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We will love to hear your feedback on Médico
Please direct all feedback to: The Editor, Médico
GP Liaison Centre, National University Hospital,
1E Kent Ridge Road, NUHS Tower Block, Level 6,
Singapore 119228

Tel: 6772 5079
Fax: 6777 8065
Email: gp@nuhs.edu.sg
Website: www.nuh.com.sg/nuh_gplc

The NUHS group

A Publication of NUH GP Liaison Centre (GPLC)

Advisor
A/Prof Goh Lee Gan

Editors
Amaranta Lim
Karin Lim

Editorial Member
Yvonne Lin

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The National University Heart Centre, Singapore (NUHCS) brings together specialists and experts from a multitude of medical and surgical disciplines to provide a comprehensive and holistic approach to the treatment of cardiovascular disease. We assemble multi-disciplinary teams that work cohesively to deliver seamless care across medical disciplines.

The NUHCS provides a broad range of cardiovascular services, from screening to diagnosis to treatment, complemented by long term care and support group programmes for our patients. We have six comprehensive clinical programmes that draw on a broad range of expertise to help patients achieve better outcomes. They are:

- Heart Failure Programme
- Congenital and Structural Heart Disease Programme
- Acute Coronary Syndrome Programme
- Vascular Medicine and Therapy Programme
- Women’s Heart Health Programme
- Heart Rhythm Programme

Our surgeons from the Department of Cardiac, Thoracic & Vascular Surgery (CTVS) work in partnership with our cardiologists from the Department of Cardiology to provide comprehensive and complex treatment such as transcathether aortic valve implantation (TAVI) procedures and emergency life support measures such as extracorporeal membrane oxygenation (ECMO) implantation, for both paediatric and adult patients.

Our outpatient facilities provide a one-stop service for patients seeking consultation at NUHCS.

Heart Clinics – Specialist clinics providing expert advice and care from both the cardiologists and cardiothoracic and vascular surgeons ranging from general cardiology, cardiac rehabilitation, arrhythmia management to surgical consultations and reviews.

Diagnostic Cardiac Laboratory – Various non-invasive diagnostic investigations including treadmill, ambulatory blood pressure and ECG monitoring, echocardiography, pacemaker checks are performed by our team of cardiac technologists.

Nuclear Cardiology Laboratory – Using safe radioactive material, non-invasive heart studies are performed here to determine functions of the heart.

Diagnostic Vascular Laboratory – Patients with carotid, aortic, arterial and venous disorders are assessed through comprehensive tests done by our vascular technologists, including ultrasound scans, vein mapping and pseudo aneurysm scans. The podiatry service also supports the review of the vascular patients concurrently seeking treatment with our vascular surgeons.

Pharmacy @ Heart Clinic – Catering to the needs of patients from NUHCS, the pharmacy which is located within NUHCS premises provides immediate accessibility and convenience.

Heart Rehab – a dedicated gym for patients undergoing cardiac rehabilitation. The rehabilitation programme includes exercise training, education and counselling to encourage patients obtaining a healthy and active lifestyle after undergoing a cardiac procedure.
Sports Cardiology in NUHCS
The benefits of leading an active lifestyle apply to all populations, from elite athletes to the general population and also those with pre-existing cardiovascular disease. Contemporary large scale studies have consistently demonstrated mortality benefits with increased physical activity in addition to reduction in risk for a variety of conditions such as breast and colon cancer, diabetes and stroke. Joseph Schooling's recent Olympic success has shone the spotlight on sports in Singapore, with growing emphasis on sporting excellence at all levels. From the Singapore Sports School nurturing budding young athletes, to the newly opened National Youth Sports Institute providing state of the art support in the development of youth sports, and the Singapore Sports Institute getting the best of our local elite athletes, sports has never had such a high profile in Singapore.

On the recreational front, participation in physical activity has been facilitated by the creation of Active SG, a national movement that offers Singaporeans opportunities to experience sports as part of a healthy lifestyle. Since 1992, sports participation rates have doubled with over 700,000 Singaporeans and Permanent Residents listing jogging and/or brisk walking as their top physical activity in the 2011 National Sports Participation Survey. This is reflected in the plethora of year-long sporting events from novelty races (e.g. Pokemon Run and Colour Run) to the annual Standard Chartered Singapore Marathon, an International Association of Athletics Federations (IAAF) certified Gold Label marathon, which have encouraged many locals to turn to exercise.

In this current climate, the importance of sports cardiology cannot be overemphasised. Pre-participation cardiac screening offered by the NUHCS Sports Cardiology service allows an opportunity for the detection of potentially life-threatening conditions that may predispose to disastrous outcomes such as sudden cardiac death.

Although rare, cardiovascular disease is the most common cause of non-traumatic sudden death in sport, with one in 50,000 athletes affected by sudden cardiac death.

More importantly, up to 80% of sudden deaths have no preceding symptoms or family history, and the first clinical manifestation of an underlying cardiac disorder is sudden death.

Pre-participation cardiac screening utilises an integrated approach consisting of a targeted questionnaire, physical examination and an electrocardiogram, ensuring high sensitivity and specificity. Adoption of contemporary ECG interpretation guidelines enables reduction in false positives and unnecessary additional evaluation, thus improving cost effectiveness. From elite athletes to sedentary persons keen on starting an active lifestyle, each screen is customised to the individual’s baseline fitness, cardiovascular risk and intended sports participation. In selected individuals, echocardiogram and treadmill exercise stress testing can be included as part of the screening process. Further investigations such as cardiopulmonary exercise testing, cardiac magnetic resonance imaging, positron emission tomography and genetic testing are also readily available under one roof should they be necessary for diagnostic and/or prognostic purposes.

