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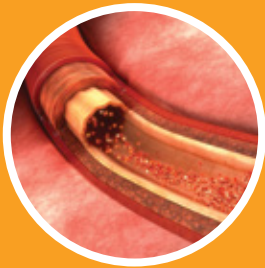
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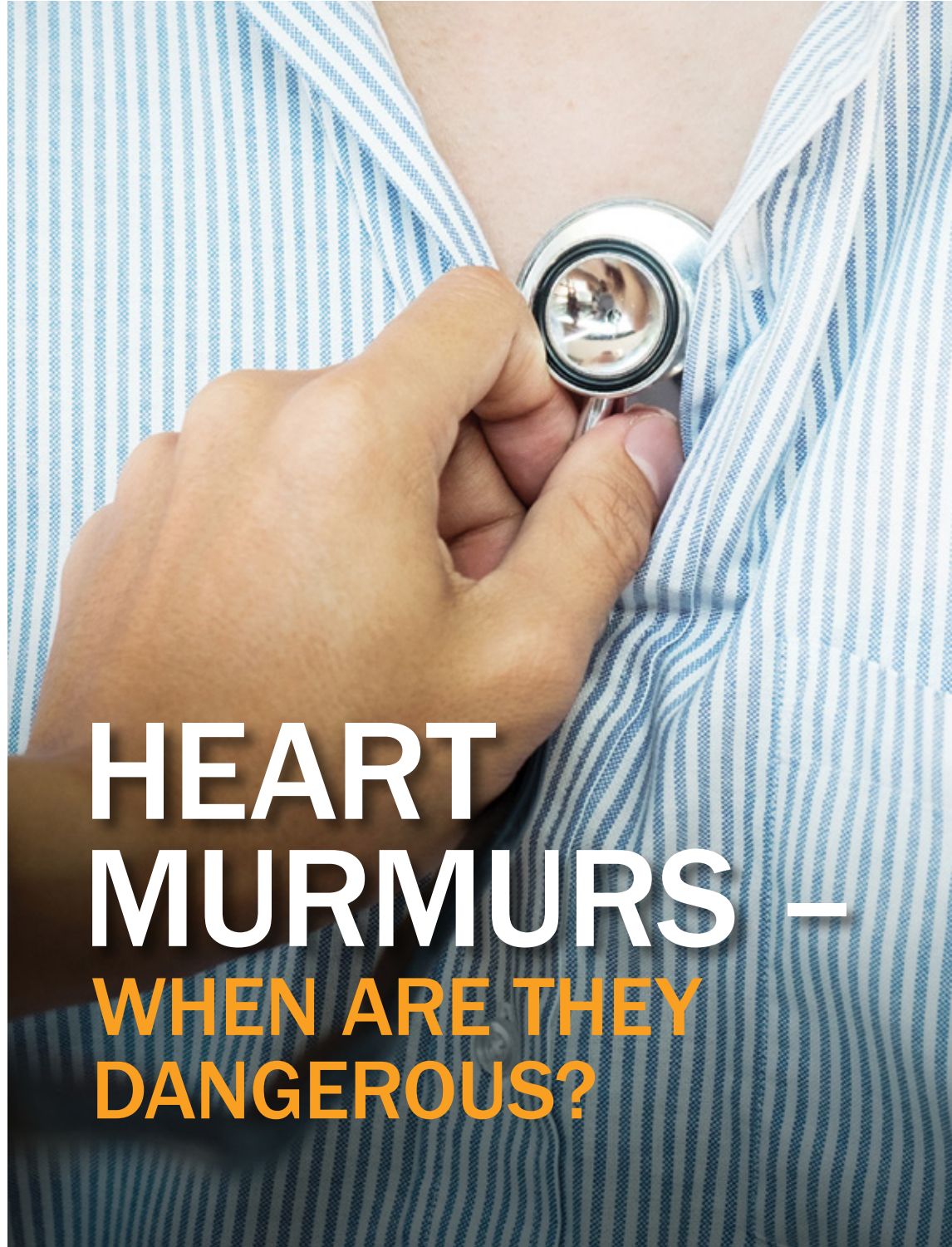
A TEAR IN MY AORTA
CHANGED MY LIFE



ADVANCES IN
HEART FAILURE



ADVANCING
CARDIOVASCULAR
SCIENCE



HEART MURMURS – WHEN ARE THEY DANGEROUS?

HEART MURMURS – WHEN ARE THEY DANGEROUS?

