



FELLOWSHIPS
CARDIAC IMAGING



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IACI NEWSLETTER

Letter from the editor

Welcome to the first edition of the IACI newsletter to mark the beginning of the twenty-twenties. With a new year come not only new beginnings but also fresh initiatives and expectations. We are immensely pleased and proud to present this year's first newsletter of the IACI. This newsletter is a collective effort from the executive committee of the IACI, which has representation from all over India. From a nascent stage, cardiac imaging in India has grown to become an established subspecialty. The IACI has been instrumental in promoting cardiac imaging in the country, bringing together a healthy community of imagers interested in learning, developing, educating and practising cardiac imaging. In this issue, we will briefly chronicle this journey of the IACI. We have included a segment which honours all the previous IACI conferences as well as announcing events for 2020. We have added the link to talks from earlier conferences for those who would want to re-visit them. Fellowship programs available in India have been listed for those keen to pursue cardiac imaging.

The IACI is one large family, and we are incredibly proud of the achievements of its members! It is our rightful duty to congratulate and bring to notice the accomplishments of our members to all the



Illustrated by Dr Harshith Kramadhari MD, DNB, DM

readers. As the IACI community is getting larger, it is not easy to keep track of each member individually. We would, therefore, request our members to send in their achievements and peer-reviewed publications for upcoming editions of the newsletter.

Research in Cardiac imaging is

continually evolving, and it is pertinent to keep abreast of the latest in evidence-based medicine. We have included a review of recent publications on cardiac CT and MRI as well as added a section on must-read articles. No imaging is complete without exciting case discussions. So, put on your thinking caps and visit the part on CT and MRI cases in this issue. Knowledge shared = (Knowledge)².

Questioning is the best way to improve ourselves. Whether new or old to this subspecialty

With a belief in this equation, we invite all our members to feel free to contribute worked up routine to rare cases for the IACI website and the future newsletters.

Questioning is the best way to improve ourselves. Whether new or old to this subspecialty, it is always good to know and understand others' practices that may help give solutions or tips to implement in our practices. We have created a Q & A bit that hopes to briefly answer the questions asked by readers, based on methods of experts in the country.

An integral part of any cardiac imaging team is the Technologists. We could not have progressed this far without their effort and support. We have introduced a section for the technologists with a topic of interest. We request technologists to give us feedback and post any topics of interest for future editions. Being healthy is essential to live, enjoy and accomplish our goals in life. As doctors, we end up forgetting this basic necessity in the process of immersing ourselves in our work. With the heart being the centre of our subspecialty, we have introduced a get-fit section. It contains a brief introduction to a fitness regimen which promises to deliver even if it takes only a few minutes of our precious time. We are not practising what we preach here, but, hopefully, this will remind us about changes we could make towards a healthier future. We would not, however, like to end our first edition on a serious note. There is always room to laugh. This artistic cartoon piece completes our newsletter with a hearty laugh for those who appreciate art and humour.

We would like to sincerely thank all our members who help make the IACI a success as a community. We want to thank every one of our amazing and enthusiastic newsletter editorial team that helped put this newsletter together. We also thank Dr Hemant Telkar and Dr Rajesh Kannan for their support and contribution. We hope that this edition of the IACI newsletter will be well received. We anticipate contributions from all our members for future editions. We will be happy to receive feedback. Please write to us for anything at teamnewsletter@gmail.com.

Sincerely,

Ashita Barthur

Aparna Irodi

Editorial Team



Dr. Aparna Irodi

Dr. Ashita Barthur

Dr. Bhavana Nagabhushana

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Dr. Nilay S. Nimbalkar

Dr. Niraj Pandey

Dr. Navni Garg

Dr. Priya Chudgar

Dr. Pudhaivan

Dr. Ragini Sharma

Dr. Vishnu Vardhan Ravilla

Dr. Yashpal Rana

(left to right)

Every Q has an A

How to perform a computed tomography angiography (CTA) in patients with Congenital heart disease (CHD)?

1. Sedation – oral vs IV: The responsibility for sedation has gradually shifted from radiologists to anesthesiologists and intensivists at our institution with most of them requiring IV sedation to avoid motion during contrast injection. Sedation is rarely necessary for faster CT scanners. Oral Pedichloryl usually works for children below the age of three depending on multiple factors.
2. Beta blocker premedication before CT for congenital heart disease. Beta blocker premedication is useful to assess intra-cardiac structures and / or coronary arteries e.g. in the imaging of Anomalous origin of the left or right coronary artery from the pulmonary artery (ALCAPA or ARCAPA). However, this may not be required in fast scanners. On the other hand, in patients with Glenn or Fontan procedures, Beta blockers are usually not necessary to answer the clinical questions.
3. ECG-gated Vs Non-gated studies: We routinely perform non-gated scans in all patients with CHD. This is usually sufficient to give information about proximal coronary arteries. Retrospective gating is usually not required for CT. Instances where retrospectively gated scans are recommended are ALCAPA, ARCAPA or coronary cameral fistula.
4. IV line – site. I.V contrast injection using a power injector through a peripheral leg vein is preferable to avoid streak artefacts from dense contrast in SVC.
5. Contrast dose and flow rate. We use up to 1.5, 2.5, 3.5 and 5 ml/sec for 24, 22, 20 and 18 G IV lines respectively. Total dose of 2ml/kg is injected over the period of 10 secs.
6. Breath hold Vs free breathing techniques. A breath hold is ideal, but in small children and faster scanners, the breath hold is not possible or not necessary.
7. Cases where Dual injection (simultaneous upper & lower limb injection) technique is preferred over single injection technique:
 1. Post Glenn
 2. Post Fontan
 3. Pre Fontan with IVC interruption. Though the above explain routine practices at our institution, the CT study can be modified according to the availability of vascular access in a patient. I find that the dual injection technique allows for optimal visualization of all of the important structures in the above-mentioned clinical scenarios. In rest of the cases, single leg injection should suffice.

