

MEETING REPORT

# Report from the Annual Conference of the British Society of Echocardiography, November 2017, Edinburgh International Conference Centre, Edinburgh

Vishal Sharma<sup>1</sup>, Martin Stout PhD MSc BSc<sup>2</sup>, Keith Pearce BSc<sup>2</sup>, Allan L Klein MD FRCP(C) FACC FAHA FESC<sup>3</sup>, Maryam Alsharqi MSc<sup>4,5</sup>, Petros Nihoyannopoulos MD FRCP FESC FACC FAHA<sup>4</sup>, Jamal Nasir Khan MBChB PhD BMedSci MRCP<sup>6</sup>, Timothy Griffiths BA BSc PGDip Card<sup>7</sup>, Kully Sandhu DM MRCP<sup>7</sup>, Sinead Cabezon MBChB<sup>7</sup>, Chun Shing Kwok MBBS MSc BSc MRCP<sup>7</sup>, Shanat Baig MBBS MRCP<sup>7</sup>, Tamara Naneishvili MBBS MRCP<sup>7</sup>, Vetton Chee Kay Lee MBChB<sup>7</sup>, Arron Pasricha MBChB<sup>7</sup>, Emily Robins MBChB<sup>7</sup>, Prathap Kanagala MBBS PhD MRCP<sup>8</sup>, Tamseel Fatima MBBS MRCP<sup>7</sup>, Andreea Mihai MBBS MRCP<sup>7</sup>, Robert Butler MBChB MD FRCP FACC<sup>7</sup>, Simon Duckett MBBS MD BSc MRCP<sup>7</sup>, Grant Heatlie MBBS PhD BSc MRCP<sup>7</sup>, Haotian Gu PhD<sup>9</sup>, Phil Chowienzyk FRCP<sup>9</sup>, Linda Arnold<sup>10</sup>, Sean Coffey<sup>11,12</sup>, Margaret Loudon MBChB MRCP DPhil<sup>10</sup>, Jo Wilson<sup>10</sup>, Andrew Kennedy<sup>10</sup>, Saul G Myerson MD FRCP FESC<sup>10</sup>, Bernard Prendergast<sup>13</sup>, Alice M Jackson MBChB MRCP<sup>14</sup>, Vera Lennie MD FESC FRCPedin<sup>15</sup>, Peter Lee Luke MSc BSc<sup>16</sup>, Christopher James Eggett PhD BSc<sup>17</sup>, Loakim Spyridopoulos MD<sup>18</sup>, Timothy Simon Irvine MBChB FRCP<sup>16</sup>, Nashwah Ismail<sup>19</sup>, Anita Macnab MBChB FRCP<sup>19</sup>, Caroline Bleakley MB BCh BAO MRCP MD<sup>20</sup>, Mehdi Eskandari MD FRACP<sup>20</sup>, Omar Aldalati<sup>20</sup>, Almira Whittaker<sup>20</sup>, Marilou Huang<sup>20</sup>, Mark J Monaghan PhD FRCP FESC FBSE FACC<sup>20</sup>, Thomas J Turner<sup>19</sup>, Conor Steele<sup>19</sup>, Anna Barton<sup>21</sup>, Alan C Cameron BSc MBChB PhD<sup>29</sup>, Piotr Sonecki<sup>21</sup>, Gyee Vuei Phang MBChB MRCP<sup>22</sup>, Christos Voukalis MD MRCP<sup>22</sup>, Hwee Phen Teh MBChB<sup>22</sup>, Stavros Apostolakis MD PhD<sup>22</sup>, Chih Wong MRCP MD<sup>23</sup>, Matthew M Y Lee MBChB MRCP<sup>23,24</sup>, Nicolas E R Goodfield MBChB<sup>22</sup>, Emma Lane BSc<sup>25</sup>, David Slessor MBBS FRCEM FFICM<sup>25</sup>, Richard Crawley BSc MBBS MRCP<sup>25</sup>, Theodoros Ntoskas MD<sup>26</sup>, Farhanda Ahmad PgDMU<sup>26</sup>, Paul Woodmansey MD FRCP<sup>26</sup>, Andrew J Fletcher MSc<sup>27</sup>, Shaun Robinson MSc<sup>27</sup>, Bushra S Rana MBBS FRCP<sup>27</sup>, Liam Batchelor BSc MSc<sup>27</sup>, Brogan McAdam<sup>28</sup>, Caroline J Coats<sup>28</sup>, Louise C Mayall BSc MRes MSc<sup>2</sup>, Niall G Campbell PhD MRCP<sup>2</sup> and Hannah Garnett PhD MSc BSc<sup>29</sup>

<sup>1</sup>Royal Liverpool and Broadgreen University Hospitals NHS Foundation Trust, Liverpool, UK

<sup>2</sup>Manchester Foundation Trust, Manchester, UK

<sup>3</sup>Center for the Diagnosis and Treatment of Pericardial Diseases, Department of Cardiovascular Medicine, Heart and Vascular Institute, Imaging, Cleveland Clinic, Cleveland, Ohio, USA

<sup>4</sup>Imperial College London, NHLI, Hammersmith Hospital, London, UK

<sup>5</sup>Department of Cardiac Technology, College of Applied Medical Sciences, Imam Abdulrahman Bin Faisal University, Dammam, Kingdom of Saudi Arabia

<sup>6</sup>Department of Cardiology, University Hospital of Coventry & Warwickshire, Coventry, UK

<sup>7</sup>Department of Cardiology, University Hospital of North Midlands, Stoke-on-Trent, UK

<sup>8</sup>Department of Cardiology, Aintree Hospital, Liverpool, UK

<sup>9</sup>British Heart Foundation Centre of Research Excellence, King's College London, London, UK

