Matters of the Heart

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There is an urgency to extend initiatives for cardiovascular health protection, such as increasing awareness for improved life style, nutritious and healthy food, and promote health wellness programmes to combat heart diseases. "Matters of the Heart" is designed to provide public health education in these areas.

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HEART FAILURE

AN INTERVIEW WITH PROF. G. VIJAYARAGHAVAN

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1. What is heart failure? Would you explain the difference between a heart attack and heart failure?

The heart is an organ made of muscles. Contraction in this muscular system is responsible for the pumping of blood to different parts of our body. During relaxation of the heart, right chambers of the heart get filled with impure blood coming from various parts of the body. This impure blood is purified in lungs and is directed to the left upper chamber (auricle) of the heart and then collected in the left lower chamber (ventricle) of the heart. During the next heart beat, this purified blood is pumped to different organs of the body. Heart diseases over a long

period of time can weaken your heart muscles. During each heart beat, the heart is able to pump out 50-70% or more of the blood from its lower chambers. Weak heart muscles lower pumping efficiency. Heart fails when it cannot pump blood as per the demand of the body systems. During the next relaxation cycle, the remaining blood volume in the right heart chambers reduces the amount of impure blood coming back to the heart from different organs. Reduced pumping ability of the heart results in significantly less blood flow and also affects the heart's ability to re-fill blood. The heart which normally beats at a rate of 60-80 beats per minute must have a constant supply of oxygen and nutrients. The coronary arteries are the network of blood vessels that carry oxygen- and nutrient-rich blood to the heart muscle tissue. If a block happens in any of the branches of these coronary arteries, the heart muscle tissue fed by the coronary artery is deprived of pure blood and stops functioning properly. This condition is called a heart attack. Heart attack in different parts of the heart results in further weakening of cardiac muscles.

2. What are the warning signs of heart failure?

Weakening of heart muscles has two outcomes. Muscles do not pump enough blood into arteries. As blood flow is not proper, it gets collected in veins. Inadequate blood flow to various parts of the body causes tiredness in the patient. Reduced blood flow to kidneys lower urine output and fluid starts accumulating in the body and is seen as swelling of the

legs and in late stages, as fluid accumulation in the abdomen. Patients will acquire more weight too. Inadequate draining of blood from the lungs results in abnormal collection of blood in the lungs causing breathlessness. In the initial phases, it affects the patients during walking only, but at later stages it can affect the patient even at resting.

3. What causes heart failure?

All heart diseases end in weak cardiac muscles. In our population, a common cause was heart valve damage due to rheumatic heart disease caused by streptococcal infections. We have been able to reduce this cause by various preventive programs. Another common cause is high blood pressure. High blood pressure or hypertension results in increased thickening of heart muscles. This is an adaptation to pump blood at a very high pressure. In the long term, muscles will get weak and pumping efficiency reduces. Yet another reason for heart muscle weakening is repeated heart attacks in patients with obstruction of arteries which supply blood to the heart. Shortness of breath during severe heart attacks is also due to weak cardiac muscles. Congenital diseases (birth defects) may cause breathlessness and further heart problems in children. Another reason is cardiomyopathy which directly affects heart muscles. This group of heart muscle disease includes those due to genetic causes, nutritional causes, long term damage after viral infections and many other rare causes.

4. How is heart health determined? How is heart failure diagnosed?

In assessing patients with heart failure, it is important to check the efficiency of their heart muscles and to determine by which treatment strategy weak heart muscles can be improved. Most important in the diagnosis procedure is to calculate the heart beat per minute. During muscle weakening, body will increase efficiency of heart by increasing the heart beat. In course of time, this would not give expected results. Treatment should target to reduce the heart rate of 110-130 per minute generally associated with heart failure to a normal 60-80 beats per minute. Breathlessness and oedema in patients are also to be treated and body weight reduced.

Echocardiography can accurately measure the strength of heart muscles. By this method, the amount of blood pumped by the heart can be assessed. Echocardiography can also assess the contractility of heart muscles. Nuclear heart scan using isotopes and heart magnetic resonance imaging (cardiac MRI) are better methods when compared to echocardiography to estimate the strength of cardiac muscles. A simple method by which the efficiency of heart muscles is assessed is to determine how much a patient can walk in six minutes.

5. How is heart failure in children different from that in adults?

Children with weak heart muscles have reduced food intake.

Infants because of shortness of breath are unable to suck enough milk. Not only breathless, they also get sweaty and get tired easily. Reduced food intake causes weight loss. The main reason for this condition is their inability to communicate their symptoms and discomforts.

6. How can we prevent heart failure?

The only way is to prevent weakening of the heart muscles. We have to prevent the causes that lead to any heart disease that would result in extensive damage to heart muscles. We were able to reduce heart diseases secondary to rheumatic fever in Kerala to a great extent. But in other states of our country, children still acquire throat infections which cause ensuing rheumatic fever resulting in heart diseases. This can be prevented if we diagnose early and prevent throat infections. High blood pressure and heart attacks are life style diseases. Taking a walk for an hour daily and reducing intake of fatty foods can help. Avoiding tobacco smoking and alcohol, reducing salt content in food etc can prevent the occurrence of high blood pressure and heart attack. Preventing these diseases will reduce the incidence of heart failure.