Compiled by
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Expert:
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B. How to perform Cardiac MRI (CMR) for CHD:

1. Sedation vs GA. In general, our anesthesiologists provide general anesthesia with endotracheal intubation for small children. Cooperative teenagers and adults do not require anesthesia.
2. Beta blocker for CMR. We do not use B blockers for CMR.
3. IV line – site (leg Vs hand), size. Typically, we use an upper extremity vein and use a single injection. Multiple dynamic post contrast images (minimum of 3) are used to ensure that all important vessels are imaged.
4. Contrast – dose, flow rate. I use a minimum of 1 ml of contrast. Our institution uses Multihance and I use a double dose (0.2 mmol/kg). Our maximum dose is 20 ml. I inject the contrast at a rate such that the injection time is approximately the same length of time as a single dynamic acquisition.
5. Use of phantom for phase contrast flow study. At our institute, we do not use any background correction methods.
6. Breath hold Vs free breathing – SSFP, Phase contrast. For younger children, free breathing techniques are used. For older patients, changes in heart rate associated with breath holding may necessitate free breathing techniques. We use breath hold for SSFP cine and free breathing for PC flow study.
7. MRI safety: cardiac valves, stent, sternal wires. Currently used cardiac valves and stents are MRI compatible, but standard publications allow for pre-procedure review prior to MRI for older equipment. I will perform MRI on patients with small, non-coiled sternal wire fragments but not on coiled, longer leads.
8. MR coronary angiogram – indications. I try to evaluate the coronary artery origins in all patients undergoing CMR to look for anomalies. However, if coronary anatomy is the primary concern, I prefer CTA.
9. ECG Vs pulse gating. I rarely use pulse gating. In recent years, cardiac ECG gating has become much more reliable.
10. Best sequence to accurately quantify stenosis for stenting: black blood, SSFP, PC or MRA? I think that diastolic gated non-gadolinium enhanced MRA is best for measurements.

C. How to read and interpret MRI for CHD?

1. Where to measure MPA, RPA, LPA (MPA size in pulmonary atresia). I measure the pulmonary artery midway between the valve and bifurcation. I measure the right pulmonary artery dorsal to the ascending aorta. I measure the left pulmonary artery midway between the origin and its bifurcation. Needless to say, any focal stenosis or aneurysm not in these locations is also measured.
2. MR ventricular volume assessment:
 1. Axial Vs Short axis view. I use a true short axis view for ventricular volumes since I perform all of my cardiac MRI measurements in this plane. However, it may be difficult to determine what actually constitutes a true short axis in a

particularly dysplastic heart. Many prefer an axial plane in patients with single ventricle physiology.

2. Include Vs exclude papillary muscle in the ventricular volumes. I think consistency is more important than any particular technique. I follow the convention of including the papillary muscles in the blood pool or within the ventricle lumen, but, do not if pressed against the ventricle wall. I include any part of the ventricle that contracts during systole, including the outflow tract, for volumetric measurements.

D. What will you prefer CT Vs MRI for suspected case of:

1. TAPVC. I prefer CTA for these cases since the patients are commonly very sick and present in the first week of life. Usually, patients with an obstructed TAPVC present to the CT department. MRA is more suitable for patients without obstruction.
2. Aortic arch anomalies/ coarctation. In babies, CTA is excellent for demonstration of collaterals and therefore pressure measurements are usually not necessary. However, MRA is better in older children and adults as we can use flow analysis to quantify collateral flow.
3. Pulmonary atresia with MAPCA. MAPCAs can be better visualized by CTA in infants.
4. Complex congenital heart disease such as TGA and DORV. Complex intra-cardiac abnormalities are better analyzed by CTA when echocardiography is not adequate. For standard abnormalities such as a D-TGA, this is usually unnecessary. However, in complex CHDs such as DORV, crisscross heart and upstairs-downstairs hearts, anatomy is better evaluated by 3D imaging available in a CTA. MRI is used to assess functional data.

Don't Miss. Read me!!!

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HUMANS BEHIND THE MACHINE

CT scan prior to Transcatheter Aortic Valve Replacement (TAVR) / Transcatheter Aortic Valve Implantation (TAVI)

Why is CT scan done prior to TAVI / TAVR?

CT is the gold standard for the pre-TAVR patient selection, detailed planning and selection of device, to plan the positioning of device, in order to reduce fluoroscopy time and to prevent intra-procedural and post-procedural complications. For this, we will need to evaluate the aortic annulus, sinuses of Valsalva, ostia of the coronary arteries and their distance from the annulus, ascending aorta, and various sites of access such as femoral and iliac arteries or even IVC, subclavian artery, innominate artery and LV apex.

PRE-PROCEDURE:

General CT related precautions:

- Fasting: No solid food for 4 hours prior to the study, but, maintain adequate hydration
- Serum creatinine and calculate GFR
- Routine Allergy precautions

TAVR/TAVI -CT related precautions:

- Refrain from stimulants (i.e. coffee) on the day of the scan
- Heart rate control as per CT coronary protocol
- Good IV-line access, preferably in an antecubital vein, at least 20G
- Sublingual Nitroglycerine is contraindicated as these cases have severe aortic stenosis.

By
Dr Megha M. Sheth DMRE
Consultant Radiologist
U.N. Mehta Institute of
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SCANNING TECHNIQUE

First phase –

Scan type: Retrospective ECG gated CT angiography of the aortic root and coronary arteries.

FOV: Should include aortic root and can include the whole heart

Contrast Volume: 100 - 120 ml non-ionic contrast media, injected through dual head pressure injector, followed by saline chaser. Scan started through bolus tracking with ROI in ascending aorta or as per institute coronary protocol.

Rate: depending on scanner it ranges from 4.5 to 5.5 ml/sec. Aim to obtain dense intra-arterial opacification with attenuation values > 250 HU.

Second phase –

Scan type: Non-gated helical MDCT angiography of the thoracoabdominal aorta including the proximal femoral arteries using the thinnest collimation.

Timing: Immediately following the first phase (either down to up or up to down).

FOV – From the angle of mandible to the pubic symphysis (to include the brachiocephalic or innominate artery to the below the common femoral artery bifurcation)

Note: Single contrast injection during the first phase. No contrast injection required for the second phase.

In order to keep radiation to minimal possible,

Weight / BMI	Tube potential	Tube current
≤90 kg or BMI ≤30 kg/m ²	100 kV	Lowest setting possible that gives acceptable image noise for the given patient size
> 90 kg or BMI > 30 kg/m ²	120 kV	Lowest setting possible that gives acceptable image noise for the given patient size

Modifications: Acquisition depends on the desired information from the CT study. For instance: In patients with renal failure, for information regarding only access, a non-gated study with a catheter directed injection of contrast through the femoral route can be performed. Information regarding aortic root can be obtained from a Trans-esophageal echocardiography or an MRI; Aortic root assessment is the only clinical question – then limit the scan to only the aortic root;

Reconstruction: Thin section at the minimum possible (e.g. 0.625 mm) slice thickness with contiguous or overlapping slices

Analysis: 30% - systolic phase of cardiac CT since aortic root dimensions are largest in systole

Caveat: This may change if patient is in atrial fibrillation. So it is best to check all the phases for the largest aortic dimension qualitatively or visually before deciding on the systolic phase.