By Dr Cai Xinzhe James, Associate Consultant, Department of Cardiology

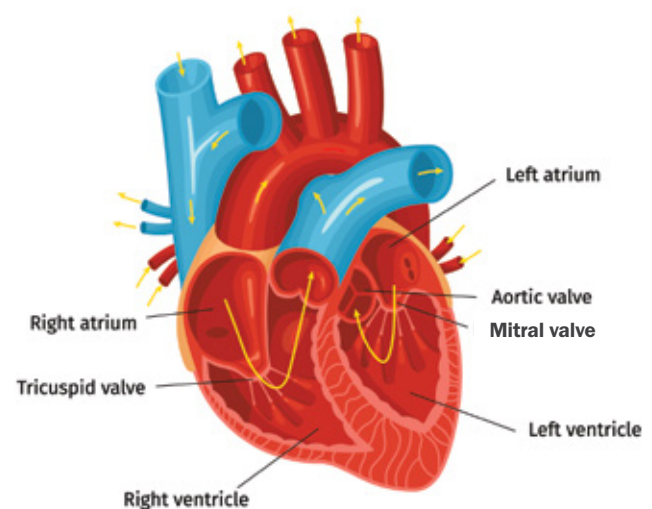
Murmurs are abnormal sounds that are heard on physical examination of the heart. While heart murmurs are often harmless, some cases may indicate underlying heart conditions that need medical attention.

A heart murmur is a term that is used by many but perhaps not very well understood. While most heart murmurs are innocent and pose no significant health risks, there are situations where heart murmurs may be considered potentially dangerous. Understanding the nature of heart murmurs and knowing when they are abnormal can help in timely diagnosis and appropriate treatment.

What causes heart murmurs?

The human heart is a remarkable organ responsible for pumping oxygen-rich blood throughout the body, ensuring the proper functioning of various vital organs. In a healthy heart, blood flows smoothly and silently in the heart through the chambers, valves and blood vessels, with the usual heart sounds made by the usual closure of the heart valves. However, sometimes heart murmurs can occur. In medicine, a murmur is used to describe a physical finding of additional heart sounds caused by turbulent blood flow in the heart. It can come in various pitches and durations - low pitch, high

pitch, continuous or short in duration. The vast majority of murmurs are due to diseases of the heart valves – either narrow (stenotic) or leaky (regurgitant) heart valves, or other structural heart conditions. In the case of healthy heart valves, our heart has four valves that ensure the one-way flow of blood through the chambers. When these valves are damaged or do not function properly, it can lead to turbulence in the blood flow, resulting in additional rumbling sounds being created, therefore causing the “murmur”.



Normal blood flow in a healthy heart – one-way flow of blood through the chambers.

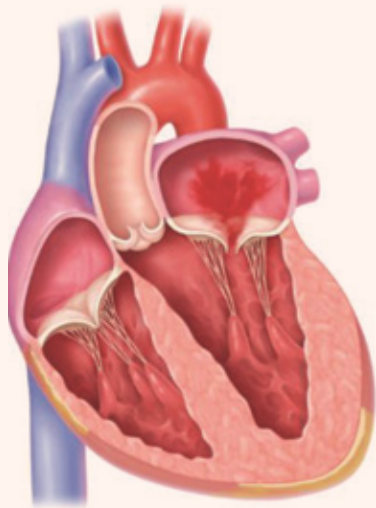
How are murmurs picked up?

Murmurs can be generally picked up through physical examination of the chest with a stethoscope. Depending on the location, pitch, as well as duration of the murmur, different diagnoses can be considered. Further referral for a transthoracic echocardiogram by the cardiologist may be required. Transthoracic echocardiogram is an ultrasound of the heart, used to evaluate the heart for structural problems. An echocardiogram will be able to assess the valves of the heart with Doppler signals (sound waves showing blood moving through the blood vessels) to detect any narrow or leaky heart valves.

What are some complications of murmurs?

Common valvular heart diseases that cause murmurs include mitral regurgitation and aortic stenosis.

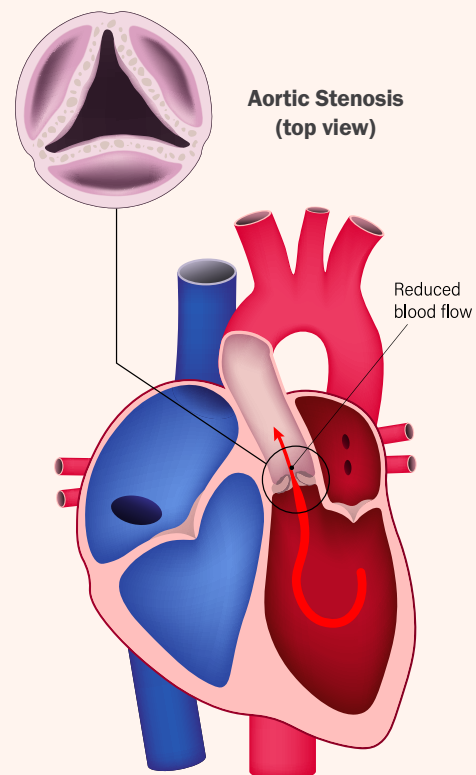
Mitral regurgitation is a common cause of murmurs in patients and is a condition where the mitral valve is leaky and resulting in blood flowing backwards from the left ventricle to left atrium. It can cause breathlessness if the amount of leakiness of the mitral is severe, however, it is common for patients to be asymptomatic without the need for any treatment. For those who are symptomatic, the treatment options available include open-heart surgery to repair or replace the heart valve (Mitral Valve Repair or Replacement), or in special circumstances, minimally invasive procedures such as Transcatheter Edge-to-Edge Repair to treat leakage of the mitral valve.