7. What is the current status of research on heart failure?

Heart diseases result in weak heart muscles. At present, research on heart failure is aimed at increasing efficiency of heart function. During the last two decades, two drugs have

made a significant change in the treatment scenario: beta blockers which slow down the heart rate and ACE inhibitors which improve cardiac function. Both these drugs have been shown to increase the life expectancy of patients with heart failure. Heart transplant surgery is a choice for severely damaged heart and patients who cannot be managed by medical treatment. Enough donor hearts are not available for transplant. Hence it is necessary to invent new treatment methods. One among such methods is the invention of a small device connected to the heart which can give electric impulse to prevent sudden death. Special pacemakers to improve the function of left ventricle of heart are also now available. This is useful in those patients who have to resort to hospital admission repeatedly because of a severely weak heart.

Artificial mechanical pumps are available for patients who have severe dysfunction of lower chambers of the heart. An artificial heart which is controlled by electric battery is connected to the patient's body and can be of help to prevent death in patients who are waiting for heart transplantation surgery.

8. How do you think research should be targeted in heart failure?

Even though new devices and drugs are found in modern medicine, they are not readily available to the common man. The main reason is the high cost of the treatments. Research should be targeted not only for the prevention and

management of heart diseases, but it should also aim to invent cost effective heart devices and drugs which are affordable to the common man. Pacemakers, which give electric impulse and prevent sudden cardiac death and special pacemakers (cardiac resynchronisation devices) which improve function of lower chambers of the heart used to cost around 10 lakhs earlier. Currently, they are available at nearly half the earlier price; the price should go further down.

9. Are there any routine diagnostic blood tests/ biomarkers to detect heart failure early?

Early diagnosis of cardiac muscle weakness will help in earlier treatment and will help in prevention of further muscle damage. Circulatory hormones produced by heart are significant in the early detection. BNP (brain natriuretic peptide) is a peptide which is produced from the lower chamber of the heart. High levels of BNP in blood indicate abnormal filling of blood in the left ventricle due to relaxed heart walls. BNP level can be determined by blood tests in speciality hospitals. This is an effective test for determining weak or damaged heart muscles.

Damage to heart muscle cells releases protein components from muscle cells to the blood stream. One such is troponin. Troponin level is increased in patients with heart failure. Their levels reduce as a result of good treatment response.

10. What are the treatments available for patients with heart failure?

Studies for finding treatment methods for oedema and abdominal swelling due to heart problems were started centuries ago. William Withering in 1885 discovered digitalis from plants. This drug was effective in increasing cardiac muscle strength and slowing down the heart rates there by reducing oedema. In 1960's, drugs to increase urine output were discovered. This helped to reduce oedema due to heart diseases. Beta blocker, which was found to reduce heart rate, was introduced in the recent past. Discovery of ACE inhibitors have brought great changes in treatment strategies. Above all are the changes in lifestyle. Earlier patients with heart failure were advised bed rest. Now patients are asked to slowly walk every morning and evening as it is found to be more effective. Reducing salt in food can reduce oedema. Water intake by patients should also be regulated. In instances where these treatments fail, new methods are used.

11. Are there surgical treatment options for heart failure? What are they?

Studies in several countries now target at rejuvenating heart muscles in a damaged heart. Heart diseases result in heart muscle cell death and leads to dysfunctional scars. Our current aim is to replace these scarred tissues with healthy heart cells. In most heart diseases, the heart tries to heal itself by replacing the damaged or dead heart muscles with healthy

cells. In patients who had heart attacks, it was observed that stem cells circulating in blood try to alter into heart muscle cells. But this conversion is limited in effect. Strategies in which stem cells are introduced into arteries supplying the heart seem to be a hopeful approach. Clinical trials to test the efficacy of stem cells are progressing in patients with heart failure.

12. Can stem cells be used in treatment of heart failure?

Stem cells are not used as a routine treatment method at present. Several issues connected to this method are to be resolved. Stem cells delivered to the heart integrate with heart muscle cells and can start beating. They have the capability to contract and relax too. But we are not yet sure how long they can continue to survive and perform this activity. Several of these replaced cells are found to die in course of time.

We need to identify the best source from where the stem cells can be collected and how they can be delivered to the heart. Most experimental studies have used bone marrow stem cells which are cultured and then used for interventions. Some research groups have isolated stem cells from the heart itself. If stem cell research becomes successful, a novel and efficient treatment for heart failure can be expected.

13. What is the main cause of a steep increase in cardiac problems amongst youngsters less than 40 years of age in India? What advice would you give them?

In India, the number of patients with heart diseases is increasing. Our society is growing and most of them are in their middle age. Our youth population develop heart disease 10 years earlier when compared to those in USA and Europe. The main reason is our lifestyle. During the last 25 years, our lifestyle has changed considerably. As a society, we have become less physically active. We need to change ourselves to a physically active society. Food habits have also changed in our society. A high carbohydrate and low fat diet has now changed to a high fat and high protein diet which possibly does not suit our genetic makeup. Quantum of food intake has also increased. Food intake has to be regulated according to each person's energy requirement. Fat intake should be reduced. Only 3-4 teaspoon oil per day is enough for a person. Equally important is to reduce salt in food. We should eat more fruits and vegetables. A good lifestyle will help in maintaining better heart health and prevent heart problems.

10 COMMANDMENTS FOR A HEALTHY HEART

1. Reduce large food intake and thus reduce overweight. Most important is to find children who are overweight and give awareness to them and their parents regarding change in diet. This will help in creating a healthy future population.

