



British Society
of Echocardiography



Conference Report

The journal of the
**British Society of
Echocardiography**

ECHO

ISSUE 112 / DECEMBER 2020

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PRESIDENT'S MESSAGE

Thank you, have to be my first words as President.

Every one of our membership has stepped up to the plate during COVID, rapidly acquiring the new skills needed to carry on working for patients.

Council and the executive team have also stepped up, rapidly producing guidance to keep us all safe as we carry on echoing those critically ill from COVID and those who were facing more 'ordinary' cardiac problems in an extraordinary world.

Our accreditation team have dug deep to preserve our candidates' progress through their exams, communicating with groups struggling with learning in COVID times and hosting our first ever socially distanced exam using Heartworks simulators: thank you Intelligent Ultrasound.

Our education and office teams took a leap of faith and delivered our first virtual conference on October the 5th in record time: a conference that was attended by nearly half of our membership across 31 countries. Together – in our new virtual world, we watched 65 presenters give 94 world class presentations, and through the world of social media we danced round our kitchens at the BSE(dis)cho and ran, cycled, swam and walked to Italy to support and raise money for the BHF.

The wide-ranging learning offered by conference is still available on the website – take a look whenever you have 20 minutes to sit down with a cup of tea and keep learning, or read the conference articles we have included in this issue.

Congratulations, is my second word as President.

Huge congratulations to Keith Pearce for his Lifetime Achievement award, Keith's achievements span clinical leadership, accreditation development and governance innovation, but it is his concern for patients that makes him a brilliant ambassador.

Congratulations to our newly elected Council members Dan Augustine, Shaun Robinson, Sadie Bennett and Wendy Gamlin. Dan and Shaun continue in their roles as co-leads for education, Sadie has moved into her new role as co-chair of accreditation with Rakhee Hindocha as our co-opted co-chair. Wendy joins the team as an experienced educator and leader.

This year we have also co-opted Anita MacNab to lead the support for stress echo candidates, Sandeep Hothi to keep the voice of the TOE team at the table and Sarah Ritzman to lead departmental accreditation.

Welcome onboard everyone and thank you for your time and input.

Congratulations to our four new Society Fellows, Jan Forster, Reinette Hampson, Fadia Makaram and Siva Ratnatheepam. Our candidates this year are all examples of colleagues demonstrating sustained commitment to patients throughout careers.

Congratulations also to Helen Jordan, our winner of the Investigator of the Year award for her work on Level I echo and lung ultrasound in COVID patients: a timely and effective patient intervention leading to a direct effect on clinical management in 70% of patients. A staggering effect and particularly relevant in patients who are difficult to transport.



Where are we now?

As I write, cases of COVID-19 are rapidly increasing across the UK and the call for our expertise will increase again. Please do stay in touch with us about issues you may be facing and we will try to help guide practice centrally. Contact us at admin@bsecho.org.

We have recently been involved in pan-London discussions about addressing the routine work backlog over the coming months. I was delighted that the outcomes were focussed on retaining senior echo staff through better career development pathways, triaging patients accurately and looking at local streamlining of workflows; for example by using allied healthcare workers to release time for echocardiographers to do what we do best.

There was wide acknowledgement at the meeting that this is a pan-UK issue, and by no means exclusive to London. More on this as hard outcomes develop.

Where do we want to be?

I am delighted to have become President in the age of cross-boundary working. I will continue to drive the Society in this direction, appreciating and supporting every member's talents and skills in echo, in whatever workplace they operate.

How will we provide this support?

By acting as a national hub for echo education and resource: Look out for news on our website about our upcoming BSE and ICE (Irish Cardiac Imaging and Echocardiography Group) event and spring exam preparation course. We have just launched our virtual regional meetings programme, see the website for more details.

By offering high quality world class accreditation in every echo modality:

Our next COVID-safe practical exam will be delivered to 92 candidates on November the 28th: the venue may be subject to change to ensure the safest exam experience that we can.

Over 240 candidates sat our recent written exam, many benefiting from the opportunity to complete it remotely.

By developing departments and echo leaders:

Our Echo Quality Framework will soon be up and running on our website guiding departmental leads through the process of preparing for departmental accreditation. Tom Ingram, our Co Chair for clinical standards, will also be managing a leadership academy programme for six developing leaders from our membership: please get in touch if you are interested at admin@bsecho.org.

By communicating effectively with our whole membership:

Look out for the full set of new BSE reporting guidelines coming out over the next few months, and the Apple and Android reporting apps to follow shortly. We will let you know as soon as we know a launch date for these.

And my final words are have a happy and peaceful Christmas, look after yourselves and stay safe.

Claire Colebourn
President, British Society of Echocardiography

BSEcho 2020

We're delighted to say that we had over 1,500 members registered for our first ever virtual annual conference!

This was a great opportunity for our members to come together and hear from a plethora of fantastic speakers in what has been such a hard year for the echo community.

Remember that as well as the insightful articles in this edition of ECHO, you can still catch up with the conference presentations at bsecho.org/BSEcho2020.

As ever, a huge thank you goes to our exhibitors:

- Philips
- GE Healthcare
- Change Healthcare
- Janssen
- Alnylam
- In Health
- Intelligent Ultrasound
- Ultromics
- Akcea Therapeutics
- Takeda
- British Cardiovascular Society
- British Heart Valve Society
- European Association of Cardiovascular Imaging
- National School of Healthcare Science

#BSEMiles

Our team of 78 participants ran, walked, swam and cycled over 1,500 miles to raise money for the British Heart Foundation – they (virtually) made it all the way to Professor Luigi Badano's office in Milan!

With over £2,500 raised, we'd like to thank all of our amazing members for coming together as a community to support this initiative.

Accreditation updates

The next written exam will take place on **Tuesday 23 March 2021** in TTE, ACCE & **Congenital Echo*. Pre-registration is open from Monday 16 November and closes on Monday 21 December 2020 through www.bsecho.org.

**Pilot exam – provisionally booked*

Recognition for healthcare scientists, clinical physiologist and technologists

The BSE was delighted to see the joint statement issued by the Royal College of Physicians acknowledging the pivotal role played by scientists, physiologists and technologists in the clinical workforce. The statement highlighted the huge range

of services provided by these specialists and the critical nature of their roles in the face of COVID-19. It also emphasised that healthcare scientists, clinical physiologist and technologists often have a low profile within the NHS.

The organisations (listed below) expressed their wish to formally acknowledge the significant contributions made by this workforce during COVID-19 and their importance to the future of patient care in the NHS.

The organisations committed to support these professions by campaigning for

1. Recognition, investment and support for these services in workforce and clinical service planning as the NHS moves towards comprehensive integrated care services by March 2021
2. Championing the benefits of these services for patient care and excellence as evidenced by the 'Getting It Right First Time' (GIRFT) programme
3. Improved recording of such activity through NHS coding procedures
4. Support for staff in these services to improve their wellbeing and working lives

The statement was endorsed by

- Association of British Clinical Diabetologists
- Association of British Neurologists
- Association of Cancer Physicians
- Association for Palliative Medicine
- British Association of Dermatologists
- British Association for Sexual Health and HIV
- British Association of Stroke Physicians
- British Cardiovascular Society
- British Geriatrics Society
- British Nuclear Medicine Society
- British Society for Allergy & Clinical Immunology
- British Society for Clinical Neurophysiology
- British Society for Haematology
- British Society of Gastroenterology
- British Thoracic Society
- Clinical Genetics Society
- Faculty of Intensive Care Medicine
- Faculty of Sport and Exercise Medicine
- National Blood Transfusion Committee
- Renal Association

INSTRUCTIONS TO AUTHORS

ECHO is published four times per year. It is the official publication of the British Society of Echocardiography. The contact address is: BSE Administration, Unit 204, The Print Rooms, 164-180 Union Street, London SE1 0LH, email admin@bsecho.org. Members of the Society are invited to submit articles, case reports or letter correspondence.

Submission should be sent to 'The Editor', ECHO and forwarded by email to: editor@bsecho.org.

The format should be text as a normal Word document and images supplied as high resolution (300dpi) jpeg, tiff, eps or pdf files. Other formats including PowerPoint or of web image construction may result in reduced resolution and may be unacceptable.

Articles should contain appropriate references. References to be constructed with the first two authors, thereafter abbreviate to 'et al', then article title, followed by journal reference.

Submissions to ECHO are currently not peer reviewed. The Editor has discretion on acceptance. Patient consent is required for case reports.

If the submitted article (or a very similar version) has been submitted for or been published by another journal, the submitting author(s) should clarify this at the time of submission to ECHO with a justifiable reason for requesting re-publication. Additionally, permission from the previous publisher should be obtained and submitted.

It should be noted that opinions expressed in articles or letters are the opinions of the author(s) and not the of the Council of the British Society of Echocardiography (BSE). Official BSE Council views or statements will be identified as such.

Information in respect of advertisements can be obtained from events@bsecho.org.

BSECH

2020 IN NUMBERS

WHO ARE YOU?

1540 ATTENDEES



COUNTRIES 31

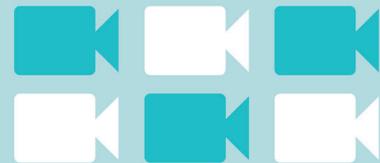


14 EXHIBITORS

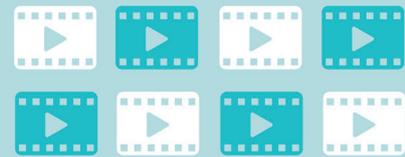


WHAT HAPPENED?

6 LIVE SESSIONS



ON DEMAND VIDEOS 68



23 PDF RESOURCES



COMMUNITY CHATS 60



208 QUESTIONS ASKED



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78 PARTICIPANTS



INJURIES 0



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#BSECHO2020

BSECHO 2020 Conference Report

BSEcho2020 Monday, October 5: Mitral Valve



Dr Bushra Rana

Achieving ‘next level understanding’ with 3D echo assessment of MR

Dr Bushra Rana

When assessing mitral regurgitation (MR), 3D echo complements 2D echo and “goes to the next level in terms of understanding”.

Dr Bushra Rana, Consultant Cardiologist at Imperial College Healthcare Trust, spoke about the

different 3D imaging formats and gave practical tips on how to carry out assessments during the first session of the day.

With simultaneous multiplane imaging, sonographers can use lateral steer, iRotate, Xplane rotate and Xplane tilt to achieve multiple views. Live 3D single or multi-beat imaging enables narrow volume, full volume and zoomed views, as well as colour assessment.

“All of these are a play off between your quality of imaging, that’s your temporal and spatial resolutions, versus your area of interest – the bigger your dataset the less resolution you have,” Dr Rana explained.

Background: Optimal MV 3D image acquisition		
IMAGE ACQUISITION	SIMULTANEOUS MULTIPLANE	LIVE 3D IMAGING
Choose echo window	PSAX or A2C Scan plane aligned perpendicular to leaflet coaptation line	PLAX often best MV closest to probe
Optimise image	Focus level of pathology Gain 2D V 3D Harmonics better turned on, HGen/Hpen Sector width optimise to include all components	Focus level of pathology Gain 2D V 3D Harmonics: better turned off? adjust during 3D live imaging Sector width optimise to include all components HVR or stitch multiple beats
Orientate image	Orthogonal view anatomically correct? If not then invert image (L-R)	Image orientation anatomically correct? LA (or LV) view landmarks in correct position 3D rotate with trackball, Z rotate
Image acquisition	At each leaflet segment capture 1-2 beats Sweep through entire valve capture several beats	Single heart beat complete data volume Multiple beats narrow volumes of several heart beats stitched together to create one single beat image

Fig. 1. Optimal MR 3D image acquisition

Assessing MR and what 3D offers

Recapping the key mechanism descriptors used to assess MR, Dr Rana outlined the three groups of Carpentier’s classification (see fig 2). 3D echo, particularly photorealistic imaging, provides a much deeper understanding of these concepts.

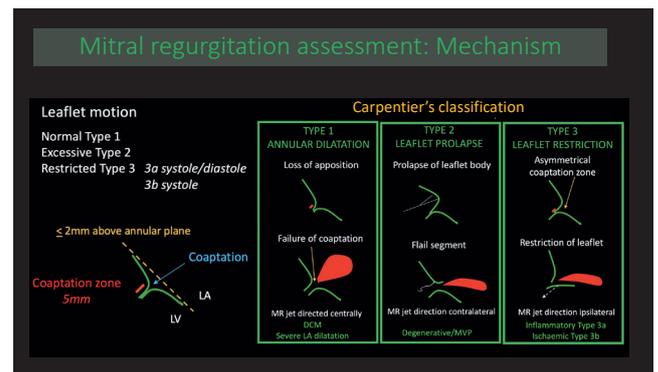


Fig. 2. MR assessment: Mechanism

Severity: Accounting for elliptical orifices

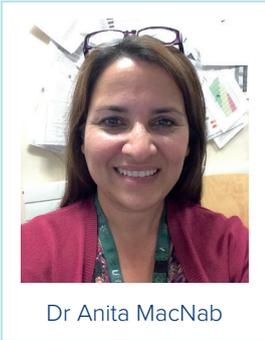
Historical data assumes we are looking at a circular regurgitant orifice as it is derived, in the main part, from mitral valve prolapse patients. We now know, however, that the regurgitant orifice is an elliptical shape in secondary MR. This means traditional measurements tend to over- or underestimate the size of the orifice. “What we now know is that we need to look at the anatomy of the regurgitant jet in more detail by looking at it in 3D. That’s where multiplane imaging becomes very useful to look at the coaptation line, and then cut through the centre of that and look at it through its narrow orifice. If you get the widest and the narrowest, you can then do an average calculation,” said Dr Rana.

Haemodynamics and accuracy

Dr Rana said: “Not only can 3D help us in terms of mechanism and severity, we can also think about it in terms of haemodynamic consequences, which is very important in terms of outcomes. The size of your left atrium, the size of your left ventricle, and volumes become very important here.”

3D assessments such as Heart Model can measure LA and LV volume much more accurately than standard 2D assessments as it measures the entire chamber without making assumptions, she added.

Summing up, she said sonographers should always remember to include height, weight, body surface area, blood pressure, and heart rate and rhythm in reports. “These become very relevant in terms of putting it into the patient context,” she concluded.



Using exercise stress echo to unmask MR “red flags”

Dr Anita MacNab

There are no randomised controlled trials on how best to proceed in asymptomatic severe degenerative mitral regurgitation. This means there is much global variation in how such patients are cared for, said Dr Anita MacNab, Consultant Cardiologist at Manchester University NHS Foundation Trust.

“In Europe, we tend to follow the watchful wait strategy,” she said, adding that in her valve surveillance clinic, it took an average of four years for patients to reach surgical criteria. *“But we all know how crucial it is to intervene before patients reach the slippery slope of decompensation. If we leave it too late, the prognosis is poor, even after correct intervention.”*

The onset of exertional symptoms represents a “key development”, is one of the most common reasons for intervention, and is a well-known predictor of adverse outcomes. As such, Dr MacNab believes stress echo can play an important monitoring role. *“We rely very heavily on the patient history about their symptoms rather than testing them. Most specialists will be aware that symptom status is highly subjective: many patients with severe MR may not recognise symptoms that are slow and insidious, others may deny them or adopt a sedentary lifestyle to remain asymptomatic.”*

Many echo parameters that can be measured at peak exercise are markers of latent left ventricular (LV) dysfunction, or reduced contractile reserve, in asymptomatic patients, Dr MacNab explained. Ejection fraction (EF) and global longitudinal strain (GLS) can be useful, though these may be difficult to assess in clinic at high heart rates. *“In real-life practice, eyeballing the LV may be all that is feasible to look for latent LV dysfunction,”* she added.

In a subgroup of patients, MR increases with exercise, and these people should be offered early intervention, explained Dr MacNab.

Which stressor?

Dr MacNab said her team did not use a treadmill to carry out exercise stress echoes. *“That’s for practical reasons. Once they stop on a treadmill you have 90 seconds to get all your information – LV assessment, MR assessment, tricuspid valve assessment etc – and, even in the best hands, that’s a bit too much to expect.”* Instead, they use a bicycle at incremental resistance, increasing by 25 watts every two minutes. Patients cycle at around 60 revolutions a minute until they develop symptoms or reach a target heart rate.

Dr MacNab said there was no role for dobutamine stress echo in this context. *“Paradoxically, as the inotropes start to make the LV better, the MR can actually decrease. However, dobutamine stress echo still appears in the guidelines for MR management, especially when you are assessing patients who have concurrent ischemia.”*



Advancing practice and enhancing care with scientist/physiologist-led TOE services

Elliot Smith

Scientist/physiologist-led services increase access to advanced diagnostic services within cardiology, particularly echocardiography, says Elliot Smith.

The Clinical Scientist and Lead Echocardiographer at St George’s University Hospitals NHS Foundation Trust spoke to delegates about his own experience of establishing a transoesophageal (TOE) echo service. While scientist-led services are becoming commonplace throughout the UK, he said, this hasn’t yet extended to TOE, a traditionally cardiologist-led imaging modality largely because of its invasive nature and the risks associated with intubation.

Scientists and physiologists, though, are ideally placed to lead these services – and assist with increasing TOE capacity – under the auspices of advanced practice.

Benefits

By increasing access to echo, scientist/physiologist-led services reduce pressure on consultant-led services. *“Increased availability decreases patient waiting time, which leads to better diagnosis, quicker diagnosis, and overall better patient treatment outcomes,”* he said.

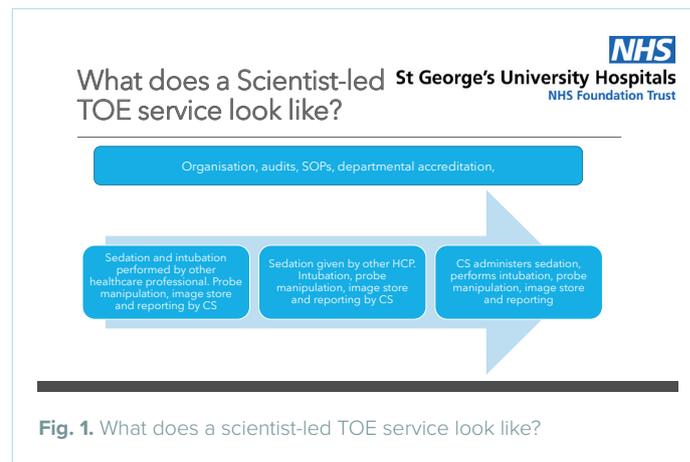
Getting started

Elliot recommended any trust considering this route to appoint a physiologist or scientist into a role from which they can lead on the development of standardised operating practices, procedures, departmental accreditation and audit.

The higher that person’s skillset, the more straightforward governance approval will usually be, Elliot said. He explained that he is a Health and Care Professions Council (HCPP)-registered Clinical Scientist who holds the Scientist Training Programme (STP) accreditation and was trained in administering xylocaine and local anaesthetic.

Service models might vary from centre to centre. In the most basic scenarios, the clinical scientist would carry out just probe manipulation and store and report on the images, whereas in the most advanced, they might also administer the sedation and perform intubation (see fig 1).

Whichever model is used, consultant support was vital to the successful establishment, and continuation, of services.



Achieving competency and securing governance

Elliot said he achieved competency in TOE by gaining British Society of Echocardiography (BSE) accreditation. *"It is fairly easy to do, and requires very little or no governance,"* he said, adding that it consisted of a theory and a practical element, as well as a log book and the submission of five video cases. He also made great use of his Trust's simulator and completed BSE's TOE Heart Works e-learning module which carried six CPD points. The BSE syllabus does not cover intubation, so Elliot's team decided to follow an American document which used a minimum of 25 successful procedures as a benchmark of competency.

Gaining governance approval involved writing a series of documents, including SOPs and a competency framework. They covered subjects such as the reasons behind the service, what training was in place, associated risks and emergency protocols relating to intubation and local anaesthetic.



Professor Mark Monaghan

How 3D echo can help surgeons plan mitral valve repair

Professor Mark Monaghan

3D transoesophageal (TOE) echo can help surgeons plan mitral valve repair procedures, Professor Mark Monaghan told delegates.

Prof Monaghan, Consultant Clinical Scientist at King's College Hospital, said: *"One thing we have to do when we are talking to our*

surgeons is make sure we speak their language. When we describe the different aspects of the mitral valve, we and the surgeons tend to use the Carpentier classification." He went on to say that 3D TOE was a *"fantastic communication tool"* that allowed echocardiographers to show surgeons exactly *"what they will see when they operate"*.

"We can take a still 3D image of the mitral valve, rotate it round and play with it. The surgeons will get a lot more information out of this than they can from 2D images and be able to plan exactly what they are going to do in terms of repair," said Prof Monaghan.

Predictors of successful repair

There are a few *"simple rules"* to follow in terms of predictors of successful mitral valve repair in primary mitral regurgitation (MR), Prof Monaghan said. *"Those who are ideal for surgical repair are those where the pathology is mainly limited to the posterior leaflet, where there is no calcification, and there is a focal abnormality with the valve. However, surgical techniques are improving all the time facilitating more complex repairs"*

Audit

Audit is an important part of any service, as it helps to drive improvement and build the evidence base, Elliot said. Since the service launched in September 2019, he has attempted 44 intubations and eight, or 18%, were unsuccessful. *"Only two have been unsuccessful so far this year, which suggest a steep learning curve,"* he said.

He has also asked for feedback from his colleagues and patients, collecting *"encouraging"* scores from both, and confirming his belief that clinical scientist-led TOE services can drive advanced practice and enhance patient care.

