replacement, either partial upper sternotomy, or right mini thoracotomy is the choice of exposure

to the diseased valve. For mitral valve repair/replacement, sometimes with concomitant maze procedure (a surgical procedure used to treat atrial fibrillation) and/or tricuspid valve repair, the surgery is performed through right mini thoracotomy. Catheter-based procedures such as transcatheter aortic valve implant and mitral clip are part of MICS as well.

MICS is now a standard approach for straight forward cases in many parts of the world. In NHCS, with the well-equipped MICS equipment, trained anaesthetists, scrub nurses, perfusionists and experienced cardiologists, more of our patients could benefit from MICS in future.

** Patient's name has been changed to protect his identity.*



FOR
PHYSICIANS



PROCEDURE IN-DEPTH

For minimally invasive direct coronary artery bypass, patient is positioned with slight right decubitus position and put on single right lung ventilation to allow better visualisation in left chest. A small incision of five to six centimetres is made on fourth intercostal space usually to gain exposure to target vessels. A specialised retractor is then applied through the incision to elevate left side of chest to allow harvesting of left internal mammary artery (LIMA). Then a suction device is used to stabilise left anterior descending (LAD) artery on a beating heart, and anastomosis of LIMA-LAD is performed thereafter.

For mitral valve surgery, the strategy of putting a patient on cardiopulmonary bypass is different from traditional way (centrally on ascending aorta and right atrium) – instead, it is established peripherally (femoral artery and vein). The access of heart is achieved through a four to five centimetres thoracotomy incision on right fourth intercostal space usually, aided with a thoracoscope for better visualisation of surgical field. Specialised long instruments are used for achieving diastolic arrest of heart, and subsequent repair or replacement of the diseased mitral valve.



Asst Prof Chua Kim Chai, Consultant, Department of Cardiothoracic Surgery

SINGAPORE LIVE 2021 GOING 'LIVE' ONLINE

Asia's pre-eminent annual live course in cardiac interventions, Singapore LIVE (Live Interventions in in Vascular Endotherapy), held its first-ever virtual meeting on 22-23 January 2021.

2021 marks the third decade of the SingLIVE Course, a monumental milestone since its humble beginning in 1989. This year also marks the course's first-ever virtual meeting, in light of the challenging COVID-19 pandemic.

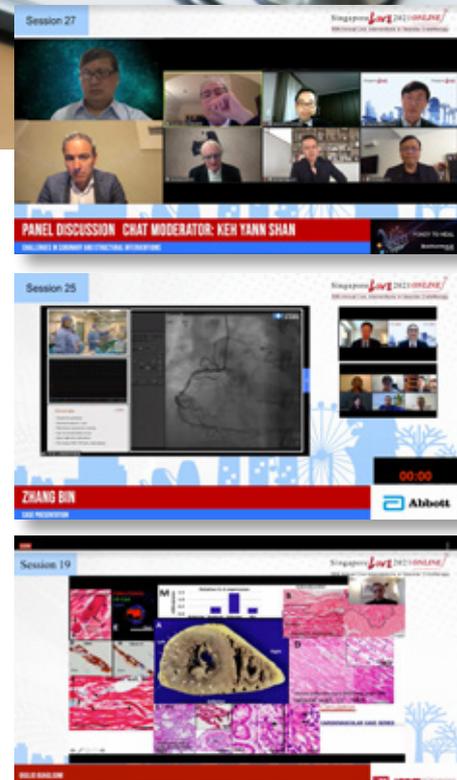
Attended by over 1,500 regional delegates from over 44 countries, the virtual meeting was held over two days, with over 30 hours of live programmes in 30 sessions, including nine live cases from overseas transmission centres as well as NHCS. The higher than expected turnout was a remarkable example of how the pandemic gave new impetus to innovative and novel ways of learning in a safe environment.

Transcending Borders, Empowering Learning

Singapore LIVE 2021 ONLINE continued to deliver concise and enhanced programme unique to the Asian population. Participants acquired new skills and techniques through live case transmissions from four major international Percutaneous Coronary Intervention (PCI) centres, namely, Centre Hospitalier Universitaire Vaudois, Switzerland; Medanta Hospital and Fortis Escorts Hospital, India; Guangdong Provincial People's Hospital, China, and National Heart Centre Singapore.

The global COVID-19 healthcare crisis has irrevocably changed the way healthcare professionals practice, and given rise to unique cases and learning opportunities in heart care. Unique cases from Asia-Pacific and Europe were shared by various experts to demonstrate the treatment of ST-segment elevation myocardial infarction (STEMI) patients who were now presenting differently during the pandemic.