For those with pre-existing cardiac conditions who may be fearful of the risks involved with exercise, a sports cardiology consultation at NUHCS includes a comprehensive cardiovascular assessment with a view to generate a dedicated exercise prescription and the option of participation in a supervised exercise-based cardiac rehabilitation program. Individuals who wish to fulfil specific goals following a cardiac event (e.g. to complete a 10 km running event) can benefit from a structured progressive training regimen that enables safe and individualised participation in physical activity. This includes patients at high risk, such as those with low left ventricular ejection fraction and with implanted devices (implantable cardioverter-defibrillator or cardiac resynchronisation therapy). Whether it is a patient with dilated cardiomyopathy, an individual post coronary artery bypass grafting, or one with repaired congenital heart disease, the availability of a full complement of cardiology
and cardiothoracic surgical sub-specialties ensures prompt and directed management of the underlying cardiovascular condition.

Apart from a stable cardiovascular system, the ability to engage in sports and physical activity hinges on a properly functioning musculoskeletal system. NUHCS Sports Cardiology provides pre-participation cardiac screening. They also work closely with the rehabilitation team to help athletic individuals with heart disease return to sports or physically demanding occupations. In addition, a very close working relationship with the NUH Sports Centre helps in the facilitation of seamless multi-disciplinary care in individuals.

The NUH Sports Centre provides a myriad of non-cardiac services focusing on maintaining physical activity, including orthopaedic sports surgery consultation, musculoskeletal physiotherapy, sports dietetics and many more.

Research is also an important aspect for NUHCS Sports Cardiology. We recognise that it translates to improved clinical outcomes for all coming through our doors via ongoing and potential collaborations with local and international institutions, in order to contribute to the overall physical fitness and wellbeing of our nation.

Dr Yeo Tee Joo
Consultant, Department of Cardiology, NUHCS

Dr Yeo graduated from the NUS Faculty of Medicine in 2004 and in 2013, he received specialist accreditation in Cardiology, and was certified as a Clinical Exercise Specialist by the American College of Sports Medicine. Dr Yeo was awarded the MOH Training Scholarship to complete sub-specialty fellowships in Cardiovascular Prevention and Rehabilitation at the Toronto Rehabilitation Institute (2014 to 2015) and Sports Cardiology at St George’s University of London (2015 to 2016). Passionate about research, he obtained a Master of Clinical Investigation (MCI) from NUS (2015). Dr Yeo hopes to improve the uptake of Cardiac Rehabilitation, as well as raise the profile of Sports Cardiology in Singapore, and potentially the region.
Women’s Heart Health Programme @ NUHCS

Cardiovascular disease (CVD) remains a leading cause of death for both men and women in Singapore\(^1\). One out of every three deaths in Singapore is due to CVD. CVD is the top killer in women. However, less than 10% of women were aware of this in the Singapore Heart Foundation’s Go Red For Women Heart Health Awareness Survey in 2009\(^2\).

Women have unique risk factors for CVD, including those related to pregnancy and autoimmune disease\(^3\). Women’s manifestations of coronary artery disease (CAD) differ from men\(^4\). The mechanisms and pathophysiology underlying certain heart diseases in women are different, leading to emergence of management strategies specific to women\(^5,6\). A Women’s Heart Health programme dedicated to the specific features and management of women with CVD becomes essential.
CORONARY ARTERY DISEASE (CAD) IN WOMEN
Although the incidence of CAD in women lags behind men by 10 years, the rate of death attributable to CAD is increasing in young women (<55 years old).

More women have died from CAD than of cancer, chronic lower respiratory disease, Alzheimer’s disease and accidents combined.

The consequences of CAD are worse in women than in men. Among individuals with premature myocardial infarction (age < 50), women experience a two-fold higher mortality rate after acute MI compared to men. Among older individuals (age > 65), women are more likely to die within the first year after MI. In individuals 45 to 64 years of age, women are more likely than men to have heart failure within five years of MI.

Despite the prevalence of ischemic heart disease in women, the recognition is often delayed or deferred in women. This lack of recognition is multifactorial. Women tend to have atypical symptoms and presentation of CAD. Compared to men, they are also less likely to seek care promptly when they have symptoms. There are also gender-specific differences in the pathophysiology of CVD. The current understanding of CAD is largely built upon studies in which majority of subjects were men with flow limiting atherosclerotic CAD.

Women are more likely to have non-obstructive CAD which is highly prevalent in women presenting with typical symptoms of IHD. This non-obstructive CAD pattern and the tendency among women to have plaque erosion with subsequent thrombus formation, along with coronary microvascular and/or endothelial dysfunction, are not well recognised. Non-obstructive CAD may be defined as having at least one coronary artery stenosis ≥20, but <50%, whereas obstructive (single-, double-, or triple-vessel) CAD may be defined as having at least one coronary artery stenosis ≥50%. Data are emerging to show that more extensive non-obstructive CAD involvement is associated with a rate of major adverse cardiovascular events (MACE) that may approximate that of obstructive CAD. Besides symptom relief and CVD risk factor management, there is no guideline recommended therapy currently available for non-obstructive CAD. As a result, a large proportion of these patients (majority are women) are currently dismissed from speciality care and even general care, despite persisting symptoms.

CARDIOVASCULAR DISEASES DURING PREGNANCY
At present, 0.2–4% of all pregnancies in western industrialised countries is complicated by CVD, and the number of the patients who develop cardiac problems during pregnancy is increasing.

In the western world, maternal heart disease is now the major cause of maternal death during pregnancy. Increasing age at first pregnancy and increasing prevalence of cardiovascular risk factors (diabetes, hypertension and obesity) have increased the risks of CVD in pregnancy. Hypertensive disorders are the most frequent cardiovascular events during pregnancy, occurring in 6–8% of all pregnancies.

Improvement in management of congenital heart disease (CHD) has also increased women with CHD reaching childbearing age. Congenital heart disease is the most frequent cardiovascular disease present during pregnancy (75–82%), with shunt lesions predominating (20–65%). Rheumatic valvular disease predominates in non-western countries, comprising 56–89% of all cardiovascular diseases in pregnancy.