Mitral regurgitation is a condition where the mitral valve becomes leaky and blood flows backward into the left atrium.

Illustration courtesy of Abbott Structural Heart.

Aortic stenosis is another common cause of murmurs in the elderly, which is commonly caused by the degeneration of the aortic valve. In such a condition, the aortic valve is narrow and makes it difficult for blood to pass through. Just like mitral regurgitation, aortic stenosis can cause patients to become breathless, have chest pain or faint. When symptoms developed due to severe narrowing of the aortic valve, treatment interventions can be performed. These include aortic valve surgery to replace the valve (Aortic Valve Replacement), and minimally invasive procedures (key-hole techniques) such as Transcatheter Aortic Valve Replacement to replace a narrowed aortic valve that fails to open properly.



Aortic stenosis is a condition where the aortic valve becomes narrow and blood flow is disrupted.

However, not all murmurs are due to disease. There are some murmurs that can be due to benign conditions such as in young individuals with a dynamic circulation where blood flow is fast and causes a murmur even if the heart valves are normal. This also occurs commonly in pregnant ladies who tend to have a higher amount of blood flow during pregnancy. In some patients, a murmur can be due to congenital heart conditions such as holes in the heart or other abnormal cardiac conditions.

There are many possible causes of heart murmurs. Murmurs that are particularly loud or intense may indicate a significant underlying problem. A murmur that persists beyond childhood or undergoes a change in intensity or pitch may also suggest an underlying heart abnormality or disease. If a heart murmur is accompanied by symptoms of chest pain, shortness of breath, fatigue, dizziness, fainting, or swelling in the legs, these can be warning signs of a more serious heart condition and there is a need for immediate medical attention. Do always seek the opinion of a trusted doctor for a proper diagnosis and treatment.

A TEAR IN MY AORTA CHANGED MY LIFE

At just 32 years old, Tianfu had a tear in his aorta, a dangerous condition known as Type A Aortic Dissection. Aorta is the largest artery in the human body. While he underwent an emergency, high-risk surgery to repair his aorta, he was told that there was a high risk of a stroke and/or loss of his left leg.

“Remember that Tuesday all too well. Tianfu was taking a long time to prepare dinner so I went to check on him. I found him breathless and terribly pale. Immediately, his brother and I rushed him to the hospital,” shared Tianfu’s partner, Jean. At just 32 years old, Tianfu had a tear in his aorta, a dangerous condition known as Type A Aortic Dissection. Aorta is the largest artery in the human body. While he underwent an emergency, high-risk surgery to repair his aorta, he was told that there was a high risk of a stroke and/or loss of his left leg.

A whirlwind of events

For almost a decade, Mr Heng Tianfu was an auxiliary police officer. He led an active lifestyle outside of work such as playing soccer with his friends. He and his partner, Ms Jean Sam, enjoyed exploring new restaurants and cafes together, one of their favourite pastimes. Even though they only knew each other for a few months, talks of marriage was already on the cards. Little did they know that their situation would change overnight.

Even though his aorta was repaired, Tianfu suffered a massive stroke after the operation. The aortic dissection had caused insufficient blood supply to his lower left leg, and resulted in increased pressure and swelling of muscle. Tianfu had to also undergo a procedure to relieve these symptoms. After the surgery, he was also having difficulties to breathe on his own despite using the breathing tube, hence the doctors had to perform a tracheostomy (an opening at the



Singapore Health Inspirational Patient & Caregiver Award recipients, Mr Heng Tianfu (left) with his partner, Ms Jean Sam (right).

What is an aortic dissection?



An aortic dissection occurs when an injury or tear occurs to the innermost layer of the aorta, causing blood to flow between the layers of aortic wall and forcing the layers apart.

With an aortic dissection, there is reduced or no blood supply to the vital organs at times, leading to a heart attack, stroke or even death. An open-heart surgery is required to repair the tear in the aorta.