Contraindications include moderate to severe calcification on the leaflet, severe annular calcification, thickening of leaflets with retraction and thickening caused by past surgery or radiation. *"These are the kinds of things we should be including in our reports so the surgeons can make a plan as to whether it is realistic for them to go in and repair this particular valve,"* Prof Monaghan explained.

In secondary MR, unfavourable predictors include mitral valve deformation and local or global left ventricle (LV) remodelling which may cause excessive leaflet tethering and tenting.

Photorealistic 3D TOE

Emerging methodologies are offering further promise of helping surgeons to plan mitral valve repair, he went on. *"3D echo is changing rapidly and we have improvements in resolution, very good probes with high volume rates and also the ability to look at cardiac tissues in a different way,"* said Prof Monaghan, adding that high-definition photo realistic 3D TOE rendering allowed the use of a moveable light source and enabled much deeper understanding of mitral valve anatomy, including the thickness of the leaflets. *"Surgeons can look at the annulus in much more detail, look at where they will be suturing in the annuloplasty ring and look at the quality of the tissues,"* he said. *"It's almost as though you can hold the heart in your hand and rotate it round."*

Echo is key

Concluding his talk, Prof Monaghan said echo had a pivotal role in managing mitral valve disease and planning mitral valve repair.



Dr Rick Steeds

Uncommon and uncertain: MVP and MAD

Dr Rick Steeds

Mitral annular disjunction (MAD) – and its connection to mitral valve prolapse – may be topical, but it is still shrouded in unknowns, said Dr Rick Steeds, Consultant Cardiologist at the University Hospital Birmingham.

Speaking at the virtual BSEcho 2020 conference, he said: *"There is extensive case literature on the association between complex ventricular arrhythmias, sudden cardiac death (SCD), MVP, and, later on, MAD."*

MVP

MVP affects between 2% and 3% of the general population, and prognostic factors include age, mitral regurgitation severity and left ventricle (LV)/ left atrium (LA) size and function. While outcomes are *"pretty good"*, adverse outcomes include requiring mitral valve surgery, congestive heart failure and an increased risk of infective endocarditis or stroke. There is also a risk of arrhythmia and SCD, which varies between 0.2% and

1.9% in the literature. Predictors of SCD in people with MVP seem to include complex premature ventricular contractions (PVCs), increased tissue velocity and inferolateral fibrosis, while there is no clear relationship to severity of mitral regurgitation, said Dr Steeds.

MAD and MVP

MAD is commonly, but not exclusively, found in people with MVP, Dr Steeds explained, before highlighting a study published earlier this year in JACC. It found an excess of deaths in MVP patients with MAD, leaflet redundancy and altered T/ST repolarisation. “You can identify a group of patients with MVP who also have mitral annular disease and ECG changes who are at higher risk going forward,” he said adding that the pathogenesis of arrhythmia in MVP/MAD is uncertain.

“People might rush back to the echo department and think ‘I’ve got to look out for this because these people are at a really bad risk,’ but the numbers we are talking about are pretty small,” said Dr Steeds. The at-risk groups have both MVP and MAD and they have a 0.2% to 0.4% risk of an adverse reaction. It’s also worth noting, he said, that the current risk factors, including ST/T changes and PVCs, lack specificity and have a poor predictive value.

Current treatment

“What you do about it is also unclear,” said Dr Steeds. Targeting ablation to the papillary muscles can reduce symptoms and ventricular ectopics (VE) burden, but has an uncertain risk/benefit profile. It is also unclear how efficacious MVP surgery or implantable cardioverter defibrillators (ICDs) are in this group of patients.

Concluding his talk, Dr Steeds said this remained a “research topic”, adding that it was “not a common clinical problem” and that the “treatments are uncertain”.

BSEcho2020 Tuesday, October 6: Hypertrophic Cardiomyopathy



Dr Rick Steeds

Differentials of HCM by Multi-Modality Imaging

Dr Rick Steeds

Take a whole-person approach to distinguishing between hypertrophic cardiomyopathy (HCM) and other causes of left ventricular hypertrophy (LVH), said Dr Richard Steeds.

Dr Steeds, a Consultant Cardiologist at University Hospitals in Birmingham, said that true HCM – a

sarcomeric protein gene mutation – takes up about two thirds of a standard clinic. Between one in 10 and one in 20 patients have a mimic that gives an appearance like HCM. “It’s that 5% to 10% that we are interested in today,” he said.

As well as HCM, a number of conditions can lead to LVH. These can include simple conditions that result in LVH due to afterload, such as hypertension and aortic stenosis, but also more complex multisystem diseases that arise from extracellular (e.g. amyloidosis) and intracellular infiltration (e.g. Fabry disease).

Clues such as age of the patient are important and can help to distinguish between the various conditions (see fig 1). “Things like Pompe and Danon will usually present in childhood, and things like amyloidosis and aortic stenosis tend to happen after you are 60,” said Dr Steeds, adding that historical hypertension and blood pressure records and any echo evidence of aortic stenosis will also assist in making a diagnosis.

Cardiorenal disease

Renal disease should also be considered when making a differential diagnosis said Dr Steeds. “We have done a lot of research in this area and one of the interesting things is that you get progressive LVH the more advanced your kidney

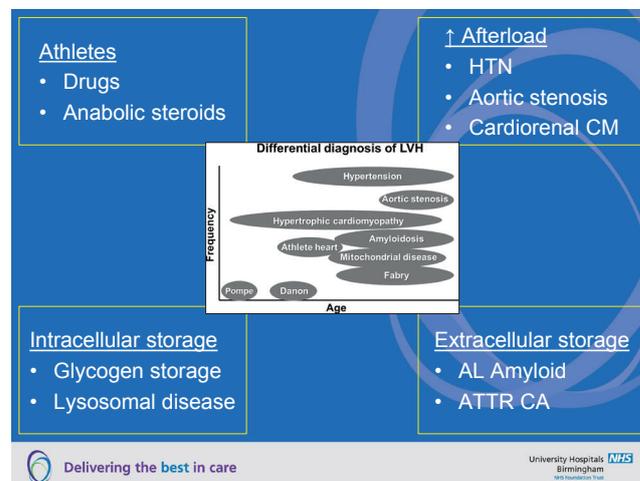


Fig. 1. What is causing LVH in this patient?

disease is.” If a patient is on dialysis or has a history of renal disease, Dr Steeds continued, this can sometimes account for increased afterload in addition to hypertension and be attributed to cardiorenal cardiomyopathy.

Physical clues

“There could be physical clues,” said Dr Steeds, before going on to give a number of examples. “Someone who turns up with dark glasses and a white stick could have mitochondrial cardiomyopathy. Someone with ataxia, or uncontrollable movements of their limbs, raises the possibility of Friedreich’s ataxia.” A patient with Pompe disease will often be short, because the condition is usually associated with growth retardation, and a person with Fabry disease may have a rash on the trunk or back, Dr Steeds explained.

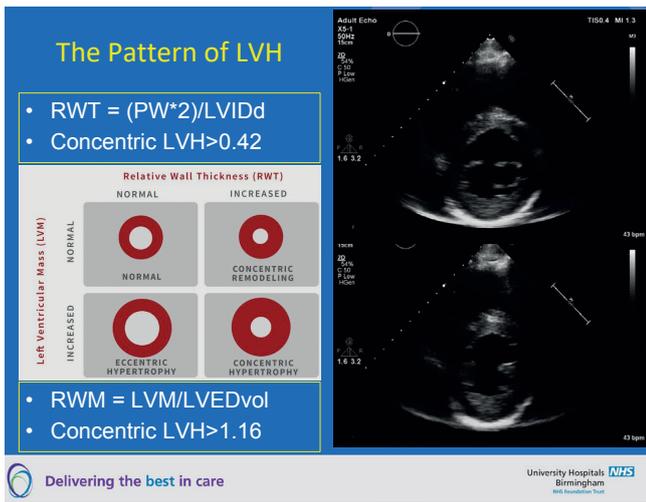


Fig. 2. The pattern of LVH

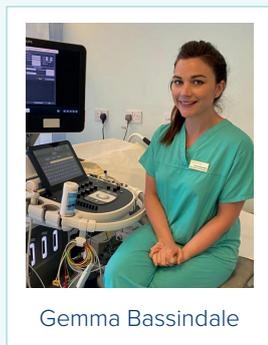
Things to think about on echo

Echo findings will also offer clues as to whether the patient in front of you has HCM or something else. “An important thing is to think about classifying the hypertrophy into concentric and eccentric LVH,” said Dr Steeds (see fig 2). Fabry disease, for example, will often result in diffuse hypotrophy in a concentric pattern, where the cavity is small but the wall is thickened right the way round.

Granular sparkling

Dr Steeds said he wanted to put the matter of granular sparkling being a sign of HCM “to bed”. It is present in cardiac amyloidosis, Pompe disease, chronic kidney disease, hypertension and haemochromatosis, so “as a sign it’s useless”, he said, adding it was “much more important” to think about diastolic function and strain.

He concluded by saying that any diagnosis was likely to be a composite of physical clues, echo findings, biomarkers and information from other imaging modalities such as MRI.



Stress echo can unmask latent obstruction in HCM

Gemma Bassindale

There’s a growing body of evidence to support the use of exercise stress echo in hypertrophic cardiomyopathy (HCM), said Gemma Bassindale.

Gemma, who is the Lead Sonographer for Inherited Cardiac Conditions at Leeds Teaching

Hospitals, started her talk by explaining what HCM is and how it manifests. “HCM is, by definition, the presence of left ventricular hypertrophy (LVH) that cannot solely be explained by abnormal loading conditions such as hypertension or aortic stenosis,” she said. It was an inherited disorder with great heterogeneity and a variable phenotype, she said, adding: “Disease progression can look different in every patient.”

Most people with HCM have a normal lifespan and many are asymptomatic. “However, individuals can develop symptoms, often years after their initial diagnosis. Many complain of chest pain at rest or on exertion, and this may be precipitated by food or alcohol,” said Gemma, explaining that common symptoms also included heart failure, palpitations and syncope.

The natural history of HCM, she said, featured a “lifelong process of progressive and adverse cardiac remodelling characterised by myocardial fibrosis and wall thinning”. This can result in systolic and diastolic impairment, outflow tract obstruction, increased mitral regurgitation, increased tricuspid regurgitation and raised heart pressures. “All of the above, if they occur on exertion, can be assessed using stress echo” Gemma said.

What does the guidance say?

There is an increasing body of evidence surrounding stress echo in non-ischemic heart disease including HCM. European Association of Cardiovascular Imaging (EACVI)/ American Society of Echocardiography (ASE) clinical recommendations say that stress echo is safe and commonly used to assess for inducible outflow obstruction, especially in patients who have equivocal symptoms. European Society of Cardiology (ESC) guidelines recommend stress echo in symptomatic patients if

it is not possible to provoke a gradient of more than 50mm Hg at the bedside. “The guidance is very clear that stress echo should be used in symptomatic patients with unremarkable resting gradients,” said Gemma. “Many causes of the symptoms can be assessed incrementally during exercise.” (see fig 1).

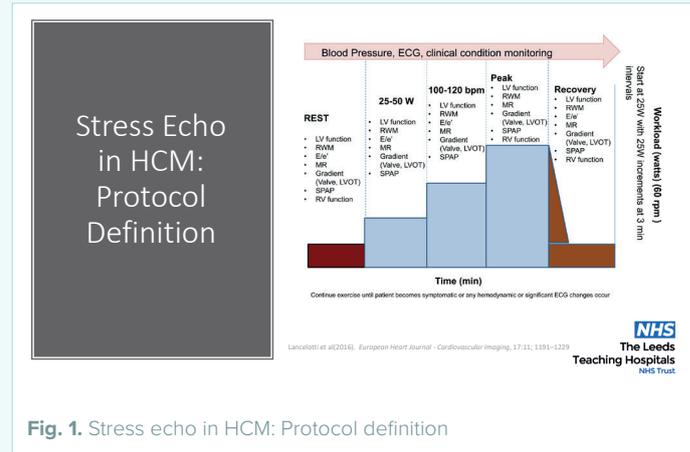


Fig. 1. Stress echo in HCM: Protocol definition

Performing the echo

Gemma shared her advice for carrying out exercise stress echo in this patient group. She said using the semi-supine position allowed for the “acquisition of the full spectrum of echo parameters” in a “more controlled way at all stages of exercise and well into recovery”. In severely symptomatic patients with negative Valsalva, we should always proceed to stress echo if possible, she added.

“Exercise under controlled conditions is the preferred gradient provocation method as it comes closest to reproducing the real-life activities patients participate in daily,” concluded Gemma.



Professor Martin Stout

Knowledge, preparation, and communication: How to create a scientist/physiologist-led stress echo clinic

Professor Martin Stout

Professor Martin Stout, Consultant Cardiac Physiologist at Manchester's Wythenshawe Hospital, talked about his own experiences of scientist/physiologist-led stress echo clinics.

Setup and logistics

Prof Stout's department provides a comprehensive stress echocardiography service for a wide range of clinical indications. It is important to ensure these services can run efficiently with the most suitable staff to ensure the best quality outcome for the patient. "At Wythenshawe, we provide both dobutamine and exercise stress echocardiography. Bicycle stress is the most common modality," he said.

The physiologist or scientist leading the procedure oversees the safety of the patient. They should ensure all the necessary equipment is set up accordingly and the correct imaging protocols are selected. They are also charged with ensuring all staff are aware of the clinical indications and potential adverse risks. "Safety is paramount, so whoever is leading the test must ensure that any safety equipment, resuscitation drugs and defibrillators are present," said Prof Stout.

Wythenshawe's stress service typically runs with a lead scientist/physiologist and a specialist cardiac procedural nurse, but the individual roles vary across the UK. An experienced imaging medic should be at the end of the telephone or in a nearby room, dependent on the lead sonographer's experience. Prof Stout said: "It's really important that you have a brief huddle prior to the stress session with the physician present so that there is complete awareness among the whole team of the patients' clinical backgrounds and the nature of the tests that are going to be undertaken."

Training requirements

Prof Stout said most people who have completed the Scientist Training Programme (STP) will need "a couple more years of further experience" to safely drive a nonmedical-led stress echo. "The academic aspects of the training programme will go some way to providing a knowledge of practice when clinically assessing patients and understanding how tests fit into treatment pathways," he said. "Physiologists who have significant experience and expertise in echo can build these skills over time and they've certainly got enough knowledge of cardiology to perform the role safely."

Prof Stout highlighted the benefits of undertaking the BSE Stress Accreditation process and suggested non-medical sonographers attend as many relevant specialist cardiac clinics as possible to improve their clinical history/examination and communication skills.

Considerations

The considerations for leading exercise versus pharmaceutical stress echo are "broadly similar" (see fig 1). "Important aspects may include the assessment of symptoms, physical changes in clinical signs and an understanding of how the history, symptoms and signs fit with a wider picture for diagnosis and treatment. Communication and discussion among the team should remain ongoing throughout the case," he added. Patient safety and obtaining the best test results possible for analysis are paramount.



Fig. 1. DSE vs. ESE considerations

Valve and structural studies tend to be more complex than ischaemic studies, both clinically and with respect to the volume of data. As such, experience is key to ensuring a good standard of image acquisition, robust data collection, adherence to protocols, patient safety and compiling a well-written, authoritative clinical report. (see fig 2). An additional operator allows the lead to step back and drive the procedure.

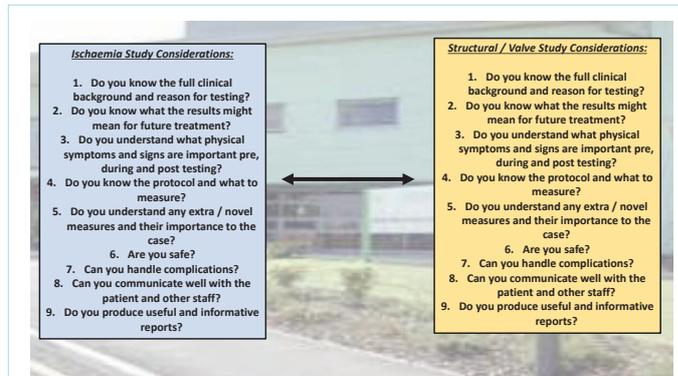


Fig. 2. Ischaemia study vs. structural / valve study considerations

Prof Stout said scientists/physiologists should ensure they provide a safe environment for the patient by selecting the most suitable approach, communicating with the stress echo team, and obtaining the most accurate images. This, alongside regular quality assurance, should facilitate effective and robust service delivery, he said.



Dr Dan Augustine

Athlete's heart or HCM: How to make the call

Dr Dan Augustine

A thorough assessment of a patient's history and investigations can be needed to help differentiate athlete's heart from mild phenotypes of hypertrophic cardiomyopathy (HCM).

Dr Dan Augustine, Consultant Cardiologist at the Royal United

Hospital Bath, said there were many potential overlaps between the two conditions.

"The incidence of sudden cardiac death (SCD) in athletes is higher than in age-matched, risk matched cohorts," said Dr Augustine, before pointing to registry data which found 6% of athletes who died from a sudden cardiac event had HCM¹.

He also explained that adaptation to exercise could be influenced by sporting discipline, ethnicity, gender and age. "It's important when we assess any patient that we always have a thorough assessment of clinical history to include symptoms and family history, go on to perform a full examination and then undertake several investigations," he said.

Investigations and clues

HCM, an inherited cardiac condition caused by mutations in the sarcomeric proteins, is characterised on echo by having at least one myocardial segment of 15mm in thickness, or 13mm if there is a confirmed diagnosis in a first degree relative. Apical HCM is defined by a ratio of 1.3 times the thickness at the apex compared to the basal cavity. In HCM, hypertrophy is not explained by loading conditions, Dr Augustine pointed out.

Athletes can also develop left ventricular hypertrophy (LVH) through physiological adaptation to exercise. "When trying to distinguish physiological adaptations due to sports from pathology with relevance to HCM, there are a number of different investigations that we need to review," said Dr Augustine, adding that ECG changes can occur in sports participation due to physiological change, though this varies depending on ethnicity, gender and age.

The pattern of LVH can also provide clues, he went on, pointing to a study that found concentric LVH was more likely to be found in athletes heart than in athletes with HCM. The

same paper also found that lateral T wave inversion and ST depression were not in keeping with the physiological changes associated with adaptation to exercise². "Athletes with HCM mainly have a combination of septal and apical hypertrophy, rather than athletes with physiological hypertrophy who usually will have concentric hypertrophy," said Dr Augustine.

Diastolic function is another differentiator. "With athlete's heart we would expect the tissue Doppler S' to be normal or elevated, and with HCM and progressive disease this will be reduced," he went on, explaining that advanced HCM would usually cause diastolic dysfunction.

Supportive features

Other things to look for including symptoms, family history, other investigations and ancillary echo findings.

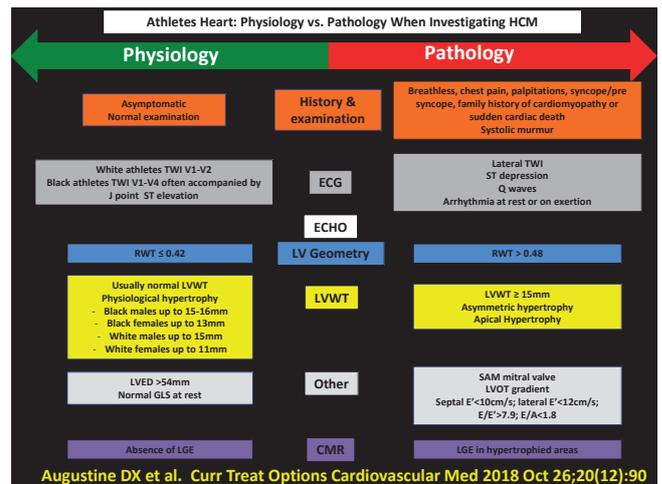


Fig. 1. Physiology vs pathology when investigating HCM

¹ Finocchiaro, G., Papadakis, M., Robertus, J.L., Dhutia, H., Steriotis, A.K., Tome, M., Mellor, G., Merghani, A., Malhotra, A., Behr, E. and Sharma, S., 2016. Etiology of sudden death in sports: insights from a United Kingdom regional registry. Journal of the American College of Cardiology, 67(18), pp.2108-2115.

² Sheikh, N., Papadakis, M., Schnell, F., Panoulas, V., Malhotra, A., Wilson, M., Carré, F. and Sharma, S., 2015. Clinical profile of athletes with hypertrophic cardiomyopathy. Circulation: Cardiovascular Imaging, 8(7), p.e003454.



Dr Will Bradlow

New guideline hopes to unmask HCM cases

Dr Will Bradlow

New hypertrophic cardiomyopathy (HCM) recommendations hope to give echocardiographers confidence that they are "extracting as much information as possible" from scans.

That's according to Dr Will Bradlow, Cardiologist Consultant at the

Queen Elizabeth Hospital, Birmingham, who presented the British Society of Echocardiography's HCM guideline to the conference. "We hope this will enhance care by reducing the

number of patients who are under- or over diagnosed, but also, importantly, by identifying those sub cohorts who need additional tests and treatments," he said.

Making the diagnosis

The diagnostic criteria of HCM is a wall thickness of ≥ 15mm in any of the left ventricular (LV) myocardial segments that is not explained solely by loading conditions. The key complications associated with the condition include atrial fibrillation, LV impairment and sudden or resuscitated cardiac death.

The echo measurement of wall thickness, the guideline recommends, should be done in the short axis of each of the three segments – basal, mid-ventricular, and apical – taking care to avoid "common pitfalls" (see fig 1).