Cardiomyopathies are rare, but represent severe causes of cardiovascular complications in pregnancy. Peripartum cardiomyopathy (PPCM) is defined as an idiopathic cardiomyopathy frequently presenting with heart failure secondary to LV systolic dysfunction (LVEF <45%) towards
the end of pregnancy, or in the months following delivery, if no other cause of heart failure is found\textsuperscript{(17)}. PPCM is the most common cause of severe complications\textsuperscript{(18)}.

The risk of pregnancy depends on the specific heart disease and clinical status of the patient. Pre-pregnancy risk assessment and counselling are indicated in all women with known or suspected congenital or acquired cardiovascular and aortic disease. Medications should be reviewed so that those which are contraindicated in pregnancy can be stopped or changed to alternatives where possible\textsuperscript{(13)}. The European Society of Cardiology (ESC) guidelines on the management of cardiovascular diseases during pregnancy recommend that maternal risk assessment is carried out according to the modified World Health Organization (WHO) risk classification (Figure 1, 2).

<table>
<thead>
<tr>
<th>Risk Class</th>
<th>Risk of pregnancy by medical condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>No detectable increased risk of maternal mortality and no/mild increase in morbidity.</td>
</tr>
<tr>
<td>II</td>
<td>Small increased risk of maternal mortality or moderate increase in morbidity.</td>
</tr>
<tr>
<td>III</td>
<td>Significantly increased risk of maternal mortality or severe morbidity. Expert counselling required. If pregnancy is decided upon, intensive specialist cardiac and obstetric monitoring needed throughout pregnancy, childbirth, and the puerperium.</td>
</tr>
<tr>
<td>IV</td>
<td>Extremely high risk of maternal mortality or severe morbidity; pregnancy contraindicated. If pregnancy occurs termination should be discussed. If pregnancy continues, care as for class III.</td>
</tr>
</tbody>
</table>

Women with significant heart disease should be managed jointly by an obstetrician and a cardiologist with experience in treating pregnant patients with heart disease from an early stage. High risk patients should be managed by an expert multi-disciplinary team in a specialist centre. All women with heart disease should be assessed at least once before pregnancy and during pregnancy, and hospital delivery should be advised.

CARDIOVASCULAR DISEASES IN AUTOIMMUNE DISEASES
Autoimmune diseases (AD) are more common in women, nearly 80% of all ADs occur in women. Underlying hypotheses include the effect of sex hormones, microchimerism, genes on X or Y chromosomes, X chromosome inactivation and differing responses to environmental factors.

CVD occurs more frequently in women with rheumatic ADs such as systemic lupus erythematosus (SLE), rheumatoid arthritis (RA), systemic sclerosis, myositis, Sjögren’s syndrome (SS) and antiphospholipid syndrome (APS). SLE and RA result in premature development of atherosclerosis, myocardial infarction, and arterial stiffening. Pericardial disease is common in SLE and clinically significant valvular disease develops in a minority of patients. Congestive heart failure is independently related to RA. Effective control of disease activity in RA may improve vascular and myocardial disease. In systemic sclerosis, the most prominent cardiovascular abnormalities are microvascular perfusion abnormalities of the ventricular myocardium resulting in ischemia, fibrosis, systolic dysfunction, and conduction disease. Prognosis in systemic sclerosis is adversely affected by evidence of cardiac involvement.

WOMEN’S HEART HEALTH CLINIC (WHHC)@NUHCS
Our Women’s Heart Health Clinic at NUHCS (WHHC@NUHCS) is designed to provide holistic, multi-disciplinary and patient-centric care to women with CVD. We recognise that women have differences in CVD prevalence, manifestations, pathophysiology and therefore, management strategies.

Our medical team at the WHHC@NUHCS comprises of dedicated cardiologists, nurses and allied health professionals with specialised interests in cardiovascular conditions specific to women.
Clinical care in the programme encompasses medical, cardiac rehabilitation and care coordination tailored to women-specific CVD, health behaviour and beliefs. Through inter-disciplinary, collaborative clinical efforts with our colleagues from different medical specialties (i.e. Obstetrics & Gynaecology, Rheumatology, Endocrinology), we hope to provide comprehensive, integrated and patient-centric clinical services to our women with CVD.

References:
The treatment of aortic diseases has revolutionised since the introduction of endovascular technology in the last 20 years. This technology has continued to evolve every year with better and more robust devices that can stand the test of time. Although open aortic surgery remains the gold standard for valves, aneurysms or dissections, standalone endovascular treatment or sometimes in combination with open surgery in all branches of aortic work has helped to bring mortality and morbidity down for patients especially for those with advancing ages.
Since 2011, we have been able to perform complex open and combined endovascular aortic operations in the hybrid operating theatre.

The volume of endovascular aortic stenting has been high in terms of volume at NUHCS for the past four years. We continue to be a referral centre for both local hospitals as well as those in the regional countries. As such, we are now setting up an aortic centre to offer our expertise to our local as well as international patients.

PURPOSE
The Aortic Centre aims to be a one-stop centre for diagnosis, screening and treatment of aortic diseases. The centre will be formed by multi-disciplinary and multi-specialty teams. Currently our team includes cardiothoracic surgeons, vascular surgeons, interventional radiologists, interventional cardiologists and stroke physicians. Each patient’s case is discussed at a multi-disciplinary meeting held twice a week, and offer multi-modality treatments tailored to individual needs with the most advanced technology and evidence based solutions.

VISION
Our vision for this centre is to become a leading aortic centre in South East Asia. This means that our local Singaporeans will have access to cost effective and high quality treatment with optimal outcomes. We look forward to achieving regional as well as international recognition to offer complex treatments to all patients as we continue to improve ourselves through research and teaching.

DISEASE SCOPE
The aorta starts from the aorta valve all the way to iliac bifurcation. The most common admissions for aortic disease are aortic dissections and aortic aneurysms.

In aortic dissections, most patients come in as emergency admissions either as Stanford Type A or Type B dissections (see Figure 1).
Dr Julian Wong specialises in both open and endovascular surgery, including complex aortic aneurysms, carotid disease and peripheral vascular disease as well as redo surgery. In addition, he has a strong interest in education.