The symptoms of acute aortic dissection include sudden or severe chest or back pain. Other symptoms may also occur as a result of reduced blood flow to various parts of the body, or due to the pressure exerted on vital organs by an enlarging blood clot, such as:

- Shortness of breath
- Fainting or dizziness
- Excessive sweating, pale and clammy skin
- Rapid or weak pulse
- Difficulty speaking, weakness on one side of the body and blurred vision (similar to stroke symptoms)

neck with a tube inserted) to help him to breathe. It was a chain of blows to Tianfu.

Dr Naik Madhava Janardhan, Senior Consultant, Department of Cardiothoracic Surgery explained, “In an aortic dissection, blood flows through the aorta as well as into a false passage caused by the tear. This results in some parts of the body not getting the blood supply required. In Tianfu’s case, blood supply to his left leg was affected. To repair his aorta, his heart was stopped during the operation, and a heart and lung machine took over the function of his heart. During this process, blood is re-routed to the machine before it goes to the body. Although the operation restored the blood supply to the body, there was already damage to his leg muscles and sensitive brain tissues.”

Tianfu’s condition worsened when he developed a wound infection in his leg. To stop the infection from spreading and endangering his life, he had to undergo an above-knee amputation.

“When I woke up, I was devastated at the sight of the space where my leg used to be,” said Tianfu.

The road to recovery

Tianfu was emotional from the drastic changes in his life. Not only was he suddenly dependent on others to care for him, being on a tracheostomy also meant he could not even speak, let alone have his favourite food and drinks. He became despondent.

Jean proved to be the beacon of light that led Tianfu out of his darkest hours. Even with a full-time job, she made arrangements to be by his side and requested for caregiving guidance from the nurses. Her commitment and infectious positivity moved Tianfu, and slowly, he weaned off the tracheostomy and became motivated to get better. Everyone cheered, including the nurses who cared for him.

Tianfu shared, “After my discharge, Jean moved in with me to be my main caregiver. Although I can feed myself independently, I need

help in basic activities of daily living. I am thankful I can count on Jean and my mum for support.”

Control of risk factors and lifestyle modification paramount

Prior to his health episode, Tianfu had been complaining of giddiness, headaches, and aching shoulders on and off – signs of high blood pressure. He attributed these symptoms to his job which required long hours of being outdoors, and not getting enough rest.

“He (Tianfu) was rarely sick so when he caught a flu and had a headache a few days before the incident, he just took a Panadol, and we still went ahead for a movie. A few days before the incident happened, Tianfu felt nauseated and vomited. However, the symptoms that he experienced on that fateful day – shortness of breath, profuse sweating, backache, and numbness of leg – all of these were new to us,” Jean recounted. She added that when they arrived at the hospital, Tianfu’s blood pressure was very high and required morphine to control his pain.

After surgery, control of risk factors such as blood pressure, blood sugar and cholesterol levels are crucial in aiding recovery. Additionally, Dr Naik recommends lifestyle modifications such as eating a more heart healthy diet, reducing stress and stopping smoking, all of which go a long way in lowering the risk in getting a recurrent episode or cardiovascular disease in general.

Since his discharge, Tianfu has cut down on oily and fried food, and started having more home-cooked meals. Jean shared that he now sleeps earlier and no longer smoke as well. These healthier habits help to keep his blood pressure in check. Tianfu has also been referred to the rehabilitation team near his home for follow-up therapy with hopes of getting a prosthetic leg in the near future.

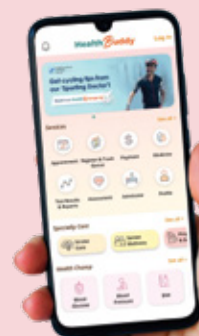
He said hopefully, “I want to get stronger, sit up for a longer time and walk. I would love to travel again, marry Jean and have children of our own. She means the world to me.”

Mr Heng Tianfu and his partner, Ms Jean Sam, are winners of the Singapore Health Inspirational Patient and Caregiver Awards 2023 – Patient, and Caregiver Category respectively.

NHCS currently sees about 40 patients with aortic dissection annually. While this is a rare condition, the numbers are on the rise, indicating a need to further monitor one’s risk factors such as blood pressure, blood sugar and cholesterol levels.



Check out the heart disease risk calculator on Health Buddy to help manage your heart health.



When a serious heart episode such as aortic dissection happens in a younger person, Dr Naik cautioned that it may also be due to rare health conditions such as Marfan Syndrome, Ehlers Danlos Syndrome and certain Rheumatoid conditions such as Ankylosing Spondylitis.



FOR THE PHYSICIANS

ADVANCES IN HEART FAILURE

By Asst Prof Iswara Devi Balakrishnan, Consultant, Department of Cardiology

Heat failure (HF) is a prevalent and chronic condition that affects millions of people worldwide. Thanks to medical advancements, significant progress has been made in understanding, diagnosing, and treating this complex condition. In this article, we will explore the diagnosis, updated classification, various aetiologies of HF, and the latest treatment options that are transforming the landscape of HF management.