MAKING DIAGNOSIS : WALL THICKNESS

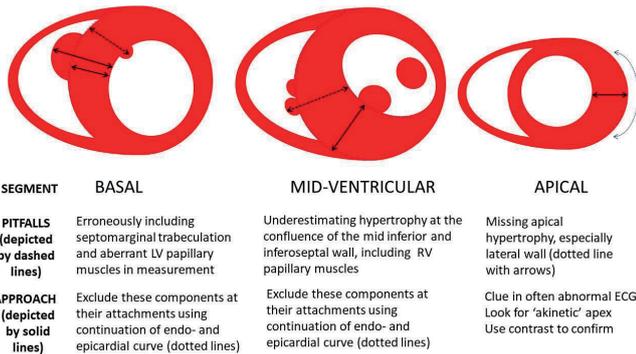


Fig. 1. SE-recommended approach to wall thickness measurements in HCM

Dr Bradlow also said there are several “grey area” cases, where the degree of LVH in HCM can overlap with that caused by afterload issues such as hypertension, renal disease, aortic stenosis, elevated BMI, or athletic remodelling.

Risk stratification

Wall thickness, left atrium size and peak LVOT gradient can help with risk stratification and guide treatment decisions and so should be included in the echo report conclusion, along with any apical aneurysm and even subtle LV impairment, said Dr Bradlow.

Patients with restrictive physiology are at a higher risk of pulmonary hypertension and heart failure, so this also needs to be “flagged up” in echo reports.

RECOMMENDATIONS FOR REPORT

1. The likelihood of the patient having HCM using suggested phrases: *does not fulfil criteria for HCM, unlikely to have HCM, likely to have HCM, features consistent with HCM.*
2. The presence of red flags pointing to a phenocopy of HCM.
3. The pattern of LVH: sigmoid septal, reverse curvature, apical or neutral.
4. The values for maximal wall thickness, LVOT gradient and LA size.
5. The presence or absence of disease complications.
 - a. Systolic dysfunction with EF 50-60%, EF<50%.
 - b. Diastolic dysfunction, specifically the presence of a restrictive filling pattern with preserved ejection fraction.
 - c. LVOT obstruction, other forms of obstruction and intrinsic mitral valve disease.
 - d. Aneurysm formation.

Fig. 2. BSE recommendations for echo report in HCM

Concluding his talk, Dr Bradlow said echo played a “critical role in the assessment of patients with either suspected or confirmed HCM, as well as their family members”. “This guideline is intended to give readers the knowledge and tools to perform these important studies at a high level,” he said.

BSEcho2020 Wednesday, October 7: COVID-19



Professor Bernard Prendergast

The “twin pandemics” of CVD and COVID-19

Professor Bernard Prendergast

There’s still much to learn about SARS-CoV-2 and COVID-19, but the cardiovascular involvement and overlap with other heart conditions cannot be ignored.

Professor Bernard Prendergast, Consultant Cardiologist at St Thomas’ in London, said that while he “is not an expert in

virology” his role at St Thomas’ during the peak of the pandemic meant he was “very familiar with the implications and applications” of COVID-19.

Since the outbreak of the pandemic, there have been cases of both acute and chronic cardiovascular manifestations of the disease, including myocarditis, takotsubo cardiomyopathy, ST-elevation myocardial infarction (STEMI), STEMI mimics and thrombotic complications at the microscopic and macroscopic level.

Curiously, he went on, there was a dramatic reduction in the number of people with acute STEMI and cerebrovascular accident presenting at heart attack and acute stroke units earlier this year. “We’re not sure whether this reflected a change in the natural history of the condition or whether it related to a reluctance of patients to present to hospitals,” said Prof Prendergast.

Phases of COVID-19

While we are still a long way from fully understanding the viral behaviour and replication dynamics of SARS-CoV-2, we do have some information on the natural history of the acute condition. There appears to be an early prodromal stage of approximately 7-10 days, followed, in some patients by the onset of respiratory embarrassment, potential progressive pulmonary infiltration and/or thrombosis and hospitalisation. However, many people are asymptomatic or have low grade respiratory symptoms.

“We now know that this is predominantly affecting the elderly, patients living in care homes, patients with comorbidity (particularly men), and those with coexistent hypertension, diabetes or pre-existing respiratory disease,” said Prof Prendergast, adding that while case numbers were currently rising, the infection seemed to be affecting a younger population with less of a likelihood of developing COVID-19.

Twin epidemics

In cardiology, we need to remember that the symptoms of COVID – breathlessness, chest discomfort and fatigue – are very similar to those of underlying cardiovascular disease (CVD), and that those with pre-existing cardiovascular problems are more susceptible, said Prof Prendergast.

“We also need to remember that cardiologists and cardiovascular technologists are already addressing a second pandemic,” he said. *“CVD kills and affects many more millions*

of people each year, has done so the last 20 to 30 years, and, despite our best efforts, is likely to continue to afflict these patients for many years to come.”

It means that we have a “*dual responsibility*” to care for those with the cardiovascular complications of COVID while “*retaining our focus on the needs of our pre-existing and future cardiovascular patients*”. Distinguishing between the two pandemics, he said, was challenging.



Dr Richard Fisher

Echo manifestations of COVID: Left heart

Dr Richard Fisher

We need to understand the echo manifestations of COVID-19 so we can decide who to scan and when, which type of scan is needed and how to interpret the findings.

But while the evidence on SARS-CoV-2 has been growing steadily in the last few months, there are

still “*far more questions than answers*”, said Dr Richard Fisher, Intensive Care Consultant at London’s King’s College Hospital.

Viral myocarditis

A question posed earlier this year had been can SARS-CoV-2 cause viral myocarditis. Most of the evidence comes from case reports, Dr Fisher said, presenting a review of all nine available case reports, published in August¹. Two thirds had a troponin level of less than 10,000 ng/L and a third had normal left ventricular ejection fraction on echo. Histology was available for just one of the patients. It showed viral particles inside macrophages within the interstitium, but not in the myocytes, and only low-grade inflammatory infiltrate was apparent. “*Does COVID-19 cause viral myocarditis? Maybe, but it doesn’t seem to be terribly prevalent,*” he said.

Practical advice

“I really believe these scans are important. We have identified immediately life-threatening pathologies in people with COVID-19,” said Dr Fisher.

Patients with chest pain, an abnormal ECG, raised troponin or BNP, who are in shock, or have the symptoms of heart failure should be scanned, he said, before offering some practical tips on doing so (see fig 1).

Post-acute COVID

For some patients, recovery can take some time, with symptoms such as breathlessness, palpitations and fatigue, lingering for weeks or even months. “*We do not know if this is related to lung damage, cardiac damage or some other mechanism, but this is the sort of thing that we need to start learning about over the next 12 to 24 months,*” said Dr Fisher.

It is reasonable to expect that echo departments will soon start to see patients with “*long COVID*” symptoms referred into them from GPs and respiratory clinics and this should be seen as an opportunity to build the evidence base, he said.

“I think these patients should be considered low risk for onward viral transmission. Therefore, we should be doing full studies in these patients,” said Dr Fisher, before finishing his talk with a “*call to arms*” involving the establishment and maintenance of large registries. “*I think that the potential is there for some cardiac disease post-COVID and we need to be looking for it actively,*” he said.

¹ Kariyanna, P.T., Sutarjono, B., Grewal, E., Singh, K.P., Aurora, L., Smith, L., Chandrakumar, H.P., Jayarangaiah, A., Goldman, S.A., Salifu, M.O. and McFarlane, I.M., 2020. A Systematic Review of COVID-19 and Myocarditis. American journal of medical case reports, 8(9), p.299.

Echo manifestations of COVID-19: The Left Heart

Practical advice regarding scanning acutely unwell patients with COVID-19

In sick patients with COVID-19 echocardiography frequently identifies abnormalities and changes immediate patient management.

Chest pain, ECG abnormalities, raised cardiac biomarkers, shock and clinical signs of heart failure should all prompt echocardiography.

The purpose of echo here is to detect gross pathology, therefore a level 1 scan (or modified level 1 scan) is appropriate.

Perform measurements post-hoc.

Contrast agents may be useful in challenging patients.

At present there is no convincing evidence for routinely using speckle tracking in the acute phase.

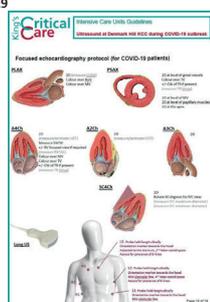


Fig. 1. Practical advice on scanning acutely unwell patients with COVID-19



Kelly Victor

Echo manifestations of COVID: Right heart

Kelly Victor

Right ventricular (RV) dilation and global and/or longitudinal dysfunction appear to be common in people with COVID-19.

Talking about echo findings in relation to the right heart, Kelly Victor, Clinical Scientist in Cardiology at Guys' and St

Thomas's Hospital, London, said the resulting RV failure could be a consequence of acute respiratory distress syndrome (ARDS) caused by pulmonary vasoconstriction, hypercapnia, or high driving pressures relating to ventilation. *"In these patients we need to focus on assessing RV size and function, RVSP, and really integrating the movement of the interventricular septum, paying particular attention to any evidence of D-shaped flattening,"* said Kelly.

COVID-19 patients have an increased risk of thrombus formation, meaning pulmonary emboli (PE), are another potential cause of RV failure in this cohort. Kelly said: *"What we don't know is if it's the disease causing the PEs or if it's the disease combined with the population we are treating. We are commonly seeing obese and elderly patients who carry a higher risk of PE formation."* During echo, readers should focus on identifying RV dilatation and RV dysfunction, look at RV systolic pressures and confirm the presence or absence of thrombus within the RV, RVOT and the pulmonary artery vasculature.

Early evidence

An early study of a small number of patients from Wuhan in May 2020 found RV dysfunction was *"tightly linked"* to mortality in people with COVID and suggested RV longitudinal strain was the best indicator of mortality¹. A US pilot study, again of a very

small cohort, showed that RV global strain and free wall strain were significantly decreased in those who had poor outcomes, compared to those who did not². *"Perhaps being more vigilant in monitoring patients with reduced RV strain could prompt early treatment and better outcomes,"* said Kelly. *"But I would suggest further investigations into the prognostic value are required before it's rolled out."*

What could we do differently?

Talking about what we have learned from the first wave of COVID, Kelly said raised troponin should be used as an indicator for echo, and that point of care echo on initial presentation could be helpful. *"Would that have helped us to decipher those critically unwell patients through comparison of the initial scan and the effects of ventilation?"*, she asked. It might also be useful to perform interval scans post-recovery, she said. *"This may assist us in understanding the disease process and recovery more comprehensively,"* said Kelly.

Summing up, she said it had been a steep learning curve, but there was *"still much that we need to learn before we understand COVID-19 and the long-term consequences"*.

¹ Li, Y., Li, H., Zhu, S., Xie, Y., Wang, B., He, L., Zhang, D., Zhang, Y., Yuan, H., Wu, C. and Sun, W., 2020. Prognostic value of right ventricular longitudinal strain in patients with COVID-19. JACC: Cardiovascular Imaging.

² Krishnamoorthy, P., Croft, L.B., Ro, R., Anastasius, M., Zhao, W., Giustino, G., Argulian, E., Goldman, M.E., Sharma, S.K., Kini, A. and Lerakis, S., 2020. Biventricular strain by speckle tracking echocardiography in COVID-19: findings and possible prognostic implications. Future Cardiology, (0).



Dr Aneil Malhotra

When are athletes ready to return to play post-COVID?

Dr Aneil Malhotra

Cardiac involvement in acute COVID-19 appears to be wide ranging, but the main concern in athletes and people who exercise is myocardial injury, or myocarditis.

Dr Aneil Malhotra, Consultant Cardiologist at Wythenshawe and Manchester Royal Infirmary

Hospitals, said that continuing to exercise with myocarditis can accelerate the development of arrhythmias, heart failure, and even lead to sudden cardiac death. *"Therefore, when we diagnose myocarditis, the aim is to rest the heart as quickly as possible. We normally ask people to stop exercising completely for between three and six months,"* said Dr Malhotra.

Return to play protocols

Various sporting associations have produced return to play guidelines, but in the absence of longitudinal data, all recommendations are consensus based.

A collaborative international initiative, endorsed by The European Society of Cardiology, takes a pragmatic, balanced approach, said Dr Malhotra (see fig 1). *"Asymptomatic individuals, irrespective of their test status, can return to play in a normal or graduated fashion,"* he said.

ECG and echo are recommended *"as a minimum"* for anyone with a protracted illness over seven days or more, or who experienced cardiac symptoms suggestive of myocarditis. If these tests are normal, the athlete can undergo exercise testing if it can be done safely.

"Comprehensive clinical evaluation including troponin and cardiac MRI, have been reserved only for the group that's been severely debilitated by COVID-19 or have ongoing cardiac symptoms," said Dr Malhotra.

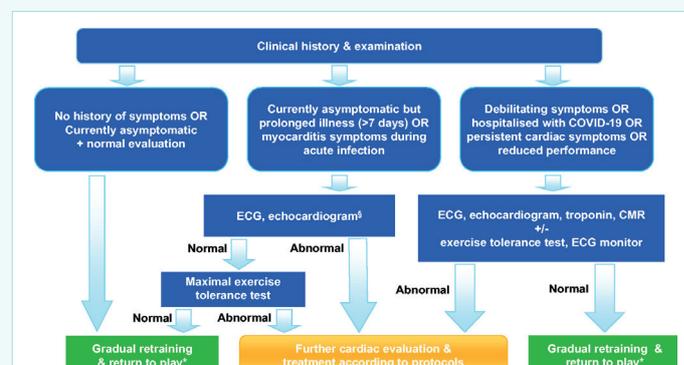


Fig. 1. Return to play protocol, Bhatia et al, Eur J Prev Cardiol 2020

It's worth bearing in mind that while myocarditis is serious in this population, it is not common, Dr Malhotra said. *"Only a small proportion of severely affected individuals will have cardiac involvement."*

Considerations

In conclusion, Dr Malhotra said athletic individuals, whether recreational or professional with no or only mild evidence of infection, *"don't necessarily require cardiac evaluation prior to the resumption of sports"*. Echo should be considered, he said, in those with persistent or cardiac-specific symptoms, those who have been hospitalised and those with reduced exercise performance. *"Just bear in mind that echo features may be subtle among this particular group of individuals,"* said Dr Malhotra.

¹ Bhatia, R.T., Marwaha, S., Malhotra, A., Iqbal, Z., Hughes, C., Börjesson, M., Niebauer, J., Pelliccia, A., Schmied, C., Serratos, L. and Papadakis, M., 2020. Exercise in the Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) era: A Question and Answer session with the experts Endorsed by the section of Sports Cardiology & Exercise of the European Association of Preventive Cardiology (EAPC). *European Journal of Preventive Cardiology*, p.2047487320930596.



Dr David Oxborough

Preparing for the next wave: The BSE COVID Survey

Dr David Oxborough

The results of the British Society of Echocardiography's COVID-19 Survey will help departments plan for the next wave of the pandemic.

That's according to Dr David Oxborough, Reader in Cardiovascular Physiology at the Liverpool John Moores University,

who presented the results of the survey at the BSEcho 2020 conference. *"It allowed us to gauge a snapshot of echocardiographic service delivery across the UK and Ireland in the early stages of this pandemic,"* said Dr Oxborough. The primary aim, he went on, was to *"generate valuable information that would allow us to plan for the next stage, future pandemics and future waves"*.

The survey, conducted in May and June, consisted of 32 questions, and attracted 132 responses from centres across the UK and Ireland. The main service providers were secondary care, closely followed by tertiary centres, while primary care and community clinics represented a small proportion.

Service changes

In the majority of cases, routine lists were cancelled during the early stages of the pandemic, though referrals were triaged and, in general, urgent scans were carried out. There was a significant change to working patterns, including the addition of seven-day services, extended hours, and the introduction of *"on call"*.

"With regards to absolute workloads, redistribution occurred to ensure ample resources," said Dr Oxborough. This included equipment, areas and teams being dedicated to COVID management. A total of 40% of respondents said their department had purchased additional equipment, generally hand-held machines, for use in COVID-19 care. Departments were rearranged to allow for social distancing, and, in the main part, personal protective equipment (PPE) was made available.

Echo provision

The overall number of scans being performed each week fell significantly during the first peak of the pandemic, the survey found. *"Tertiary centres were performing similar numbers of confirmed COVID-19, suspected COVID-19, and non-COVID-19 scans, while secondary care were performing more outpatient and less COVID-19 scans. I think that's probably related to the divisions and the availability of staff and equipment,"* said Dr Oxborough.

Staffing

Over the seven weeks of the survey, 22% of the echocardiographic workforce was unavailable due to testing positive for COVID-19, they or their family having symptoms, or having an underlying health condition. Said Dr Oxborough: *"That's something that we have to take into account for any future wave."*

Learnings

The survey results showed some *"clear common threads"* in terms of what was learnt during the first half of 2020. Chief among them was the importance of supporting each other. Said Dr Oxborough: *"The staff were described as amazing. They were flexible and they pulled together. This is a difficult and challenging time for everybody and it's important to acknowledge that the staff were there, they were working, they were doing the best they could and there was clear communication and teamwork throughout."*

The respondents also said they would look to create more stringent triage and inpatient referral processes, only perform scans where they may inform a change in patient management and that COVID-dedicated handheld scanners were very useful.

Looking ahead

With cases of COVID-19 infection once again on the increase, it's crucial that societies such as BSEcho provide leadership, said Dr Oxborough.

"As the scientific evidence becomes more robust, so will the guidelines, and that will make life easier for echocardiographers. I think surveys like this are ideal in terms of generating information, gauging what's happening on a national scale, and allowing us to adapt our guidelines accordingly."



Dr Benoy Shah

When to stress test the aortic valve

Dr Benoy Shah

In selected patients, stress echo can help guide aortic valve replacement decisions and prognosis.

Consultant Cardiologist at University Hospital Southampton, Dr Benoy Shah, said stress echo was helpful in classical low-flow low-gradient severe aortic stenosis (AS) with

reduced left ventricular ejection fraction (LVEF), symptomatic moderate AS and aortic regurgitation. Evidence is lacking, he explained, for its prognostic value in severe asymptomatic AS and low flow low gradient severe AS with preserved LVEF.

When to test

Severe low-flow low-gradient AS, defined as LVEF of <40%, mean aortic valve gradient of <30mmHg, and aortic valve area (AVA) of <1cm². "The first thing that's worth doing when evaluating these patients is be absolutely certain they fit the diagnostic criteria," said Dr Shah. "Patients with impaired EF may not necessarily have severe AS, but sometimes the gradients have been underestimated and many patients may inappropriately be sent for dobutamine stress testing."

If a patient's resting echo fits the criteria, a dobutamine stress echo can be useful to confirm the presence of severe disease or left ventricular contractile reserve prior to aortic valve replacement surgery.

Some people with moderate AS at rest will have more severe symptoms on exertion, said Dr Shah. "Treadmill testing can be very helpful to check their blood pressure and heart rate in response to exercise," he said. "It's not essential to perform the echo component, although this can let you look at LV function and pulmonary pressures on excess exercise."

There is limited data and clinical use of stress echocardiography in aortic regurgitation. However, the modality can be used to demonstrate LV dysfunction at peak stress and inform surgery decisions.

How to test

Dr Shah's team traditionally start at 5mg of dobutamine per kilo per minute for the first five minutes, then increase the dose to 10mg for another five minutes. "I will often go to 15mg especially if there has not been much change in heart rate in the first stage," he said. At Southampton, they use a study report template (see fig 1) to make sure all the relevant information is collected and fed back.

"I would strongly recommend when you're doing these studies that you document all the basic patient data, including their size, body surface area and resting heart rate and blood pressure," he added.