<sup>10</sup>Department of Cardiology, John Radcliffe Hospital, Oxford, UK

<sup>11</sup>Kolling Institute of Medical Research, University of Sydney, Sydney, Australia

<sup>12</sup>Department of Cardiology, Royal North Shore Hospital, Sydney, Australia

<sup>13</sup>Department of Cardiology, St Thomas' Hospital, London, UK

<sup>14</sup>University Hospital Crosshouse, Kilmarnock, Scotland

<sup>15</sup>University Hospital Ayr, Ayr, Scotland

<sup>16</sup>Echocardiography Department, Freeman Hospital, Newcastle upon Tyne, UK

<sup>17</sup>School of Biomedical Sciences, Newcastle University, Newcastle upon Tyne, UK

<sup>18</sup>Institute of Genetic Medicine, Newcastle University, Newcastle upon Tyne, UK

<sup>19</sup>University Hospital of South Manchester, Manchester, UK

<sup>20</sup>King's College Hospital, London, UK

<sup>21</sup>Queen Elizabeth University Hospital, Glasgow, UK

<sup>22</sup>Sandwell and West Birmingham NHS Trust, Birmingham, UK

<sup>23</sup>Glasgow Royal Infirmary, Glasgow, UK

<sup>24</sup>British Heart Foundation Glasgow Cardiovascular Research Centre, University of Glasgow, Glasgow, UK

<sup>25</sup>Queen Alexandra Hospital, Portsmouth Hospitals NHS Trust, Portsmouth, UK

<sup>26</sup>New Cross Hospital, Wolverhampton, UK

<sup>27</sup>Royal Papworth Hospital NHS Foundation Trust, Cambridge, UK

<sup>28</sup>Golden Jubilee National Hospital, Glasgow, UK

<sup>29</sup>Echocardiography Department, Freeman Hospital, Newcastle upon Tyne, UK

**Correspondence should be addressed to V Sharma: [vishal.sharma@rlbuht.nhs.uk](mailto:vishal.sharma@rlbuht.nhs.uk)**

## MEETING REPORT

# Foreword

Vishal Sharma<sup>1</sup>, Martin Stout<sup>2</sup> and Keith Pearce<sup>2</sup>

<sup>1</sup>Royal Liverpool and Broadgreen University Hospitals NHS Trust, Liverpool, UK

<sup>2</sup>Manchester Foundation Trust, Manchester, UK

Correspondence should be addressed to V Sharma: [vishal.sharma@rlbuht.nhs.uk](mailto:vishal.sharma@rlbuht.nhs.uk)

The 2017 Annual Conference of the British Society of Echocardiography (BSE) was held in Edinburgh on the 10th and 11th November. This was an extremely well-supported conference with 751 delegates attending. We were delighted to offer an extremely high-quality educational programme. A particular highlight was the final session, which included the current presidents of the three major echocardiography societies in the world. Our own President, Mr Keith Pearce was joined by the President of the American Society of Echocardiography, Prof. Allan Klein and the President of the European Association of Cardiovascular Imaging, Prof. Bogdan Popescu.

This year's BSE International Lecture was given by Prof. Klein, who gave a thorough overview of pericardial diseases and how to assess them with echo. The BSE Invited Lecture was delivered by Prof. John Simpson in which he gave us a glimpse into the future of echocardiography with his talk entitled 'Frontiers in Congenital Heart Disease Imaging'. Prof. Bogdan Popescu also delivered an excellent talk on the assessment of atrial function as part of a dedicated session on the assessment of the left atrium.

For the first time the BSE also included a dedicated session devoted to patients. In the 'My Echo' session, patients gave their own unique perspectives of how their conditions have affected them and how echocardiography had directly impacted their lives. In one particularly memorable anecdote, one of the patients recounted how they had been admitted to hospital with significant breathlessness. Despite being treated for days for a chest infection, their condition steadily worsened and there were real concerns that they would not survive. They then described being taken into a darkened room for an 'ultrasound scan' that was undertaken by a cardiac physiologist. From that point on, the patient recounted that the course of their treatment and ultimately their life changed completely. Following the echo, their severe heart failure was diagnosed, they were moved to a cardiology ward, commenced on appropriate treatment and

began to feel better. Their condition improved dramatically and over the next few weeks made an almost complete recovery. This important anecdote not only highlighted the impact that echocardiography has on patients but the importance of ensuring that it can be provided rapidly in all hospitals across the country.

A key theme for this conference was echocardiography in congenital heart disease and there was a dedicated congenital track running throughout the programme. Topics included detailed sessions on the sequential analysis of congenital heart disease with echocardiography, atrial and ventricular septal defects, right and left obstructive lesions and Tetralogy of Fallot. A particular highlight was the session on the assessment of atrial septal defect closure by Alex Savis and as a consequence we invited her and Prof. John Simpson to write a review on the topic for *Echo Research and Practice* (1).

We were also delighted to hear about the high-quality research that is happening across the United Kingdom at the conference and we have included the abstracts that were presented at the conference in this report.

As always we are grateful to all of our sponsors and industry partners without whom, the annual conference would not be possible.

#### Declaration of interest

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

#### Funding

This work did not receive any specific grant from any funding agency in the public, commercial or not-for-profit sector.