2. Stop smoking completely.

3. Alcohol is injurious to health. Alcohol is not a medicine for heart disease in any way. Avoid alcohol consumption.

4. Exercise for minimum 1 hour a day. Children and adults should engage in some playing activities or exercise. More playgrounds for children and parks for walking for adults should be maintained by the help of panchayats, municipalities and corporations.

5. All who have crossed 30 years of age should take a medical examination once in every 3 years. They should check their weight, blood glucose, cholesterol and lipid profile during this examination.

6. Those who have family members with history of heart attacks, strokes and high blood pressure should undergo medical examinations even before they reach 20 years of age. Schools and colleges should have facilities for this.

7. It would be good if all Government and private hospitals and other health institutions in Kerala give their lab facilities free of charge for a day in a week. This day can be used for blood sugar and cholesterol check-ups.

8. Salt intake through food is more in the Kerala Population. This needs to be regulated. Salt is needed just to add taste to the food. By reducing salt, 20% of blood pressure can be reduced.

9. Vacations and weekends should be spent with family for mental relaxation. A relaxed and happy mindset is good for maintaining good health.

10. During pregnancy, expectant mothers should have balanced nutritious food. This will help in the growth and development of organs, especially internal organs in the fetus. Children of healthy mothers will have less chance to have diabetes, high blood pressure and stroke when they reach 40-50 years of age.

If we are able to focus on the above ten points, we can expect that in the next 10 years, lifestyle diseases in our society would be reduced by 30%.

ENVIRONMENT POLLUTION AND CARDIOVASCULAR DISEASE

Mira Mohanty

Yes, there is a definite association of increased air pollution with pulmonary and cardiovascular diseases. As recent as August, 2016, a very meticulously designed study, the largest to date, by Kaufmann and his colleagues has brought to the fore the dangerous association between environmental pollution and coronary artery calcification (CAC) (Kaufman *et al,* 2016). The Kaufmann study followed numerous reports on the association of air pollution with cardiovascular diseases. Contribution of particulate matter air pollution to cardiovascular disease (ischemic heart disease, heart failure, cerebrovascular involvement, peripheral arterial and venous

diseases, cardiac arrhythmias and arrest) and deaths was first announced as a statement by the American Heart Association in 2004 (Brooke *et al,* 2004, updated in 2010 (Brooke *et al,* 2010). Birth defects of heart have also been found to be more in areas of high industrial pollution.

Kaufmann and colleagues studied the pattern of exposure to pollution in about 7000 people in different areas in the USA over a period of 10 years, noted the progress of CAC and delineated a definite association. The exposure assessment relied on monitoring campaigns and advanced spatio-temporal modelling. Ultrasound examination to determine thickness of the vessel wall, CAT scan to track calcium deposition in the coronary artery and blood pressure examination formed part of the medical data collection.

Fine particulate matter (PM) less than 2.5 µm in diameter was found in concentrations ranging from 9.2 to 22.6 µgm/ m^3 and CAC progressed across all the participants. They found that particulate matter and high levels of nitrogen oxide can age blood vessels and cause an increase in calcification in the coronary artery. Further, the association between long term exposure to $PM_{2.5}$ and cardiovascular disease is observed irrespective of socioeconomic strata of the population studied (Chi *et al,* 2016).

During the last decade, environmental pollution has been in the news for its effect on life in general. Today, we are very much aware of the effect such pollution has on human health.

Is the air we breathe in, safe? The air we breathe in carries oxygen and other gases, which are carried from the lungs to each and every cell of our body. Each cell needs this oxygen to keep its machinery working. The air we breathe out carries carbon dioxide which is formed in the body and released from cells.

We also breathe in whatever is suspended in the air in the environment - gases, liquids and particulate matter. Our body does have mechanisms along the passage way to the lungs as well as in the lungs to filter out these pollutants. However, there is a limit for everything; so too, for these pollutants. Above a certain limit, we are overcome with various diseases of lungs and heart caused by these pollutants.

Tiny solid particles or liquid droplets suspended in the air are considered as particulate matter (PM). They vary in size in a mixture. Coarse particles of 2.5 to 10 μm in diameter (PM 10) come from the road, tyre wear, construction materials and demolition dust. Particles 2.5 μm (PM 2.5) and less than 2.5 μm mainly come from traffic emissions and industry. These are the particles which have been found to predominantly affect the cardiovascular system. The ultrafine particles (UFPs) less than 0.1 μm are emitted from tail pipes of vehicles.

Pollution of the environment with these particulate matters has spiralled high all over the world. We are experiencing this increase in our country too, particularly in large cities with high vehicular traffic and industries.

Environmental pollution leads to increased mortality; this was made so clear in the historic Harvard Six Cities Study, in which around 8,000 people in polluted and non-polluted cities were studied for about 14 to 16 years (Dockery *et al*). The report indicated for the first time the link between increased pollution and long term increase in death rates. Following reports on this association worldwide, currently, it is believed that there is a significant relationship between pollution and deaths from cardiopulmonary diseases (Bhatnagar, 2006).

How does all this really happen?