The treatment of aortic aneurysms has also evolved as custom-made devices can be used from the ascending arch aneurysm above coronary sinus to the rest of aorta to iliac bifurcation. Devices such as arch branch grafts, single to multiple fenestrations can be used for almost all situations. However, custom-made limitations will need time to be manufactured. However, the high volume of aortic cases managed at NUHCS allows accessibility to custom-made devices faster when compared to other centres in the region. In addition, we store a variety of devices which allow us to treat most situations effectively, acute and elective.

With the formation of Aortic Centre under NUHCS, we are confident that we will be able to concentrate resources and expertise under one roof in the near future and continue to expand our scope in treating different branch of aortic diseases.

**TYPE A AORTIC DISSECATIONS**
Stanford type A dissections classically require urgent open heart surgery and an interposition graft is placed on the ascending aorta to prevent further complications. When Type A aortic dissections occurs, the patient is faced with a high mortality rate. Time is of essence as the mortality is 1% per hour while waiting for surgery. The surgery itself is about 30% mortality depending on the extent of the aortic dissections. A rapid transfer to hospitals offering aortic surgery and prompt diagnosis is absolutely paramount to the survival of the patient. The complications of Type A dissection include stroke, bowel ischemia, renal artery occlusion and sometimes stroke and paraplegia. As these complications can occur immediately with the onset of the aortic dissection or post-operatively, it is key to have multi-specialty involvements and inputs to increase the survival rate of the patient.

Once the Type A aortic dissection open surgery is done successfully, only 10% of patients will have complete resolution of the true and false lumen back into one entity. Therefore, these patients will require up long term follow-up with vascular specialists to check on the development of dissecting aneurysms and subsequent ruptures. A rupture of aorta occurs when the thoracic aortic double lumen is more than 6 cm. There is also emerging evidence that if the remaining double lumen is endovascularly stented within 90 days after the first open surgery, resolution does occur most of the time. At present, the treatment of aortic dissections is aggressive open surgery combined with staged endovascular stenting, which has been the practice at NUHCS since 2013.

**TYPE B AORTIC DISSECIONS**
Since the Instead XL trial results in 2013, management of aortic Type B dissections has totally changed from conservative management with good blood pressure control to endovascular stenting of the whole thoracic aorta. The trial results show that early stenting for uncomplicated Type B dissections will help to improve long term survival of patients as well as reduce complications rate in medium and long term. Other research has also shown that stenting within 90 days from onset of disease will restore the double lumen back to one through remodelling.

Figure 3. Types of Aortic Dissections (Source: http://fr.ap-hm.fr/site/centre-aorte-timone/maladies-de-l-aorte)
Modern Surgery at its Best

@ NUHCS
Modern day surgery now involves multi-disciplinary teams working together to fix a patient back to health. Advanced technology, better surgical techniques and the latest medicine formulations have reached a stage where a particular heart or blood vessel condition can be managed in a way that reduces mortality risks of surgery and their length of stay in hospital. Advances have also pushed the envelope enabling surgery on more complex cases for patients who were previously considered non-surgical candidates due to their health conditions and age. This, of course, is good news for patients previously relegated to palliative medical treatment. However, these changes put a strain on resources and stretch the limits of surgical capability. Our nursing partners too feel the challenge having to work at the top of their license. I will share just two conditions which have benefitted from our Centre’s multi-disciplinary setup.

**TREATMENT OF CORONARY ARTERY DISEASE BY THE HEART TEAM**

In this group, the main development that has made surgical patients more challenging is the use of modern stenting techniques to treat previously conventional or “straight-forward” surgical cases. The use of the latest drug-eluting stents by our cardiology colleagues to treat one half of this spectrum; many of the elective low-medium risk coronary artery disease cases that need mechanical intervention to restore flow to the critically blocked coronary arteries, are now being stented. This is considered beneficial for patients but has raised the proportion of patients going for coronary bypass surgery who are deemed not technically suitable for stenting because of high syntax scores - difficulties due to heavy calcification, multiple tandem lesions, long length lesions or severely tortuous vessels or left main disease. There are large ‘stent versus surgery’ trials, which have shown heart bypass surgery to be superior in terms of re-infarction rates or re-stenosis rates in most of these complex patients i.e. better long-term outcomes. Many of these patients will have chronic kidney impairment or diabetic mellitus. Surgery has also shown to be advantageous in those with poor heart function (poor ejection fraction (EF)) where paradoxically, the surgical risk is highest but the patient benefits the most. In summary, triple vessel disease, left main disease, poor EF and multiple co-morbid conditions like diabetes do best with bypass surgery.

The other group that has benefited from coronary stenting has been patients with severe conditions that come through the emergency room for acute myocardial infarction. In this group, acute stenting has made a dramatic difference to the outcome for these patients with dying myocardium, by reducing the ‘door to balloon time’ so that more myocardium at risk can be saved within the six hour time limit. This restores heart (left ventricular) function and pulls them from death’s door or away from a life confined to chronic physical disability from heart failure if they are fortunate enough to survive. This has reduced the need for high risk heart surgery in this acute setting but has imposed the ultimate duty on surgery to salvage the “dying” patient who cannot be rescued by emergency stenting. Many of these patients have ‘crashed’ or have to undergo cardiopulmonary resuscitation. Surgery is fraught with difficulties as these patients bleed profusely from the heavy load of blood thinners pumped into them for acute stenting. Despite technically sound surgery, they may end up with extracorporeal life support with a portable heart-lung machine and could perish a few days later. This is termed ‘salvage bypass surgery’ but we still offer them in the hope that we can save the few destined to survive. The overall message to be understood is that a ‘Heart Team’ comprising cardiologists and heart surgeons is essential to review the specific disease pattern and presentation, and to recommend the best option for that particular patient. There are many options: stenting, multi-vessel/multi-stage stenting, hybrid option with stenting and surgery, minimally invasive bypass surgery and conventional bypass surgery.