#### Reference

- 1 Savis A & Simpson J. Echocardiographic approach to catheter closure of atrial septal defects: patient selection, procedural guidance and post-procedural checks. *Echo Research and Practice* 2018 **5** R49–R64. (<https://doi.org/10.1530/ERP-18-0007>)

Received in final form 21 October 2019

Accepted 21 October 2019

## MEETING REPORT

# International Lecture 2017: Multimodality imaging in pericardial disease: an imaging-guided approach

Allan L Klein MD FRCP(C) FACC FAHA FESC

Center for the Diagnosis and Treatment of Pericardial Diseases, Department of Cardiovascular Medicine, Heart and Vascular Institute, Imaging, Cleveland Clinic, Cleveland, Ohio, USA

Pericardial diseases involve diseases of the sac that surrounds the heart. Compared to other cardiac diseases, there has been little interest in pericarditis since it has little effect on mortality. However, pericarditis can be associated with significant morbidity which has raised the interest in this field. In 2017, the new term ‘complicated pericarditis’ describes patients who have multiple recurrent episodes as well as constrictive pericarditis. Imaging modalities such as echo-Doppler, strain imaging and CMR/CT can help establish the diagnosis, prognosticate the severity as well as inform treatment.

The pericardium is composed of a serous layer including the visceral (epicardium) and parietal component as well as a fibrous layer. Viruses, uraemia, neoplasm and radiation can all damage the pericardial sac. Initially, there will be fibrinous exudates followed by neutrophil infiltration, neovascularization and then fibrosis. CMR with late gadolinium enhancement (LGE) has become an imaging biomarker of pericardial inflammation. Interestingly, LGE seems to relate to neovascularization of the pericardium and relates to the severity of the inflammation which portends a bad prognosis for having multiple recurrences and likely starting DMARDS and biologics.

Pericardial syndromes include acute, recurrent, incessant and chronic pericarditis, pericardial effusions/tamponade, constrictive pericarditis and effusive constrictive pericarditis, pericardial masses, cysts and congenital absence of the pericardium. Recent ASE and ESC guidelines have defined how these conditions are diagnosed clinically. Ancillary signs such as elevated inflammatory markers (WSR and CRP) and pericardial inflammation on advanced imaging may help with the diagnosis. It is estimated that 15–30% of patients with acute pericarditis

will develop recurrent episodes of which 6% may show multiple recurrences while some will develop transient constrictive pericarditis (treated with anti-inflammatories) and some will develop calcific constrictive pericarditis. The aetiology of pericarditis is different depending whether in the Western world (viral or idiopathic) or developing world (TB). An emerging cause of pericarditis is traumatic or iatrogenic (perforation or delayed onset).

Multimodality imaging plays an integral part in the diagnosis and treatment of pericardial diseases. Echo is usually the first-line test followed by CMR/CT which are second line which are recommended in patients with technically poor echoes, assessing inflammation or evaluating calcium in the setting of previous open heart surgery. Recognition of the different stages of pericarditis from single recurrence to advanced constriction will inform when to use echo, strain imaging, CMR and CT. Recent understanding of the pathophysiology of recurrent pericarditis suggests that there is activation of the ‘inflammasome’ of the cell, which may cause release of inflammatory biomarkers markers such as interleukins. This may be especially important due to the use of newer targeted therapies such as Il1 alpha and beta receptor blockers.

In conclusion, assessment of pericardial diseases using an imaging-guided approach is responsible for the new renaissance in pericardial diseases.

#### Declaration of interest

The author declares that there is no conflict of interest that could be perceived as prejudicing the impartiality of this article.

#### Funding

This work did not receive any specific grant from any funding agency in the public, commercial or not-for-profit sector.

Received in final form 21 October 2019

Accepted 21 October 2019

## MEETING REPORT

# Abstract 1: Left ventricular twist mechanics in hypertensive patients with preserved left ventricular ejection fraction and its relation to left atrial phasic function

Maryam Alsharqi MSc<sup>1,2</sup> and Petros Nihoyannopoulos MD FRCP FESC FACC FAHA<sup>1</sup>
<sup>1</sup>Imperial College London, NHLI, Hammersmith Hospital, London, UK

<sup>2</sup>Department of Cardiac Technology, College of Applied Medical Sciences, Imam Abdulrahman Bin Faisal University, Dammam, Kingdom of Saudi Arabia

## Aims

To evaluate the relation between left ventricular (LV) twist mechanics and left atrial (LA) phasic function in patients with systemic hypertension using speckle tracking echocardiography (STE). We hypothesised that the impairment of LA function is directly related to the reduction in LV untwisting rate (UTR) in hypertensive patients with preserved LV ejection fraction (EF).

## Methods

In this prospective study, 74 hypertensive patients (54.17±16.37 years) with preserved EF (65.7±7.29%) were enrolled and compared with 20 normotensive controls. Basal and apical parasternal short axis views were used to assess LV twist mechanics, and apical four- and two-chamber views were used to evaluate LA phasic function. Using EchoPac GE STE software, LV twist, UTR, and time to peak UTR were measured and LA longitudinal strain was obtained.

## Results

Hypertensive patients with preserved LV EF showed reduced early diastolic UTR ( $P=0.0001$ ), prolonged time to peak UTR ( $P<0.0001$ ), impaired LA reservoir ( $P<0.0001$ )

and conduit ( $P<0.0001$ ) function when compared with controls. The reduction of LV UTR was positively correlated with the impairment of LA reservoir ( $r=0.54$ ,  $P<0.0001$ ) and conduit ( $r=0.65$ ,  $P<0.0001$ ) function.

## Conclusion

In hypertensive patients with preserved LV EF (>50%), the impairment of LA reservoir and conduit function was correlated positively with the reduction in LV UTR, and inversely with time to peak UTR. These correlations may contribute toward the impairment of LV relaxation in hypertensive patients. LV twisting and LA strain indices by STE enable early detection of diastolic abnormalities even in the presence of normal findings in conventional 2D echocardiography.