Studies on mechanisms of cardiovascular diseases suggest that development of coronary atherosclerosis (occlusive disease of blood vessels supplying the heart), may be accelerated either over a period of time or even suddenly by triggering of an arrhythmia (abnormal heart rhythm) or myocardial infarction (death of heart muscles) by acute inflammatory responses, altered platelet (small circulating cells involved in blood clotting) adhesiveness, or perhaps vascular endothelial (inner lining cells of blood vessels) dysfunction. There is also a causal association between active and passive smoking and heart disease.

Gases and ultrafine particles may cross directly into blood circulation through the pulmonary epithelium (lining cells of air spaces in the lungs). Particulate interaction with epithelial cells may activate pulmonary neural reflexes with resulting changes in autonomic tone thus affecting

plaques in blood vessel walls or initiate abnormal heart rhythms (arrhythmias). The pollutants over time, may cause pulmonary oxidative stress (releasing oxygen free radicals) or causing inflammation which could gradually assume a systemic inflammatory state leading to activation of blood clotting pathways, derange vascular function and enhance fat deposition in vessel walls. Presence of suspended particles in the air we breathe increases fibrinogen (a clotting factor) in the blood which in turn increases blood viscosity. The association between increased blood viscosity in relation to cardiovascular disease is well known.

Air pollution is also linked to heart failure. Inhalation of particulate matter is associated with increased systemic blood pressure and constriction of small blood vessels as well as an increase in lung and right ventricular filling pressures during relaxation. Along with arrhythmias, this imposes an increasing demand on the failing heart, potentially precipitating acute failure. Further, death of heart muscle causes loss in contractile capacity and inhalation of particulate matter has been found to be associated with adverse ventricular remodelling and a worsening of scar formation in the heart. All these factors collectively affect heart function.

Environmental pollution is a major problem the world over; newspaper headlines state “Poison in the air”. Environmental pollution by industries in 1952 in London which killed about 12,000 people led to the air pollution legislation. But today it is

the transport vehicles that are the dangerous contributors to air pollution. Petrol and diesel emissions, particulate matter, oxides of nitrogen, volatile organic chemicals and secondary phytochemical production of ozone collectively pollute the air we breathe. A collaborative effort by the Royal College of Physicians and the Royal College of Pediatrics and Child Health carried out a large study on the health of individuals exposed to both indoor and outdoor air pollution. The report *'Every breath we take: the lifelong impact of air pollution'* submitted in February 2016 (Royal College of Physicians, 2016) is alarming and throws light on the close association between inhalation of primary and secondary small and ultrafine particles (PM10, PM 2.5 and PM0.1) and deaths from cardiovascular and respiratory disease. No age is safe. Particulate matter impairs fetal growth, increases risk of asthma and affects heart and lungs by direct toxicity and via mechanisms that mediate gene and environmental interactions. It can also lead to adverse effects such as development of impaired cognition, type 2 diabetes, cancers, skin aging and is a risk factor for obesity as well. Stephen Holgate's call for action is indeed timely (Holgate, 2017).

Our country, India does not lag far behind. Figures provided by the Central Pollution Control Board for the last block of 4 years *ie* 2011 to 2015 reveal breach of annual pollution limits in a third of Indian cities. 680 pollution monitoring units in 300 cities all over the country have measured particulate matter, nitogen dioxide and sulphur dioxide.

Startling findings in India were revealed in February 2013, by the Global Burden of Disease report, an initiative of the World Health Organisation. The Indian and South Asia-specific data, released at a Dialogue Workshop jointly organised by the Centre for Science and Environment, Indian Council of Medical Research and the US-based Health Effects Institute, revealed air pollution as the second largest killer in India with pre-mature deaths being mainly due to respiratory and cardiovascular diseases [stroke (25.48%) and ischemic heart disease (48.6%)].

Breathe in breathe out, breathe in breathe out....this is the basic feature of *Pranayama*. It is the air around us that we breathe in and breathe out, in and out of our lungs day and night. Is the air in our cities safe today for *Pranayama*?

References

Kaufman JD, Adar SD, Barr RG, Budoff M, Burke GL, Curl CL, Daviglus ML, Roux AV, Gassett AJ, Jacobs DR, Kronmal R. Association between air pollution and coronary artery calcification within six metropolitan areas in the USA (the Multi-Ethnic Study of Atherosclerosis and Air Pollution): a longitudinal cohort study. *The Lancet.* 2016 August; 388(10045):696-704.

Chi GC, Hajat A, Bird CE, Cullen MR, Griffin BA, Miller KA, Shih RA, Stefanick ML, Vedal S, Whitsel EA, Kaufman JD. Individual and neighborhood socioeconomic status and

the association between air pollution and cardiovascular disease. *Environmental Health Perspectives.* 2016 December;124(12):1840.

Dockery DW, Pope CA, Xu X, Spengler JD, Ware JH, Fay ME, Ferris Jr BG, Speizer FE. An association between air pollution and mortality in six US cities. *New England Journal of Medicine.* 1993 December;329(24):1753-9.

Bhatnagar A. Environmental cardiology: studying mechanistic links between pollution and heart disease. *Circulation Research.*2006 February; 99: 692–705.

Brook RD, Franklin B, Cascio W, Hong Y, Howard G, Lipsett M, Luepker R, Mittleman M, Samet J, Smith Jr SC, Tager I. Expert Panel on Population and Prevention Science of the American Heart Association. Air pollution and cardiovascular disease: a statement for healthcare professionals from the Expert Panel on Population and Prevention Science of the American Heart Association. *Circulation.* 2004 June ;109(21):2655-71.