At NUHCS, we have the deliberate practice on obtaining a consensus opinion through combined weekly meetings. The whole purpose is to ensure the option with the best long term outcome at the lowest possible risks advocated for each patient. All other considerations, namely cosmetic considerations and cost, though important, are secondary to the primary aim of safety and efficacy.
TREATMENT OF AORTIC ANEURYSM DISEASE BY THE AORTIC GROUP

The aorta is the largest vessel in the body that starts at the heart and ends in the abdomen just above the groin. Unfortunately, it may become enlarged to the point that an aneurysm forms (> 5 cm). This is when the vessel has become so large that the wall has thinned out and can easily rupture even with normal physiological fluctuations in blood pressure. The risk rises dramatically if the patient suffers from poorly treated hypertension or the size of the aneurysm increases beyond 7 cm.

When the aorta ruptures at the first instance or dissects (internal tear) initially and then ruptures, death comes quickly from either of two mechanisms. First is exsanguination into the natural sac surrounding the heart (called the pericardium) causing suffocation (tamponade) of the heart which leads quickly to death. Death also happens when blood spills out into the other spaces of the body, usually the pleural spaces (the void around the lungs within the rib cage) or the peritoneal space within the abdomen. This causes the body’s blood volume to empty out from the circulatory system. Death quickly follows as blood pressure is lost and the patient succumbs from lack of perfusion of the brain and other vital organs. Sometimes the patient is lucky and spillage occurs in a controlled fashion and if the patient comes in time to a hospital with the required technical expertise and the capacity to institute the procedures rapidly, the patient may survive.

What is the best-practice treatment today? Again, a multi-disciplinary group is the best ‘doctor’ for this patient. This group consists of heart surgeons and vascular surgeons deciding on the same principle previously discussed. And the quickest or least complex option with the lowest risk for the patient presenting to them? This inevitably consists of a combination of open surgery and less invasive/endovascular aortic stenting. The latter uses modern off-the-shelf or even specially customised stent grafts depending on the acuteness of presentation, the particular anatomy of the aorta and the patient’s unique body habitus. The third member of this aortic group are our radiology colleagues who provide rapid and accurate imaging techniques.

This provision is paramount to the success of any open surgery-stenting endeavor. This group, like the Heart Team, is what we consider a “First Class” platform. The best possible avenue to obtain an opinion so crucial on deciding the fate of any treatment in such complex cases.

WORK IN PROGRESS

We have officially started our inter-hospital ECMO transfer programme at NUHCS. This entails safely transporting extremely sick patients on the brink of death on total cardiopulmonary (veno-arterial ecmo) or lung support (veno-veno support) using portable heart lung machines back to our Centre for further management. Patients may have suffered acute decompensated heart failure from a massive myocardial infarction where inotropic drugs and intraaortic balloon support are insufficient to sustain life and require definitive treatment like coronary bypass surgery. Another recent example was acute massive heart failure from wide open mitral valve incompetence where almost all blood flow is reversed in the heart. These patients need to arrive at our surgical centre “alive” on support so that salvage surgery may be attempted.

An increasingly not uncommon condition is caused by severe unrelenting community acquired pneumonia due to various infective organisms both viral and bacterial organisms. Here the patient’s lungs need to “rest” by pulling back artificial ventilator support that has “max-ed” out and has become dangerous and ineffective so that the widespread lung damage may recover. Only ECMO can help the patient in these deadly circumstances. Our ECMO transport team coordinates with all hospitals in Singapore to achieve these aims by streamlining the complex process. Kudos to the entire healthcare teams from all hospitals for pushing the envelope in medical transport on artificial life support.

To know more about our team of specialists and their niche areas of practice, please visit our website at www.nuhcs.com.sg.

Adjunct Associate Professor Caleb graduated from National University of Singapore with MBBS in 1987. He passed the PRCS Edin in 1991 and the Conjoint FRCS (Edin) / Masters Med (Surgery) S’pore in 1992. He underwent the advanced cardiac specialty training at the Cleveland Clinic, Ohio, United States of America and The Peter Munk Cardiac Centre at University of Toronto, Canada from 1996 to 1998. He is currently the Associate Chairman (Risk Management & Medico-Legal), Medical Board at NUH. He specialises in all aspects of cardiac surgery including coronary bypass, mitral and aortic valve surgeries, atrial fibrillation surgeries and heart failure surgeries.

Head & Senior Consultant
Department of Cardiac, Thoracic and Vascular Surgery, NUHCS

Adjunct Associate Professor Caleb
Electronic ECG - EasyG

An electrocardiogram (ECG) is the basic and most widely performed cardiac investigation that records the electrical activity of the heart. The electrical activity is related to the impulses that travel through the heart that determines the heart rate and rhythm.

WHY THE NEED FOR ECGS TO BE ELECTRONIC?
The electronic ECG (EasyG) project started during an internal meeting with our Head of Department, A/Prof Yeo Tiong Cheng. I had raised my concerns when reviewing patients referred from Emergency Department for cardiac arrhythmia, as their crucial electrocardiogram (ECG) is either missing or not available at the time of consultation. A/Prof Yeo immediately suggested that I work on an electronic ECG project.

Previously, nurses had to manually enter patient identification data on ECG machines, leaving human error to chance. There was also the process of getting the paper ECG reports signed and verified by the doctors, which was time consuming and tedious. Easy access to electronic ECG is crucial for timelier medical care.

WHAT WE DID
Under the abled guidance of A/Prof James Yip, the Chief Medical Information Officer in NUHS, we started working on this project since October 2013. The EasyG project, an integrated loop solution for ECG, was rolled out across the hospital at the end of March 2014.

The electronic link-up of all hospital ECG carts to a centralised cardiovascular management information system that provides real-time ECG results that can be reviewed by doctors from any hospital workstation.

Patient data is scanned rather than entered manually into ECG carts to prevent data entry errors during patient identification. The integration with hospital result management system allowed automating escalation based on abnormal ECG.