Post Procedure:

Give instructions to patient to maintain hydration. Ensure all phases of ECG gated study of the aortic root in thinnest possible slice thickness and also thinnest possible slices of the non-gated angiogram study are available on the workstation for performing measurements of the aortic root, aorta and ilio-femoral vessels. All measurements should be give on double oblique images so that the true cross-section of the annulus, valve or vessel is determined. Images to be provided: Double oblique images of aortic annulus and valve en-face, 3D volume reendering of the aorta and iliac vessels and common femoral artery bifurcation with respect to the femoral head and additional, curved planar reconstructions of the coronary arteries (if the scan is optimised for coronaries) and iliac arteries if requested.

An unusual epicardial mass

Case: An elderly lady presented with complaints of progressive breathlessness for a month. Chest radiograph revealed cardiomegaly.

2D echocardiography (Fig 1) showed pericardial effusion (blue arrow) and a hypo to isoechoic epicardial lesion (yellow arrow). She was referred for a cardiac magnetic resonance imaging (CMR) to further characterise the abnormality.

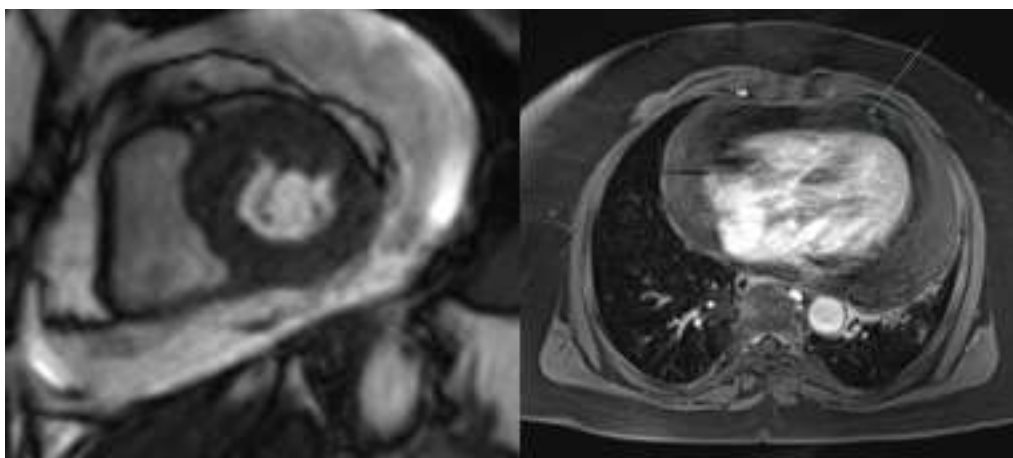


Case contribution:

*Dr Nilay S. Nimbalkar DMRD, DNB
 Founder Director Precision Scan and
 Research Centre, Nagpur.
 Cardiac imaging specialist in Precision
 scan and Seven Star Hospital
 Nagpur*

Balanced echo and Fat saturated post gadolinium

T1 images are given below (Fig 2a, 2b).



What are your findings? What is the epicardial lesion that was seen on echo?

Diagnosis:

MRI findings reveal pericardial effusion along with hyperintense epicardial lesion on balanced echo images (2a). There is complete suppression of the signal from the epicardial lesion on Fat saturated T1W images (2b). No pericardial thickening or abnormal post contrast enhancement was observed. Fat density of the epicardial lesion was also confirmed on plain CT sections (Fig 3).

Figure 2a: Still image of cine steady-state free precession CMR sequence in the short axis plane demonstrating a large pericardial effusion (yellow arrow) and an Indian ink artefact corresponding to the visceral pericardium (blue arrow). The visceral pericardium is separated from the epicardium by a hyperintense lesion occupying the epicardial space.

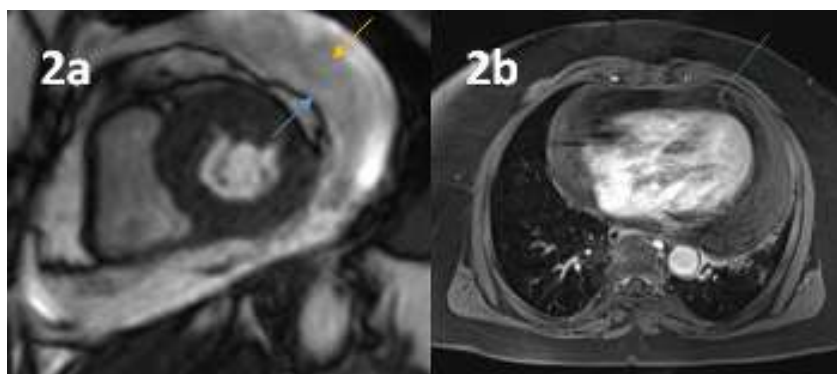


Fig 2b: Fat saturated post gadolinium T1 image in the axial plane demonstrating the suppression of signal from the epicardial lesion (green arrow) . Signal intensity of epicardial lesion is similar to the subcutaneous fat confirming the diagnosis of epicardial lipomatosis.



Figure 3: Plain CT scan of the chest in the axial plane also confirms the presence of epicardial fat (blue arrow). Also, note that this epicardial fat encases the coronary vessels (yellow arrows) with no mass effect on the adjacent structures.

Pericardiocentesis revealed scattered mesothelial cells and lymphocytes. No atypical or malignant cells were seen. Therapeutic pericardial window procedure was performed. Biopsy of epicardial lesion was also performed during the surgery. Pericardial biopsy revealed nonspecific chronic inflammatory changes, which might have caused pericardial effusion. Epicardial lesion biopsy confirmed presence of

adipose tissue, consistent with epicardial lipomatosis. Patient had significant relief of symptoms after pericardiocentesis and pericardial window procedure. She was advised regular follow up with echocardiography.

Discussion:

Cardiac lipomatosis is characterized by the accumulation of non-encapsulated mature adipose tissue caused by hyperplasia of lipocytes. The aetiology is unknown, but may be associated with obesity and advancing age. Lipomatous hypertrophy of the interatrial septum is the most common fat containing lesion in heart. Characteristic sparing of fossa ovalis, helps to differentiate it from other lesions. Epicardial fat deposition is also common and it may mimic a mass on transthoracic echocardiography. Our case highlights the importance of tissue characterisation provided by CMR. These lesions may be difficult to characterise by echocardiography, hence, non-invasive imaging in the form of CMR or CT may be used to confirm diagnosis.