SE Reporting



```
LVOT DIAMETER = 2.3cm LVOT area = 4.15cmsq

RESTING ECHOCARDIOGRAPHY
- LV systolic function is severely impaired, EF by Simpson's biplane = 27%
- Calcified trileaflet aortic valve with restricted cusp motion
- LVOT VTI = 11.5cm
- Stroke volume = 48ml, ejection time = 285ms, thus flow rate = 168ml/sec
- AoV Peak gradient = 33mmHg, mean gradient = 20mmHg, VTI = 57.4cm
- Dimensionless index = 0.2, Doppler-AVA = 0.83cm squared

LOW-DOSE DOBUTAMINE (10mcg/kg/min)
- Quantitated EF = 36%
- LVOT VTI = 13.7cm
- Stroke volume = 56.8ml, ejection time = 236ms, thus flow rate = 240ml/sec
- AoV Peak gradient = 54mmHg, mean gradient = 30mmHg, VTI = 69.4cm
- Dimensionless index = 0.19, Doppler-AVA = 0.82cm squared

MID-DOSE DOBUTAMINE (15mcg/kg/min)
- LVOT VTI = 14.3cm
- Stroke volume = 59.3ml, ejection time = 246ms, thus flow rate = 241ml/sec
- AoV Peak gradient = 58mmHg, mean gradient = 34mmHg, VTI = 63.3cm
- Dimensionless index = 0.22, Doppler-AVA = 0.93cm squared
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Fig. 1. UHS stress echo report template

Summing up

Concluding his talk, Dr Shah said stress echocardiography was useful in selected aortic valve patients, though he no longer performed it in patients with asymptomatic severe AS, in whom he favoured exercise treadmill testing.

"I do find it useful in the patients who have LV dysfunction and who have classical low-flow low-gradient, severe AS for clarifying stenosis severity, and the presence or absence of LV contractile reserve, which we know significantly influences the perioperative risk of procedures," he said. "I also find it useful in selected cases of moderate AS and occasionally in aortic regurgitation."

Changing landscapes in AS assessment

Mr Shaun Robinson

Echocardiographers should consider the inaccuracies of some of the routine measures of aortic stenosis (AS) severity.

Mr Shaun Robinson, Consultant Clinical Scientist, at North West Anglia Foundation Trust, outlined emerging concepts in AS measurements during BSEcho2020.



Mr Shaun Robinson

Inaccuracies of measures: DI and SVI

Dimensionless index (DI) is considered a good load-independent indicator of AS severity because, unlike peak velocity and mean gradient, it isn't affected by variations in stroke volume and flow.

However, it is significantly affected by variations in LVOT geometry and size, said Shaun, explaining that the DI cut-off to define severe AS (when the aortic valve area (AVA) falls below 25% of the LVOT area) therefore represents an AVA that changes according to changes in LVOT dimension. Based on the premise that patients with larger body surface areas will have larger aortic valves and vice versa, Michelen¹ and colleagues propose the cut-off for severe AS should be determined by LVOT diameter instead he added.

Stroke volume index (SVi) is another area of interest. “When we’re assessing AS and we find our parameters are discordant, we usually consider this to be because of low flow rate and the majority of current guidelines define flow on the basis of SVi alone,” said Shaun. But SVi is simply the static volume of blood ejected by the left ventricle (LV) during systole and doesn’t tell us anything about velocity, rate of flow through the valve, or the duration of ejection. “Whereas flow rate, calculated as stroke volume divided by the ejection time, puts flow in the context of time and tells us a rate of flow through the aortic valve.”

A new way to describe flow

The SVi, AVA and ejection time can be used to calculate the mean velocity of blood through the valve and indicates that for a given AVA and SVi the mean velocity will increase or decrease according to changes in the ejection time. This will result in variations in peak velocity and mean pressure gradient and will be reflected by alterations in flow-rate. Flow rate is therefore likely to be a better indicator of flow status than SVi alone, Shaun said. “If you are finding that your parameters are discordant but your SVi is normal, consider whether this is a low flow rate, i.e. <250ml/s.”

Non-routine measures

Shaun went on to describe three non-routine methods of assessing AS, all based on the concept of pressure recovery (see fig 1). “What’s clinically important is the net pressure difference between the LV and the aorta. This is the true reflection of the hemodynamic burden of AS, whereas on echo we calculate the pressure difference at the vena contracta.” When the aorta is small, this can lead to an underestimation of AVA and an overestimation of AS severity.

Instead, echocardiographers could measure recovered pressure gradient (see fig 2) or energy loss index (see fig 3), he said.

¹ Michelena, H.I., Margaryan, E., Miller, F.A., Eleid, M., Maalouf, J., Suri, R., Messika-Zeitoun, D., Pellikka, P.A. and Enriquez-Sarano, M., 2013. Inconsistent echocardiographic grading of aortic stenosis: is the left ventricular outflow tract important?. Heart, 99(13), pp.921-931.

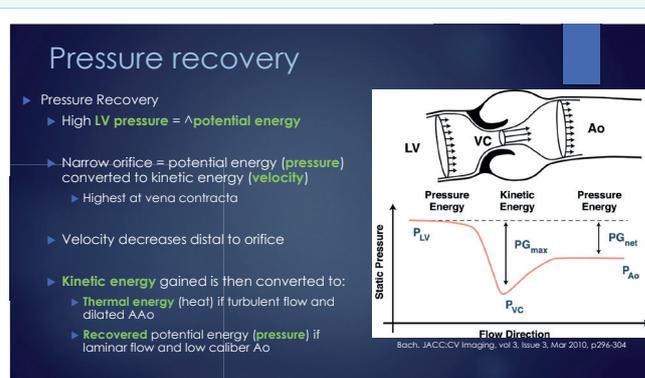


Fig. 1. Pressure recovery

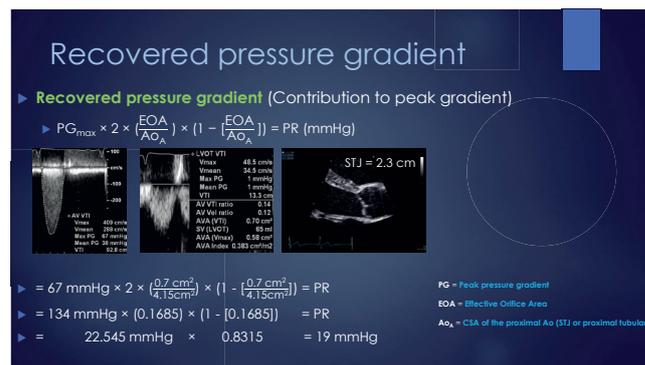


Fig. 2. Calculating recovered pressure gradient

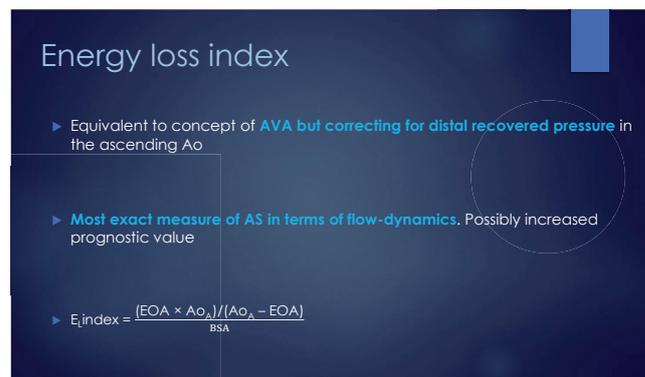


Fig. 3. Calculating energy loss index



Keith Pearce

Shortening the path to valve surgery with scientist/physiologist-led services

Keith Pearce

Scientist/physiologist-led services can improve patient outcomes by streamlining access to expertise, diagnosis and intervention.

Consultant Cardiac Physiologist Keith Pearce demonstrated this by

talking delegates through the set up and running of a complex valve assessment clinic at Manchester’s Wythenshawe Hospital.

The problem

He said the service had grown out of a “very successful” nurse-led valve surveillance clinic that has been looking after 1,200 to 1,300 patients for the last 10 to 15 years. “It just keeps growing

and growing as more and more patients are identified,” he said, explaining that patient relocation and mortality are the only reasons for discharge.

It is, he said, “fantastic for the asymptomatic population”, but patients will often get sent back to the original referring clinician when they develop symptoms. They then must wait to be diagnosed and referred back in – a process that was taking an average of 10 weeks, in contrast to the European Society of Cardiology’s guideline of 62 days. “From the onset of symptoms, some of our patients can be waiting up to 193 days to get onto the surgical table, and that is not what we want for anyone,” said Keith, adding that protracted wait times were linked to a higher risk of mortality.

While there are many elements of the pathway scientists and physiologists cannot influence, such as how long it takes for a patient to go see their GP, said Keith, “we can influence how quickly we see the patients and how smoothly we can transition them”.

The solution

Wythenshawe’s answer is the complex valve clinic (CVC). It consists of a weekly teleclinic, during which Keith talks to new patients about their symptoms, comorbidities, medications, history, and exercise tolerance. He said: “It means that when I see them face-to-face, I’ve already done quite a lot of the pre-clinical assessment.”

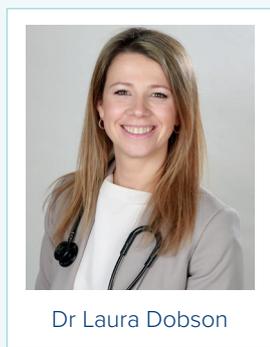
Patients are then booked into a diagnostic clinic, involving a head-to-toe examination, and a tailored mix of echo, functional imaging, six-minute walk test, bloods and more. “All of that can be achieved in a single patient visit which is really, really important for our population.”

The results

The CVC has audited its first 47 patients, all of whom were seen between June/July 2019 and February/March 2020. All had a confirmed diagnosis of valve disease but had previously been asymptomatic. So far, 11 people have been referred for valvular intervention and eight of these operations have already been carried out.

“That’s about a 23% interventional rate, and, more importantly, the 77% who we didn’t refer to the surgeon have had rapid access to a system that’s given them a definitive outcome that says ‘your symptoms are not related, currently, to your valvular status,’” said Keith.

The average wait from symptom onset to being seen by the CVC team was 13 days, and the time from symptom onset to surgery was 14.4 weeks. “That’s a nearly 48% reduction in the time patients wait to access surgery when compared to previous, traditional referral routes,” Keith said.



TAVI: When to scan and what to look for

Dr Laura Dobson

There is limited evidence on when a post-transcatheter aortic valve implantation (TAVI) echo is needed, with the only real guidance being published back in 2012.

But eight years on, so much about TAVI has changed that the document holds limited value, said

Dr Laura Dobson, Consultant Cardiologist at Wythenshawe Hospital in Manchester. “2012 was an era of TAVI under general anaesthetic and first-generation valves, when there were significantly more complications and a frailer patient group.”

However, the paper recommends a 30-day post-discharge echo to obtain baseline values, followed by annual scans thereafter.¹ Dr Dobson also highlighted a recent, COVID-related publication from the British Heart Valve Society which was “much more relaxed”. It suggests a post-procedural echo be carried out before discharge to prevent future admissions, and that, during the pandemic, further scans are only needed if the patient becomes symptomatic.² This reflects the fact that newer valves perform well haemodynamically and complications are rare.

Evaluating TAVI on echo

Essential information to include in a post-TAVI echo report include the basics of height, weight, and body surface area, as well as blood pressure. Aortic regurgitation (AR) can be really variable according to the blood pressure, and a wide pulse pressure can be suggestive of significant AR, said Dr Dobson. Heart rate should also be noted as patients with significant bradycardia will have prolonged diastolic filling times making them less tolerant of AR.

Dr Dobson said that 99.9% of valves will be “nice and stable”, but any rocking should be commented on in the report. “It’s an ominous sign that there’s instability in that aortic root, usually due to infection,” she said. How the valve is seated in the LVOT is also important – being too high or too low is associated with higher rates of paravalvular AR. Quantitating any AR is especially important following TAVI, said Dr Dobson (see fig 1).

TABLE 1 Scheme, Modalities, Parameters, and Criteria for Grading the Severity of PVR

	3-Class Grading Scheme		4-Class Grading Scheme		5-Class Grading Scheme		Severe
	Trace	Mild	Mild	Mild to Moderate	Moderate	Moderate to Severe	
	Grade 1	Grade 1	Grade 1	Grade 2	Grade 3	Grade 4	Severe
Cineangiography							
Invasive hemodynamics							
Aortic regurgitation index*	>25	>25	>25	10-25	10-25		>10
Doppler echocardiography							
Structural parameters							
● Valve stress	Usually normal	Usually normal	Normal/abnormal†	Normal/abnormal†	Usually abnormal†	Usually abnormal†	Usually abnormal†
○ LV size	Normal	Normal	Normal/mildly dilated	Normal	Mildly/moderately dilated	Mildly/moderately dilated	Moderately/severely dilated
Doppler parameters (qualitative or semiquantitative)							
● Jet features							
Extensive/wide jet origin	Absent	Absent	Absent	Present	Present	Present	Present
Multiple jets	Possible	Possible	Often present	Often present	Usually present	Usually present	Usually present
Jet path visible along the stent	Absent	Absent	Possible	Often present	Usually present	Usually present	Usually present
Proximal flow convergence visible	Absent	Absent	Absent	Possible	Often present	Often present	Often present
○ Vena contracta width (mm) color Doppler†	<2	<2	2-4	4-6	6-8	8-10	>10
○ Vena contracta area (mm ²); 2D/3D color Doppler†	<5	5-10	10-20	20-30	30-40	40-60	>60
● Jet width at its origin (%LVOT diameter) color Doppler†	Narrow (<15)	Narrow (5-15)	Intermediate (15-30)	Intermediate (30-45)	Large (45-60)	Large (45-60)	Large (>60)
○ Jet density CW Doppler	Incomplete or faint	Incomplete or faint	Variable	Dense	Dense	Dense	Dense
○ Jet deceleration rate (PW†, ml. CW Doppler*)	Slow (<1500)	Slow (<1500)	Slow (<1500)	Variable (200-500)	Variable (200-500)	Variable (200-500)	Steepl (>200)
○ Diastolic flow reversal in the descending aorta PW Doppler**	Absent	Absent or brief early diastolic	Intermediate	Intermediate	Holodiastolic (end-diast. vel. >20 cm/s)	Holodiastolic (end-diast. vel. >20 cm/s)	Holodiastolic (end-diast. vel. >25 cm/s)
● Circumferential extent of PVR (%s color Doppler)	<10	<10	10-20	20-30	>30	>30	>30
Doppler parameters (quantitative)							
○ Regurgitant volume (ml/beat)†	<15	<15	15-30	30-45	45-60	>60	>60
○ Regurgitant fraction (%)†	<15	<15	15-30	30-40	40-50	>50	>50
○ Effective regurgitant orifice area (m ²)**†	<5	<5	5-10	10-20	20-30	>30	>30
Cardiac magnetic resonance imaging							
Regurgitant fraction (%)††	<10	<10	10-20	20-30	30-50	>50	>50
	<15	<15	15-25	15-25	25-50	>50	>50

Pibarot 2015, JACC CVI

Fig. 1. Scheme, modalities, parameters, and criteria for grading the severity of PVR

Complications

Possible rare complications include endocarditis and late valve embolization, said Dr Dobson, adding that it was extremely rare for TAVIs to fail. She said: “A mean gradient of >20mmHG or a 50% increase in the mean gradient is suggestive of structural failure, alongside an effective orifice area (EOA) of <0.9, or a dimensionless velocity index (DVI) of <0.35.” There are also “very rare case reports” of cusp rupture causing acute AR.

¹ Alli, O.O., Booker, J.D., Lennon, R.J., Greason, K.L., Rihal, C.S. and Holmes, D.R., 2012. Transcatheter aortic valve implantation: assessing the learning curve. JACC: Cardiovascular Interventions, 5(1), pp.72-79.

² Shah, B.N., Schlosshan, D., McConkey, H.Z.R., Buch, M.H., Marshall, A.J., Cartwright, N., Dobson, L.E., Allen, C., Campbell, B., Khan, P. and Savill, P.J., 2020. Outpatient management of heart valve disease following the COVID-19 pandemic: implications for present and future care. Heart, 106(20), pp.1549-1554.



Dr Nav Masani

Mechanisms and assessment of aortic regurgitation

Dr Nav Masani

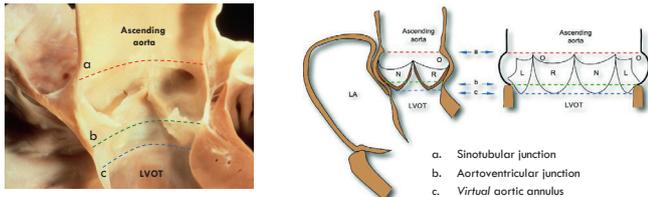
Dr Nav Masani, Consultant Cardiologist at the University Hospital of Wales in Cardiff, spoke about the mechanisms of aortic regurgitation (AR) and the role of echo in its assessment.

“Our role is to describe the aortic valve and root in detail and we then need to go on and assess the severity of the regurgitation and, in complex cases, quantify that,” he said. “We need to measure left ventricle (LV) size and function and we need to measure pulmonary artery pressure and identify associated lesions.”

Classification

AR is often classified as type one, two, or three according to cusp motion (see fig 1), but Dr Masani said this was arbitrary and of more use to surgeons than to sonographers. “I think it is more useful for echocardiographers to classify this into primary disease of the leaflets or secondary disease where there’s aortic root dilatation,” he said.

AR - anatomy, mechanisms & classification



Classification

- | | | |
|----------------------------------|-------------------------------------|--------------------------------------|
| Type 1 normal cusp motion | Type 2 excessive cusp motion | Type 3 restricted cusp motion |
| - Root dilatation | - Prolapse/flail | - Degenerative/calcific |
| - Cusp perforation | | - Rheumatic |

Fig. 1. AR anatomy, mechanisms, and classification

Primary versus secondary AR

Primary AR may be degenerative, rheumatic, bicuspid, or a result of endocarditis. Less common causes include prolapse, radiation and antiphospholipid syndrome. Marfan syndrome, bicuspid and arteriosclerosis/hypertension are all common causes of secondary AR, or AR due to aortic dilation. Each will have a different appearance on echo (see figs 2 and 3).

Causes of primary (valvar) AR

- Common**
- Degenerative/calcific
 - Rheumatic
 - Bicuspid*
 - Endocarditis*
- *type 1, 2 & 3
- Uncommon**
- 1° Prolapse
 - Radiation
 - Antiphospholipid syndrome

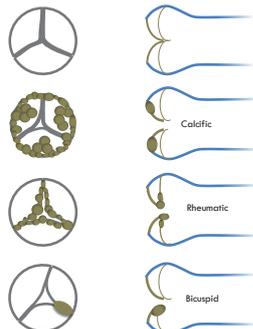
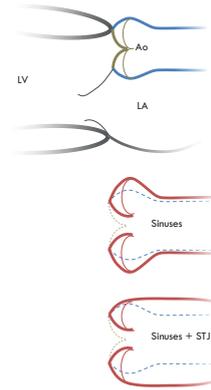


Fig. 2. Causes of primary AR

Causes of secondary AR – Aortic dilatation

- Common**
- Marfan syndrome*
 - Bicuspid
 - Arteriosclerosis/hypertension
- Uncommon**
- Ehlers Danlos syndrome
 - Sinus of valsalva aneurysm
 - Dissection
 - Trauma
 - Syphilis



*TGFBR1/TGFBR2 mutation

Fig. 3. Causes of secondary AR

Assessing the aortic valve

When assessing the aortic valve, Dr Masani said he looks “from out to in”, starting in the parasternal long axis view. “I start by looking at the hinge points, then the body, then the leaflet tips, the aortic root and ascending aorta. Is the valve three leaflet, tricuspid, or is it bicuspid with an asymmetric closure line? Are the leaflets thickened and calcified and if so, at what location?”

Quantifying severity

Assessing the severity of AR, said Dr Masani, can be done in a number of ways. For example, if the vena contractor is <0.3cm or the jet width occupies <25% of the LVOT diameter, the AR is classed as mild. But if the vena contractor is >0.6cm, or the jet width occupies ≥65% of the LVOT diameter, the AR is severe.

Sonographers should disregard the tail of the jet but can look at CW spectrum. “If the jet is very dense, that’s in keeping with severe AR,” he said. Pressure half time can also be used, with >500m/s being indicative of mild AR, and <200m/s pointing to severe.

In complex cases, it is extremely important to quantify the severity of AR as it can influence management. This is done using regurgitant volume, regurgitant fraction, and regurgitant orifice area (see fig 4).

Severity of AR quantitative

Normal

LV stroke vol = MV stroke vol
LV stroke vol = RV stroke vol
 $LV_{SV} = LV_{Vti} * 0.785 * d^2$
LVvti ~20cm

AR Rvol the difference

$LV_{SV} > MV_{SV}$
 $LV_{SV} > RV_{SV}$
 $AR\ Reg' Vol = LV_{SV} - MV_{SV}$
 $AR\ Reg' Fract^* = ARvol / SV_{LV}$
LVvti ↑↑

Quantitative	mild	moderate	severe
Regurgitant volume	≤30ml	31-59ml	≥60ml
Regurgitant fraction	≤30%	31-49%	≥50%
Regurgitant orifice area	≤0.10cm ²	0.11-0.29cm ²	≥0.30cm ²

*annulus measurements
*cross check LV_{SV} vs Biplane LV_{SV}

Fig. 4. Quantifying the severity of AR

Summing up, Dr Masani told delegates to always cross check their measurements when quantifying AR severity. Measure LV size and function, analyse the haemodynamics and ensure everything makes sense, he said, adding that the BSE Echo Calc App is a very useful quantification tool and offers a “useful cross check”.



Dr Dan Knight

Towards standardised right heart assessments

Dr Dan Knight

Assessment of the right heart by echo is crucial to a variety of diseases, both of congenital and acquired aetiologies, but can be difficult because of its complex, 3D shape.

New British Society of Echocardiography (BSE)

guidelines aim to provide a practical, reproducible approach to assessments said Dr Dan Knight, Consultant Cardiologist at the Royal Free Hospital in London. *“In terms of diagnostic and prognostic significance, it’s important to accurately and comprehensively assess the right heart in a uniform manner between sonographers,”* he said. *“However, this is a complex subject area with multiple planes of acquisition from a 2D echo giving rise to multiple sources of possible variability. There is also so much of the right heart you miss when you only focus on one 2D view,”* said Dr Knight.

RV focused view

To obtain the right ventricle (RV) focused apical view, the guideline recommends taking *“a conventional apical four-chamber view, avoiding foreshortening which can distort the shape and size of the RV. Then move the transducer laterally so the RV takes centre stage and you can see all of the RV free wall whilst keeping the left ventricle (LV) apex at the top of the image. Finally, rotate the transducer to maximise the basal diameter of the RV,”* said Dr Knight, adding that the resulting image is the RV focused view from which to take measurements.

Normal reference ranges

The Normal Reference Ranges for Echocardiography (NORRE) study dataset has been used to provide gender-specific normal reference values for the echo assessment of right heart size. Furthermore, in terms of test-retest reproducibility, the RV basal diameter (RVD1) has been shown to be the most reproducible 2D linear cavity measurement of the RV on echocardiography¹. The NORRE dataset defines the RVD1 normal cut-offs at ≤ 47 mm for males and ≤ 43 mm for females².

RV systolic function

There are several measures of RV systolic function. *“There is an abundance of data for tricuspid annular plane systolic excursion (TAPSE), RV S’, and fractional area change (FAC),”* said Dr Knight, adding that the guidelines advise taking at least two of these evidence-based measurements, ideally with FAC being one of them. According to the NORRE dataset, an FAC of $<30\%$ is abnormal in men and $<35\%$ is abnormal in women.²

Disease-oriented approach

“Different RV indices have different benefits in different pathologies,” said Dr Knight. *“If we look at RV systolic dysfunction, we can split this into three groups: pressure overload, such as in pulmonary hypertension; volume overload, due to tricuspid or pulmonary valvular insufficiency or shunts, for example; and RV myocardial disease – including infarction, infiltrative disease, myocarditis or cardiomyopathy affecting the right heart. All of these different conditions actually should prompt consideration of which approach to take and which metrics may be useful.”*