## Declaration of interest

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

## Funding

This work did not receive any specific grant from any funding agency in the public, commercial or not-for-profit sector.

Received in final form 21 October 2019

Accepted 21 October 2019

MEETING REPORT

# Abstract 2: Feasibility, safety and accuracy of physiologist-led stress echocardiography for the detection of coronary artery disease

Jamal Nasir Khan MBChB PhD BMedSci MRCP<sup>1</sup>, Timothy Griffiths BA BSc PGDip Card<sup>2</sup>, Kully Sandhu DM MRCP<sup>2</sup>, Sinead Cabezon MBChB<sup>2</sup>, Chun Shing Kwok MBBS MSc BSc MRCP<sup>2</sup>, Shanat Baig MBBS MRCP<sup>2</sup>, Tamara Naneishvili MBBS MRCP<sup>2</sup>, Vetton Chee Kay Lee MBChB<sup>2</sup>, Arron Pasricha MBChB<sup>2</sup>, Emily Robins MBChB<sup>2</sup>, Prathap Kanagala MBBS PhD MRCP<sup>3</sup>, Tamseel Fatima MBBS MRCP<sup>2</sup>, Andreea Mihai MBBS MRCP<sup>2</sup>, Robert Butler MBChB MD FRCP FACC<sup>2</sup>, Simon Duckett MBBS MD BSc MRCP<sup>2</sup> and Grant Heatlie MBBS PhD BSc MRCP<sup>2</sup>

<sup>1</sup>Department of Cardiology, University Hospital of Coventry & Warwickshire, Coventry, UK

<sup>2</sup>Department of Cardiology, University Hospital of North Midlands, Stoke-on-Trent, UK

<sup>3</sup>Department of Cardiology, Aintree Hospital, Liverpool, UK

## Background

Physiologist-led stress echocardiography (PLSE) services provide potential for expansion of SE services and increased productivity for cardiologists. There is only one published study on PLSE and no studies assessing its accuracy. We sought to assess the feasibility, safety and accuracy of PLSE and CLSE for coronary artery disease (CAD) assessment.

## Methods

Retrospective analysis of 898 patients undergoing PLSE or CLSE for CAD assessment using exercise or dobutamine stress over 24 months. Sixteen-segment wall-motion scoring (WMS, WMSI) analysis was performed. Feasibility (stressor, image quality, proportion of completed studies), accuracy (agreement with imaging cardiologist analysis, sensitivity and specificity compared with invasive coronary angiography) and safety (complication rate) were compared for PLSE and CLSE.

## Results

The majority of studies were CLSE (56.2%) and used dobutamine (68.7%). PLSE more commonly used exercise (69.2%). 96% of studies were successfully completed (>14 diagnostic segments in 98%,  $P=0.899$  PLSE vs CLSE). Commencement of PLSE was associated with an increase in annual stress echocardiograms performed for CAD assessment. Complication rates were comparably very low

for PLSE and CLSE (0.8 vs 1.8%,  $P=0.187$ ). There was excellent agreement between PLSE and CLSE WMS interpretation of 480 myocardial segments at rest ( $\kappa=0.87$ ) and stress ( $\kappa=0.70$ ) and WMSI (ICCs and Pearson's  $r$  values all >0.90, zero Bland–Altman mean bias). Sensitivity, specificity and accuracy for detection of significant CAD (correct identification of artery with >70% stenosis on invasive angiography) was high and similar for PLSE (sensitivity: 83% (95% CI: 62–104%), specificity 78% (95% CI: 61–95%), accuracy 80%) and CLSE (sensitivity: 70% (95% CI: 42–98%), specificity 77% (65–88%), accuracy 75%).

## Conclusion

To our knowledge, this is the first study of the feasibility, safety and accuracy of PLSE. PLSE performed by well-trained physiologists is feasible and safe in contemporary practice. PLSE and CLSE interpretation of stress echocardiography for CAD agree closely and show similar accuracy compared with invasive angiography.

### Declaration of interest

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

### Funding

This work did not receive any specific grant from any funding agency in the public, commercial or not-for-profit sector.

Received in final form 21 October 2019

Accepted 21 October 2019

MEETING REPORT

# Abstract 3: First-phase ejection fraction as a link between early systolic dysfunction and impaired diastolic function

Haotian Gu PhD and Phil Chowieczyk FRCP

British Heart Foundation Centre of Research Excellence, King's College London, London, UK

## Background

Impaired shortening-deactivation of cardiac myocytes could sustain myocardial contraction, preserving ejection fraction at the expense of diastolic dysfunction.

## Objective

To examine whether an impairment of early systolic ejection is associated with sustained myocardial contraction and diastolic dysfunction.

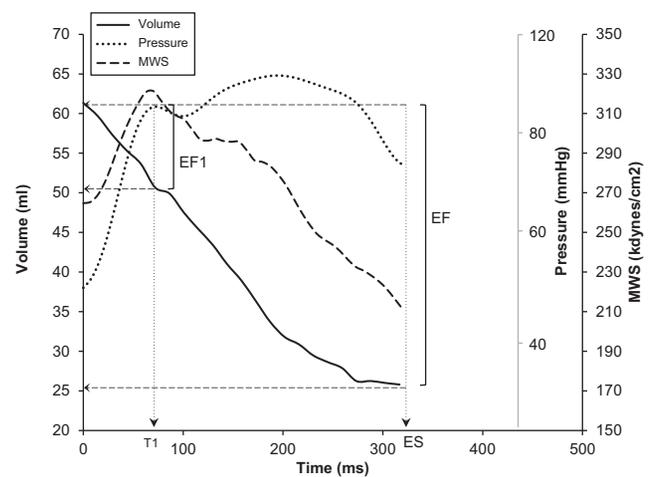
## Methods

The relation between first-phase ejection fraction (EF1), the fraction of left ventricular volume ejected from the start of systole to the time of the first peak in LV pressure (corresponding to the time of maximal ventricular shortening) to duration of myocardial contraction and diastolic function was examined in patients with hypertension ( $n=163$ ) and varying degrees of diastolic dysfunction. LV systolic pressure was estimated by carotid tonometry; time-resolved LV cavity and wall volume were obtained by echocardiography with speckle wall-tracking. Measurements were repeated after nitroglycerin, a drug known to influence ventricular dynamics, in a sub-sample ( $n=18$ ) of patients.