Another key highlight of SingLIVE, the Training Village, also brought a totally new learning experience to participants with a procedure performed in a 'beating heart' simulation model; providing both the realism of an actual procedure, and the ability to visualise the actual mechanics involved in the complex procedure.



Screen captures of the comprehensive webinar sessions including live cases, from overseas and NHCS, symposiums and the Training Village featuring a beating heart model used in a simulated learning session

Singapore LIVE 2022
31st Annual Live Interventions in Vascular Endotherapy
20 - 22 January 2022

What's next: The 31st Edition

The next SingLIVE will be happening on 20-22 January 2022 to continue to bring expertise on coronary interventions and structural heart interventions in the pursuit of improved skills and knowledge to provide better cardiac care to patients.

Stay tuned for more information on SingLIVE 2022 (www.singlivecourse.com)!



RESEARCH PUBLICATIONS

August 2020 – December 2020

AUGUST 2020

Bioresorbable metals in cardiovascular stents: material insights and progress *Materialia* Volume 12, August 2020, 100727 <https://doi.org/10.1016/j.mta.2020.100727>

Effects of Combined Renin-Angiotensin-Aldosterone System Inhibitor and Beta-Blocker Treatment on Outcomes in Heart Failure With Reduced Ejection Fraction: Insights From BIOSTAT-CHF and ASIAN-HF Registries *Eur J Heart Fail.* 2020 Aug;22(8):1472-1482. doi: 10.1002/ehf.1869.

Quantification of Effects of Mean Blood Pressure and Left Ventricular Mass on Noninvasive Fast Fractional Flow Reserve *Am J Physiol Heart Circ Physiol.* 2020 Jul 17. doi: 10.1152/ajpheart.00135.2020.

Implications of serial measurements of natriuretic peptides in heart failure: insights from BIOSTAT-CHF *Eur J Heart Fail.* 2020 Aug;22(8):1486-1490. doi: 10.1002/ehf.1951.

Genetic and functional insights into the fractal structure of the heart *Nature.* 2020 Aug;584(7822):589-594. doi: 10.1038/s41586-020-2635-8.

Mechanical Stimuli for Left Ventricular Growth During Pressure Overload *Experimental Mechanics.* <https://link.springer.com/article/10.1007/s11340-020-00643-z>

SEPTEMBER 2020

Evaluation of high-sensitivity C-reactive protein and uric acid in vericigat-treated patients with heart failure with reduced ejection fraction *Eur J Heart Fail.* 2020 Sep;22(9):1675-1683. doi: 10.1002/ehf.1787.

Therapeutic approaches in heart failure with preserved ejection fraction: past, present, and future *Clin Res Cardiol.* 2020 Sep;109(9):1079-1098. doi: 10.1007/s00392-020-01633-w.

Life beyond Heart Failure- what are the long-term challenges, supportive care needs and views towards supportive care of multi-ethnic Asian patients with left ventricular assist device (LVAD) and their caregivers? *J Pain Symptom Manage.* 2020 Sep;60(3):577-587.e1. doi: 10.1016/j.jpainsymman.2020.03.022.

Heart failure with preserved ejection fraction diagnostic scores in an Asian population *Eur J Heart Fail.* 2020 Sep;22(9):1737-1739. doi: 10.1002/ehf.1851.

Two-year Outcomes Post-Discharge in Asian Patients With Acute Coronary Syndrome: Findings From the EPICOR Asia Study *Int J Cardiol.* 2020 Sep 15;315:1-8. doi: 10.1016/j.ijcard.2020.05.022.

Non-obstructive High-Risk Plaques Increase the Risk of Future Culprit Lesions Comparable to Obstructive Plaques Without High-Risk Features: The ICONIC Study *Eur Heart J Cardiovasc Imaging.* 2020 Sep 1;21(9):973-980. doi: 10.1093/ehjci/jeaa048.

Ethnic Differences in Quality of Life and Its Association With Survival in Patients With Heart Failure *Clin Cardiol.* 2020 Sep;43(9):976-985. doi: 10.1002/clc.23394.

Risk of Bias in Studies Investigating Novel Diagnostic Biomarkers for Heart Failure With Preserved Ejection Fraction. A Systematic Review *Eur J Heart Fail.* 2020 Sep;22(9):1586-1597. doi: 10.1002/ehf.1944.