For example, it is known that transverse (rather than longitudinal) right ventricular (RV) wall motion is more reflective of global RV systolic function in pulmonary hypertension, for which FAC is recommended. Conversely, in amyloidosis, TAPSE has been shown to be highly prognostic (more so than RV ejection fraction), likely reflecting a combination of subendocardial infiltration of longitudinal myofibres and a secondary effect from left ventricular infiltration. *“Clearly, the right ventricle behaves differently in different disease states. This should prompt us to consider a more disease-oriented approach for right heart assessment,”* concluded Dr Dan Knight.

¹ Willis J, Augustine D, Shah R, Stevens C, Easaw J, 2012. Right Ventricular Normal Measurements: Time to Index? J Am Soc Echocardiogr 2012;25:1259-67.

² Kou, S., Caballero, L., Dulgheru, R., Voilliot, D., De Sousa, C., Kacharava, G., Athanassopoulos, G.D., Barone, D., Baroni, M., Cardim, N. and Gomez De Diego, J.J., 2014. Echocardiographic reference ranges for normal cardiac chamber size: results from the NORRE study. European Heart Journal—Cardiovascular Imaging, 15(6), pp.680-690.



Dr Stephanie Curtis

Ebstein’s: More than an offset tricuspid valve

Dr Stephanie Curtis

Ebstein’s disease is *“so much more than a simple downward displacement of the tricuspid valve,”* said Dr Stephanie Curtis, Consultant Cardiologist at University Hospitals Bristol.

Talking about the rare congenital defect at BSEcho2020, she said the

classical definition of Ebstein’s as a >8 mm/m² offset of the valve was too simplistic.

“It is a RV myopathy characterised by embryonic failure of delamination of all the tricuspid valve leaflets that results in leaflet adherence to the underlying myocardium,” she said. The involved leaflets then rotate away from the atrioventricular (AV) junction – an anteroapical shift in effective orifice towards the RVOT. The septal and posterior leaflets’ hinge points are displaced into the body of the RV.

What to expect

Everyone with Ebstein’s will have right bundle branch block and around half will also have a first-degree heart block. There is a substrate for atrial arrhythmias and accessory pathways are very

common. The majority of patients will have a patent foramen ovale (PFO) and around 30% will have an atrial septal defect (ASD). Mitral valve dysplasia is not uncommon.

Data from the Mayo Clinic shows that about 39% of people with Ebstein's have left heart lesions, said Dr Curtis.¹ "Don't think of it as a right heart problem, it is a whole heart problem," she said.

Role of echo

Echo, particularly transthoracic echo (TTE), is the tool of choice in assessing Ebstein's, Dr Curtis said. The four-chamber view is useful, as it will usually give a view of the septal and anterior leaflets. Unless the ventricle is very dilated, sonographers will not see all three leaflets on a 2D echo.

The American Society of Echocardiography has published advice on quantifying tricuspid regurgitation.² Put simply, it says that mild tricuspid regurgitation (TR) has a parabolic Doppler and a narrow flow convergence zone and vena contracta and severe has a dagger shaped Doppler, a wide vena contracta and a large flow convergence zone, said Dr Curtis. "Remember, with Ebstein's you don't always get systolic flow reversal in the hepatic veins the way you would expect."

Echocardiographers will often underestimate TR in Ebstein's, but it's worth noting that, if the RV is dilated, severe TR is usually present.

Reporting

During echo, the leaflets should be assessed for size, attachments, hinge points and the appearance of the leading edges. The location and size of the effective orifice plane and the degree of TR should be recorded, along with the RV size and function, measured by strain and fractional area change (FAC).

All this information, along with the size of the annulus and confirmation of any associated lesions, will help teams estimate the probability of repair, said Dr Curtis.

¹ Jost, C.H.A., Connolly, H.M., O'Leary, P.W., Warnes, C.A., Tajik, A.J. and Seward, J.B., 2005, March. Left heart lesions in patients with Ebstein anomaly. In Mayo Clinic Proceedings (Vol. 80, No. 3, pp. 361-368). Elsevier.

² Zoghbi, W.A., Adams, D., Bonow, R.O., Enriquez-Sarano, M., Foster, E., Grayburn, P.A., Hahn, R.T., Han, Y., Hung, J., Lang, R.M. and Little, S.H., 2017. Recommendations for noninvasive evaluation of native valvular regurgitation: a report from the American Society of Echocardiography developed in collaboration with the Society for Cardiovascular Magnetic Resonance. Journal of the American Society of Echocardiography, 30(4), pp.303-371.



Maria Paton

Scientist/physiologist-led clinics on the front line of the HF epidemic

Maria Paton

Scientist/physiologist-led clinics represent a valuable opportunity in the fight against the "epidemic of heart failure (HF)".

Nearly 1million people in the UK are living with the condition, but just 2.2% of those admitted to

hospital with decompensated HF have a primary cause of right heart failure, said Maria Paton, Cardiac Scientist at the Leeds Teaching Hospitals NHS Trust

"Make no mistake – HF is an epidemic," said Maria. "But we can reduce hospitalisations by 30% if we achieve best practice care."

HF patients are a "tricky bunch", she said. They tend to be older, frailer and have more co-morbidities than the general population. While survival rates have been increasing in recent years, most patients still die from progressive HF. "The circulatory system is a closed circuit; progressive dysfunction of the left heart is likely to affect the right heart and vice versa. What that means is more patients are surviving to develop pulmonary hypertension and right heart failure, and that's become known as a common final pathway."

The role of the cardiac scientists

"With our experience, cardiac scientists can really improve services for our HF patients. It's really essential to achieve a definitive diagnosis as early as possible to initiate life prolonging treatment," said Maria.

Describing what best practice looked like, she said that optimal management happened within a structured HF service offering "one-stop" approach and individualised care planning.

"I believe we can train to deliver specialist echocardiography, a key diagnostic tool in the patient pathway, but also undertake clinical history, medication review and a clinical examination. We can give important lifestyle advice and prescriptions. We can contribute to multidisciplinary team discussions, and support seamless care across settings," said Maria.

The clinic

Most patients referred to the HF clinic have a raised BNP, symptoms such as breathlessness, either on exertion or at rest and a history of hypertension. They have a variety of underlying diseases that affect them in a multitude of ways. "The first assessment is watching a patient walk into the clinic room, assessing their breathing and mobility, seeing if they've got any signs of oedema, or checking for signs of a raised jugular venous pressure, which is actually quite specific to right heart failure," said Maria.

Clinical history taking, including asking about risk factors, previous cardiovascular or lung disease and how the symptoms have progressed over time is the next step followed by an echo assessment of the right heart.

Said Maria: "I look for concordance between measures. I want to know if the tricuspid annular plane systolic excursion (TAPSE) and the S' velocity are telling me the same thing, and that my parasternal long axis diameter suggests the same degree of dilatation as my typical four chamber."

If there are any discrepancies, Maria will investigate them while she is still with the patient and can obtain more images. "The aim of the scan is to explain patient's symptoms and assess for significant changes to direct further management."

Improving care

Scientists/psychologist-led HF services can improve models of care, improve the accuracy of diagnosis and shorten time to diagnosis. "We can contribute expert knowledge and improve patient clinical outcomes, including their quality of life and patient experience. This is particularly true in detecting right heart disease where specialist echo can provide critical information," said Maria.



Dr Madalina Garbi

Differentials of the dilated right heart

Dr Madalina Garbi

Many causes of a dilated right heart are obvious on echo, but sometimes additional modalities are needed to make a firm differential diagnosis.

Dr Madalina Garbi, Consultant Cardiologist at the Royal Papworth Hospital in Cambridge, said

pulmonary hypertension (PHT) was the most common cause of right heart dilatation. *“But we diagnose these patients at different stages of disease and in different clinical scenarios of presentation,”* she said.

At the early stages of PHT, the dilation may be caused by pure pressure overload and there may be no tricuspid regurgitation (TR) to allow estimation of systolic pulmonary artery pressure. As the PHT progresses, there may be decrease in tricuspid valve leaflets coaptation, developing TR with progressive increase in severity and, as consequence of TR-induced volume overload, inferior vena cava (IVC) dilation.

If diagnosed late in the course of disease, the patients may have severe TR with right ventricular (RV) pressure and volume overload and with complete loss of tricuspid valve leaflet coaptation – free TR. Trying to diagnose a patient at this stage of disease can be challenging as well, said Dr Garbi, because the systolic pulmonary artery pressure (SPAP) cannot be estimated on echo in conditions of free TR.

This makes it difficult to distinguish between PHT-secondary TR and right atrial- (RA) secondary TR caused by right atrial dilatation, for example in chronic atrial fibrillation. Dr Garbi said

that right heart catheterization (RHC) can identify PHT at any stage of disease, including cases with free TR. Furthermore, cardiac MRI can detect the impaired RV function associated with PHT-secondary TR and the hyperdynamic or normal RV function in RA-secondary TR. In conclusion, RHC and cardiac MRI are often needed for differential diagnosis of dilatation of the right heart.

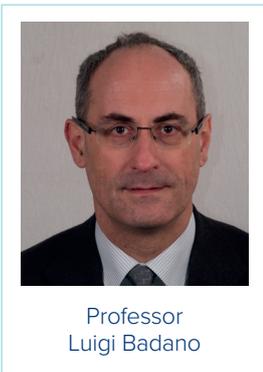
Differential diagnoses

If a patient has RV dilation with both volume and pressure overload, sonographers should look to exclude an atrial septal defect (ASD). This can be done on echo by colour flow mapping the interatrial septum at the level of the fossa ovalis in parasternal short axis view, modified four-chamber view and subcostal view.

Another differential diagnosis is RV infarct. Patients may present with chest pain, syncope, inferior ST elevation and hypotension. An echo at late presentation might show akinesia of the RV free wall and hypokinesia in the right coronary artery’s distribution territory and the posterior wall.

Arrhythmogenic right ventricular cardiomyopathy (ARVC) can also cause RV dilation. Typical echo findings in advanced disease include severe RV dilation and a thin RV free wall with dyskinetic segments or aneurysms.

If ARVC is not obvious on echo, Dr Garbi recommended the use of cardiac MRI. Findings consistent with the condition include a RV ejection fraction of <40%, a (RV) end-diastolic volume index of >100ml/m²BSA, a paper-thin RV free wall with aneurysms and extensive late gadolinium enhancement indicating replacement fibrosis.



Professor Luigi Badano

3D tricuspid valve assessment

Professor Luigi Badano

Unlike the majority of traditional 2D scans, 3D echo allows us to see all three of the tricuspid valve’s leaflets in one view.

It enables a better view of the anatomy, aids diagnosis of the aetiology of regurgitation and allows for the quantitative assessment of the right ventricle

(RV) and right atrium (RA), said Professor Luigi Badano from the University of Milano-Bicocca and Director of Cardiovascular Imaging at Milan’s Istituto Auxologico Italiano.

With 2D echo, he said, it was difficult to identify the leaflets without a considerable amount of probe tilting and a significant level of experience. Scans could be misleading because of the variability in leaflet morphology and imaging plane.

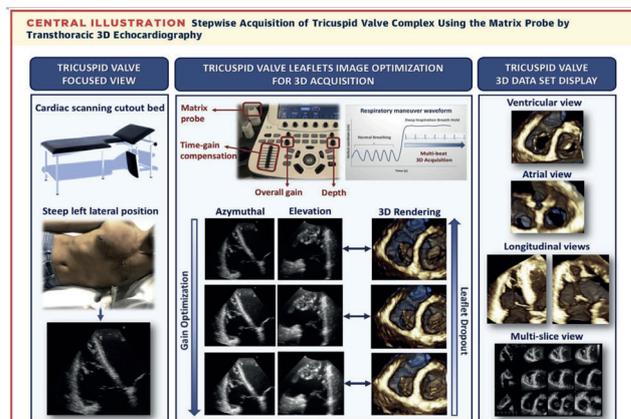
Conversely, 3D echo provides an anatomical view of the tricuspid valve leaflets and the surrounding tissue.

TTE

3D echo datasets are best acquired using the transthoracic approach, said Prof Badano, adding that it was *“relatively easy”* (see fig 1).

“Do not underestimate the value of the cut-out of the bed so you can move the probe more laterally than the conventional apical view to get a right ventricular (RV) focus apical view,” he said. Sonographers can use the multi-slice view to make sure that the whole tricuspid annulus, leaflets and part of the RV are included in the dataset. *“You can then choose your favourite rendering mode to display the valve on your monitor.”*

Tricuspid valve anatomy and function



Muraru, D. et al. J Am Coll Cardiol Img. 2019;12(3):500-15.

Fig. 1. Stepwise acquisition of tricuspid valve complex using the matrix probe TTTE 3D echo

Clinical relevance

Prof Badano used a case of a 50-year-old man with atrial fibrillation following non-cardiac surgery to demonstrate how 3D echo can change practice.

The patient was sent for an echo to exclude arrhythmogenic right ventricular cardiomyopathy (ARVC), and the scan showed RV enlargement and severe tricuspid regurgitation (TR). No major abnormalities of the tricuspid valve were detected by conventional 2D views, and the patient was referred for tricuspid annuloplasty.

“However, when you press your magic 3D button, your perspective changes a lot,” said Prof Badano. The 3D images clearly showed the anterior leaflet was untethered and flailing with a ruptured cord. This prompted additional history taking from the patient and the re-examination of chest X-rays which showed a history of blunt thoracic trauma. *“The patient remembered that at the age of 15 he had been thrown against the wall of his house by a tornado,”* said Prof Badano, adding that the patient had since undergone a successful tricuspid valve replacement procedure.

Tricuspid discoveries

3D echo also allows for a quantitative assessment of the upstream and downstream cardiac chambers (i.e. the right ventricle and the right atrium) and of the components (annulus and leaflets) of the tricuspid valve, said Prof Badano, enabling a better understanding of the pathophysiology and clinical course of the tricuspid valve disease.

Through the modality, researchers are also discovering that there is large variability in the number and morphology of tricuspid leaflets. Cases of valves having between two and six leaflets have been described and posterior leaflets may have between one and three scallops.

“3D echo,” concluded Prof Badano, *“offers a unique opportunity to understand the mechanisms of TR, to quantify the valve’s geometry and the relative importance of its components in the development of functional regurgitation.”*

BSEcho2020 Saturday, October 10: BSE Guidelines



Allan Harkness

BSE guidelines: Normal reference intervals

Allan Harkness

Over the years, the way echo is performed and measured has changed substantially – and the British Society of Echocardiography’s (BSE) guidelines have changed to reflect that

Allan Harkness, Consultant Cardiologist, at East Suffolk and North Essex NHS Foundation Trust, said the new normal reference intervals guidelines account for evolving technology and medical understanding. *“The first measurements were done in M mode with paper and callipers and then conversion,”* he said, adding that the latest technology allows for *“far more realistic assessment of volumes”*.

Changing methods

This has changed the way sonographers measure, he went on. *“Traditionally, we have measured the size of aorta from leading edge to leading edge,”* said Dr Harkness. Modern echo equipment enables the more appropriate measurement of inner edge to inner edge and the guideline recommends this approach.

Calculations have also changed as knowledge has improved and Dr Harkness said the guideline recommended the use of the Simpson’s biplane method to measure the volume of the left atria as well as the left ventricle. *“Your machine may be set up to measure left atrial volumes by area length and we would ask that you speak to your vendor about getting the programming changed,”* he added.

NORRE advantages and limitations

The new BSE reference interval guidelines are taken from the 2013 Normal Reference Ranges for Echocardiography (NORRE) study.¹ The dataset was chosen, Dr Harkness said, as it was deemed to be the most reflective of modern European “normal” values as well as being based on technically adequate echocardiograms.

The study had 1,100 healthy, adult volunteers, evenly spread across age bands from 25 to 75. They all had a normal ECG and physical cardiac examination and no obvious cardiovascular risk factors, history of cardiovascular disease, or any systemic disease known to affect the cardiovascular system. Subjects had no chronic excessive alcohol consumption, were not taking any cardio-active drugs and had no structural disease on echocardiogram. Exclusion criteria ruled out trained athletes, pregnant women and anyone with a BMI of more than 30kg/m². There are some limitations with the dataset, however, as it is drawn from a Caucasian, non-obese population.

Height and weight are currently the best generic normaliser, and the guidelines recommend the DuBois equation to calculate body surface area. All measurements, he highlighted, must be understood within the context of the individual patient, Dr Harkness said.

Ejection fraction

Grading is just a shorthand communication tool and all echo reports should report left ventricle ejection fraction (LVEF). Dr Harkness said the guideline authors had *“caused some controversy”* by keeping the severe impairment cut off at $\leq 35\%$ despite the society’s American and European counterparts opting for $< 30\%$. *“We regard the severe category as being a call to arms to demand therapy or intervention and we feel $\leq 35\%$ is still the most useful cut-off for the vast majority of drugs and interventions,”* he said (see figure 1).

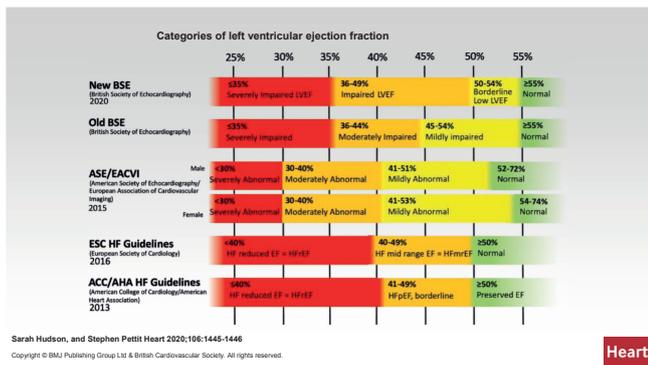


Fig. 1. Categories of LV EF

In conclusion, Dr Harkness said: “Please remember that each number and every reference interval is only a rough guide to what’s normal for that individual. You need to look at all the measurements you’ve made and look at the context of the problem, the patient, the pathology, and their past.”

To read the full document, go to <https://doi.org/10.1530/ERP-19-0050>

¹ Lancellotti, P., Badano, L.P., Lang, R.M., Akhaladze, N., Athanassopoulos, G.D., Barone, D., Baroni, M., Cardim, N., Gomez de Diego, J.J., Derumeaux, G. and Dulgheru, R., 2013. Normal Reference Ranges for Echocardiography: rationale, study design, and methodology (NORRE Study). European Heart Journal—Cardiovascular Imaging, 14(4), pp.303-308.



Dr Bushra Rana

BSE guidelines: Mitral valve

Dr Bushra Rana

New British Society of Echocardiography (BSE) guidelines provide a step-by-step guide to assessing the mitral valve by echo.

Presenting the document at conference, Dr Bushra Rana, Consultant Cardiologist at London’s Imperial College Healthcare Trust,

said the guideline aimed to make sure everyone “was talking the same language”.

Mechanism

Understanding of leaflet motion, as described by Carpentier’s classification (see fig 1) helps us describe the mechanism and the underlying aetiology. “They go hand in hand,” said Dr Rana. Other descriptors of leaflet disease, according to the guideline, are thickening, commissural fusion and calcification. “All these aspects can involve the leaflets, the annulus and the sub-valve apparatus,” she explained.

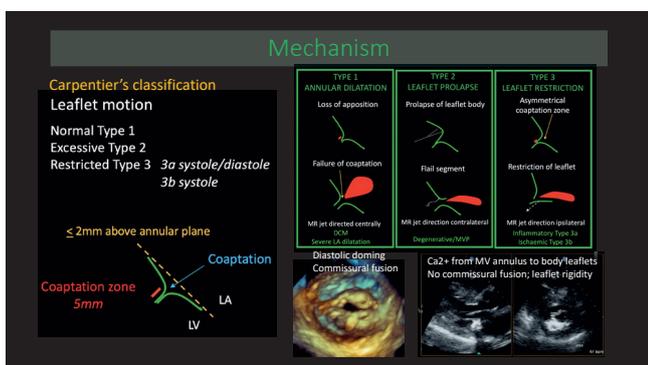


Fig. 1. Carpentier’s classification of leaflet motion

Severity

The guideline contains qualitative, quantitative and supportive parameter descriptions of how to look at and assess the severity of mitral regurgitation and mitral stenosis. “Everything we do in valve assessment is based on describing the orifice areas. Whether it’s regurgitant orifice area or the stenotic orifice area, that’s how we quantify severity,” said Dr Rana.

However, measurements such as proximal isovelocity surface area (PISA) and flow convergence are based on the assumption that the valve orifice is circular, even though this is not always true. “The key is to accurately define the shape of the orifice.”

For regurgitation, that means obtaining a long and short axis measurement of the vena contracta at the coaptation line and calculating an average. “Anything above 8mm is severe,” said Dr Rana. Ideally, this will then be confirmed on 3D TOE. “Taking that concept to mitral stenosis, we really should be using our 3D formats to align ourselves with the stenotic orifice,” she added. Sonographers can then find the tips of the valve leaflets and at the narrowest point accurately assess the shape of the orifice.