## Results

EF1 and time of onset of ventricular relaxation (TOR, as determined from the temporal pattern of myocardial

wall stress) were strongly correlated (standardized regression coefficients  $-0.34$  and  $0.34$  respectively, each  $P<0.001$ ) with diastolic function as measured by the ratio of transmitral Doppler early filling velocity to tissue Doppler early diastolic mitral annular velocity ( $E/E'$ ) irrespective of adjustment for age, sex, anti-hypertensive treatment, measures of afterload and ventricular geometry. Nitroglycerin increased EF1,



**Figure 1** Endocardial volume curve (solid line) obtained by echo wall-tracking, central aortic pressure waveform (dotted line) obtained by carotid tonometry, together with ejection-phase myocardial wall stress (dashed line), computed from the central aortic systolic pressure waveform and instantaneous left ventricular dimensions in a normotensive subject. Myocardial wall stress starts to fall at the first peak of central aortic pressure (T1), coinciding with peak aortic flow and maximal rate of ventricular shortening. EF1 is percentage volume change between end-diastole and T1.

**Table 1** Multivariate analysis of relations between EF1 and E/E', TOR and E/E' and ED/ES MWS.

Covariate	EF1		TOR		ED/ES MWS	
	$\beta$	<i>P</i> value	$\beta$	<i>P</i> value	$\beta$	<i>P</i> value
Model 1 (Enter)						
Age (years)	0.085	0.453	0.067	0.544	0.085	0.474
Gender	-0.195	0.040	0.017	0.859	0.070	0.488
BMI (kg/m <sup>2</sup> )	0.122	0.135	0.076	0.358	-0.125	0.159
HR (bpm)	0.040	0.668	-0.078	0.407	0.117	0.236
SBP (mmHg)	0.045	0.831	0.182	0.401	-0.063	0.786
DBP (mmHg)	-0.248	0.154	-0.109	0.540	0.122	0.527
arPWV (m/s)	0.007	0.960	0.064	0.669	-0.170	0.274
AV Peak Flow (m/s)	0.078	0.499	-0.112	0.343	-0.073	0.558
EDV (mL)	-0.036	0.730	-0.160	0.130	0.172	0.119
LVMI (g/m <sup>2</sup> )	-0.011	0.916	-0.143	0.191	-0.070	0.551
T1 (ms)	0.207	0.040	0.195	0.059	0.053	0.630
Anti-hypertensive	0.157	0.062	0.042	0.626	0.025	0.782
LA volume (mL)	-0.034	0.701	0.160	0.079	-0.094	0.339
Reflection Index	0.018	0.835	0.012	0.890	-0.154	0.094
E/E'	-0.337	0.001	0.343	0.001	-0.233	0.030
Model 2 (Stepwise)						
Gender	-0.225	0.002	-	-	-	-
DBP (mmHg)	-0.246	0.001	-	-	-	-
Anti-hypertensive	0.166	0.026	-	-	-	-
LA volume (mL)	-	-	-	-	-0.161	0.045
E/E'	-0.328	<0.001	0.384	<0.001	-0.341	<0.001

arPWV, aortic root pulse wave velocity; AV, aortic valve; BMI, body mass index; bpm, beats per minute; DBP, diastolic blood pressure; E/E', ratio of mitral valve Doppler early flow (E wave velocity) to tissue Doppler mitral annulus movement (E' wave velocity); EDV, end-diastolic volume; EF1, first-phase ejection fraction; HR, heart rate; LA, left atrium; LVMI, left ventricular mass index; MWS ED/ES, ratio of end-diastolic and end-systolic myocardial wall stress; SBP, systolic blood pressure; T1, time to first systolic peak on pressure waveform; TOR, time to onset of relaxation.

decreased TOR and improved diastolic function (each  $P < 0.05$ ) (Fig. 1 and Table 1).

## Conclusion

Hypertensive patients with diastolic dysfunction exhibit reduced first-phase ejection fraction which may sustain myocardial contraction, preserving systolic ejection fraction at the expense of impaired diastolic function.

### Declaration of interest

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

### Funding

This work did not receive any specific grant from any funding agency in the public, commercial or not-for-profit sector.

Received in final form 21 October 2019

Accepted 21 October 2019

MEETING REPORT

# Abstract 4: Cardiovascular risk assessment should be performed in patients with incidental aortic sclerosis

Linda Arnold<sup>1</sup>, Sean Coffey<sup>2,3</sup>, Margaret Loudon MBCHB MRCP DPhil<sup>1</sup>, Jo Wilson<sup>1</sup>, Andrew Kennedy<sup>1</sup>, Saul G Myerson MD FRCP FESC<sup>1</sup> and Bernard Prendergast<sup>4</sup>

<sup>1</sup>Department of Cardiology, John Radcliffe Hospital, Oxford, UK

<sup>2</sup>Kolling Institute of Medical Research, University of Sydney, Sydney, Australia

<sup>3</sup>Department of Cardiology, Royal North Shore Hospital, Sydney, Australia

<sup>4</sup>Department of Cardiology, St Thomas' Hospital, London, UK

## Background

Aortic sclerosis (ASc) is a frequent incidental finding during echocardiographic examination. ASc is associated with, and may be an independent risk factor for, the development of cardiovascular (CV) events.