Long-term Antithrombotic Management Patterns in Asian Patients With Acute Coronary Syndrome: 2-year Observations From the EPICOR Asia Study *Clin Cardiol.* 2020 Sep;43(9):999-1008. doi: 10.1002/clc.23400.

Fibroblast – specific IL11 signaling drives chronic inflammation in murine fibrotic lung disease *FASEB J.* 2020 Sep;34(9):11802-11815. doi: 10.1096/fj.202001045RR.

Statin intolerance: an updated, narrative review mainly focusing on muscle adverse effects *Expert Opin Drug Metab Toxicol.* 2020 Sep;16(9):837-851. doi: 10.1080/17425255.2020.1802426.

Mycobacterium chimaera in a post thaw pulmonary valve homograft as a result of contaminated heater cooler unit in use during the implant surgery *Ann Pediatr Cardiol.* Jul-Sep 2020;13(3):277-278. doi: 10.4103/apc.APC_72_20.

Associations between cardiac function and retinal microvascular geometry among Chinese adults *Sci Rep.* 2020 Sep 9;10(1):14797. doi: 10.1038/s41598-020-71385-0

Treatment to reduce vascular calcification in hemodialysis patients using vitamin K (Trevasc-HDK): A study protocol for a randomized controlled trial *Medicine (Baltimore).* 2020 Sep 4;99(36):e21906. doi: 10.1097/MD.00000000000021906.

Beta-blockers and renin-angiotensin system inhibitors in acute myocardial infarction managed with inhospital coronary revascularization *Sci Rep.* 2020 Sep 16;10(1):15184. doi: 10.1038/s41598-020-72232-y

Left Ventricular Blood Flow Kinetic Energy Assessment by 4D Flow Cardiovascular Magnetic Resonance: A Systematic Review of the Clinical Relevance *J Cardiovasc Dev Dis.* 2020 Sep 10;7(3):E37. doi: 10.3390/jcdd7030037

Comparing a novel machine learning method to the Friedewald formula and Martin-Hopkins equation for low-density lipoprotein estimation *PLoS One.* 2020 Sep 30;15(9):e0239934. doi: 10.1371/journal.pone.0239934.

OCTOBER 2020

How to Measure the Aorta Using MRI: A Practical Guide *J Magn Reson Imaging.* 2020 Oct;52(4):971-977. doi: 10.1002/jmri.27183.

Calibration of a Physical Functioning Item Bank for Measurement of Health-Related Quality of Life in Singapore *Qual Life Res.* 2020 Oct;29(10):2823-2833. doi: 10.1007/s1136-020-02535-0.

Double-Kissing Culotte Technique for Coronary Bifurcation Stenting *EuroIntervention.* 2020 Oct 9;16(9):e724-e733. doi: 10.4244/EIJ-D-20-00130.

Different roles of interleukin 6 and interleukin 11 in the liver: implications for therapy *Hum Vaccin Immunother.* 2020 Oct 2;16(10):2357-2362. doi: 10.1080/21645515.2020.1761203.

Extracellular vesicle Cystatin C and CD14 are associated with both renal dysfunction and heart failure *ESC Heart Fail.* 2020 Oct;7(5):2240-2249. doi: 10.1002/ehf2.12699.

A Boosted Ensemble Algorithm for Determination of Plaque Stability in High-Risk Patients on Coronary CTA *JACC Cardiovasc Imaging.* 2020 Oct;13(10):2162-2173. doi: 10.1016/j.jcmg.2020.03.025.

Genetic Studies of Hypertrophic Cardiomyopathy in Singaporeans Identify Variants in TNNI3 and TNNT2 that Are Common in Chinese Patients *Circ Genom Precis Med.* 2020 Oct;13(5):424-434. doi: 10.1161/CIRGEN.119.002823.

Incremental value of left ventricular global longitudinal strain in a newly proposed staging classification based on cardiac damage in patients with severe aortic stenosis *Eur Heart J Cardiovasc Imaging.* 2020 Oct 20;21(11):1248-1258. doi: 10.1093/ehjci/jeaa220.

Patient-reported outcomes in heart failure with preserved vs. reduced ejection fraction: focus on physical independence *ESC Heart Fail.* 2020 Oct;7(5):2051-2062. doi: 10.1002/ehf2.12950.

Comparative prospective study of the performance of chest pain scores and clinical assessment in an emergency department cohort in Singapore *J Am Coll Emerg Physicians Open.* 2020 Sep 5;1(5):723-729. doi: 10.1002/emp2.12242.