Haemodynamics

The guideline also describes timings for interventions, said Dr Rana, adding that echo plays a “pivotal role” in deciding whether a mitral valve is suitable for repair or replacement. “The key thing here is that stenotic valve areas of less than 1.5cm², so sitting in the moderate range, might suggest a clinically significant mitral valve lesion.” The first line treatment here is a percutaneous mitral commissurotomy (PMC), so the presence of any contraindications should be included on the echo report. In mitral stenosis, these include a mitral valve area of >1.5cm², thrombus within the left atrium (including LAA), any mitral regurgitation over the mild classification, severe bi-commissural calcification, absence of commissural fusion and severe concomitant aortic and tricuspid valve disease.

In patients with mitral regurgitation, the posterior leaflet, particularly P2 prolapse, is usually a simple, long-lasting repair. But as the anatomy gets more complex, to include commissure lesions, bi-leaflet prolapse, or anterior leaflet prolapse, the chances of successful durable repair reduce. “Think about the aspects of the leaflets you are describing,” said Dr Rana. 3D

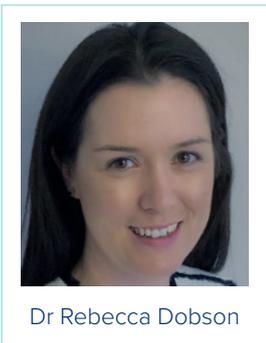
echo is very helpful in understanding clefts and commissural lesions, as well as the leaflet thickening and calcification that should be highlighted in cases of primary valve disease in leaflet repair.

Rounding off her talk, Dr Rana said exercise stress echo was indicated in two groups: asymptomatic patients with severe valve lesions and symptomatic patients with non-severe valve lesions (see fig 2 overleaf).

- The full guideline is expected to be published in the coming months

Exercise stress echocardiography	
Indications in 2 groups	Severe valve lesion without symptoms Non-severe valve lesion with symptoms
Primary MR	Increase in MR severity by >1 grade Dynamic PH (>60 mmHg) Reduced LV contractile reserve (LVEF augmentation <5% or GLS <-2%) Reduced RV contractile reserve (TAPSE <18 mm)
Secondary MR	Increase in severity as identified by increase in EROA by >13 mm ² SPAP >60 mmHg
MS	MVG >15 mmHg with exercise SPAP >60 mmHg

Fig. 2. Exercise stress echo in mitral valve assessment



BSE guidelines: Cardio-oncology

Dr Rebecca Dobson

With more people surviving cancer, cases of chemotherapy-related cardiotoxicity are on the rise. It means the time is ripe for a British Society of Echocardiography (BSE) guideline on cardio-oncology.

Dr Rebecca Dobson, Consultant Cardiologist and Liverpool

Heart and Chest Hospital, said the emerging subspecialty involves risk stratification pre-cancer treatment, screening and monitoring to detect cardiovascular problems at an early stage and cardioprotective therapies to enable uninterrupted chemotherapy. *“Because the burden of heart failure continues for decades after treatment, the specialty also involves long term follow-up to detect late effects. Cardiac imaging, which in the vast majority of cases means transthoracic echocardiogram (TTE), is pivotal to decision making in virtually all aspects of cardio-oncology,”* said Dr Dobson.

Many cancer drugs and treatments are associated with cardiotoxicity, but the *“most common culprits”* are the anthracyclines and monoclonal antibodies, such as Herceptin.

Echo protocol

At baseline, sonographers should obtain a full BSE minimum dataset, as well as 3D volumes, left ventricular ejection fraction (LVEF) and global longitudinal strain (GLS). Asymptomatic, clinically stable patients with no new cardiovascular symptoms should undergo targeted follow-up assessment. That would include 2D/3D volumes and LVEF, GLS, diastolic function assessment, LV tissue Doppler imaging (TDI) and right ventricle (RV) size and function as measured by TDI and tricuspid annular plane systolic excursion (TAPSE). Any follow-up patients with new cardiovascular symptoms require a full assessment as per the baseline protocol.

Said Dr Dobson: *“One of the themes of the guideline is that accurate, reproducible assessment of LV function is crucial. We need to be absolutely confident that any detected decline in systolic function reflects true toxicity, as the implications for the patient are potential discontinuation of cancer treatment.”* As such, the guideline recommends both 2D and 3D assessment of EF, as the latter has a greater degree of reproducibility.

“However, it’s not all about EF. GLS will detect subtle early myocardial injury prior to a drop in EF. Therefore, the guidelines recommend that, where possible, GLS is measured in all cardio-oncology patients,” explained Dr Dobson.

The guideline defines cardiotoxicity as a drop in EF by >10% to a value of <50%, or a >15% relative reduction in GLS. However, neither of these measures should be taken in isolation, said Dr Dobson.

Post-treatment assessment

The BSE guideline recommends the first surveillance scan be performed between 3 and 12-months post-cancer treatment and emphasises the importance of a personalised approach to ongoing monitoring.

“Decisions regarding the frequency of long-term surveillance should consider the patient’s total anthracycline dose, their exposure to other potentially cardiotoxic treatments, including radiotherapy, their cardiovascular comorbidities, any cardiotoxicity the patient experienced during treatment and their LV function both during and at the end of treatment,” said Dr Dobson.

High-risk

Some patients are more likely to develop cardiotoxicity: females, under 18s and over 65s and people with pre-existing cardiovascular or renal disease, or diabetes, or who have had previous exposure to cardiotoxic chemotherapy, for example. Smoking, obesity, inactivity and high alcohol intake are also risk factors. *“Early detection and prompt treatment of cardiac dysfunction is so important for these patients,”* said Dr Dobson.

- The full guideline is expected to be published in the coming months



Dr Liam Ring

BSE guidelines: Aortic stenosis

Dr Liam Ring

The cornerstone of aortic stenosis (AS) assessment is measuring velocity, said Dr Liam Ring, Consultant Cardiologist at West Suffolk Hospital.

“As the valve becomes progressively more narrowed, blood flows more rapidly across it.

And we of course, can measure velocity very accurately using echocardiography and Doppler,” said Dr Ring.

He reiterated the best practice approach of using continuous wave, setting the sweep speed to 50mm/s to 100mm/s and optimising depth and scale. *“We should trace round three waveforms and the computer will then work out the mean gradient,”* he said, adding that sonographers should use the PEDOFF probe and repeat the process from multiple windows.

Aortic valve area

Calculating the aortic valve area (AVA) is essential in every AS assessment, said Dr Ring. To do so, sonographers should measure the LVOT diameter immediately below the cusp, as this produces more reproducible results and contributes to more accurate assessments of severity in the overall equation. (see fig 1).

	Mild Aortic Stenosis	Moderate Aortic Stenosis	Severe Aortic Stenosis
Peak Velocity	<3m/s	3-3.9m/s	≥4m/s
Mean Gradient	<20mmHg	20-39mmHg	≥40mmHg

Fig. 1. Grading of aortic stenosis severity

Common misconceptions

During his talk, Dr Ring sought to dismiss some common misconceptions around AS assessment. If a sonographer is unable to measure the LVOT diameter for whatever reason, it is *“absolutely wrong”* to assume it is 2cm. *“More than 80% of patients have an LVOT ≥2.1cm, so if we assume it’s 2cm, we’re going to systematically underestimate size, which means you overestimate severity,”* he said.

Valve area is not a better measurement than maximum velocity (Vmax) and mean gradient, he said, adding that they are complementary and AVA and index valve area were *“equally good”* at identifying people at risk of AS-related events. *“One is not better than the other,”* said Dr Ring.

BP and rhythm

He went on to say that blood pressure (BP) and rhythm *“can hugely impact on our ability to assess the valve”*. Hypertension can lead to an under- or over-estimation of stenosis severity, so ideally echo should be repeated when their systolic BP is 130-140mmHg.

Atrial fibrillation (AF) will cause beat-to-beat variation on Doppler indices. While the traditional approach would be to measure and average between five and 10 consecutive wave forms, the matched R-R interval method produces identical results for the AVA.

Severe AS

Prognostic indicators of intervention success can be obtained during a comprehensive echo exam. The guideline states that an LVEF of <55%, a global longitudinal strain (GLS) of >-14% and a rate of AV Vmax change of >0.3m/s/year, as well as pulmonary hypertension, are all associated with poorer survival. Increased LV mass is also an important finding.

Dr Ring went on to say in the presence of high gradient, an LVEF of <35% can reflect an afterload mismatch that will usually significantly improve after valve replacement. *“These patients absolutely need to be operated upon,”* he said.

Mixed aortic valve disease

In mixed aortic valve disease – at least moderate AS combined with at least moderate aortic regurgitation – the aortic valve area does not identify at-risk patients. Vmax provides *“much better prognostic data”*, said Dr Ring. *“The guidelines advocate that instead of reporting them separately as AS combined with aortic regurgitation, we report it as a single lesion, as mixed aortic valve disease with the severity defined by the Vmax.”*

- The full guideline is expected to be published in the coming months



Dr Abbas Zaidi

BSE guidelines: Pulmonary and tricuspid valve

Dr Abbas Zaidi

The British Society of Echocardiography (BSE) is currently putting together a new guideline on the assessment of the pulmonary and tricuspid valves

It comes as the assessment of the right-sided heart valves has evolved in recent years, said Dr Abbas Zaidi,

Consultant Cardiologist at Cardiff’s University Hospital of Wales.

3D echo now allows us to better quantify right ventricle (RV) dimensions and function and has informed a better understanding of the mechanisms and progression of tricuspid

valve (TV) disease, he said. This has been coupled with a large rise in catheter-based interventions and an increase in long-term outcome data linking RV lesions to poor outcomes.

General principles

When assessing any valve, sonographers should use a multiparametric approach, he said. *“Use 2D, 3D, continuous wave, pulse wave and colour flow Doppler. Always use multiple echo views and never make a judgement about a valve lesion from a single echocardiographic window.”* Readers use qualitative, semi-quantitative and quantitative assessments and should be aware of the limitations of each approach.

“Finally, we have to individualise our findings to the patient. We have to recognise that there are influences of body size, body surface area, chronicity and right ventricular compliance that will affect the impact of any lesion on the patient,” said Dr Zaidi, adding that most patients will experience a combination of both primary and secondary valve disease.

“When assessing pulmonary and tricuspid valves, you need to do your linear dimensions, your fractional area change (FAC), tricuspid annular plane systolic excursion (TAPSE) and estimations of pulmonary pressure,” he said, explaining that the RV-focused apical four-chamber view was favoured.

Tricuspid valve

Causes of primary tricuspid regurgitation (TR) include congenital diseases, such as Ebstein’s, as well as blunt chest trauma, rheumatic disease, endocarditis and myxomatous degeneration. “Importantly, a growing cause of acquired TR is interference or damage from catheters, pacemaker leads and other intracardiac devices,” said Dr Zaidi. The most common cause of secondary TR, which is being increasingly linked to poor prognosis, is ‘atriogenic TR’, i.e. secondary to chronic atrial fibrillation.

To assess severity, sonographers can measure the tricuspid valve annulus on 2D echo, with a measurement of >40mm being considered significantly dilated and strongly associated with severe TR. A TV tenting area at end systole of >1cm² is predictive of more than mild secondary TR and >1.6cm² predicts severe TR. In terms of tenting height, >0.76cm is predictive of significant residual TR after TV surgery. Other useful measurements include colour-flow mapping (CFM), vena contracta and proximal isovelocity surface area (PISA), and TR jet area (see fig 1), as well as pulse wave, continuous wave and hepatic vein pulse wave.

TR – Assessment of Severity

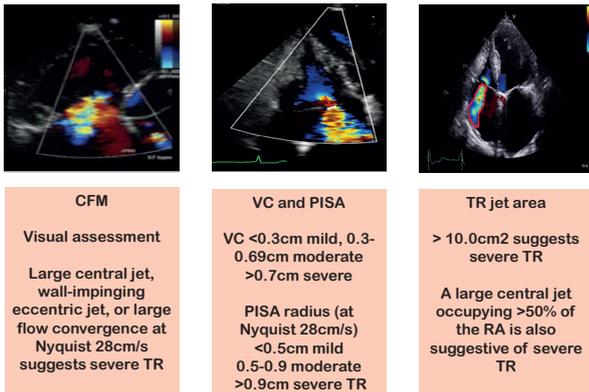


Fig. 1. TR assessment of severity

Pulmonary valve

Pulmonary stenosis is usually congenital, though in rare cases may be caused by rheumatic disease and can be valvular, supra-annular, or sub-annular. 2D echo allows for visual assessment of the level of obstruction.

“We use colour flow so you can tell where the obstruction is by looking at where the flow turbulence originates and where the flow convergence starts. We use continuous wave Doppler to work out the velocity and the severity,” said Dr Zaidi, explaining that <3m/s is mild, 3-4m/s is moderate and >4m/s is severe stenosis. Pulse wave Doppler can be used to interrogate the level of the obstruction.

Pulmonary regurgitation is also mainly congenital but can sometimes be acquired due to pulmonary artery dilatation in the context of pulmonary hypertension. Assessment is performed by CFM, RV and RA size and CW (see fig 2).

PR – Assessment of Severity

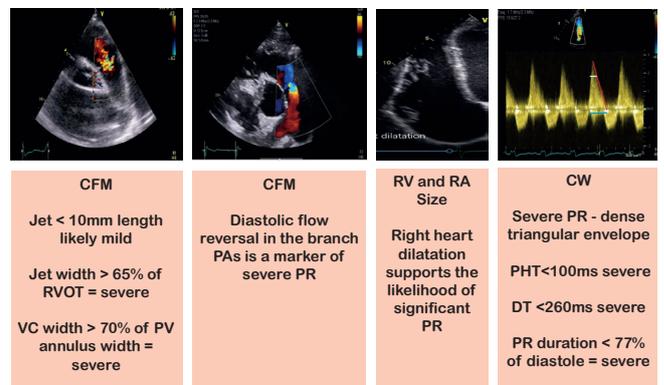


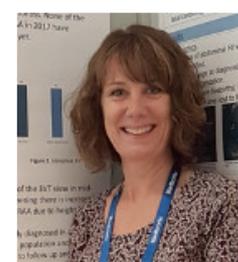
Fig. 2. PR assessment of severity

- The full guideline is expected to be published in the coming months.

BSE Congenital Accreditation

JAN FORSTER

CONSULTANT CONGENITAL SONOGRAPHER
LEEDS TEACHING HOSPITALS



Jan Forster

The BSE was established in 1991, and by the mid-1990s, there were just two accreditation pathways; adult and paediatric. The aim of these processes was to improve standards of echocardiography across the UK. In 2004, the BSE paediatric examination was withdrawn and so sonographers wishing to maintain accreditation in this area only had the option of obtaining congenital accreditation with the European Association of Cardio Vascular Imaging (EACVI).

The theoretical EACVI examination takes place once a year at Euroecho in the form of MCQ's and video style questions. In addition, candidates are required to submit a logbook of 250 cases organised by pathology and provide evidence of 10 direct observational practice (DOP) cases. These cases are reviewed by the candidate's local supervisor, the full cases need to be available to be reviewed if requested by the EACVI. Reaccreditation occurs every 5 years by means of a 100 case logbook and evidence of continuing professional development (CPD). The EACVI congenital examination is open to sonographers from any background. EACVI also has accreditation routes for transthoracic, transoesophageal and stress echocardiography.

The BSE today has an established portfolio of accreditation pathways with robust theoretical and practical assessment processes supported by the Accreditation Committee and the administrative team at the BSE office. Immediate Past President, Keith Pearce, approached me at the joint BSE/ICE meeting in 2019 in Belfast to discuss reintroducing the BSE paediatric examination. Throughout my career, I have been involved in scanning patients of all ages with congenital heart disease (CHD). I too felt that this was a really important accreditation for BSE to reinstate but felt we should consider the patients across their lifetime, rather than just to focus on the paediatric population. We are all aware of the growing numbers of patients with CHD that are now in our adult clinics due to the surgical success and medical management of patients with congenital cardiac lesions. Subsequent meetings with Dr Claire Colebourn, then BSE accreditation lead and now the current BSE President and with Professor John Simpson, president of the British Congenital Cardiac Association (BCCA) took place over the following months. I am currently the physiologist representative on BCCA council so have been able to keep BCCA council members fully involved in this process.

We established a small working group of experienced sonographers who hold both BSE adult and EACVI congenital accreditation to work on the new BSE Congenital Accreditation. This core working group consists of myself working in a tertiary congenital unit, Harpreet Sahemey, Senior Echocardiographer from the Hammersmith Hospital and Wendy Gamlin, Transthoracic Echo Lead at Manchester University Hospitals. Harpreet and Wendy are both experienced examiners and members of the BSE Accreditation Committee and their input has been invaluable. We recognised that for most cardiac physiologists undertaking scans on congenital patients, the

patients would be over 16, however we felt that it was imperative that the candidates had knowledge of CHD from the cradle to the grave. The syllabus has been written to include unrepaired and repaired congenital lesions and is grouped together by pathology rather than age. We also wanted to recognise the prior knowledge that BSE members have attained by already having BSE accreditation and so we have removed areas that have previously been examined, such as the physics components. In addition we have made a reduction in the size of the logbook requirement. We hope that the logbook categories will be achievable and can be tailored to reflect your case mix, whether that be predominantly ACHD or a mixed age range, just as with the European logbook. We know that many physiologists support visiting the tertiary congenital cardiology outreach clinics and we hope this accreditation will provide you with the underpinning knowledge to facilitate this. We do however recommend that you seek the assistance of your local tertiary centre to help you attain the accreditation.

Just as with other BSE accreditation routes, there is a two part examination, comprising of a theoretical and a practical assessment. The theoretical examination has 100 true/false questions and 10 video style case questions, each with a choice of 4 statements to choose the best fit answer. The practical examination includes the review of a 200 case logbook, a viva session to include 5 video cases and a practical demonstration of competence in sequential segmental analysis. Candidates working in a DGH are encouraged to liaise with their local surgical congenital centre to allow sufficient exposure to a wide range of CHD. Further details of the requirements to successfully complete accreditation can be found in the accreditation pack which will be available in the new year on the website. Accreditation is valid for 5 years, at which point reaccreditation can be sought.

This new BSE accreditation route is endorsed by the BCCA and aims to improve standards of echocardiography in patients with congenital heart disease. We hope that this process will ensure that echocardiographers have the underpinning knowledge to confidently scan patients with congenital heart disease. We are currently working on the examination pack and hope to have this ready for the new year with the first theoretical examination being held in the Pearson-Vue centres in Spring 2021 and we hope to be able to provide the first practical examination in Autumn 2021. From 2022 we hope to run the theoretical examination twice a year.

We have enlisted the help of Dr Antigoni Deri, Paediatric Cardiologist at Leeds and Dr Wei Li, ACHD Consultant at Royal Brompton Hospital to assist the working group with writing the questions for the examination. Jo Thanjal, the BSE Accreditation Manager, is assisting us with the examination pack and the process as a whole.

We hope that this will provide a robust and attainable route for echocardiographers to obtain accreditation in scanning patients with congenital heart disease.

**Jan Forster, Consultant Congenital Sonographer
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On behalf of the BSE Congenital Accreditation working group**

LETTER

Latest British Society of Echocardiography recommendations for left ventricular ejection fraction categorisation: potential implications and relevance to contemporary heart failure management

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Letter to the Editor

We read with interest the recent guideline publication from the British Society of Echocardiography (BSE) relating to normal reference intervals for cardiac dimensions and function for use in echocardiographic practice (1). We commend the authors and the Education Committee for attempting to produce updated guidance taking into account contemporary, prospective data to determine new reference ranges for echocardiographic parameters. However, we suggest the newly proposed categories for left ventricular ejection fraction (LVEF) derangements from the BSE may contribute to diagnostic and therapeutic uncertainty and create new challenges for the management of heart failure (HF) patients in the United Kingdom (UK).