Brook RD, Rajagopalan S, Pope CA, Brook JR, Bhatnagar A, Diez-Roux AV, Holguin F, Hong Y, Luepker RV, Mittleman MA, Peters A. Particulate matter air pollution and cardiovascular disease. *Circulation.* 2010 June; 121(21):2331-78.

Holgate ST. 'Every breath we take: the lifelong impact of air pollution'–a call for action. *Clinical Medicine.* 2017 February; 17(1):8-12.

RESEARCH NEWS

A 'stiff' drink a day builds stiff arteries overtime

Drinking heavily can cause stiffness of the arteries of the heart affecting its elasticity and causing premature aging of the arteries ultimately interfering with regular blood flow. Researchers from the University College of London found that men who were heavy drinkers were at risk for accelerated arterial stiffness compared with moderate drinkers. This trend was not found in females perhaps because 73% of the populations studied were males. These findings were recorded over a period of 25 years in 3869 participants. The data was sourced from the Whitehall II cohort study which recruited 10308 civil servants living in the United Kingdom.

Moderate drinking has been long reported to reduce risk of cardiovascular disease. The question that arises is how to distinguish between 'heavy drinking' and 'moderate drinking'. In this study, published in the *Journal of the American Heart Association* (JAHA, January 2017), researchers compared data about participant's alcohol consumption with carotid femoral pulse wave artery velocity (PWV) measurements. PWV is measured between the main arteries found in the neck and the

thigh. Greater the velocity, stiffer the artery. Intake of alcohol was measured periodically across 25 years and these long term intake patterns were correlated with pulse wave velocity and its progression over a span of 4 to 5 years. Heavy drinking was defined as more than 112 grams of ethanol per week and moderate as 1-112 grams of ethanol per week. Results of the study indicate that male participants who habitually consumed heavy volumes of alcohol had significantly higher PWV than consistently moderate consumers.

As per American Heart Association (AHA), moderate alcohol consumption is an average of one to two drinks per day for men and one drink per day for women. More than this and in excess can cause alcohol dependency and increase blood pressure, obesity, cardiovascular disease risk, stroke and certain cancers. Dr Darragh 'o' Neill, the lead author of this study from University College London says that heavy alcohol intake may activate enzymes that lead to collagen accumulation which causes arterial stiffness, whereas moderate drinking may increase high density lipoproteins (the good cholesterol) levels and decrease platelet stiffness thus improving cardiovascular health.

Reference

O'Neill D, Britton A, Brunner EJ, Bell S. Twenty-five-year alcohol consumption trajectories and their association with arterial aging: a prospective cohort study. *Journal of the American Heart Association.* 2017 February ;6(2):e005288.

Surya Ramachandran

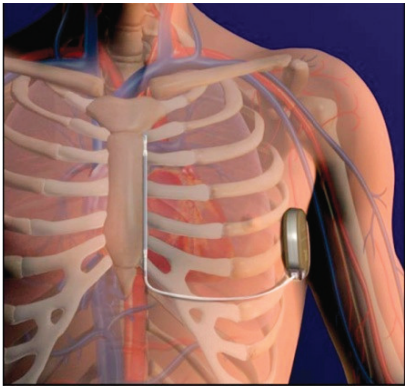
Towards personalized care for heart diseases

Personalized medicine enables use of customized diagnostic and screening methods to meet the progress of an individual patient's disease status or predict tendency toward a disease. Metabolomics is an emerging field of medicine that uses strategies to identify and quantify different metabolic parameters, like measuring thousands of small molecules in body fluids, such as blood, urine, spinal fluid or fluids inside cells using sophisticated analytical tools. Study of metabolomics can offer improvement in diagnosis and treatment of several conditions including cardiovascular diseases. Traditional cardiovascular risk factors considered include age, sex, blood pressure, lipids, smoking and diabetes. Routine monitoring of biochemical factors like blood glucose levels, cholesterol, HDL/LDL ratio etc also helps clinicians to assess heart health. These factors, however, allow clinicians to measure only a very small part of the information contained in the body fluids whose variations are correlated to health and disease states of an individual. This necessitates the need for a far more comprehensive system that measures a wide set of metabolic parameters. Such detailed information would allow clinicians to understand how disease develops and spreads, identify diagnostic markers of different diseases, understand the genetic reasons behind several disorders, classify patients based on the changes in body fluids and also note how well

an individual responds to treatments or monitor recurrence of diseases.. Advanced studies in metabolomics is expected to help the search for novel, robust and cost-effective risk markers for heart diseases and there by provide a more personalized approach of treatment.

Aghila Rani

Implants to treat abnormal rhythms and heart failure



A Subcutaneous Implantable Defibrillator (S-ICD) system

Heart failure is a serious medical condition where the heart does not efficiently pump the blood. In this condition, the amount of oxygen and nourishment circulating throughout the body is compromised as the heart cannot work to meet the demands of the body. It is the most common cause of hospitalization in patients over 65 years of age. Cardiac resynchronization therapy devices are designed to treat heart failures and it helps to maintain blood flow through the heart. An example is implantable Cardioverter-Defibrillators (ICDs).