Prdm16 Deficiency Leads to Age-Dependent Cardiac Hypertrophy, Adverse Remodeling, Mitochondrial Dysfunction, and Heart Failure *Cell Rep.* 2020 Oct 20;33(3):108288. doi: 10.1016/j.celrep.2020.108288.

Interleukin-11 is important for vascular smooth muscle phenotypic switching and aortic inflammation, fibrosis and remodeling in mouse models *Sci Rep.* 2020 Oct 20;10(1):17853. doi: 10.1038/s41598-020-74944-7.

Effect of Vericigat vs Placebo on Quality of Life in Patients With Heart Failure and Preserved Ejection Fraction: The VITALITY-HFPEF Randomized Clinical Trial *JAMA.* 2020 Oct 20;324(15):1512-1521. doi: 10.1001/jama.2020.15922.

Electrocardiography findings in right ventricular apical pacing *Singapore Med J* 2020; 61(10): 517-522 <https://doi.org/10.11662/smedj.2020148>

Accurate detection of myocardial infarction using non linear features with ECG signals *J Ambient Intell Human Comput (2020).* <https://doi.org/10.1007/s12652-020-02536-4>.

NOVEMBER 2020

Long-Term Adherence to Renin-Angiotensin System Inhibitors and β -Blockers After Heart Failure Hospitalization in Senior Patients *J Cardiovasc Pharmacol Ther.* 2020 Nov;25(6):531-540. doi: 10.1177/1074248420931617.

Classification of Heart Sound Signals Using a Novel Deep WaveNet Model *Comput Methods Programs Biomed.* 2020 Nov;196:105604. doi: 10.1016/j.cmpb.2020.105604.

The Effects of Combination Canagliflozin and Glucagon-Like peptide-1 Receptor Agonist Therapy on Intermediate Markers of Cardiovascular Risk in the CANVAS Program *Int J Cardiol.* 2020 Nov 1;318:126-129. doi: 10.1016/j.ijcard.2020.06.011.

Association of Coronary Microvascular Dysfunction with Heart Failure Hospitalizations and Mortality in Heart Failure with Preserved Ejection Fraction - a follow-up in the PROMIS-HFPEF study *J Card Fail.* 2020 Nov;2+6(11):1016-1021. doi: 10.1016/j.cardfail.2020.08.010.

Generating wall shear stress for coronary artery in real-time using neural networks: Feasibility and initial results based on idealized models *Comput Biol Med.* 2020 Oct 7;126:104038. doi: 10.1016/j.combiomed.2020.104038.

N-Terminal Pro-B-Type Natriuretic Peptide and Clinical Outcomes: Vericigat Heart Failure With Reduced Ejection Fraction Study *JACC Heart Fail.* 2020 Nov;8(11):931-939. doi: 10.1016/j.jchf.2020.08.008.

Verifying Death Reports in the Platelet Inhibition and Patient Outcomes (PLATO) Trial *Am J Ther.* Nov/Dec 2020;27(6):e563-e572. doi: 10.1097/MJT.0000000000001286.

Diastolic function and its association with diabetes, hypertension and age in an outpatient population with normal stress echocardiography findings *Cardiovasc Ultrasound.* 2020 Nov 20;18(1):46. doi: 10.1186/s12947-020-00228-9.

Long-term prognosis in patients with end-stage renal disease after coronary artery bypass grafting *J Thorac Dis.* 2020 Nov;12(11):6722-6730. doi: 10.21037/jtd-20-2046.

Comparison of overexpansion capabilities and thrombogenicity at the side branch ostia after implantation of four different drug eluting stents *Sci Rep.* 2020 Nov 27;10(1):20791. doi: 10.1038/s41598-020-75836-6.

Nuclear imaging and artificial intelligence *Machine Learning in Cardiovascular Medicine.* Academic Press, 20 Nov 2020 - Medical - 454 pages

Meta-analysis of echocardiographic quantification of left ventricular filling pressure *ESC Heart Failure (2020).* DOI: 10.1002/ehf2.13119

DECEMBER 2020

Advances in CrossBoss/Stingray use in antegrade dissection reentry from the Asia Pacific Chronic Total Occlusion Club *Catheter Cardiovasc Interv.* 2020 Dec;96(7):1423-1433. doi: 10.1002/ccd.28607.

A randomized controlled trial on the effectiveness of a portable patient education video prior to coronary angiography and angioplasty *Catheter Cardiovasc Interv.* 2020 Dec;96(7):1409-1414. doi: 10.1002/ccd.28655.