HF in the Asian context

Compared to the rest of the world, prevalence of HF is higher in Singapore (4-5% vs 1-2% respectively)¹.

Registry data of Asians with HF revealed two phenotypes unique to Southeast Asia, particularly in Singapore and Malaysia – the ‘lean diabetic’ group and the ‘metabolic’ group². Patients with HF in the ‘lean diabetic’ group were characterised by high rates of diabetes despite a lower prevalence of obesity and had the worst clinical outcomes. Those in the ‘metabolic’ group were obese with higher rates of hypertension and diabetes. These distinct features seen in Asian patients underscore the impact of multi-morbidities and cardiometabolic dysregulation on HF, extending beyond left ventricular ejection fraction (LVEF: the percentage of blood pumped out of the left ventricle of the heart with each heartbeat). This highlights the significant influence of sedentary lifestyles, obesity, and inadequate management of risk factors like diabetes, hypertension, dyslipidaemia (imbalance of lipids), and tobacco smoking in HF genesis.

Another study examining Asian patients who were hospitalised for HF revealed notable disparities when compared to Western cohorts. Asian patients were relatively younger, presented with more severe clinical symptoms, had longer hospital stays, and a higher mortality rate³. These findings highlighted the need to address unique challenges in managing HF in the Asian cohort, through tailored interventions to improve outcomes.

What is HF?

HF is a clinical syndrome that occurs when the heart is not able to pump as effectively as it should. Common signs and symptoms of HF include breathlessness, swelling of the feet and abdomen, fatigue and reduced effort tolerance. It is important to understand that the

severity and manifestation of these symptoms can differ among individuals.

The most recent guidelines have established two primary classifications for HF that have overlapping components⁴.

Classification of HF by Stages

The first classification is based on the clinical stages of HF (Stage A-D). This classification recognises HF as a clinical syndrome that exists on a spectrum (figure 1).

Classification of HF by LVEF

The second classification is based solely on LVEF (figure 2). This classification aims to guide the implementation of guideline-directed medical therapy (GDMT) since large clinical trials were primarily designed around LVEF criteria and carries prognostic significance. It is important to note that patients with normal LVEF can also experience symptoms of HF. This reaffirms the fact that HF is not exclusively based on LVEF alone.

Causes

HF is the eventual and downstream consequence that arises from different types of heart disease. One of the main causes of heart disease is coronary artery disease, which involves the buildup of atherosclerotic plaques leading to heart attacks. This often leads to heart failure with reduced ejection fraction (HFrEF). Inadequately managed risk factors such as hypertension, diabetes, dyslipidaemia, and unhealthy lifestyle choices including tobacco smoking, sedentary behaviour, and unhealthy diet contribute to accelerated atherosclerosis (plaque buildup), can increase the risks of heart attacks and HF.

Even without experiencing heart attacks, traditional risk factors like uncontrolled hypertension, diabetes, and obesity can contribute to the development of HF. This occurs due to cardiometabolic dysregulation, where these risk factors disrupt the normal functioning of the heart. It typically results in heart failure with preserved ejection fraction (HFpEF), a condition predominantly seen in those aged 65 years and above⁵.

Other less common causes of HF include valvular heart disease, arrhythmias (irregular heartbeat), cardiotoxicity mediated by