They have been proven to be superior to medical therapy in treating potentially life-threatening abnormal rhythms of the heart. The technique involves simultaneous pacing of

both the chambers of the heart in a synchronized manner. First introduced in 1980s, ICDs have shown noteworthy survival benefits in individuals at risk for abnormal heart rhythms (arrhythmias). Use of conventional ICDs are however associated with serious procedural and long-term complications in young patients. Removal of implanted devices, which is occasionally required, is also associated with serious procedural risks and high mortality rates. Recent advancement in this field is the development of Subcutaneous Implantable Defibrillator (S-ICD) systems that eliminate the risks associated with the conventional leads that are used on or in the heart. Advantage is that S-ICDs are implanted under the skin on the side of the chest below the arm pit and not in or on the heart. They are programmable devices that allow the doctor to provide tailored therapy for the patients. Clinical studies are ongoing to further establish the long term safety and efficacy of S-ICD systems.

Aghila Rani

Childhood obesity and risk of cardiovascular disease in old age

Childhood obesity is associated with several clinical complications, higher cardiovascular disease risk and a lower quality of life. Until recently, the impact of childhood obesity on overall physical abilities when these individuals attain old age was not clear. As a part of the Chicago Healthy Aging study, researchers from Northwestern University in Chicago, USA evaluated a group of 1,325 men and women. These individuals were initially examined in 1967-1973 and again during 2007-2010 in a 39 years follow up study. Physical capabilities in these subjects were measured using a SPPB score (Short physical performance battery) to assess static standing balance, walking speed, and getting in and out of a chair in specific time periods.

At the follow-up, subjects who were overweight when they were younger and had gained more than 20 or more pounds thereafter, were more likely to have a low SPPB score which denotes worst performance, slow walking speed and low hand grip strength when compared to those participants who had normal weight at base line with minimal weight change, independent of other risk factors for cardiovascular disease. Dr Thanh Huyen Vu presented these findings at the recent American Heart Association's (AHA) Epidemiology and Prevention, Lifestyle and Cardiometabolic Health 2017 Scientific Sessions in Oregon and concluded that overweight

youngsters who continue to gain weight have significantly worse physical capabilities in their old age when compared with their peers whose weight remains normal.

The Bogalusa Heart Study which began in 1972 as an epidemiology study of cardiovascular risk factors in children and adolescents also reported a direct relationship between childhood overweight and cardiovascular diseases later in early adulthood.

Results of these two studies highlight the fact that prevention is better than cure. Preventive efforts in lifestyle diseases such as heart disease, obesity and type 2 diabetes mellitus should start at a young age, for a longer and healthier life.

References

1. Vu TH, Carnethon MR, Liu K, Lloyd-Jones DM, Ogbole GI, Garside DB, Daviglus ML. Obesity Status in Younger Age, 39-year Weight Change and Physical Performance in Older Age: the Chicago Healthy Aging Study (CHAS). *Circulation.* 2017 March;135:Suppl 1

2. Berenson GS. Bogalusa Heart Study: a long-term community study of a rural biracial (black/white) population. *The American Journal of the Medical Sciences.* 2001 November; 322(5):267-74.

Sumi S

Papaya and Guava: Super foods that heals!

Fruits of Papaya and Guava are nature's marvellous gifts to mankind. Indeed, they are life enhancing medicines packed with vitamins (B vitamins, folate and pantothenic acid), antioxidants (carotene, vitamin C, flavonoids) and minerals (potassium, copper and magnesium) and the dietary fibre. These super foods are helpful in the prevention of fatty deposits in blood vessel walls (atherosclerosis). The intake of nutrient-dense food prevents oxidation of cholesterol. Only when cholesterol becomes oxidized it is able to stick to and build up in blood vessel walls, forming dangerous plaques that can eventually obstruct blood flow in vessels and result in heart attack or strokes.

An extremely high level of vitamin C in guava stimulates the production of collagen and elastin. These structural proteins keep our skin firm and elastic, veins and arteries strong and

toned, thereby improving blood circulation within our body. Rich fibre content and bioactive constituents of guava have the potential of lowering blood glucose levels. Eating fruits as a part of a healthy diet can be part of an alternative and complementary treatment to keep many diseases at bay. Guava and papaya have a low glycemic index.

According to Tey *et al,* papaya and guava influences glycemic response (GR) in both elderly and young adults. Elders who restrict fruits with the assumption that fruits increase blood glucose may be reassured that consuming guava and papaya is nutritionally advisable. It is reassuring that all forms and types of the fruits have low glycemic indices. Hence, it is advantageous to inculcate the habit of fruit intake as a part of the diet. These fruits which are low energy dense but nutrient dense food, can improve glycemic control and diet quality in the elderly. Their overall benefits are manifold!

Reference

Tey SL, Lee DE, Henry CJ. Fruit form influences postprandial glycemic response in elderly and young adults. *The Journal of Nutrition, Health & Aging.* 2017 February; 15:1-5.

Ciji Varghese

More to heart disease than modern diet

Is fat deposition in blood vessel walls (atherosclerosis) a disease of modern diet? "No" says Prof. Thomas, author of an article published recently in *The Lancet*. Atherosclerosis is often considered to be a disease of modern times, related to a sedentary lifestyle. Its prevalence before the modern era was unknown. Recent reports shed light on the incidence of atherosclerosis in mummies from many cultures across four different geographical regions over several time periods with varying lifestyles, diets and genetics. These findings suggest that our understanding of the causative factors of atherosclerosis is incomplete.