## Purpose

To determine whether the increased CV risk associated with ASc was predicted by standard risk stratification using the QRISK2 CV risk assessment tool (prediction of 10-year CV event rate) in a cohort of patients over the age of 65 years.

## Methods

We evaluated subsets of participants (total  $n=201$ : 135 with ASc; 66 controls) recruited to a population valve disease screening study (OxVALVE Study) using a nested, quantitative case-control study approach.

The QRISK2 10-year risk score was calculated and analysed according to echocardiographic results. Data concerning patient medication were also collected.

## Results

The average QRISK2 score was significantly higher in the ASc group compared to the non-ASc group (30.1 vs 23.8%,  $P=0.0006$ ). The ASc group was older by just under 3 years

(72.5 years vs 69.6 years,  $P=0.0001$ ). Total cholesterol and HDL/cholesterol ratios were similar in the two groups. There was a non-significant trend towards higher systolic blood pressure (155 mmHg vs 150 mmHg,  $P=0.068$ ) and diabetes in the ASc group (12.6 vs 6.1%,  $P=0.22$ ). The study was not powered to determine whether ASc was an independent risk factor for cardiovascular disease. Of patients ( $n=143$ ) with a QRISK of  $>20\%$ , only 56% were on statins, 34% on aspirin and 28% on ACE inhibitors.

## Conclusion

We have confirmed that ASc is a marker for higher cardiovascular risk as assessed by the QRISK2 score. Therefore, the incidental finding of ASc should serve as a prompt to reassess cardiovascular risk and echocardiography reports could highlight this finding. Many patients with high cardiovascular risk in our study were not on appropriate primary prevention medication.

### Declaration of interest

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

### Funding

The OxVALVE study is funded by the NIHR Oxford Biomedical Research Centre.

Received in final form 21 October 2019

Accepted 21 October 2019

MEETING REPORT

# Abstract 5: Use of plasma NT-proBNP in patients with raised left ventricular filling pressure: assessment of the open access heart failure service in a Scottish hospital

Alice M Jackson MBChB MRCP<sup>1</sup> and Vera Lennie MD FESC FRCPEdin<sup>2</sup>

<sup>1</sup>University Hospital Crosshouse, Kilmarnock, Scotland

<sup>2</sup>University Hospital Ayr, Ayr, Scotland

## Introduction

It is well known that up to half of patients hospitalised for heart failure have a normal left ventricular ejection fraction (LVEF). Identifying raised LV filling pressures (LVFP) in this cohort is important to guide management. Data regarding the use of NT-proBNP in this setting, and its correlation with diastolic dysfunction, are lacking.

## Aims

- Describe the relationship between NT-proBNP and LVFP.
- Identify the proportion of patients with raised NT-proBNP but normal LVEF and LVFP.
- Examine the correlation between NT-proBNP and markers of LV systolic and diastolic function, including global longitudinal peak systolic strain (GLPSS).

## Methods

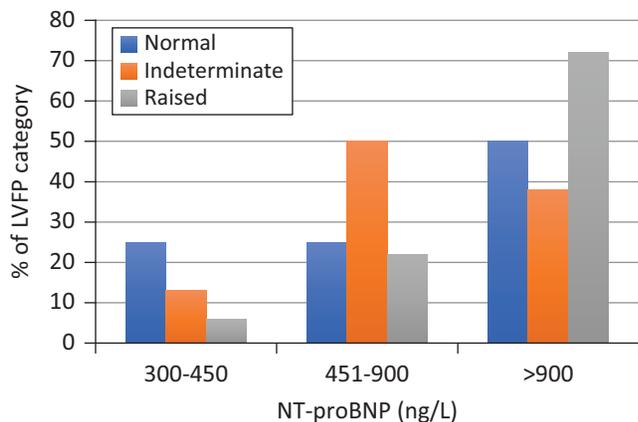
We performed a retrospective analysis of all patients referred to our open access heart failure service over 9 months. For those with NT-proBNP >300 ng/L, we collected echocardiographic measurements of LV systolic and diastolic function, and valvular disease. Contemporary ASE/EACVI recommendations were used to estimate LVFP. GLPSS was calculated using speckle tracking (GE software).

## Results

A total of 172 NT-proBNP measurements were performed during the study period. Forty-eight (28%) patients had levels >300 ng/L. Baseline characteristics are shown in Table 2. LVFP was raised in 38%. 72% of patients with raised LVFP had NT-proBNP levels >900 ng/L and 6% had NT-proBNP levels of 300–450 ng/L (Fig. 2). A third of the cohort had normal LVEF and LVFP. Of these, 31% (*n*=5) had atrial fibrillation (AF). 23% (*n*=11) of patients had no evidence of reduced LVEF, raised LVFP, or AF. Figure 3 shows the correlation of NT proBNP with markers of LV systolic and diastolic function, including GLPSS.