Electronic ECGs have now been in place at NUH for more than two years, and has made patient management much more seamless. Medical care is also timelier with the alerts on those ECGs with abnormal results. Our hard work has seen vast improvements in productivity and medical care management, and we are honoured to have won the prestigious Excellence Award at the Hospital Management Asia Award 2014 competition. The success of this project is the result of our teamwork at NUHCS with our various colleagues from the IT teams and other medical and nursing colleagues in the hospital.

Assistant Professor
Devinder Singh

Consultant, Department of Cardiology,
NUHCS

Assistant Professor Singh is trained in internal medicine and completed his Advanced Specialty Training (AST) in cardiology. He also did a fellowship in clinical cardiac electrophysiology and advanced clinical cardiac electrophysiology, with level 2 training in Cardiac Magnetic Resonance Imaging.

Medical care is also timelier with the alerts on those ECGs with abnormal results. Our hard work has seen vast improvements in productivity and medical care management, and we are honoured to have won the prestigious Excellence Award at the Hospital Management Asia Award 2014 competition. The success of this project is the result of our teamwork at NUHCS with our various colleagues from the IT teams and other medical and nursing colleagues in the hospital.
Pulmonary Arterial Hypertension Meeting

Each year, Associate Professor James Yip and his pulmonary hypertension team conducts the Pulmonary Hypertension Preceptorship Course, a comprehensive review course dedicated for specialists from overseas and around the region who have an interest in managing pulmonary hypertension. This year, we held a simplified Pulmonary Arterial Hypertension Workshop for local attendees. This one-day interactive workshop was designed to give a brief overview in the approach to diagnosis and management of pulmonary arterial hypertension; a rare disease that is often labelled to have a sinister prognosis.

We recognised the need to increase awareness of this uncommon but serious condition, and the educational objectives were to (1) provide information to expedite the diagnosis of pulmonary hypertension and promote early referral to a pulmonary hypertension expert centre, (2) provide updates on the most recent international pulmonary hypertension guidelines, and (3) provide learning through case discussions, identifying treatment challenges and sharing experience in real-world practice.

The workshop was well attended by 32 rheumatologists, cardiologists, respiratory physicians, and internists. Real world case presentations and a patient’s account of her personal journey with pulmonary hypertension were most well received. The participants got to indulge in good food by the Intercontinental Hotel, with support from Actelion Pharmaceuticals and Bayer. Feedback was excellent, and we look forward to making this workshop a biannual event.
The 7th Undergraduate Cardiology Review Course was held on the 22nd and 23rd of October 2016. This review course was designed as an exam preparatory course and initiated by NUHCS independently of the NUS school body.

Our lectures were delivered by 13 of our NUHCS specialists who are individually experts in their own fields, and covered all topics including Coronary Artery Disease, Heart Failure, Valvular Disease, Adult Congenital Heart Disease, and core yet essential topics such as Hypertension, Lipid Management, Cardiac Emergencies and ECG interpretation. This was followed by an extensive simulated examination carousel in the afternoons with real-life patients, facilitated by 18 MRCP trained clinical examiners. All in all, we took in 274 students in total.
The students gave excellent feedback for this year’s course, with over 99 percent indicating that they would recommend this course to the future batches of medical students as the course had significantly benefited them in their knowledge of Cardiology and inspired them further. Many have mentioned that they were much more confident going into their final MBBS exams having been exposed to a wide variety of cases during our lecture series and clinical stations.

The Undergraduate Cardiology Review Course is just one of many Medical Education initiatives by NUHCS. We recognise the importance of guiding and instructing our future generation of young doctors, and this course, amongst many other initiatives, illustrates our firm commitment to Education. This review course would not have been possible without the combined effort of the entire department.

Figure 5: Dr Eugene Tan, Senior Resident, with a clinical group during the afternoon session.

Figure 6: Dr Lim Yinghao, Course Co-Director, going through the patient’s condition with the students.

Consultant, Department of Cardiology, NUHCS

Dr Low graduated from the National University of Singapore (NUS) in 2005 and completed Basic Specialist Training in Internal Medicine. She was conferred Membership of the Royal College of Physicians (United Kingdom) in 2010 and completed Advanced Specialist Training in Cardiology at NUHCS (2014). She will be proceeding with advanced fellowship training in adult congenital heart disease intervention and pulmonary hypertension in Toronto, Canada. Presently, she is actively involved in the management of patients with adult congenital heart disease, pulmonary hypertension and running the women’s heart clinic. Dr Low is also active in both undergraduate and postgraduate medical education, being a core faculty member of the Cardiology Senior Residency Programme and a clinical educator with the School of Medicine, NUS.
Your role at the National University Heart Centre, Singapore (NUHCS) is part clinician and part scientist. Share with us what draws you towards this clinician-scientist (CS) pathway. It really started when I was a cardiology registrar at NUHCS. There was already quite a bit of research activities going on back then. My colleagues and I would discuss problems with real patients and come up with research ideas. Professor Ling Lieng Hsi was one of the most inspirational mentors back then and still is. He approaches research with a curiosity, intensity and methodism that few can parallel. So I would say a strong research culture and good role models were the main draws.

Has your research work influenced and/or assisted you in your clinical work with your patients? Most certainly. Even if none of my discoveries make it to the clinic, the depth of knowledge that I have developed by just reading extensively on a specific field adds a whole new dimension to how I take care of my patients with acute coronary syndrome (heart attacks). As a clinician-scientist, I have learnt that I have to be highly specialised in a narrow field and those are the type of patients I will be seeing. Many of us doing percutaneous coronary intervention (PCI or angioplasty and stenting) do not recognise how much deep tissue injury and thrombosis occurs during routine stenting. Working on an ex vivo stent thrombosis model really gave me first-hand biological insights into how much damage we do to the artery and how much hidden thrombus actually forms during a routine procedure. Indeed, no PCI is ever routine now for me.

What do you think are three important qualities that are required of a clinician-scientist?