It is well recognised that HF transitions across the spectrum of LVEF and irrespective of LVEF, and that the prognosis for patients with HF is worse than in those without this diagnosis. Moreover, recent evidence points to adverse outcomes even in the setting of 'supra-normal' LVEF (2). As addressed in the recent publication (1), the latest BSE guidance for LV function categorisation ('severely impaired', LVEF $\leq 35\%$; 'impaired', LVEF 36–49%; 'borderline low', LVEF 50–54%; and 'normal', LVEF $\geq 55\%$) is clearly out of keeping with current guideline documents from international echocardiographic societies

(American Society of Echocardiography (3), European Association of Cardiovascular Imaging (4) and with those from international cardiology societies in Europe (European Society of Cardiology (ESC) (5)) and North America (American College of Cardiology/American Heart Association (6)). Both the ESC and the AHA define (heart failure with reduced ejection fraction) HFrEF at, or below, 40%. The ESC and AHA HF diagnostic thresholds have been reached not just on the basis of prognosis alone. Both heart failure with mid-range ejection fraction (HFmrEF) and heart failure with preserved ejection fraction (HFpEF) groups are characterised by marked heterogeneity and display differing epidemiological and pathophysiological profiles compared to HfrEF (7, 8, 9, 10). While the BSE document suggests that LVEF displays a continuous relation to prognosis 'i.e. as the LVEF gets progressively lower, survival is progressively poorer', LVEF exhibits a U-shaped, rather than a linear, relation to mortality (2). Both HFrEF and those with supra-normal LVEF are associated with the highest degrees of mortality, albeit HFmrEF and HFpEF patients have poor prognosis relative to those without HF (11).

Current ESC HF diagnostic thresholds have been conceived on the basis of evidence-based treatment response, with the demonstration in multiple clinical

trials of clear benefit from various classes of medication and device therapy for patients with HFrEF (defined as LVEF $\leq 40\%$), unlike HFmrEF and HFpEF. While the BSE document cites beneficial impacts upon mortality for angiotensin converting enzyme-inhibitors (ACEi), angiotensin receptor blockers (ARB), betablockers, mineralocorticoid receptor antagonists (MRA), I_f channel inhibitors, angiotensin receptor neprilysin inhibitors (ARNI) and device therapies for those with 'severely impaired' systolic function, that is, LVEF $\leq 35\%$ (1, 12, 13, 14, 15, 16, 17, 18, 19, 20), some of these same classes of pharmacotherapy also (and importantly) have a well-established and evidence-based extended survival benefit in those HF patients with LVEF $< 40\%$ (e.g. ACEi (21), ARBs (22), MRAs (23), ARNI (17)). The results of the BLOCK HF trial (mean LVEF 40%) support the use of cardiac resynchronisation therapy in HF patients in whom there is conventional pacing indication and with LVEF up to 50% (24). In addition to the aforementioned medications, newer classes of drugs have also recently shown prognostic benefit in large-scale multi-centre HFrEF trials with inclusion of patients with LVEF up to 40%: sodium-glucose cotransporter 2 inhibitors (dapaglifozin) (25) in the DAPA-HF study (study inclusion LVEF $< 40\%$) and soluble guanylate cyclase stimulators (vericiguat) in VICTORIA (26) (93% of patients had LVEF $< 40\%$). On this background, the apparent distinction in the BSE document of patients with LVEF $\leq 35\%$ from those with LVEF 35–40% is not based upon the totality of evidence from randomised, controlled trials and carries the risk of some patients being deemed ineligible for specific interventions for which there is evidence of therapeutic benefit.

To suggest, as proposed by the latest BSE guidelines, that a LVEF of 36% equates to a comparable degree of systolic derangement as a LVEF of 49% (both classed as 'impaired' in the recent BSE guideline document) is striking and is not based upon the totality of evidence from large-scale clinical trials. The BSE guidance potentially encompasses both HFrEF and HFmrEF subsets under the umbrella of the newly proposed 'impaired' LVEF range raising the following scenarios: (1) a significant proportion of HFrEF patients are denied evidence-based HF therapies and (2) inappropriate and potentially harmful prescription of therapies in those with HFmrEF, for whom there is no evidence of clinical benefit. Additionally, historical data show that a proportion of HFrEF (nearly one in four) demonstrates improved (or recovered) LV function over time (27). Such patients may have inappropriate cessation of prescribed pharmacotherapies by non-HF

specialists with potential deleterious consequences (28). Furthermore, in the setting of an individual patient LVEF improving from 36% to 48 or 49% over time, the suggested BSH guideline that this patient's status would be unchanged, appears illogical.

While we agree that LVEF calculation should not be used as a standalone metric of LV systolic function, it continues to be an extremely important imaging biomarker which not only provides both diagnostic and prognostic information but forms the basis of pharmacological and device management of patients and of enrolment into the majority of HF clinical trials (historical and current). The dichotomisation of reduced LV systolic function into a 'severely impaired' and 'impaired' range may further impact upon research settings in HF. In the clinical setting, community HF clinics which are predominantly nurse-led could be overwhelmed, since the majority of these services are commissioned by clinical commissioning groups and acceptance criteria often stipulates a diagnosis of HFrEF. However, as we have noted, the basis for inclusion of patients with LVEF $> 40\%$ in this category is unclear and specific and evidence-based interventions for such patients are lacking.

We do applaud the BSE for recommending that LVEF should be quoted in all patients with 'impaired' LV function. However, in typically elderly HF populations with concomitant co-morbidity, endocardial border definition is sub-optimal in nearly one-third, precluding calculation of LVEF using the biplane Simpson's method (29), and may add to the uncertainty in the 'impaired' LV range. We suggest that patients with LVEF in the range of 36–49% in this situation fail to guide management.

The management of patients with heart failure is largely based upon evidence gained from multiple clinical trials performed across three or more decades; these trials have, for the most part, defined HFrEF in the range of LVEF 35–40%. It is our view that to diverge from this classification is unlikely to address the BSE-stated aim of enabling 'appropriate interpretation of values into a clinically relevant report' for HF patients. We do, however, welcome the view advocated by the BSE in their latest guidance and supported by British Society for Heart Failure that all echo reports should ideally provide an actual value for LVEF, thereby enabling individualised treatment plans in HF patients (30).

Declaration of interest

The authors declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of this letter.

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REPLY

Response to Latest British Society of Echocardiography recommendations for left ventricular ejection fraction categorisation: potential implications and relevance to contemporary heart failure management

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We thank Dr Kanagala and Professor Squire for their keen interest in our paper (1) and their insight into the challenge of grading left ventricular ejection fraction (LVEF) (2). We must emphasise that our paper's remit was not to be a clinical guide on heart failure nor on its treatment.

The cut-off for what is regarded as a severely impaired LVEF has changed over the last half-century and vary from society to society (3). Previous BSE guidelines recommended that severe LVEF was $\leq 35\%$, therefore, the BSE has chosen to remain consistent with reporting standards used throughout the UK. Every BSE accredited sonographer and department has issued a report stating severe LVEF was $\leq 35\%$ for almost a decade. We have also been consistent in recommending measuring (and reporting) the LVEF as accurately as possible.

The American Society of Echocardiography and European Association of Cardiovascular Imaging have also remained consistent in their definition of severe LVEF as $< 30\%$ in their 2015 chamber definitions paper (4), unchanged from their 2005 paper (5). This is despite the ACCF/AHA defining HFrEF as $\leq 40\%$ in 2013 (6). Our paper outlines why we chose to adhere to $\leq 35\%$.

In the 2012 European Society of Cardiology (ESC) paper on heart failure (7), the authors pointed out that

'The major trials in patients with HF and a reduced EF (HF-REF), or "systolic HF", mainly enrolled patients with an EF $\leq 35\%$, and it is only in these patients that effective therapies have been demonstrated to date'. In 2016, the ESC brought in the term 'Heart Failure with mid-range Ejection Fraction' (HFmrEF) and almost (but not quite) aligned with the ACCF/AHA by defining HFrEF as an LVEF $< 40\%$ (8).

Since 2012, the cut-off LVEF used in trials of heart failure medications has varied; it is this value that then determines a drug's license. None of the imaging or clinical American, European or British society guideline provides a cut-off for severe LVEF or HFrEF that universally determines prescribing across all drug classes. The numerical value of the ejection fraction is essential to determine if a particular drug is indicated, which is why we insist on it being quoted; the only exception being cases where image quality is so poor it would be inaccurate to do so. We also recommend that when management plans are determined by LVEF, but routine trans-thoracic echo images are of poor quality, contrast echocardiography or alternative modalities are considered.

For this reason, we must disagree with Dr Kanagala and Professor Squire in claiming that the MRAs and the ARNIs have 'a well established and evidence-based

extended survival benefit' across the entire HFrEF population. We would urge readers to refer to the *British National Formulary* and the NICE guidelines as well as the landmark trial papers for the actual LVEF and specific clinical criteria required for prescribing within license (9, 10, 11, 12, 13, 14, 15).

Similarly, we also disagree with Dr Kanagala and Professor Squire that there is a clear benefit for device therapy in patients with HFrEF when defined as an LVEF \leq 40%. The NICE guidelines (16) and thus clinical commissioning groups insist on an LVEF \leq 35%. The results of a study of patients who had a conventional indication for pacing (17) does not open up the utility of complex device therapy to all the heart failure patients with an LVEF up to 50% but rather highlights the potential detriment of the conventional RV pacing on heart function in this group.

We note Dr Kanagala and Professor Squire's criticism that we have simplified the relationship between prognosis and LVEF. However, we stated that 'a lower ejection fraction is associated with a poorer prognosis' only in the context of considering and rejecting the use of 30% or lower as a useful cut-off for severe LVEF as opposed to 35%.

Reducing systolic dysfunction categories from three groups to two will not adversely affect future heart failure research nor will it overwhelm community heart failure services. The BSE has not changed its severe cut-off from its previous guidelines used throughout the UK for almost a decade and we do not define HFrEF in our paper. We have merely removed the arbitrary 'mild' and 'moderate' terms and replaced them with the quoting of an ejection fraction. This emphasis on quoting LVEF% for this group was also highlighted in our poster to accompany the paper.

The scenarios that Dr Kanagala and Professor Squire describe where they envisage that our guidelines would cause patient harm do not stand scrutiny when a report contains a numeric LVEF%. We make no recommendation that would lead to patients with impaired LVEF being offered inappropriate therapy, nor would they be denied treatment, let alone have it withdrawn if their LVEF has improved. In fact, we concur with the ESC clinical guidelines that patients with impaired LVEF should be considered for therapy whilst accepting that, for many patient groups, further research is required. By quoting the LVEF, those specific patients who may benefit from a particular therapy in certain circumstances can be selected by the clinician.

Measurement and reporting of LVEF are recommended in our BSE normal reference interval guideline and are the key take home message we would like to put to Dr Kanagala and Professor Squire. Most of the treatments mentioned in their letter require an ejection fraction to be measured to ensure prudent, safe, and evidence-based care. While categorisation of systolic dysfunction has useful but limited benefits (mainly to non-specialists), we agree that the numerical reporting of ejection fraction is important for all prescribing clinicians and especially heart failure specialists (3). It is recommended as standard practice by the BSE.

Declaration of interest

The authors declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of the article.

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Behind the Scenes

CATHY WEST

PRINCIPAL ECHOCARDIOGRAPHER, ROYAL BROMPTON HOSPITAL



Cathy West

1. What is your role at the BSE?

In late 2019 I was appointed as the International Representative on Council. It's a new development within the Society to extend the BSE's profile beyond our borders. I think it was fantastic to have a good number of international delegates join our meeting this year.

2. How long have you been with the BSE?

I joined in 2011 but only recently have become more actively involved. You get out what you put in and being active means that I get to develop a sense of the wider UK echo community without having to change my employment to do so!

3. What is your employment background?

I worked as a Cardiac Scientist in Australia at The Prince Charles Hospital for 15 years. Then I moved to the Royal Brompton Hospital in London to specialise in echo in patients with Adult Congenital Heart Disease and now I am the Principal Echocardiographer (I have to admit that came as a bit of a surprise!). I'm also involved in under-graduate and post-graduate cardiac ultrasound degree programs in Australia and currently serve on the Board of Directors for the American Society of Echocardiography.

4. What is the best piece of advice you have ever been given?

Don't take life too seriously!!

5. What are you most excited about for 2020?

Is it inappropriate to say 'the end of it' here? It's been challenging on so many levels, but equally leading my team through COVID has provided some golden moments, like the PPE dance moves. They have been so awesome.

6. What is your greatest achievement?

Professionally? The staff and students I work with. When they do well, I am proud to have been a small part of their journey. And if they don't, then I will damn well help them get over that! Sometimes we all need a little help to find our mojo.

Personally? Completing el Camino de Santiago – that took a bit of time, effort and Compeed. I went solo from Australia and it challenged my view of the world.

7. What are you most passionate about?

Atticus Finch sums it up best in *To Kill a Mockingbird* – "You never really understand a person until you consider things from his point of view... Until you climb into his skin and walk around in it." For me it is important to acknowledge there are many things I just don't understand yet, but that's not going to stop me from trying.

8. How would you like to be remembered?

As someone who cared.

9. Favourite album?

Kylie – Golden. Drives my household bonkers when I play it on repeat.

10. Favourite film?

City Slickers. That scene when Norman the calf is crossing the river is guaranteed to reduce me to tears. Every. Single. Time.

11. Favourite TV show?

Gavin and Stacey. What's occurin'?!

12. Favourite hobby?

Being under a wide-open sky – not that fussed about why I'm there or what I'm doing.

13. Favourite holiday?

Georgia! This country has amazing food, scenery and cultural experiences at every turn.

14. What keeps you awake at night?

My downstairs neighbour smoking outside the window.

15. Three words you would use to describe yourself

Open-minded, positive, creative.

16. Your 'claim to fame'

In grade 4 we learnt about government systems and politics, so the school held an election for Prime Minister of our year group. I was nominated to run for office, so I had to design my own policies and campaign trail. I started out promoting world peace like my opposition, but in the end, I promised to abolish homework. Mine was a landslide victory!

17. Who would you take to a desert island?

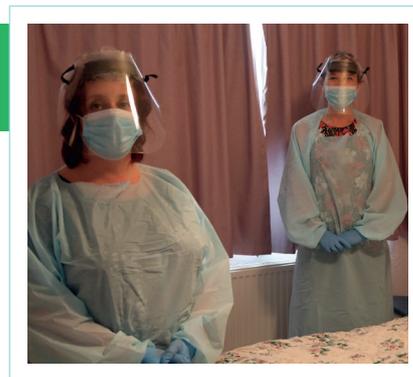
My better half – he is seriously the only person who could tolerate me.

18. Which 3 guests (living or dead) would make up your ideal dinner party?

Stacey Dooley, Elle Macpherson and Mahatma Gandhi.

Assessment of echo diagnostic clinics completed in patients homes as a response to the Covid-19 crisis

BY HANNAH JONES AND LIANA SHIRLEY
ADVANCED CLINICAL PHYSIOLOGISTS
(SEPTEMBER 2020)



Background

With the closure of outpatient clinics and the conversion of community outpatient rooms to beds, the Community Heart Failure Echo diagnostic team, consisting of two advanced clinical Physiologists, initially worked from home and began phone triaging all patients on the waiting list, including any new referrals.

It soon became apparent that we were faced with a dilemma between putting the clinics on hold (like many other services) and watching a waiting list grow, or to adapt our service delivery in some way to continue to support our vulnerable patient group. It was decided that to avoid decompensation from undiagnosed heart failure during this critical time, these patients needed to be clinically assessed in the safety of their own homes and assessed using echocardiography. In view of this, the community echo-diagnostic clinics responded dynamically and adapted their service to provide home visits from April 2020.

The clinical assessments are performed in full appropriate PPE (agreed by our Health Boards Infection Prevention team) by the Advanced Physiologists with clinical skills, providing a clinical examination, echocardiogram, diagnosis and management plan; all included in this one home visit, with remote support from Dr Graham Thomas GPwSI in Cardiology.

A portable GE Vivid Q was used and each scan was allocated one and a half hours. This time allocation allowed for the history, examination Echo and result and included all cleaning and donning and doffing of PPE. The clinical letter/report was written the next day, as there was no access to a reporting system in patients' houses.

This vital one-stop home visit service is provided across West and Central North Wales to patients referred by their GP with suspected heart failure. This service ensures that patients who are vulnerable and/or shielding with suspected heart failure can still have access to a diagnosis with a management plan initiated if required to avoid de compensation and prevent urgent/unplanned hospital admissions throughout the Covid-19 crisis.

Diagnosis of heart failure and other cardiac disease.

From April 2020, the service, consisting of two Advanced Clinical Physiologists started home visits, in total, we have carried out seventy to date (up to the 10th September 2020). A summary of our findings is as follows:

Twenty-nine patients were diagnosed with a form of heart failure, equating to **41%** of all patients seen. **Four** patients were found to have severe aortic stenosis (two requiring an urgent referral to cardiology, the other two requiring palliative care

management); There were **nine** patients in total found with new valve disease. Pleural and pericardial effusions were identified and needed management. There was an urgent referral made for unstable angina, this patient was then referred urgently for CT angiogram. Other referrals to the chest pain team were also made for another two of our patients following our assessment.

An urgent admission was also arranged for a patient that was decompensating from their heart failure.

A high number of patients were identified as having sub optimally controlled hypertension and atrial fibrillation. In total 57% of the patients seen needed medication changes to their management plan, including starting anti coagulation therapy to reduce their risk of stroke, hospitalisation, cardiovascular event or symptoms.

Abnormality/Action	Total Number
Heart Failure (Total)	29
LVSD HF	8
HF-NEF	21
Pericardial Effusion	1
Angina	3
Valve disease	9
Sub optimally controlled hypertension	8
Medication changes	40
Referrals to other specialists	12
Referral for spirometry	4
Referral for other tests	3

Patient – Reported Experience Measures (PREMS).