**Table 2** Baseline characteristics (*n* = 48).

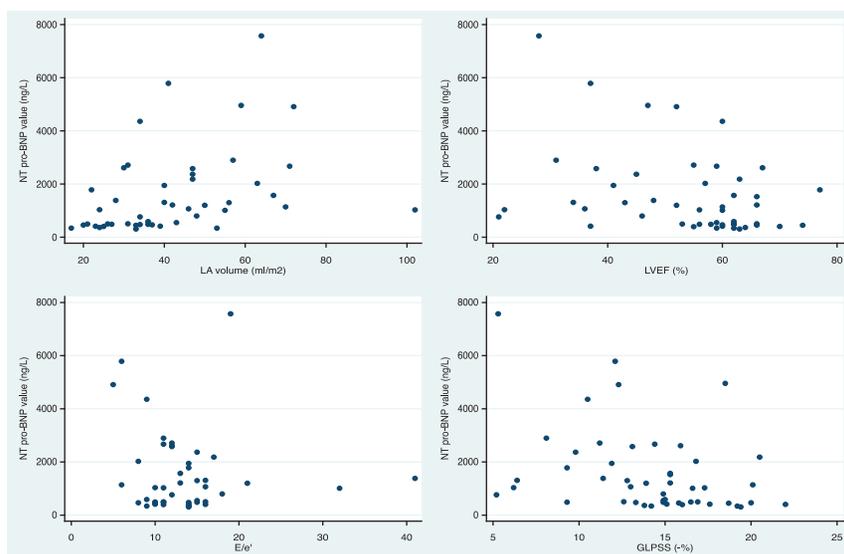
Parameter	Value
Male sex, <i>n</i> (%)	26 (54)
Age ≥75 years, <i>n</i> (%)	27 (56)
NT-proBNP (ng/L), <i>n</i> (%)	
300–450	9 (19)
451–900	12 (25)
>900	27 (56)
Atrial fibrillation, <i>n</i> (%)	11 (23)
More than mild valvular disease, <i>n</i> (%)	8 (17)
LVEF <50%, <i>n</i> (%)	15 (31)
GLPSS (%)	−14 ± 0.6
LV filling pressure, <i>n</i> (%)	
Normal	20 (42)
Indeterminate	8 (17)
Raised	18 (38)



**Figure 2**  
Degree of NT-proBNP elevation according to LV filling pressure.

## Conclusion

Our study demonstrates a clear association between NT-proBNP level and LVFP. This becomes more robust as the level increases >900 ng/L. Left atrial volume appears to correlate with NT-proBNP and is of value in routine assessment of patients with breathlessness. Few patients with raised LVFP had NT-proBNP levels <450 ng/L. There remains debate surrounding the optimal cut-off value.



**Figure 3**  
Correlation of NT-proBNP with markers of LV systolic and diastolic function.

### Declaration of interest

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

### Funding

This work did not receive any specific grant from any funding agency in the public, commercial or not-for-profit sector.

Received in final form 21 October 2019

Accepted 21 October 2019

MEETING REPORT

# Abstract 6: A comparative analysis of British and American Society of Echocardiography recommendations for the assessment of left ventricular diastolic function

Peter Lee Luke MSc BSc<sup>1</sup>, Christopher James Eggett PhD BSc<sup>2</sup>, Loakim Spyridopoulos MD<sup>3</sup> and Timothy Simon Irvine MBChB FRCP<sup>1</sup>

<sup>1</sup>Echocardiography Department, Freeman Hospital, Newcastle upon Tyne, UK

<sup>2</sup>School of Biomedical Sciences, Newcastle University, Newcastle upon Tyne, UK

<sup>3</sup>Institute of Genetic Medicine, Newcastle University, Newcastle upon Tyne, UK

## Introduction

The echocardiographic assessment of left ventricular diastolic function (LVDF) remains challenging. At present there are two recognised guidelines provided by the British Society of Echocardiography (BSE) and American Society of Echocardiography/European Association of Cardiovascular Imaging (ASE/EACVI). However, to date, no direct comparison of these guidelines has been performed to establish whether they provide similar diastolic grading.

## Methods

Three hundred and thirty-three patients in sinus rhythm were extracted from our echo database (McKesson Cardiology). Eighty-seven (26%) patients were excluded due to left bundle branch block (2.1%), no indexed left atrial volume (18.2%) and annular calcification (5.7%). For each patient, LVDF assessment was performed using both guidelines and the results compared. Chi-square, Spearman correlation and Kappa score statistical tests were used to evaluate the data at a level of  $P < 0.05$ .

## Results

The most frequent outcome was unclassifiable LVDF with significantly more patients being labelled unclassified by BSE (ASE/EACVI 31.3% vs BSE 39.5%,  $P < 0.0001$ ). Having excluded unclassifiable patients, no difference was observed between the two schemes ( $P = 0.422$ ) with

substantial agreement when differentiating between normal and abnormal diastolic function ( $k = 0.694$ ,  $P < 0.0001$ ). Where there was disagreement between the two guidelines, (i.e. normal LVDF by one and abnormal by the other), the degree of LVDF was never more than grade I. When grading subcategories were individually compared there was moderate agreement between the two guidelines ( $k = 0.581$ ,  $P < 0.0001$ ). A significant correlation was seen between LV impairment ( $r = 0.55$ ,  $P < 0.0001$ ), indexed LA volume ( $r = 0.41$ ,  $P < 0.001$ ) and  $E/e'$  ( $r = 0.68$ ,  $P < 0.0001$ ) with both diastolic grading schemes.

## Conclusion

In around one-third of patients it was not possible to grade LVDF by either guideline. For those patients where grading was possible, there was no significant difference between BSE and ASE/EACVI guidelines with substantial agreement between each scheme when diagnosing normal or abnormal diastolic function and moderate agreement when comparing each LVDF subcategory.

### Declaration of interest

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

### Funding

This work did not receive any specific grant from any funding agency in the public, commercial or not-for-profit sector.