Final Diagnosis

1. Chronic idiopathic pericarditis with large pericardial effusion
2. Epicardial lipomatosis.

References:

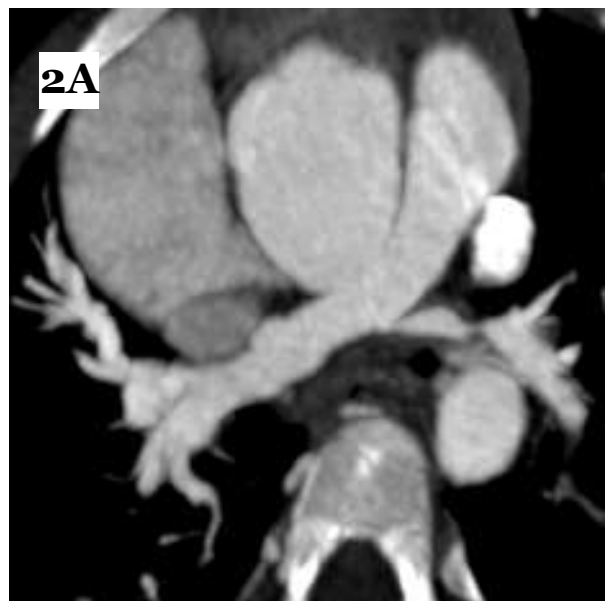
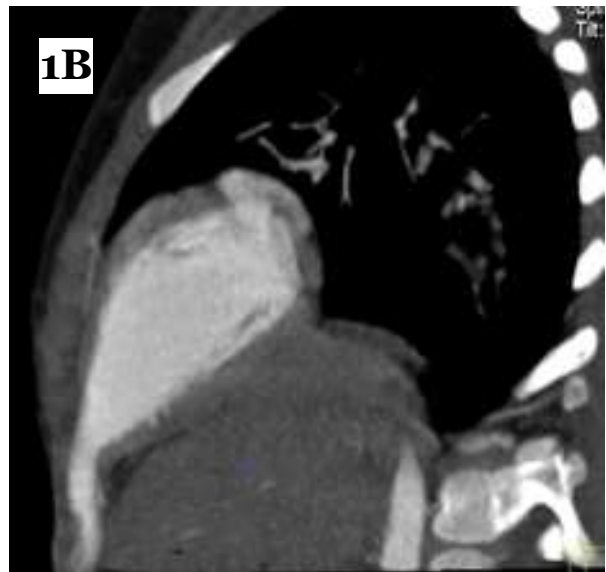
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Piece them together

Case: A 3-year-old female child was referred to radiology department at U. N. Mehta institute of cardiology and research centre, Ahmedabad, Gujarat for Cardiac CT study for detailed evaluation of the congenital heart disease after 2D echocardiography revealed diagnosis of double outlet of right ventricle (DORV).

Case contribution:
Dr Yashpal Rana MD
Consultant Radiologist
UN Mehta institute of cardiology and research centre, Ahmedabad, Gujarat

See the images below.





What are your findings? What is the diagnosis?

Answer: The CT shows DORV with D-malposed aorta, dilated right ventricle, severe infundibular pulmonary stenosis, severe stenoses in the left pulmonary artery, large atrial septal defect amounting to a common atrium, conoventricular ventricular septal defect and bilateral superior vena cavae. Also, there is a lower sternal defect, defect in the diaphragmatic pericardium and an anterior diaphragmatic defect through which there is herniation of the left ventricular apex forming a left ventricular apical diverticulum. The presented case has all defects consisted in the pentalogy of Cantrell except midline supraumbilical wall defect and ectopia cordis.

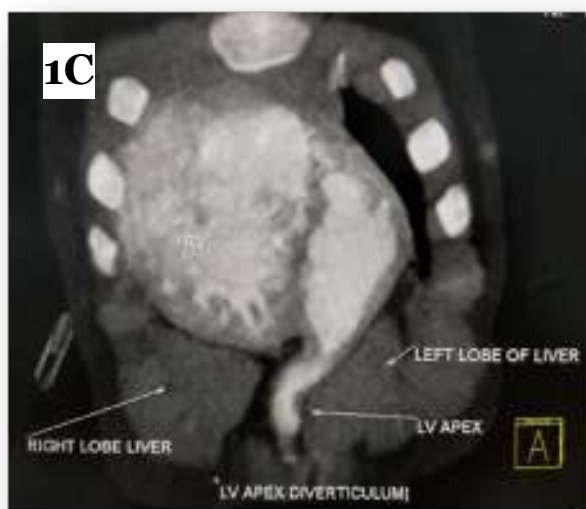
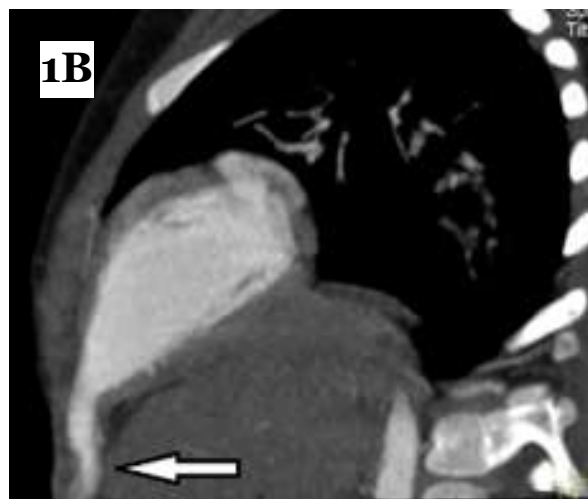
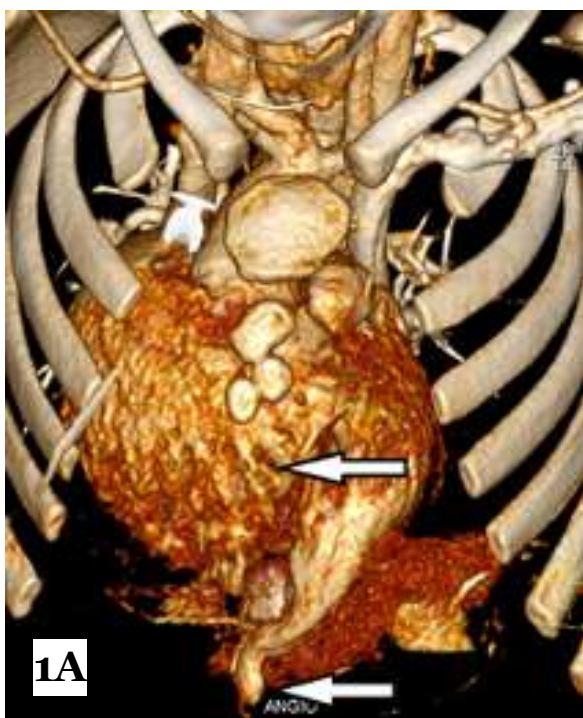
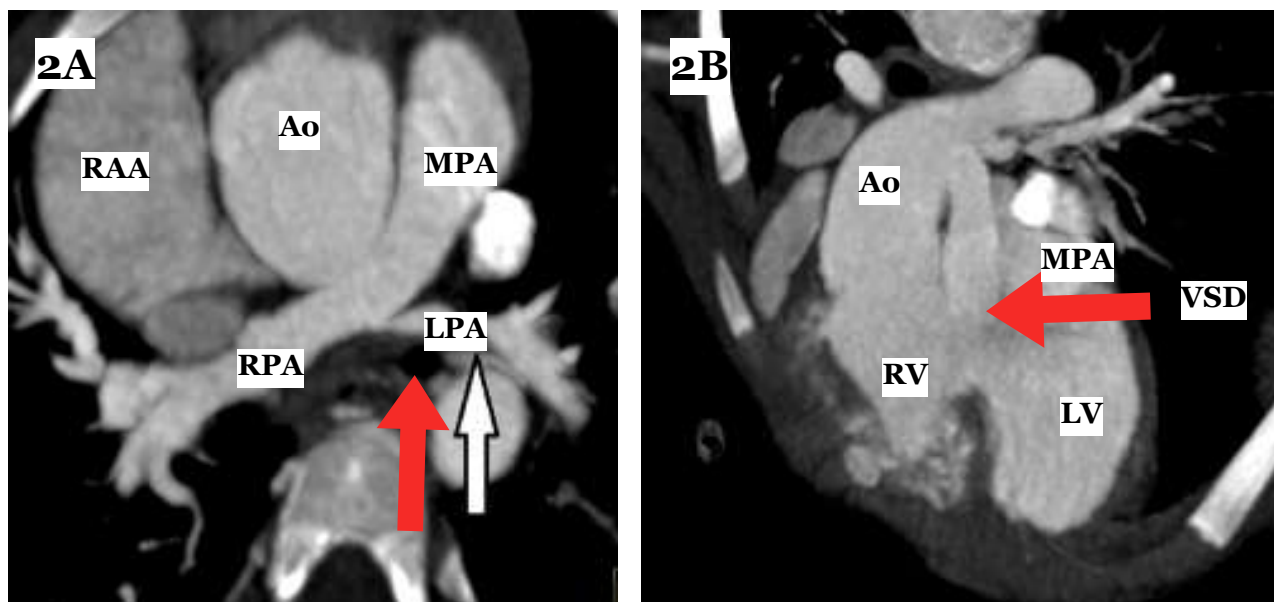