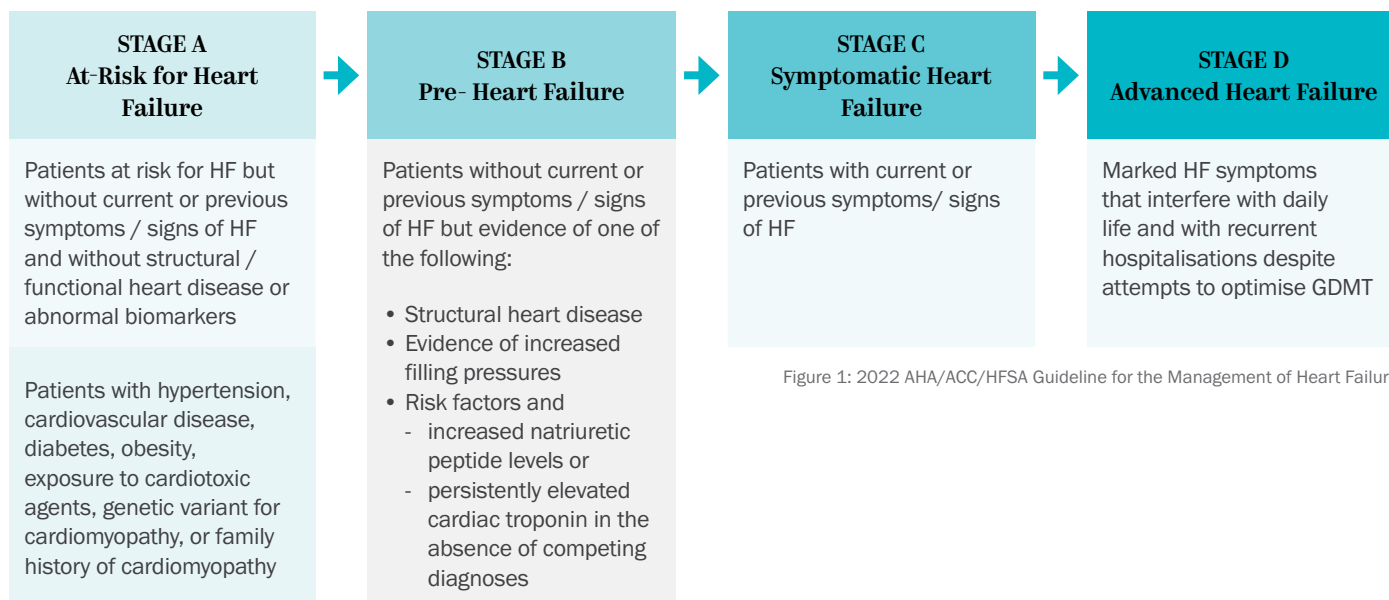


Figure 1: 2022 AHA/ACC/HFSA Guideline for the Management of Heart Failure

cancer therapeutics or substance abuse (e.g. alcohol), myocarditis (inflammation of the heart muscles), genetic cardiomyopathy (heart muscle disease), stress-induced cardiomyopathy, peripartum cardiomyopathy and infiltrative heart disease (e.g. amyloidosis, sarcoidosis)⁴. Ascertaining the specific aetiology of HF requires a thorough evaluation.

Classification	LVEF
Heart Failure with reduced ejection fraction (HFrEF)	40%
Heart Failure with mildly reduced ejection fraction (HFmrEF)	41-49%
Heart Failure with preserved ejection fraction (HFpEF)	50%

Figure 2: Adapted from 2022 AHA/ACC/HFSA Guideline for the Management of Heart Failure

Diagnosis

HF often co-exists with other medical conditions and cannot be diagnosed with a single test. To diagnose HF, a thorough process is followed. This involves gathering a detailed medical and family history, conducting a physical examination, performing blood tests, and depending on the specific clinical situation, cardiac imaging (e.g. echocardiography, cardiac magnetic resonance imaging) and coronary artery assessment (e.g. coronary angiogram). After a comprehensive evaluation, a diagnosis of HF and its aetiology can be established. With this in hand, a treatment plan can be tailored to address the individual's condition effectively.

How to Manage HF?

Management options for HF include risk factor and lifestyle modification, guideline-directed medical therapy (GDMT), and in some cases device therapy, ventricular assist device (VAD) and/or heart transplant.

Risk Factor Screening and Lifestyle Modification

The serious implications of cardiovascular risk factors in the genesis of HF have been previously discussed. Regular age-appropriate screening is crucial to identify these risk factors, as they are often

unrecognised. Early detection through screening enables timely intervention and treatment, reducing the incidence of HF. In addition, a heart-healthy lifestyle through dietary improvements, regular exercise and stress management is key in preventing HF decompensations.

Guideline-Directed Medical Therapy (GDMT)

GDMT for HF is primarily based on LVEF, with specific treatments tailored to the underlying cause.

The greatest body of evidence exists for patients with HFrEF where GDMT has significantly improved survival and prognosis. In the last decade, the introduction of novel medical therapies has significantly transformed clinical practice and established the four pillars of GDMT for HFrEF⁴. These include angiotensin-converting enzyme inhibitors (ACE-I) or angiotensin receptor/neprilysin inhibitors (ARNI), beta-blockers, mineralocorticoid receptor antagonists (MRA), and sodium-glucose cotransporter-2 inhibitors (SGLT2I). Second-line therapies targeting alternative pathways to improve outcomes in HFrEF include ivabradine and vericiguat.

In the context of HFmrEF and HFpEF, where symptomatic treatment with diuretics was previously the main approach, the emergence of SGLT2I has made a breakthrough with significant reduction in HF hospitalisations and cardiovascular deaths.

Device Therapy in HF

In patients with HFrEF who do not show sufficient improvement to GDMT, CRT (cardiac resynchronisation therapy) may be considered. This treatment aims to enhance the heart's pumping efficiency and alleviate heart failure symptoms. Additionally, for individuals who are at high risk of life-threatening arrhythmias, an implantable cardioverter defibrillator (ICD) plays a crucial role in reducing the risk of sudden cardiac death⁴.