Assessment of quality indicators for acute myocardial infarction management in 28 countries and use of composite quality indicators for benchmarking *Eur Heart J Acute Cardiovasc Care.* 2020 Dec;9(8):911-922. doi: 10.1177/2048872620911853.

The effect of forskolin on membrane clock and calcium clock in the hypoxic/reoxygenation of sinoatrial node cells and its mechanism *Pharmacol Rep.* 2020 Dec;72(6):1706-1716. doi: 10.1007/s43440-020-00094-2.

Feasibility and validation of trans-valvular flow derived by four-dimensional flow cardiac magnetic resonance imaging in pacemaker recipients *Magn Reson Imaging.* 2020 Dec;74:46-55. doi: 10.1016/j.mri.2020.08.024.

Cardiac and renal biomarkers in recreational runners following a 21 km treadmill run *Clin Cardiol.* 2020 Dec;43(12):1443-1449. doi: 10.1002/clc.23459.

Accurate deep neural network model to detect cardiac arrhythmia on more than 10,000 individual subject ECG records *Comput Methods Programs Biomed.* 2020 Dec;197:105740. doi: 10.1016/j.cmpb.2020.105740.

Ferric carboxymaltose for iron deficiency at discharge after acute heart failure: a multicentre, double-blind, randomised, controlled trial *Lancet.* 2020 Dec 12;396(10266):1895-1904. doi: 10.1016/S0140-6736(20)32339-4.

Catheter ablation for atrial fibrillation in a low-volume center using contemporary technology *Int J Cardiol Heart Vasc.* 2020 Oct 23;31:100661. doi: 10.1016/j.ijchc.2020.100661.

YAP/TAZ deficiency reprograms cardiophage phenotype and improves infarct healing and cardiac function after myocardial infarction *PLoS Biol.* 2020 Dec 2;18(12):e3000941. doi: 10.1371/journal.pbio.3000941.

Multi-modal AsynDGAN: Learn From Distributed Medical Image Data without Sharing Private Information *IEEE Transactions on Pattern Analysis and Machine Intelligence.* DOI: arxiv-2012.08604

JOIN US ONLINE VIA ZOOM!

Register by scanning the QR code below.



Practical Tips and Tricks for Managing Heart Failure in the Community (For General Practitioners)

Date: 21 May 2021, Friday
Time: 1pm – 2pm

Heart failure is a prevalent condition which affects around 4.5% of our local Singapore population. Join us as we share the practical approach to holistically manage heart failure patients in the community.



What to do when you have a heart attack? (For Public)

Date: 22 May 2021, Saturday
Time: 11am – 12pm

How would you know if you are having a heart attack? What happens when a patient with heart attack is brought to the hospital? Can you continue to exercise and what is the “new norm” after a heart attack? Join us and have your questions answered!



Looking Through the Thick and the Thin; A Primer to Cardiomyopathies (Hypertrophic, Dilated and TTR Amyloid Cardiomyopathy) (For General Practitioners)

Date: 26 June 2021, Saturday
Time: 1pm – 2pm

Cardiomyopathy is a disease of the heart muscle, which is primarily caused by hereditary factors. Join us as we share an in-depth session - the presentation, diagnosis and treatment strategies, on three cardiomyopathies.



APPOINTMENTS & PROMOTIONS

With Duke-NUS Medical School



Assoc Prof Yap Jiunn Liang Jonathan
Clinical Associate Professor



Asst Prof Ho Jien Sze
Clinical Assistant Professor



Asst Prof Nakao Masakazu
Clinical Assistant Professor



Asst Prof Chua Kim Chai
Clinical Assistant Professor



Asst Prof Khoo Chun Yuan
Clinical Assistant Professor



Asst Prof Ng Choon Ta
Clinical Assistant Professor



Asst Prof Foo Jie Sheng
Clinical Assistant Professor



Asst Prof Lee Phong Teck
Clinical Assistant Professor

ADVISORS

Prof Terrance Chua
Prof Koh Tian Hai

MEDICAL EDITOR

Asst Prof Calvin Chin

EDITORIAL TEAM

NHCS Corporate Communications

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

All rights reserved. No part of this publication is to be quoted or reproduced without the permission of National Heart Centre Singapore (Registration no. 199801148C). The information in this publication is meant for educational purposes and should not be used as a substitute for medical diagnosis or treatment. Please consult your doctor before starting any treatment or if you have any questions related to your health or medical condition.



**Keen to receive
NHCS news online?
Sign up now!**