Thomas and his group performed CT scans on 137 mummies from four different ancient populations: Egyptian, Peruvian, the ancestral Puebloans of south-west America and the Unangans of the Aleutian Islands in Alaska. The Egyptians were embalmed, whereas the other bodies were preserved naturally by bare or freezing conditions. The four selected groups had different lifestyles — for example, the Ancestral Puebloans were farmers, whereas the Unangan were hunter–gatherers with an exclusively marine diet. The mummies' scans analyzed by the researchers for calcified plaques along the expected course of an artery were diagnosed as probable or definite atherosclerosis in 47 (34%) of the 137 mummies

in all the four populations. Post-mortem studies done as long ago as the mid-19th century, revealed atherosclerosis in ancient Egyptians. A previous study using CT scan also showed atherosclerotic calcifications in the aorta of the Iceman, who is believed to have lived about 3200 BC and was discovered in 1991 in a high snowfield on the Italian-Austrian border. The researchers concluded that atherosclerosis was common in four pre-modern human beings including pre-agricultural hunter-gatherers.

Although commonly assumed to be a disease of modern times, the presence of atherosclerosis in pre-modern human beings and across a wide span of human history raises the possibility of a more basic predisposition to the disease. The presence of atherosclerosis in pre-industrial populations suggests that it is not a characteristic of any diet or sedentary lifestyle but an inherent component of human ageing.

Reference

Thompson RC, Allam AH, Lombardi GP, Wann LS, Sutherland ML, Sutherland JD, Soliman MA, Frohlich B, Mininberg DT, Monge JM, Vallodolid CM. Atherosclerosis across 4000 years of human history: the Horus study of four ancient populations. *The Lancet.* 2013 April ;381(9873):1211-22.

Dhanya Rajendran

Soft robotic sleeve supports heart function

Soft Robotic Sleeve

(Image courtesy: Harvard University)

Heart failure is a condition where the heart is unable to pump sufficient amount of blood to the body due to weakening of heart muscle, leading to disability or death. The main symptoms of heart failure are shortness of breath, especially when lying down, swelling in the feet and ankles, on a sudden weight gain. Patients in end-stage heart failure when other medical or surgical treatments have failed are often considered for heart transplantation. As donor organ availability is limited, many patients die awaiting transplantation.

In some cases, in those patients who have severe heart failure, doctors advise a mechanical support to the failing heart using ventricular assist devices (VADs). Ventricular Assist Devices (VADs) are used as a life-prolonging therapy, either as a bridge to transplant or as a 'destination therapy', meaning the device remains implanted for the rest of the patient's life where heart transplantation is not an option. It is a battery-operated, mechanical pump-type device that is surgically implanted. It helps continue the pumping capacity of a heart that cannot work effectively by its own.

VAD is called as a 'bridge to transplant' because sometimes patients might wait for a long time for a suitable heart for transplantation. During this wait, patient's already-weakened heart's function may get worse and become unable to pump enough blood to sustain life. During this time VAD can help the weak heart and reduce the need for a heart transplant.

The use of VAD increases the risk of thromboembolic (formation of blood clot) events including stroke, which may occur in up to 20% of patients. Blood clots in the legs that may travel to the lungs and blood clots that form in the device, sometimes leading to heart attack or stroke, and infections are the major risk factors in the usage of VAD.

Sometimes, most external devices reverse the normal twist of the heart and act differently from the remaining native cardiac contraction mechanisms. Many of these devices do not integrate and synchronize with native cardiac

contraction mechanics and direction, and some cannot assist the relaxation (filling) phase of the cardiac cycle. Because of these reasons it is important to discover the shortcomings of existing technologies and thus increase the efficiency of the failing heart to pump sufficient amount of blood.

To overcome these disadvantages, Roche and colleagues invented a soft robotic device with material properties analogous to native heart tissues (cardiac muscles) that can be placed tightly around the heart and provide ventricular support without contact of blood. The robotic sleeve uses compressed air to power artificial silicon muscles that compresses and twist, mimicking the movement of the normal human heart. They could show that this device increases cardiac ejection volume using adult pigs with drug induced cardiac arrest. The efficacy of soft robotic sleeve as a cardiac assist was validated in pigs with acute heart failure induced by infusing esmolol, a short acting cardioselective beta blocker that reduces contractility and cardiac output.

The main advantages of using soft robotics for cardiac compression are the ability to apply timing schemes to optimize the actuation sequence which can simultaneously monitor and record physiological performance parameters such as heart rate and pulmonary artery and ascending aorta pressures and flow rates. Inflammation at the device-tissue interface, a major risk factor of using VAD, can be controlled.

Unlike VADs (currently in clinical use) which cause forced

non-physiological motions that do not mimic the natural motion of the heart, soft robot device restore circulatory function without contact of blood. This device prevents the need for anticoagulation among patients receiving mechanical circulatory support, thus reducing the risk of complications from clotting, simplifying treatment, and reducing costs. Different from currently used supports, the soft robot sleeve uniformly squeezes the heart from the outside or use twisting action alone to achieve circumferential and longitudinal shortening of the ventricle, which finally increases ejection fraction.

The soft robot sleeve can mimic the dynamically changing mechanical properties of the native tissue throughout the cardiac cycle. As robot mechanism can be recorded and monitored periodically, it can be turned off when no longer required, and clinicians can switch the device either as a passive restraint device, or for partial support, or full support. Thus, the device provides a versatile platform to manipulate the mechanical environment of the heart to target cardiac rehabilitation or recovery.