In cases of severe secondary mitral regurgitation due to HFrEF, despite GDMT and CRT (if applicable), transcatheter edge-to-edge mitral valve repair may be considered as a potential intervention to prevent the progression of HF⁶.

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GENERAL ENQUIRIES	Tel (65) 6704 8000 Fax (65) 6844 9030 nhcs@nhcs.com.sg

HEART FAILURE PROGRAMME

NHCS comprehensive suite of heart failure services offers end-to-end care services, from diagnostic tests, procedure/ surgical treatments, management of advanced heart failure therapies, to genetic counselling and palliative care. In severe heart failure cases, advanced therapies include implantable cardiac devices as a bridge-to-transplant, with heart transplantation being the destination therapy. NHCS is the only healthcare institution in Singapore that carries out heart transplantations.

OUR SPECIALISTS

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Asst Prof Victor Chao	Senior Consultant Director, Vascular Laboratory
Prof Carolyn Lam	Senior Consultant
Asst Prof Laura Chan	Senior Consultant
Asst Prof Louis Teo	Senior Consultant
Asst Prof Julian Kenrick Loh	Consultant Director, Coronary Care Unit
Asst Prof Audry Lee	Consultant
Asst Prof Iswarae Devi Balakrishnan	Consultant
Asst Prof Khoo Chun Yuan	Consultant
Asst Prof Ng Choon Ta	Consultant
Dr Alex Tan	Consultant
Dr Kenneth Michael Chew	Consultant
Dr Anbalakan Kamalesh	Associate Consultant
Dr Teo Hooi Khee	Associate Consultant

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

Ventricular Assist Device (VAD) and Heart Transplant

In some cases, patients with chronic HF may reach an advanced stage where symptoms become severe and they no longer respond to medical therapies and/or device therapies. For such individuals, a VAD can be considered. A VAD is a mechanical device that assists in pumping blood throughout the body. It has demonstrated benefits in improving symptoms and reducing mortality in these patients⁴. However, VAD implantation is a major surgical procedure that requires meticulous post-VAD care and strong commitment from the patient and their family. Therefore, a multidisciplinary team is necessary to evaluate both the medical and psychosocial aspects of the patient to ensure appropriate selection and achieve the best possible outcomes.

Heart transplantation is another option for patients with advanced HF to improve survival⁴. Similar to VAD candidacy assessment, a thorough evaluation process is imperative to identify suitable candidates who have the highest potential for favourable outcomes with a heart transplant. This rigorous process is necessitated by the scarcity of donor hearts. Eligible patients are placed on a waiting list and informed when a suitable donor heart becomes available.

As of 2023, over 90 heart transplants have been carried out at NHCS, the only healthcare institution in Singapore that carries out heart transplantations.

Advance Care Planning and Palliative Care

Even though HF treatment has improved, with the increase in life expectancy, the burden of heart failure is expected to rise in ageing societies like Singapore. Integrating advance care planning and palliative care into management plan becomes crucial to provide holistic care in conjunction with medical treatment. These initiatives address the unique needs of patients and their families, ensuring comprehensive support and enhancing quality of life.

Further Enhancements in HF Management Needed

Significant advancements have been made in understanding HF epidemiology, pathophysiology, diagnosis, medical treatment, device therapy, and palliative care. However, further enhancements in HF management are still needed. Continued focus on research and development in addressing the complexities of HF care holds tremendous potential. This dedicated pursuit will pave way for the adoption of more personalised and effective treatments, ultimately optimising health outcomes. By fostering innovation and collaboration within the community at large, we can cultivate a sense of renewed hope and work towards a brighter future in managing HF.

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ADVANCING CARDIOVASCULAR SCIENCE: A DECADE OF BREAKTHROUGHS AT NHCS' RESEARCH CENTRE

Committed to improving patient outcomes through the advancement of scientific knowledge, the NHCS has continually made remarkable strides in cardiovascular research, leading to significant advancements in the prevention, diagnosis and management of heart diseases.

With the prevalence of heart disease continuing to rise locally and globally, due to factors such as the ageing population and an increase in incidence of risk factors including hypertension, obesity and diabetes, there needs to be a greater emphasis on preventing and treating heart diseases.

Established on 5 September 2014, the National Heart Research Institute of Singapore (NHRIS) at NHCS has established itself as a premier institution for cardiovascular research in the region, with several research achievements with the potential to improve patients' outcomes since its launch.

Breakthroughs in Research

The research at NHRIS spans a wide range of disciplines within cardiovascular medicine, encompassing both basic, translational and clinical research. Some recent major achievements include:

► Discovery of new treatments for heart disease by studying patient's heart stem cells

Heart stem cells can be made from patients with heart disease and studied in a dish to better understand the patient's heart disease and discover new treatments for that patient's heart condition. This approach has been used in patients with a heart condition called hypertrophic cardiomyopathy (an inherited heart condition characterised by thickening of the heart muscle) and a new treatment using myeloperoxidase has been discovered, which has the potential to improve heart function and symptoms in patients with this heart condition¹.