Figure 1: Volume rendered (A), Sagittal oblique multiplanar reconstruction (B) and Coronal oblique multiplanar reconstruction (C) of a contrast enhanced CT study showing the sternal defect (blue arrow) and left ventricular apical diverticulum (white arrow) herniating into abdomen between the right and left lobes of the liver through a pericardial and a diaphragmatic defect.

Figure 2: Oblique multiplanar reconstructions of a contrast CT study at the level of pulmonary arteries (A) showing discrete areas of severe stenosis in the proximal (orange arrow) and mid left pulmonary artery (white arrow). Oblique multiplanar reconstructions of a contrast CT study at the level of Double outlet right ventricle (DORV) with a ventricular septal defect (green arrow) is show in this figure as a part of intracardiac anomaly.



Discussion:

Cantrell Pentalogy is a rare congenital thoraco-abdominal disruption, first described by Cantrell et al with five characteristics:

1. Lower sternal defect;
2. Midline supraumbilical thoraco-abdominal wall defect;
3. Anterior diaphragmatic defect;
4. Defect of diaphragmatic part of pericardium that results in relation between pericardial cavity and peritoneum.
5. Congenital heart malformations and ectopia cordis in extreme cases

Most infants do not develop all of the potential defects, which may be referred to as incomplete pentalogy of Cantrell. When all five defects are present, it is referred to as complete pentalogy of Cantrell. The most severe expression of pentalogy of Cantrell presents at birth with ectopia cordis and omphalocele. Additional associated anomalies include cleft lip/ palate, dysplasia of the kidneys, cystic hygroma, limb defects (club feet, absent bones in the arms or legs), neural tube defects (encephalocele) and trisomy 13 or 18.

Final Diagnosis:

Pentalogy of Cantrell with DORV with D-malposed aorta, dilated right ventricle, severe infundibular pulmonary stenosis, severe stenoses in the left pulmonary artery, large atrial septal defect amounting to a common atrium, conoventricular ventricular septal defect and bilateral superior vena cavae.

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PROUD OF YOU

Achievements by our Lifetime Members

International Clinical Fellowships

- Fellowship in Cardiac Imaging, 2016-17, Toronto General Hospital, University Health Network, University of Toronto.
- Level III SCMR certification (Feb 2018)
- Level III SCCT certification (June 2019)
- Fellow of Society of Cardiovascular Magnetic Resonance (FSCMR) March 2019
- Nominated member of Clinical Practice Committee, SCMR (2020-2024)



Dr. Leena Robinson Vimala
Associate Professor
Department of Radiology, Christian
Medical College and Hospital,
Vellore

International Clinical Research Observerships

- **Observership in Cardiothoracic Radiology**
 - **Site:** Mallinckrodt Institute of Radiology, Washington University, St. Louis, USA
 - **Date:** February 1-10, 2015
- **Observership in General Radiology**
 - **Site:** The Hospital for Sick Children, Toronto
 - **Date:** April 30- May 12, 2014
- **Observership in Cardiothoracic imaging**
 - **Site:** Toronto General Hospital, University Health Network
 - **Date:** April 13-29, 2014

International Clinical Research Fellowships

- Level III Certified Cardiac Radiologist - Allegheny General Hospital, Pittsburgh, USA
- 1 Year Cardiothoracic Imaging Fellowship - Foothills Hospital, Calgary, Canada

International Clinical Research Observerships

- Paediatric Cardiac Imaging- Boston's Children Hospital, Boston, Ma, USA



Dr. Ragini Sharma
Consultant Radiologist
PKR Health Care Institute,
Ambala City, Haryana

International Clinical Research Fellowships

- University of Pennsylvania for Level III in CMR and Fellow of SCMR 2017-2019



Dr. Avanti Vishnu Gulhane
*Research affiliate/Senior Specialist
 in Radiology Perelman Center of
 Advanced Medicine, University of
 Pennsylvania*

International Clinical Research Fellowships

- Three-month fellowship in Cardiovascular Radiology from Herzzentrum, Leipzig, Germany from 16th November 2018 – 15th February 2019.
- Selected through European Society of Radiology exchange program scholarship fellowship



Dr. Abhinav Aggarwal
*Consultant Radiologist
 Mata Chanan Devi Hospital
 Janak Puri, New Delhi*

International Clinical Research Fellowships

- Short term observership in Cardiac MRI at BARTS Heart Centre, London



Dr. Mumun Sinha
*Resident in Radiology
 Department of Cardiovascular
 Radiology and Endovascular
 Interventions
 AIIMS, New Delhi*

International Clinical Research Fellowships

- Visiting fellowship in cardiovascular imaging at Duke University, North Carolina, USA, 2014



Dr. Yashpal Rana
Consultant Radiologist
U N Mehta Institute of Cardiology &
Research Centre
Ahmedabad.