First, resilience. You need to be able to bounce back quickly from setbacks. One out of three experiments fail, eight out of 10 grants get triaged and nine out of 10 papers get rejected.

Second, generosity. You need to share and collaborate generously with colleagues; the scientist-narcissist is becoming an endangered species. You need to look after your team well and treat them as equals, as only in a flat organisational structure can creative ideas flourish.

Third, infinite curiosity. The thrill of discovering the unexpected from your research must be what gets you out of bed every day.
How can our local general practitioners (GPs) work together with the NUHCS in the fight to bring down cardiac cases?

The first thing that comes to mind is the results of a research study comparing patients with coronary heart disease in Singapore and the Netherlands. Patients were presented to cardiac catheterisation laboratory 10 years earlier than Dutch patients; despite this, their coronary artery disease was far more severe. We then looked back into possible reasons for this and we found factors at play – in addition to the Dutch having better lifestyle habits, such as regular exercise (90% of the Dutch population cycles) and much less smoking, we have also found that Dutch patients were more often started on medication for coronary heart disease risk factors, such as high blood pressure, high cholesterol and diabetes, way before they even need to come to the cardiac catheterisation laboratory. So early treatment of risk factors with early initiation of medical therapy will delay the onset of coronary heart disease and make it less severe when it actually strikes. The cardiologist does not even have to come into the picture till a decade later with good primary prevention.

What is a typical day like for you?

I am up at 5 am, sometimes earlier, to work on grants or papers that need focused attention. I usually exercise at 6 am or 7 am but may defer this to later in the day if my writing hits a creative high and I want to ride on that energy. I am in the cardiac catheterisation laboratory on some mornings or in the outpatient clinic. Afternoons are spent meeting with members of my research team and other collaborators. I try to have dinner with my family as much as possible and interact with my baby daughter by leaving the office each day at 7-8 pm. After my daughter goes to bed, I catch up on emails and reading. Like me, my research team is usually very busy in the day but it is often at night that they send me their most creative ideas on WhatsApp! I am really blessed to have parents with good health and an amazing life partner, Wern Miin. Career-wise, she is a highly accomplished cardiologist; yet, she is able to take care of our home and our little girl with great finesse. On top of that, she is able to squeeze in reporting echocardiograms on our myocardial infarction research studies. I wish I could be one-tenth as efficient as her!

Associate Professor Mark Chan is a Senior Consultant at the Department of Cardiology, National University Heart Centre, Singapore (NUHCS) and an Associate Professor with Tenure at the Yong Loo-Lin School of Medicine, National University of Singapore. He obtained his medical degree from the National University of Singapore and Master of Health Science degree from Duke University in Durham, North Carolina. He trained in interventional cardiology and platelet biology at the Montreal Heart Institute in Montreal, QC. He leads thrombosis and acute coronary syndrome research at the Cardiovascular Research Institute, Singapore.
Palpitations are the most common presenting complaint of patients attending the Arrhythmia Clinic. The most important tool in diagnosing the cause of these symptoms and identifying high-risk patients is good history taking.

My approach to palpitations:

Understand the frequency and duration of palpitations – how often does it happen and how long does each episode last? Sustained palpitations for more than 15 minutes would suggest pathological arrhythmias. A 24-hour holter monitor is unlikely to be diagnostic for a patient having symptoms once every few months.

Ask the patient to tap out his symptoms on the desk – useful trick which will tell you about the rate (most arrhythmias have rates > 120 bpm – it is quite tiring to tap at 120 bpm!), regularity (irregular beating suggests atrial fibrillation) and identify patients with ectopic beats (regularly irregular tapping with prominent pauses after the ectopic beat and is a very common complaint).

Identify precipitating and relieving triggers – arrhythmias occur unpredictably. Palpitations that occur only at fixed times or during stressful circumstances such as school exam periods, family bereavement suggest sinus tachycardia.

How does each episode start? Sudden onset and offset of palpitations is suggestive of arrhythmias. Sinus tachycardia starts and stops gradually.

Are there accompanying sinister features such as chest pain, breathlessness or syncope? These should alert the clinician to investigate more thoroughly.

Does the patient have a personal or family history of cardiac disease or sudden death? Patients with ventricular arrhythmias are often known to have heart disease. Sudden death amongst relatives of less than 40 years of age should prompt interrogation of the family tree.

Do not be falsely reassured by a normal ECG. The majority of patients with pathological arrhythmias have a normal ECG when asymptomatic. The ECG only becomes abnormal during palpitations!

Diagnosis of common arrhythmias is frequently delayed, in part due to the sporadic nature of these conditions. The cardiac electrophysiology team at NUHCS provides daily arrhythmia and pacemaker clinics at NUHCS. Early detection of arrhythmias saves lives, prevents life-threatening complications such as stroke and sudden death and allows for prompt treatment with either anti-arrhythmic medication or, more effectively with catheter ablation, the latter is now by far the most effective treatment for almost all arrhythmias.

Dr Pipin Kojodjojo
Senior Consultant
Department of Cardiology, NUHCS

Dr Kojodjojo is actively involved in clinical research with an emphasis on applying novel techniques and therapies to improve catheter ablation and device therapy for complex cardiac arrhythmias. He runs regular arrhythmia and syncope clinics at NUHCS.
21 JAN 2017
Updates for GPs by NUH Sports Centre
University Orthopaedics, Hand and Reconstructive Microsurgery Cluster
NUHS Tower Block Auditorium,
2pm – 4pm

Regular physical activity and exercise are good for us. They help to maintain our health, prevent chronic illness and keep us happy. However, injury or illness may hamper us from being physically active. The NUH Sports Centre focuses on keeping people physically active. Its Core Aims are:

1. To **Provide Quality Clinical Care** to Individuals with sports-and-exercise-related injuries and illness, so that they can remain physically active.