► A new treatment for preventing fibrosis of heart and other organs

By studying heart tissue from patients undergoing heart surgery, a new interleukin-11 antibody treatment has been discovered for preventing inflammation and fibrosis in the heart and other organs, opening up opportunities for further new treatments for patients with heart, lung, liver diseases, conditions which are characterised by inflammation and fibrosis². This innovative new treatment is currently being tested in humans and has the potential to improve health outcomes in patients with these different conditions.

"By embracing multidisciplinary approaches, harnessing new technologies, and engaging with our strong network of partners, we aim to accelerate progress of transformative cardiovascular research for our patients' benefits," said Prof Derek Hausenloy, Director of NHRIS, "We envision a future where every heartbeat matters, where cardiovascular diseases are better understood and effectively treated or prevented."

Research Efforts in the Next Ten Years

NHCS has been actively involved in leading and contributing in several ground-breaking clinical trials, evaluating new treatments and interventions for various cardiovascular conditions.

Over the next five to ten years, the research efforts for improved health outcomes in patients with heart disease will focus on three main areas: (1) Discovery of new treatments for heart disease to improve patients' outcomes; (2) Harnessing cutting-edge technologies such as artificial intelligence, heart imaging and digital

NHRIS RESEARCH ACHIEVEMENTS

\$131M

Grant funding secured

2,157

Scientific papers published

12

Clinician Scientists /
Innovators

47

Patents granted

13,513

Subjects recruited

47

Principal Investigators

4

Spin-offs

Genomics and
Metabolomics

Cardiometabolic Diseases
Models

Advanced Cardio-
metabolic Imaging

CardioVascular Systems
Imaging and Artificial
Intelligence (CVS.AI)

Clinical Studies Support

Data from 2015 to mid-2023

technology to better diagnose and manage heart diseases; (3) Clinical trials and population health studies to prevent the onset of heart disease.

With the advent of new technologies, new frontiers of research are being increasingly explored at NHRIS, including:

► **Visualising energy pathways inside the heart in patients with heart disease**

Disturbances in energy producing pathways in heart muscle contribute to many heart conditions such as heart attacks, heart failure and diabetic heart disease. Understanding the metabolic pathways underlying these disturbances may provide new treatments to improve health outcomes in patient with heart disease. In this regard, there is currently a new novel imaging technology being investigated at NHRIS, called hyperpolarised magnetic resonance spectroscopy which allows the measurement of these metabolic pathways in the heart muscle of patients with heart disease. This technology is the only one available in Asia for studying heart disease, with only five other centres worldwide with this capability.

► **Application of artificial intelligence to predict, diagnose and monitor heart disease**

The advent of artificial intelligence (AI) has gained a strong foothold in healthcare, with various AI initiatives to augment clinical services and automate work processes for improved patient care at NHCS. NHCS researchers have demonstrated the potential of AI to enhance detect, predict and diagnose heart disease, by capturing and making sense of complex imaging information and data with greater precision and efficiency.

The use of AI provides clinicians with unprecedented insights into patients' conditions, to allow for personalised care and early medical intervention, thus this could delay onset of illnesses and prevent adverse health outcomes.

APOLLO, which stands for AI-driven national Platform for CT cOronary angiography for clinical and industrial applicatiOns, is an ongoing study since 2021 to build a national system comprising several modules that will perform different AI analyses on computed tomography coronary angiography images, and provide detailed AI-generated reports on patients' conditions and their risk of developing cardiovascular disease in the future.

Improving Heart Research Efforts

NHRIS' ground-breaking research initiatives have led to significant advancements in AI, discovery of new treatments, heart imaging and more. The notable achievements of NHCS in AI applications, clinical trials and collaborative research efforts highlight its dedication to improving patient care and shaping the future of cardiovascular medicine.

The research efforts at NHRIS will synergise nationwide with other heart research institutes and hospitals through CADENCE (Cardiovascular Disease National Collaborative Enterprise), a new national platform for bringing together heart research capabilities across Singapore in 3 major areas: data science, clinical trials, and AI or digital heart.

As NHCS continues its pursuit of research excellence, it is poised to make progress in preventing, diagnosing, and managing cardiovascular diseases, ultimately benefiting patients beyond Singapore, impacting individuals around the region and world.

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RESEARCH PUBLICATIONS

January – June 2023

JANUARY 2023

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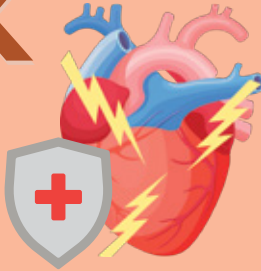
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