International Clinical Research Fellowships

- Short term observership in Department of Paediatric Cardiology, UT Southwestern Medical Centre, Dallas, Texas, USA, 2019.



Dr. Megha Sheth
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U N Mehta Institute of Cardiology &
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Ahmedabad

Conferences in 2020

IACI Mid-Term Conference - Nagpur

Dates: April 4TH and 5TH 2020

Place: Nagpur

Link: <https://www.iaciind.org/midtermconference/>

KMCH & MGH – RECIIRC 2020, Cardiac Imaging with Hands on Workshop.

Date: 6th & 7th June 2020

Place: KMCH, Coimbatore

Link: <https://kmchradconnect.com/>

10th Annual National Congress of IACI

Date: 16th, 17th and 18th October 2020

Venue: Hotel Feathers, Chennai, India

Link: <https://www.iaciind.org/annualconference/>

Bulletin Board

A thought for your heart

Time is one of our most precious resources and we never seem to have enough of it!! Many of us don't like to spend hours in the gym or loose the tempo soon after beginning. Hey! worry not! In last few years there has been a lot of research on efficient and effective exercise. The answer lies in a shift towards short but intense workouts, a training concept known as "HIIT" or high intensity interval training. The most appealing and convenient fact about HIIT is that sessions can be completed in as little as 15 minutes per week and it can be done at any convenient place, including your home. Some of the potential benefits of HIIT include:

- ☑ Improved aerobic fitness and endurance
- ☑ Reduced body fat
- ☑ Increased upper and lower body strength
- ☑ Improved insulin sensitivity

Dr Yashpal Rana MD
Consultant Radiologist
U N Mehta Institute of Cardiology &
Research Centre

Can you get the benefits of exercise in just a few minutes a week? Is there a short-cut to getting fit? ...And the answer is Yes!

With HIIT, you not only burn a lot of calories during the workout but because of the high intensity you will continue to burn calories for hours after the workout due to something called the 'excess post-exercise oxygen consumption' or the EPOC effect. The EPOC effect causes your metabolism to remain elevated, body to replace energy and repair muscle proteins damaged during exercise. As HIIT can place a tremendous amount of stress on the body, it should only be performed two to three times a week with at least 48 hours between exercise sessions. This would allow for full replenishment of energy stores, removal of metabolic waste and repair of involved muscle tissue.

It is not necessary to spend hours, sweating buckets, to obtain benefits like weight loss, muscle growth and improved overall health and well-being. Instead of working longer, work smarter by using short intervals of extremely high-intensity exercise.

Fellowships for Cardiac Imaging in India

DM- Cardiovascular Imaging and Endovascular Interventions

Duration: 3 Years

Place: AIIMS, Delhi

Link: http://www.aiimsexams.org/Pdf/seatsandcities_Jan2019.pdf

Bulletin Board

AMRITA HOSPITALS:

Fellowship Program in Cardiovascular Radiology

Duration: 1 Year

Place: Kochi

Link: <http://www.amritahospitals.org/Events/Fellowship-Program-in-Cardiovascular-Radiology>

Cardiothoracic Post-Doctoral Fellowship

Duration: 1 Year

Place: CMC Vellore

Link: <https://admissions.cmcvellore.ac.in/process.aspx>

Cardiothoracic Imaging and Research Fellowship

Duration: 1 Year

Place: Narayana Health City, Bangalore

Link: <https://www.narayanahealth.org/sites/default/files/download/academics/CIRF-2019.pdf>

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY DM Cardiovascular Imaging and Vascular Interventional Radiology

Duration: 3 Years

Place: Thiruvananthapuram, Kerala

Link: https://www.sctimst.ac.in/academic%20and%20research/academic/resources/DM_mch_Syllabus.pdf

F. SRI SATHYA SAI INSTITUTE OF HIGHER MEDICAL SCIENCES Fellowship in MR and Cardiac Imaging.

Duration: 1 Year

Place: Sri Sathya Sai Institute of Higher Medical Sciences-, Bangalore

Link: <https://ssihms.org/radiology1/fellowship/>

Expert Review: Update on Cardiovascular Applications of Multienergy CT

Dr Pudhavan A, MD reviewing Kalisz, K., Halliburton, S., Abbara, S., Leipsic, J. A., Albrecht, M. H., Schoepf, U. J., & Rajiah, P. Update on Cardiovascular Applications of Multienergy RadioGraphics. 2017 Nov-Dec;37(7):1955–1974.

Introduction:

Multi energy or spectral CT is used to characterize materials based on the attenuation differences at different energies. In addition to the conventional datasets, multi energy CT's provide iodine maps, virtual unenhanced (VU) and virtual monoenergetic (VM) images and effective atomic number (1). Myocardial perfusion imaging using iodine maps is one of the most validated application of multi energy CT of the heart, in addition to its utility in delayed enhancement imaging, calcium scoring from VU images, myocardial iron quantification and VM images to reduce beam hardening artefacts.

Discussion:

Multi energy CT can be either source based or detector based, depending on the method used for spectral separation. Source based technologies are dual source, dual spin, kilovoltage switching and split beam technology. The detector-based technology are dual layer sandwich detectors and photon counting. All source based technologies will require a prospective selection of dual energy protocol, whereas there is no such requirement for detector based technologies resulting in no change in the clinical workflow.

Multi energy CT technologies:

Dual source technology employs two x-ray source-detector system, mounted

orthogonal to each other. The high energy source uses a tin pre filter for improved spectral separation. The tube current and voltage can be independently adjusted between the two sources with separate filter materials for each source, which can improve the spectral separation of both energies (2). The smaller field of view (FOV) of one tube will restrict the final FOV. The other disadvantage is imperfect temporal and spatial registration and presence of cross scatter between tubes. Rapid kilovoltage switching has a single x-ray source system with rapid switching between low and high energies for each projection (3). This results in synchronous acquisition of spectral data with minimal scatter and no limitation in

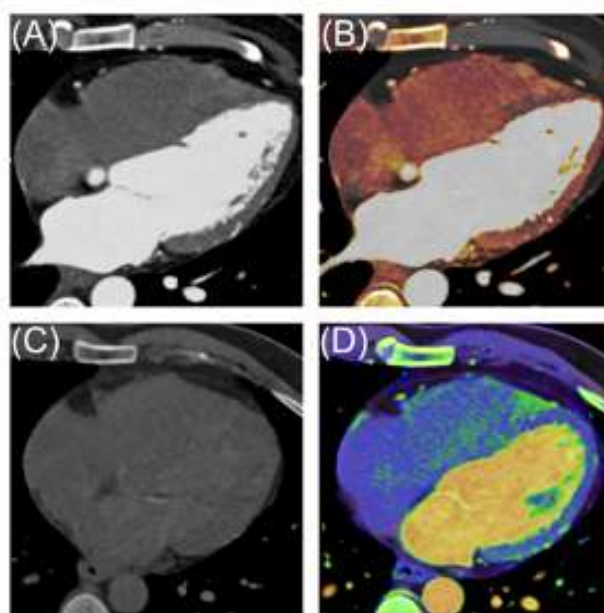


Figure 1: (A) Linearly blended conventional image and (B) Iodine map at same level shows improved definition of the perfusion defect in apical septum at rest. Virtual non contrast image (C) at same level with mass density and material type image (D).