With the introduction of this new way of working through the pandemic, it was felt it would be pertinent to collect PREMS data to assess the views of all the patients accessing the service and to collate data in order to evaluate the success of home visits from a patient perspective.

From the seventy home visits performed, we have received 48 completed questionnaires highlighting a 69% return rate to date.

The feedback has been extremely positive and the home visits have been well received by those patients that have utilised the service.

The questionnaire comprised of 9 questions and a comments/suggestion box. The full results of the questions can be provided if needed.

36 comments were recorded by patients regarding the Echo diagnostic home visits and were all extremely positive and supportive of the service. Some of the comments included,

"The professional approach and care was first class".

"Couldn't ask for better 100%, the best service ever".

"An invaluable service, very professional. A first class service, NHS at it's very best".

"Fantastic team".

"Both ladies were very caring and thoughtful. They are a credit to your profession and represented you very well, thank-you".

"They were perfectly organised to cope with a home visit under shielding. Calm and friendly, which greatly relieved the stress inherent of the situation. I thank them for their consideration, sensitivity and clarity".

"Very professional service but feel that a mobile unit would be more convenient for both parties. Wish them all the very best for the future".

"You could not improve on this home scan and everything leading up to it".

"Very impressed with both and the service".

Our experiences as health professionals working through Covid-19

We have found the home visits although challenging at times for reasons that will be highlighted in the next section, overall a privilege to conduct. The patients have welcomed us and shown us kindness and support. Patients have voiced relief in the fact they can still access this service despite Covid-19 and the opportunity to still have an echocardiogram without entering any hospitals due to the fear of contracting Covid-19.

We have found that patients appear more relaxed within their home environment. We feel the home visits have been extremely successful as a short - term measure to ensure the detection of heart failure and the prevention of de-compensating patients deteriorating and requiring admission to hospital, whilst hospitals are under strain from the current crisis. It is important to note the home visits are very much a short-term measure that cannot be sustained due to multiple factors.

To add throughout this crisis we have had no reports of any of our patients having contracted Covid-19, and no one in the Echo diagnostic service has reported any Covid-19 symptoms.

Difficulties highlighted by this new way of working

These home visit clinics, although completely necessary, are ergonomically very difficult to sustain. We found navigating all our heavy equipment in unfamiliar environments difficult at times. Most scans were performed on the patient's beds to try to ensure minimal risk of musculoskeletal injuries however even when trying to scan people on their beds, hip and back discomfort was an issue due to the position and height of the bed and the mobility of the patient. Some scans had to be performed on recliner chairs and sofas due to an impossible environment or physical disabilities of some patients.

BCUHB is the largest health board in Wales and covers an enormous geographical area, it is split into three silos (East, Central and West) and the echo diagnostic clinics cover the West and Central catchment areas so each home visit can be up to a 4 ½ hour round trip visit due to geography. Appendix 1 shows the geographical area covered by the service and the pin markers highlight actual home visits.

Performing the home visits through spring and summer months has meant generally we have been able to transfer the electrical equipment easily from a car to the patient's home without risk of rain, slips / falls etc, however, if in the event of a second Covid-19 wave through the winter, protection of us and our electrical equipment will become a greater challenge. We have travelled to destinations across west and central as far as Barmouth, Ruthin, Criccieth and Blaenau Ffestiniog where roads are often very rural. This has so far been without issues through the warmer months however, we have concerns about the weather conditions we may be exposed to through the winter months if home visits are continued to be required. During the winter months there will be an increase in the trip/slip hazards whilst carrying all the equipment in to patients' homes that also adds an additional risk in possible ice and snow. In addition Wales experiences the largest amount of rainfall in winter months so transportation of electrical equipment will be detrimental to the expensive ultrasound machines.

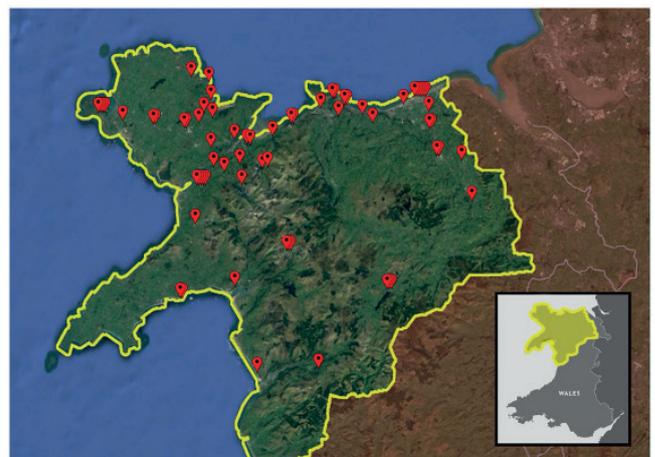
Hopes for the future whilst working through further waves of Covid-19

Moving forward through Covid-19 and towards the future we have put in a bid for a purpose built converted vehicle which can accommodate our shielded and vulnerable patients by providing a service directly outside their home. With a purpose built vehicle, we can ensure that the environment, lighting and ergonomics are appropriate for the investigation with more control of decontamination of the environment and equipment. This would also minimise the risk of any musculoskeletal injuries to staff and protect the equipment from adverse weather without the need to transfer from car to patient homes.

This can also be utilised when the out patients clinics rooms are re-opened with providing additional clinic space to relieve pressures on the outpatients service.

Appendix 2

This shows the geographical area covered by the service and the pin markers highlight the actual home visits.



An incidental finding of coronary sinus stenosis

SAMANTHA BAINBRIDGE, DR JAMIE BENTHAM ET AL
LEEDS TEACHING HOSPITALS NHS TRUST

Case report:

A teenager with Sickle Cell Disease (SCD) was referred for echocardiography due to increasing shortness of breath on exertion and lethargy. Echocardiography was indicated to exclude any cardiac causes for the symptoms. Sickle cell disease can cause recurrent episodes of ischaemia-reperfusion injury to multiple vital organs and chronic haemolytic anaemia ⁽¹⁾. The cardiovascular sequelae of SCD ⁽²⁾ includes: compensatory eccentric left ventricular hypertrophy; left ventricular diastolic dysfunction; aortic root dilatation; atrioventricular valve regurgitation and coronary artery ectasia ⁽³⁾. Ectasia is usually defined as dilatation ≥ 1.5 -fold increase in the normal vessel diameter ⁽³⁾.

On examination the patient had a resting heart rate of 80 bpm. There were no reports of recent sickle cell crises, a chest x-ray was normal and no murmurs were heard on cardiac auscultation.

Transthoracic echocardiography confirmed: cardiac situs; pulmonary and systemic venous drainage; normal valve structure; normal left ventricular size (LVEDV 76ml) systolic function and LV wall thickness. There was ectasia of the right coronary artery, Montreal Z-score +2.67 (Fig 1). The parasternal long axis right ventricular (RV) inflow view (Fig 2a) demonstrated dilatation of the lumen of the coronary sinus and narrowing as the CS extended into the right atrium (RA). Flow acceleration was demonstrated on 2D-imaging with simultaneous colour flow mapping as the CS opened into the RA, on the RV inflow view (Fig 2b) and the parasternal short axis view (Fig 3). The lumen of the CS appears to bulge and then taper down before entering the right atrium. 3D transthoracic echocardiography confirmed dilatation of the lumen and narrowing at the ostium of the coronary sinus (Fig 4).

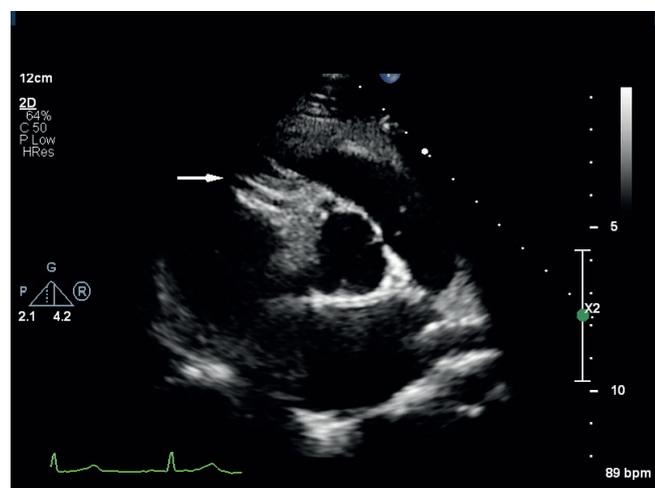


Fig. 1. Two-dimensional echocardiography at the level of aortic valve showing ectasia of the proximal right coronary artery (arrow).



Fig. 2a. Parasternal long axis RV inflow view, aneurysmal dilatation of the coronary sinus lumen (arrow) with narrowing as the coronary sinus extends into RA (open arrow).

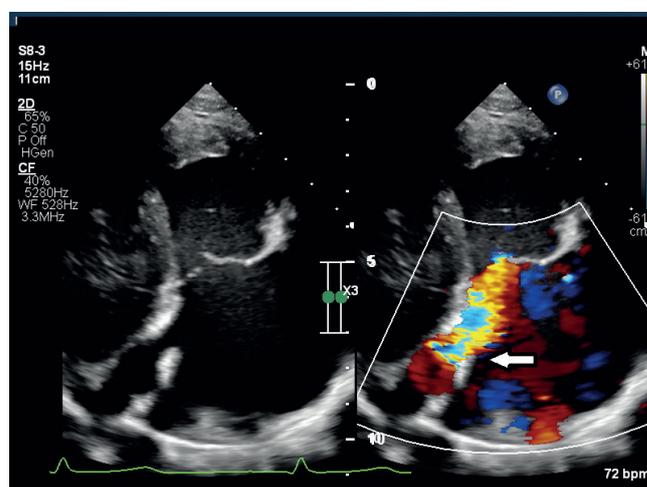


Fig. 2b. Parasternal long axis RV inflow view. Simultaneous two-dimensional (A) and colour flow Doppler (B) showing flow acceleration as the coronary sinus extends into the right atrium (arrow).

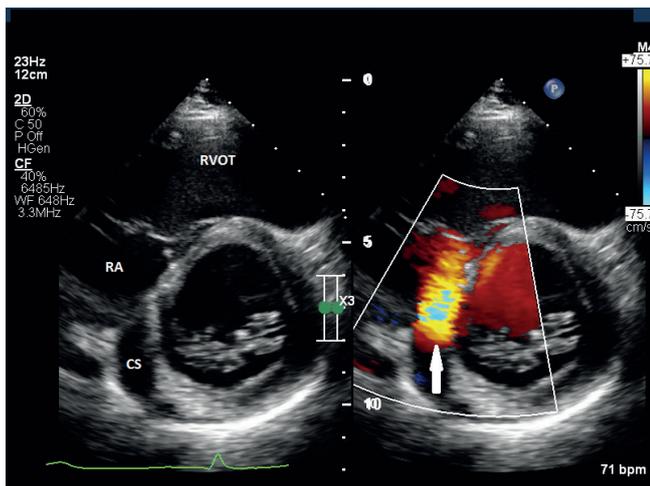


Fig. 3. Parasternal short axis view at the level of the mitral valve (A), simultaneous 2D imaging and colour flow Doppler (B) showing flow acceleration as the coronary sinus enters the RA (arrow). CS, coronary sinus, RA right atrium, RVOT right ventricular outflow tract.

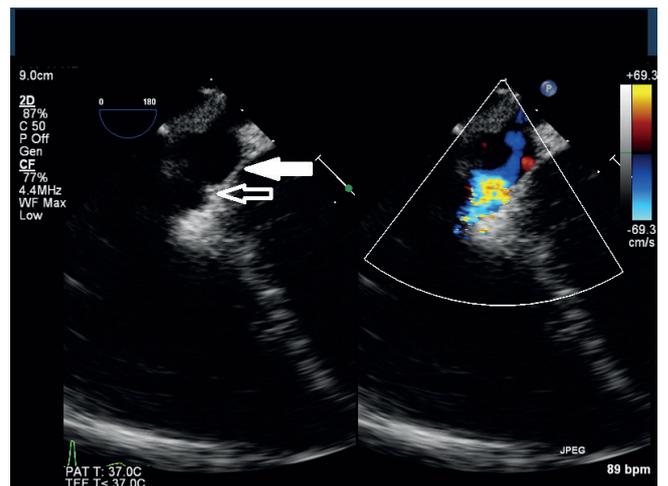


Fig. 5. Transoesophageal echocardiography apical four chamber view with posterior angulation demonstrating the CS entering the RA. Dilatation of the lumen of the CS (arrow) and narrowing as CS enters RA (open arrow).

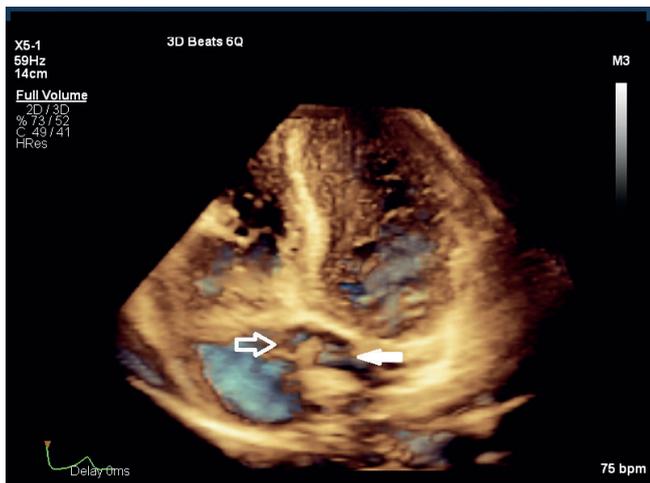


Fig. 4. Three-dimensional transthoracic echocardiography showing the posterior aspect of the heart. Dilated coronary sinus lumen (arrow), with narrowing as the coronary sinus opens into the RA (open arrow).

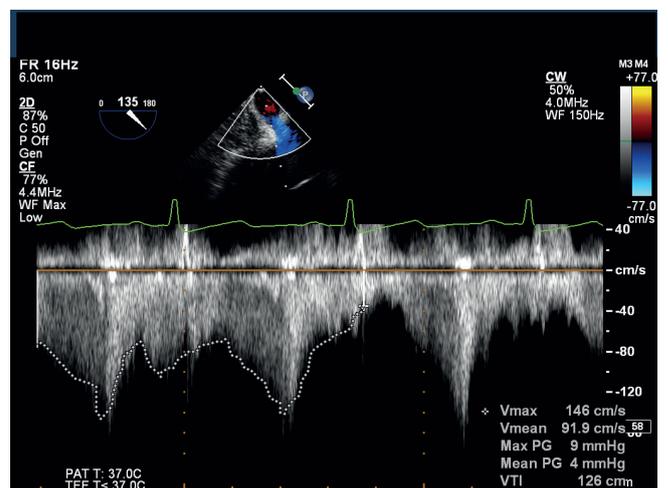


Fig. 6. Continuous wave spectral Doppler profile of coronary sinus flow, maximum velocity 146 cm/s, mean 4mmHg.

Further imaging with 3D transoesophageal echocardiography allowed evaluation of the more posteriorly located cardiac structures. Posterior angulation of the probe from the apical four chamber view (Fig 5) was used to assess the coronary sinus. The CS appeared to taper as it entered the right atrium with no evidence of membranes obstructing the flow. Colour flow Doppler demonstrated flow acceleration as the CS opened into the RA, interrogation with continuous wave Doppler showed an increased velocity and mean gradient, 146 cm/s and 4mmHg respectively (Fig 6). Coronary sinus flow pattern⁽⁴⁾ is like that of the IVC and SVC with two antegrade waves with systole (S) and diastole (D), the S wave is usually > D wave, the peak S wave velocity ≤ 50 cm/s, there are two smaller retrograde waves one between S and D and one with atrial contraction and normal physiologic variation is seen with respiration.

The differentials for the appearance of a dilated coronary sinus on echocardiographic imaging include coronary sinus stenosis, coronary artery to coronary sinus fistula, persistent left superior vena cava draining to coronary sinus or an unroofed coronary sinus defect.

Malformation of the coronary sinus (CS) and right atrium have been described including congenital enlargement, single or multiple saccular diverticular aneurysms arising from the RA or CS⁽⁵⁾. Abnormalities of the coronary sinus including shape, size, absence and atresia of the ostium have been described⁽⁵⁾.

Dilatation of the CS in the absence of a left to right shunt is usually due to the persistence of a left superior vena cava draining into the CS, because of failure of the left anterior cardinal vein to regress into the ligament of Marshall⁽⁶⁾.

A coronary arterial fistula is a connection between one or more of the coronary arteries and a cardiac chamber or great vessel ⁽⁷⁾. Coronary artery fistulas are rare defects and usually occur in isolation ⁽⁸⁾. Coronary artery fistula may remain undiagnosed during childhood and early adult life ⁽⁷⁾. Fistulas draining into the right heart i.e. coronary artery to coronary sinus would lead to volume loading of the right side of the heart, pulmonary vascular bed, left atrium and left ventricle. A continuous murmur may be heard over the precordium. This is an unlikely explanation of the findings in our patient as the chambers of the heart with the exception of the coronary sinus were normal in size and there was no audible murmur on auscultation. Coronary angiography is the main diagnostic tool for the delineation of the coronary anatomy.

Coronary sinus dilatation in the presence of a left to right shunt may be due to an unroofed CS – this is a rare congenital abnormality where the interatrial shunt is due to partial or complete absence of the wall separating the CS from the left atrium ⁽⁹⁾. This was unlikely in our patient as there was no evidence of right heart dilatation as would occur with a left to right shunt.

Further evaluation of the patient using stress echocardiography and cardiac angiography were undertaken.

Stress echocardiography using a treadmill was performed to assess exercise tolerance and heart rate and blood pressure response. The patient exercised for 7mins 34secs, 12.8 METS, on Bruce 2 minute/stage protocol, stopping due to fatigue. The results demonstrated a normal heart rate and blood pressure response with no ST/T wave changes. This suggested the abnormal coronary sinus did not cause significant haemodynamic changes with exercise.

Cardiac catheterisation confirmed normal haemodynamics. There was saccular dilatation of the coronary sinus lumen with two aneurysms measuring 12mm and 10mm. There was also narrowing as the coronary sinus ostium extended into the right atrium which was consistent with the echo findings. There was

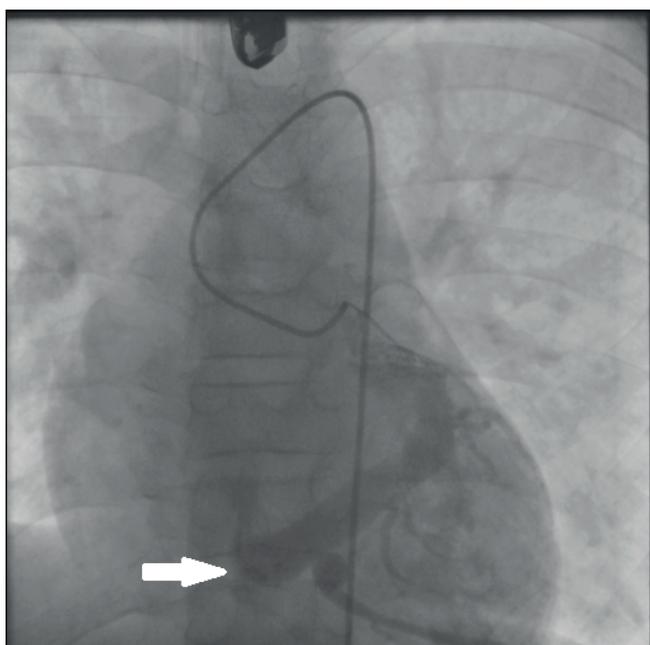


Fig. 7a. Left coronary angiogram (AP view), showing coronary venous system drainage (arrow demonstrating coronary sinus)

no left superior vena cava. The coronary sinus could not be accessed directly. Left coronary artery angiography showed normal left coronary artery without obstruction or fistula, the flow was then seen passing into the venous system and coronary sinus (see figure 7a). Findings confirmed coronary sinus obstruction without impairment of coronary artery filling or transit.

Summary:

Little is known about the clinical relevance of malformations of the coronary sinus, anomalies of the CS are rare and may occur in isolation or in association with congenital heart disease ⁽¹⁰⁾.

We report a case of saccular dilatation of the coronary sinus lumen (CS) and obstruction of the ostium of the CS without impairment of left circumflex (Cx) coronary artery filling. There had been no previous cardiac interventions to explain an iatrogenic cause for the appearance of the coronary sinus. We conclude that this is a case of congenital abnormality of the coronary sinus, which appears occult in nature and requires no intervention at the present time.

Treatment:

The patient was reviewed by the congenital cardiology multidisciplinary team; it was felt that no intervention was required for the coronary sinus stenosis. The initial symptoms of breathlessness and fatigue were not attributable to the CS stenosis. The patient remains asymptomatic from a cardiac perspective, is systemically well and stable from the point of view of his sickle cell anaemia. The plan will be to review in adult congenital cardiology outpatients in 12 months with echocardiography.

Learning points:

- Coronary sinus stenosis (CSS) is a rare often incidental finding that maybe congenital or iatrogenic in origin ⁽¹¹⁾. Narrowing of the CS is usually associated with CS dilatation. CSS may occur at the ostium as the CS enters right atrium, within the lumen or at the origin of the CS near to the junction with the great cardinal vein.
- TTE, TOE, 3D echocardiography, angiography and stress echocardiography can help differentiate the causes of coronary sinus stenosis and help in planning further management.

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Patient/guardian consent received.

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Curious case of an incidental intra cardiac mass

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Case:

A 66 year old patient presented with chest pain and an ECG showing sinus rhythm with T wave inversion in the infero-lateral leads. Laboratory examination revealed a mild neutrophilia ($8.09 \times 10^9/L$), raised C-reactive protein (192 mg/L) and elevated high-sensitivity Troponin T (3920 ng/L). The patient was managed as Non-ST segment elevation myocardial infarction and underwent a diagnostic left heart catheter coronary angiogram which demonstrated severe triple vessel disease. Transthoracic echocardiogram demonstrated severe left ventricular impairment and a bi atrial echogenic mass with villous extensions (Figure 1: Panel A-C and Figure 2). Late gadolinium enhanced magnetic resonance imaging (Figure 1: Panel D-F) showed heterogeneous uptake of gadolinium contrast, albeit poorly defined due to the limited temporal resolution of this modality for detecting highly mobile structures. Interestingly, the echocardiogram provided a better characterisation of the mass compared to magnetic resonance imaging. Following a discussion in the multi-disciplinary meeting it was suggested that the mass could represent an intra cardiac thrombus hence a trial of oral anti coagulation with Warfarin was recommended with a plan to repeat the echocardiogram after three months.

The repeat transthoracic echocardiogram demonstrated unchanged appearances of the atrial mass. Subsequently, the patient underwent combined coronary artery bypass graft surgery and excision of the bi-atrial mass with no complications. Histology of the excised mass confirmed gelatinous fragments with a myxoid stroma and papillary architecture in keeping with a villous type atrial myxoma.

Discussion:

We have described a case of incidental finding of bi-atrial villous myxoma on routine pre-operative transthoracic echocardiogram. Myxomas are the most common primary cardiac tumour found in adults accounting for 50% of cardiac tumours^[1]. The incidence of other benign tumours in order of frequency is papillary fibroelastomas (26%), fibromas (6%) and lipomas (4%)^[1]. They occur in all age groups, most frequently between the third and sixth decades. Up to 65 % of cases are noted in females^[1]. Most cases occur sporadically, but approximately 7% may be genetic, inherited as an autosomal dominant disorder associated with skin lentiginos and endocrine tumours, an association referred to as Carney complex. Familial myxomas tend to present at a younger age, are more likely multiple, and have an increased risk of recurrence after resection^[2].

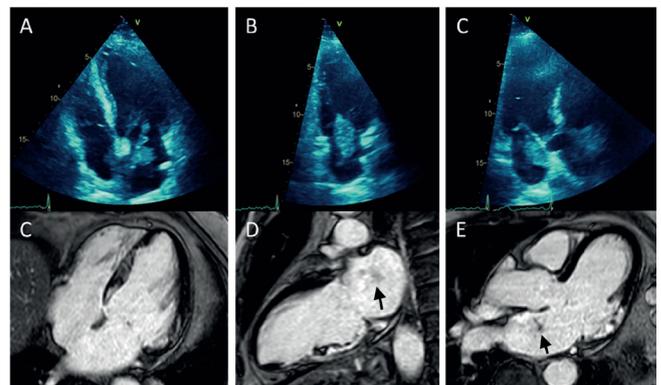


Fig. 1. **A**, 4chamber TTE, **B**, 2chamber TTE, **C**, 3chamber TTE **D**, 4chamber contrast enhanced MRI, **E**, 2chamber contrast enhanced MRI, **F**, 3chamber contrast enhanced MRI (Black arrows demonstrating the heterogenous uptake of contrast, albeit poorly defined due to the limited temporal resolution of this modality for detecting highly mobile structures)



Fig. 2. Three dimensional 4chamber TTE

The left atrium is the most common site of origin of cardiac myxoma (60-88%), followed by right atrium (10–20%), left ventricle (8%), right ventricle (2.5-6.1%) and rarely bi atrial (<2.5%),^[3].

Presentation:

Patients with cardiac myxoma may be asymptomatic but usually present with one or more features of a triad of symptoms: (1) constitutional manifestations such as weight loss, fatigue, fever, joint pains and muscle weakness; (2) embolic events, involving either pulmonary or systemic circulation depending on the myxoma location and (3) obstructive symptoms including dizziness, dyspnoea, and syncope, which are the most frequent presenting features,^[4].

Investigations:

The best available and non-invasive diagnostic tool for myxoma is transthoracic echocardiogram (TTE). The myxomas are commonly identified as smooth, polypoid, homogenous masses predominantly in the left atrium that arise via a smooth stalk from the fossa ovalis,^[5]. However, the transthoracic echocardiogram in our patient demonstrates the less common villous or papillary myxomas with multiple villous extensions and originating from both atria.

A trans oesophageal echocardiogram (TOE) can provide information about the origin of the mass, differentiate an invading sarcoma and exclude multiple masses. In addition, a TOE has good intra operative correlation and hence useful during surgical planning,^[7].

Transthoracic echocardiogram is usually adequate for making the diagnosis but in most cases a cardiac MRI can be performed for tissue characterisation and to differentiate a myxoma from other causes of intra cardiac mass like thrombus,^[6].

Myxomas will typically appear isointense to the surrounding myocardium on T1 weighted imaging and hyperintense on T2 weighted sequences. Gadolinium enhanced imaging depicts heterogenous uptake of contrast in case of myxoma, where as a thrombus is avascular and hence characterised by an absence of contrast uptake.

Treatment:

Surgical en bloc resection is the treatment of choice. The risk of recurrence is low but is much more common with familial than sporadic tumors (22% vs 3%),^[8]. The risk of recurrence increases linearly for 4 years after resection, after which risk of recurrence is low. Based on this observation, surveillance echocardiographic follow-up should be undertaken annually for 4 years following surgery,^[8].

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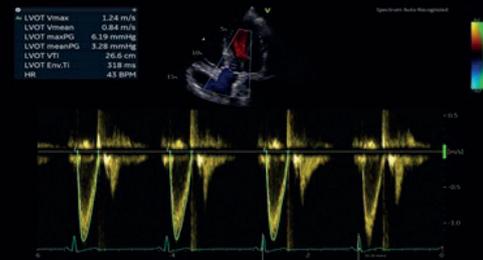
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With best wishes from
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