The current version of the device is a tethered implantable system and uses wall-compressed air supply for actuation. Roche and colleagues are trying to modify the device by connecting a fluidic tethered external pump to the soft robotic sleeve; it could serve as an additional channel for the delivery of agents that promote regeneration or prevent abnormal

heart rhythms (arrhythmia).

Roche and colleagues thus present an active sleeve that is modifiable to patient-specific needs and has a potential to bridge a heart failure patient to transplant or to aid in cardiac rehabilitation and recovery. The device can act as artificial muscles for selectively activating to twist, compress, or perform both actions on one side or both sides of the heart. Thus this artificial support helps the failing hearts to increase cardiac ejection volume during heart failure.

Reference

Roche ET, Horvath MA, Wamala I, Alazmani A, Song SE, Whyte W, Machaidze Z, Payne CJ, Weaver JC, Fishbein G, Kuebler J. Soft robotic sleeve supports heart function. *Science Translational Medicine.* 2017 January;9(373).

Vinitha A

Early age onset of hypertension is linked to cardiovascular disease risk

Hypertension is defined as abnormally high blood pressure against the walls of arteries and it often occurs when a blood vessel is narrowed or blocked. More precisely, it can be defined as a blood-pressure reading of ≥140/90 mm Hg. We all know that hypertension increase the risk for heart diseases, stroke, and kidney problems. But the risk related to an early age onset of hypertension has not been known.

A group of researchers have analyzed the data from the Framingham Heart Study (1948-2005) and identified that the age at which a person is diagnosed with hypertension predicts the chance for dying of heart disease. The Framingham Heart Study was conducted in 5209 adults in the age group of 30 to 62 years and they were followed up for 6 decades. In the follow up period of 60 years, 1151 patients died of heart disease at the mean age of 77 and 26% of them had been diagnosed with hypertension when they were 45 or younger. Persons who had early onset of hypertension (below the age of 45) are more prone to have heart diseases than those who had the onset after the age of 62 years. Eminent researcher Dr Teemu Niiranen presented these findings at the recent American Heart Association Epidemiology and Prevention - Lifestyle and Cardio metabolic Health (EPI-Lifestyle) 2017

Scientific Sessions and concluded that "it really makes a difference, not just that you have hypertension, but the age at which you get hypertension". Some previous studies have considered younger individuals with early onset hypertension under a less risk category. The present study suggests that hypertension at any age could increase the risk of dying from heart disease but having it at an early age makes the situation more dangerous. Niiranen and colleagues concluded that "Our results underscore the need for appropriate care in those at-risk individuals and potentially, more active anti hypertensive therapy," rather than using a wait-and-see approach.

Jaya Mary Thomas

Naked mole rats – a novel lead to combat heart attack

A group of naked mole rat

The Naked mole rat, a hairless rodent lives in underground colonies of tunnels and nests in regions of East Africa. Evolutionary tweaks in the amino acid sequence of tyrosine kinase A (TrkA) receptors, the pain sensors in the body make the naked mole rats incredibly insensitive to pain. These rats show fewer signs of aging and almost never get cancer. A group of neuroscientists and physiologists at the University of Illinois in Chicago and the Max Delbrück Center for Molecular Medicine in Berlin, have discovered that naked mole rats could survive for 18 minutes without oxygen. Scientists put the naked mole rats, and mice in a chamber lacking of oxygen. In this experiment, mice died within a minute, while in naked mole rats, heart beat slowed down from 200 - 50 beats per minute and they quickly became unconscious. These rats recovered when exposed to normal air, even after 18

minutes in the chamber. Researchers think that naked mole rats switch energy source to survive under these conditions. These rats had a higher level of fructose and sucrose in the blood. Also, they had a higher level of two essential enzymes of glucose metabolism, GLUT5 (transports fructose into cells) and PFK (converts fructose into a form that can enter energy generation pathway). These changes allow naked mole rats to use fructose as fuel instead of glucose, under oxygen lacking conditions.

Despite these observations, it is not clear whether switch in fuel is enough or slowed metabolism also has a significant role in the survival of the mole rats. Advanced understanding of the energy switch over by mole rats will be key in the treatment of various illnesses. Heart attack or stroke is a major killer disease in mankind. In these conditions, oxygen flow to the heart and brain is hindered and heart and brain cells begin to die within minutes. Increase in energy demand to supply ratio further deteriorates heart attack or stroke symptoms. It will be fascinating to see if activating the fructose pathway in patients with heart attack or stroke is a strategy for management.

Reference

Storz JF, McClelland GB. Rewiring metabolism under oxygen deprivation. *Science.* 2017 April;356(6335):248-9.

Vikas Kumar Panchal

PRO♥C is on!

As part of our Academy's mission, we have initiated programs in schools to promote good heart health. The aim is to spread awareness about keeping heart diseases during youth at bay by taking appropriate measures from the age of 13-15. Community level initiatives for increasing awareness about risk factors for cardiovascular diseases, which can enable preventive strategies early in life are inadequate. We believe that the change in perception of heart diseases and their preventive strategies is best initiated in an individual's formative years.

Promotion of Heart Health among Children (PRO♥C) is one of our first ventures in this direction. We intend to spread this program to all schools in the state of Kerala with campaigns in different forms such as educational lectures, walk challenges, interactive discussions, quiz competitions *etc.*

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