FOV. However, there is poorer temporal resolution and inability to modulate current and voltage independently. Usage of a single filter will also result in mixing of spectral data. Dual spin technique uses a single source-detector system which obtains two consecutive rotations of the same section at different tube potentials. But, this is

Applications in cardiovascular imaging:

Multi energy data can be used to generate various material specific images by highlighting or subtracting selected base material. The most commonly generated images by post processing the multi energy dataset are iodine maps, virtual unenhanced

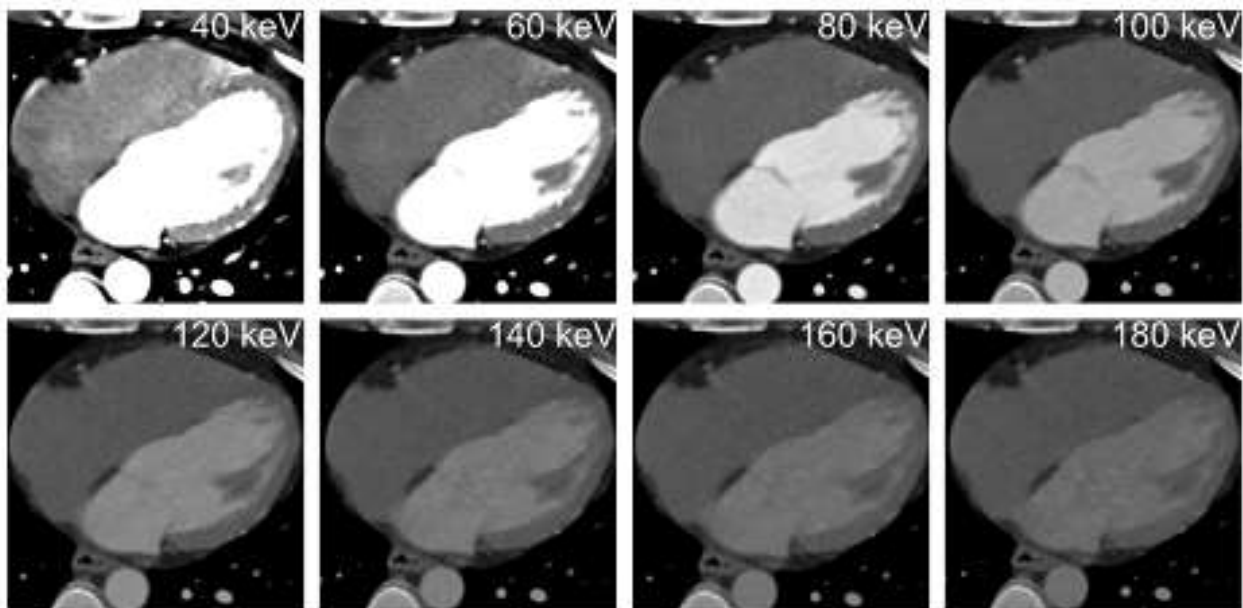


Figure 2: Virtual mono energetic images with approximated data forming a virtual monoenergetic beam at specified energy levels from 40-200 keV.

susceptible to motion between two acquisitions and the risk of variable contrast between images at different energy (4). Split beam, as the name implies produces two x-ray energy spectra simultaneously using different pre filters. Here, the spectral separation is not ideal and also the pre filtration absorbs a large amount of x-ray photons that are produced (5). Dual layer technology achieves spectral separation at the detector level by using a dual layer detector which separates the low and high energy x-ray photons (1). There is fixed energy partition between the detector layers resulting in limiting of choice of tube potential and also incomplete spectral separation. Currently, there is also limited z-axis coverage with this method of only 4 cm. Photon counting uses a single source-detector system where x-ray photons of different energies are separated into different energy bins.

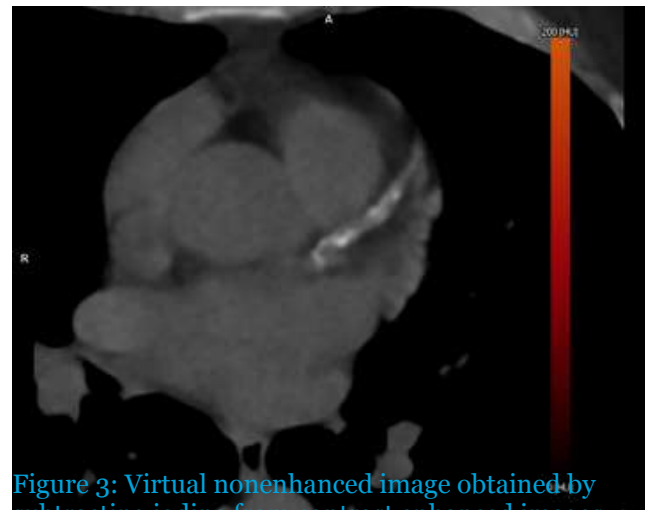


Figure 3: Virtual nonenhanced image obtained by subtracting iodine from contrast enhanced images.

(VU), virtual monoenergetic (VM) images and effective atomic number weighted images.

Iodine maps: Iodine specific maps are used to highlight areas of enhancement, which would be very subtle to discern in

conventional CT images. The iodine maps are based on the specific absorption characteristics of x-rays at different energy levels which generates an accurate map of iodine distribution. Iodine maps are especially used in myocardial perfusion imaging in assessing perfusion defects with higher sensitivity and specificity (6). It is also used in CT delayed enhancement imaging by improving scar detection and in pulmonary embolism for better detection of thrombus and differentiation from artifacts (7). Plaque characterization uses multi energy CT to differentiate between the lipid and fibrous core of plaques and the presence of plaque rupture with iodine maps. (Figure 1) Virtual monoenergetic (VM) images: The polychromatic multi energy CT data is used to simulate a monoenergetic beam and a wide spectrum of mono energetic images can be obtained. This is used to salvage a study with poor contrast to noise ratio due to low iodine density by using a low energy VM image, which accentuates the iodine density. Similarly, a high energy VM image can be used to reduce beam hardening artefacts due

to metal and thick calcium (8). (Figure 2) Virtual unenhanced (VU) images: Radiation dose saving can be achieved by generating VU images from post contrast data set. This is also being evaluated for calcium scoring from the VU images (9). (Figure 3) Other applications: Myocardial iron quantification using dual energy CT has shown good correlation with the accepted T2* magnetic resonance imaging (MRI) (10). CT has the advantage of much less imaging time and is comfortable to patients compared to MRI. Detection and characterization of thrombus in cardiac chambers, especially in LA by quantifying intralesional iodine without the need for additional delayed imaging.