2. To **Promote Sport and Exercise** as a means to improve health and well-being.

3. To **Support Education and Research** in the fields of Sports Medicine and Surgery.

Backed by a dedicated, skilled and experienced multi-disciplinary team, the NUH Sports Centre provides multi-disciplinary solutions to keep you physically active:
- Sports and Exercise Medicine
- Exercise Prescription
- Orthopaedic Sports Surgery
- Paediatric Sports Surgery
- Sports Imaging
- Sports Physiotherapy
- Sports Podiatry
- Sports Dietetics
- Sports Acupuncture
- Shock Wave Therapy

Event information listed is correct at time of print. While every attempt will be made to ensure that all events will take place as scheduled, the organisers reserve the rights to make appropriate changes should the need arises. Please refer to our events calendar at [www.nuh.com.sg/nuh_gplc](http://www.nuh.com.sg/nuh_gplc) for more updates and information.
7 MAY 2016

**GP CME - Management of Coronary Artery and Vascular Diseases at NUHCS**

At NUH, we understand and value the role of primary care physicians (PCP) as part of a larger integrated healthcare network that will form the foundation to improve the standard and quality of healthcare across the country in order to meet the needs of Singaporeans. Therefore, we are committed to organise regular Continuing Medical Education (CME) Symposiums for the PCPs in order to provide the latest clinical updates relevant to patient care. Our mission is in line with the government’s vision of Healthcare 2020 – accessibility, affordability and quality of healthcare.

Similar to previous years, National University Heart Centre, Singapore (NUHCS) took part in a CME Symposium in May 2016. This year’s focus was on coronary and peripheral vascular diseases. The event was chaired by Professor Tan Huay Cheem who acknowledged the important role PCPs play in the management of patients with cardiovascular diseases. An update on percutaneous management of coronary artery disease was given by Dr Loh Poay Huan, Consultant, Department of Cardiology; while Dr Rajesh Babu Dharmaraj, Consultant, Department of CTVS, gave an overview on peripheral vascular disease. In addition, Mr Adriaan Erasmus, NUH Principal Podiatrist, gave a lecture and hands-on session on wound care for patients with peripheral vascular disease. For the first time, we had incorporated a hands-on session that was aimed to share with PCPs on the diagnostic tests such as the echocardiogram and holter. The session was led by Dr Gavin Ng, Senior Resident, Department of Cardiology and was made possible with the collaboration from our Cardiac and Vascular Diagnostic Laboratory colleagues. The keen participation and interactive attendees had made every session interesting and informative for all.

With the data showing a decrease in smoking and an increase in diabetes, the healthcare focus is shifting towards prevention and management of chronic diseases. The percentage of smoking has slightly decreased from 14.3% in 2010 to 13.3% in 2013, while the percentage of diabetes has increased from 8.2% in 2004 to 11.3% in 2010. Additionally, the percentage of individuals aged 18-69 years found to be obese (BMI > 30 kg/m²) has also decreased from 6.9% in 2004 to 10.6% in 2010.
In Singapore, the number of death attributable to cardiovascular disease has been on the increase and cardiovascular disease accounted for 29.6% (5879 deaths or ~ 16 deaths/day) of all deaths in 2015. Alarmingly, a few major cardiovascular risk factors such as diabetes, obesity and smoking among the young have been on the increase over the past decade. According to the data from International Diabetes Federation in 2014, the prevalence of diabetes among adults between the ages of 20 and 79 years old in Singapore was 12.9%, which is approximately 50% higher than the world and regional average. More importantly, it was estimated that there were 287,900 cases of undiagnosed diabetes in 2014.

On the other hand, the life expectancy in Singapore has been increasing over the past 50 years and Singapore is currently ranked the third in the world with an average life expectancy at birth of 84.7 years (women - 86.1 and men - 80 years). In addition, the Singaporean average healthy life expectancy (HALE) in 2013 was 73.4 years in women (nine years above world average and ranked third in the world) and 70.8 years in men (10 years above world average and ranked second in the world). It has also been projected that 20% of Singaporean residents will be aged 65 and older by 2030.

With an aging population and the rising prevalence of cardiovascular risk factors, the demand on healthcare can only be expected to increase and PCPs may well be at the forefront to face such burden. Indeed, hypertension, dyslipidaemia and diabetes were among the top ten most common diagnoses in people attending primary care clinics (both private and polyclinic) according to the Primary Care Survey 2010. The same survey also found that at least 3% of the people attending polyclinics suffer from ischaemic heart disease.

Therefore, it is with the hope that these CME symposiums could serve as one of the means to bridge the gap and foster a closer collaboration between the primary care communities and specialist hospitals, not just in clinical care of patients, but also in education and research fronts. It is through such collaboration that effective health promotion can be carried out for prevention, early diagnosis and intensive treatment of various cardiovascular risk factors. An easily accessible healthcare system will also ensure early detection of cardiovascular diseases, leading to timely and evidence-based treatment in order to prevent or reduce associated morbidities and improve prognosis. Finally, with a well-structured healthcare system network, patients with chronic stable cardiovascular disease can have individualised management in a holistic approach within the primary or community care settings.
At the NUH, we recognise the pivotal role general practitioners (GPs) and family physicians play in providing and ensuring that the general public healthcare is of the highest quality and standard. As such, we believe that through closer partnerships, we can deliver more personalised, comprehensive, and efficient medical care for our mutual patients.

The GPLC aims to build rapport and facilitate collaboration among GPs, family physicians and our specialists. As a central coordinating point, we provide assistance in areas such as patient referrals, continuing medical education (CME) training, and general enquiries about our hospital’s services.

Through building these important platforms of shared care and communication, we hope that our patients will be the greatest beneficiaries.

NUH CME Events
At the NUH, we strive to advance health by integrating excellent clinical care, research and education. As part of our mission, we are committed to provide regular CME events for GPs and family physicians. These events aim to provide the latest and relevant clinical updates practical for your patient care.

Organised jointly by the GPLC and the various clinical departments within NUH, our specialists will present different topics in their own areas of specialties in these monthly symposiums.

For more information on our CME events, you can go to [www.nuhcme.com.sg](http://www.nuhcme.com.sg) or scan the following QR code.