Conclusions:

Multi energy spectral CT has expanded the scope of conventional CT in imaging cardiovascular system, offering distinct advantages over conventional CT by providing better vascular contrast, reducing artefacts, improving tissue characterization and reducing radiation dose.

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Expert Review:

LGE prediction of sudden cardiac death in HCM patients is superior to standard guideline-recommended criteria

Ashita Barthur DMRD, DNB, FRCR reviewing Freitas PJ et al. The amount of late gadolinium enhancement outperforms current guideline-recommended criteria in the identification of patients with hypertrophic cardiomyopathy at risk of sudden cardiac death Cardiovasc Magn Reson. 2019 Aug 15;21(1):5

Currently, identification of hypertrophic cardiomyopathy (HCM) patients at risk for sudden cardiac death (SCD) is dependent on risk stratification tools dependant on clinical criteria. The American College of Cardiology Foundation/American Heart Association (ACCF/AHA) recommends ICD implantation if patients have any of the following major risk factors: family history of SCD in first degree relatives, LV wall thickness ≥ 30 mm, or recent unexplained syncope as well as occurrence of NSVT in Holter monitoring or abnormal blood pressure response during exercise testing. The European Society of Cardiology advocates a multiparametric score (HCM Risk-SCD) that estimates the 5-year risk of SCD. Although these scores are validated, at times, there are disagreements between them in case recommendation. Based on this limitation in the discriminative power of guideline-recommended criteria, the authors proposed that late gadolinium enhancement (LGE) assessed by contrast-enhanced cardiovascular magnetic resonance (CMR) could facilitate the decision regarding ICD implantation in HCM patients. They hypothesised that LGE could outperform the current guideline-recommended clinical criteria in predicting the risk of SCD in HCM patients

In the 493 HCM patients analysed in this multicentric retrospective analysis, there was a minimal concurrence between ACCF/AHA criteria and HCM Risk-SCD scoring in determining SCD risk. LGE was an independent risk factor of SCD after adjustment for the HCM Risk-SCD and ACCF/AHA criteria with an adjusted HR: 1.08(95% CI: 1.04–1.12; $p < 0.001$). Among those determined to have a low risk of SCD (362) by the HCM Risk SCD criteria 11 still developed the study endpoint. Similarly, among HCM patients where ICD was not recommended (281) by the ACCF/AHA criteria, 8 developed the study endpoint. Conversely, when LGE was 0% in CMR imaging (102), none of the patients went onto develop the stud's endpoints. Kaplan Meir survival curves also revealed that risk stratification by HCM Risk-SCD and ACCF/AHA criteria did not have any difference in SCD event-free survival (log-rank $p = 0.109$ and log-rank $p = 0.101$). However, predefined LGE% risk strata showed significant differences in SCD survival with log-rank $p < 0.001$.

These results demonstrate that LGE predicts SCD in some patients that may be misclassified by current guideline-recommended criteria. The authors have acknowledged the limitations of their study. Only patients referred for CMR were included in this study, creating a referral bias and probably a higher baseline risk. They excluded a significant proportion of patients due to either missing echocardiography or Holter data. The small number of events limited the comparison between models. Although the authors manage to show clear differences in SCD survival based on predefined LGE %, they did not conclude regarding the threshold LGE in this paper. Nevertheless, this study demonstrated that LGE has a role in risk stratification of HCM for SCD.

Look into the past - IACI in 2019

The 9th Annual conference at Jaipur took IACI to a new level with enormous academic contribution from SCMR, ASCI and the industry giving us insight into the future technology and the role of Artificial Intelligence (AI) in cardiac imaging. The annual conferences significantly impact both novices and experienced cardiac imagers on all aspects of cardiac imaging. In contrast, the rigorous two-day midterm conferences dedicated to a specific topic help those who look to delve into the depths of cardiac imaging.

While the Ahmedabad and Hyderabad midterm conferences concentrated on the subtler aspects of cardiac CT, the mid-term conference at Vizag dealt exclusively with CMR learning. A usually feared aspect of

cardiac imaging is paediatric cardiac imaging. "Look beyond" was IACI midterm conference organised at Wadia children's hospital, which included mind-blowing sessions on all aspect of paediatric cardiac imaging. Credits to Dr Alpa Bharathi and her team of faculty including a cardiac radiologist, cardiologist, cardiac pathologist and cardiac surgeon for giving multidimensional approach to the paediatric cardiac imaging. All these are feathers in the cap of IACI as a team. Apart from these, there are other conferences, groups, presentations and lectures that many members of the IACI participate. This diverse involvement is encouraged as a core value of the IACI, which are experimenting, learning, educating and in the process of growing cardiac imaging in India.



Links to IACI Conferences 2018 & 2019

All those who have attended the annual IACI conferences in 2018 and IACI 2019 will have free 1-year online subscription to view the sessions on Meditube.

<https://www.themeditube.com/my-account/library/gifted-videos>.

Soulful Heart...!!!

Become an Organ Donor!

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We can pledge our organs by entering the donor form in the website of National organ and tissue transplant organization (NOTTO) - <https://notto.gov.in/>

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This page is a detailed step by step guide of how to fill up the form on the website - <https://notto.gov.in/WriteReadData/Portal/Images/DonorPledgeUserManualNotto04092014.pdf>

We can decide which organs we would wish to donate and can even decide to donate our entire body to science and medicine. We can change this as and when we may feel like.

***Gift of Organ is
a Gift of Life. Organ
Donation is
the biggest contribut
ion to humanity.***

We can get a donor card (sample below) which we can keep with our driver's license.

To pledge our organs, we can also register at the NGOs mentioned below.

1. Mohan Foundation: <http://mohanfoundation.org/>
2. Shatayu: <http://shatayu.org.in/>
3. Gift Your organ: <http://giftyourorgan.org/>
4. Gift a Life: <http://giftalife.org//>

For any queries regarding organ donation, we can call – 1800 4193737 (Toll free by MOHAN Foundation). It is very important to let our families and friends know about our wish to donate organs as the Indian law requires the next of kin of the deceased to sign the organ donation forms.

Why wait? Take the first step! Register yourself as a potential Bone Marrow (or) Peripheral Blood Stem Cell Donor. We may be a match for someone suffering from leukemia or thalassemia!

Visit any of these websites to register as a stem cell donor

<http://www.mdrindia.org/index.htm>

<https://datri.org/why-become-a-donor/>