Received in final form 21 October 2019

Accepted 21 October 2019

MEETING REPORT

# Abstract 7: Safety of stress echocardiography: a large single-centre experience

**Nashwah Ismail and Anita Macnab**

University Hospital of South Manchester, Manchester, UK

## Background

Stress echocardiography (SE) is a widely used diagnostic tool for ischaemic heart disease. However, this type of functional testing has inherent risks and there is limited contemporary data on complication rates. We therefore carried out an audit of complications in a high-volume UK stress echo laboratory.

## Methods

This was a retrospective audit of all SEs carried out in our center over 8 years between 2009 and 2017. Both dobutamine SE (DSE) and exercise SE (ESE) were included. The DSE protocol used a maximum dose of 30 µg/kg/min of dobutamine with atropine and handgrip augmentation as required. For ESEs the Bruce protocol was used on the treadmill and the WHO25 protocol on the semi-supine bicycle. Trans-pulmonary contrast was used in 95% of patients having DSE and 70% of patients having ESE. All complications were recorded even if no therapeutic intervention was required by the operator other than termination of the test.

## Results

11,803 SEs (9179 DSEs and 2624 ESEs) were performed during the study period. There were no deaths. A total of 342 (0.03%) adverse events were recorded. Complication

rates were ten-fold higher during DSE than ESE (332 during DSE (0.04%) vs 10 during ESE (0.004%)). Ventricular arrhythmias occurred in 39 patients, 6 persisted beyond test termination and required drugs and/or defibrillation (all DSE), supraventricular tachycardia in 56 (52 DSE), atrial fibrillation/flutter in 37 (34 DSE), hypotension in 175 (174 DSE), heart block in 3 (2 DSE) and ST elevation infarction in 17 requiring emergency admission for revascularization (all DSE). Contrast reactions were recorded in 15 patients with 9 developing a rapid and serious haemodynamic disturbance.

## Conclusion

Stress echo is a safe functional imaging test. ESE results in significantly fewer complications than DSE. Contrast reactions occur more frequently than that reported by the manufacturers.

### Declaration of interest

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

### Funding

This work did not receive any specific grant from any funding agency in the public, commercial or not-for-profit sector.

Received in final form 21 October 2019

Accepted 21 October 2019



MEETING REPORT

# Abstract 8: Grading of mitral stenosis by 3D transthoracic echocardiography

Caroline Bleakley MB BCh BAO MRCP MD, Mehdi Eskandari MD FRACP, Omar Aldalati, Almira Whittaker, Marilou Huang and Mark Monaghan PhD FRCP FESC FBSE FACC

King's College Hospital, London, UK

## Background

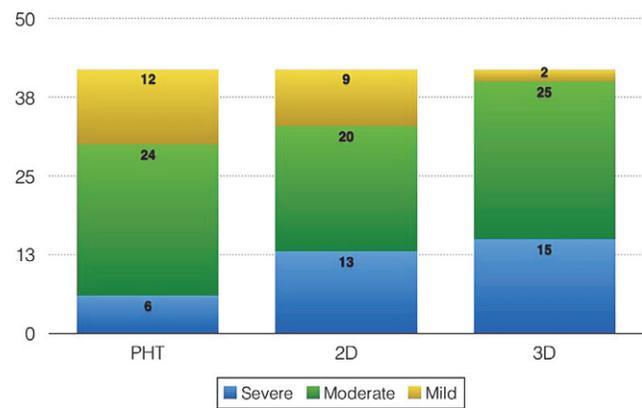
In mitral stenosis (MS), measuring the mitral valve orifice area (MVOA) by 3D transthoracic echocardiography (TTE) offers an adjustable dataset that can be manipulated to more accurately align with the true MVOA in comparison to 2D TTE. We studied differences in MVOA measurements between 2D and 3D methods, to determine if 3D echocardiography would result in the re-grading of severity in any cases.

## Methods

This was a head-to-head comparison of the three most commonly used tools to grade mitral stenosis by orifice area. 3D measurements of the MVOA were performed prospectively in 42 consecutive patients with at least mild mitral stenosis (MS) by traditional 2D estimates (pressure half-time (PHT), 2D MVO). The 2D MVOA was measured by the operator who performed the TTE, the 3D MVOA was measured separately by a blinded operator.

## Results

The majority of patients were female (36; 86%), average age 54 (17) years. Mean and peak MV gradients were 9.4 (4) mmHg and 19 (6) mmHg, respectively. Mean 2D planimetry MVOA was 1.27 (0.40) cm<sup>2</sup> and mean 3D planimetry MVOA=1.14 (0.29) cm<sup>2</sup> ( $P=0.003$ ). Mean PHT was 169 (65) ms with a mean MVOA of 1.43 (0.43) cm<sup>2</sup> by PHT estimation ( $P=0.046$  and  $P<0.001$  in comparison to 2D and 3D planimetry methods, respectively). In comparison to 2D measures, 3D planimetry reclassified seven patients from mild-to-moderate MS and three patients from moderate to severe (Fig. 4). Overall, the differences between the two methods were significant ( $\chi^2$ ,  $P<0.001$ ).



**Figure 4**

Chart depicting the numbers of patients assigned into each category of mitral stenosis by each of the methods of mitral valve orifice area assessment. PHT, pressure half time; 2D, 2D planimetry; 3D, 3D planimetry.

## Conclusion

3D planimetry of the MVOA returns significantly smaller measurements, which in some cases results in the reclassification of the grade of stenosis. Routine use of 3D measurements may have significant impact on the management of patients with MS by suggesting an increased severity of disease.

## Declaration of interest

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

## Funding

This work did not receive any specific grant from any funding agency in the public, commercial or not-for-profit sector.

Received in final form 21 October 2019

Accepted 21 October 2019

## MEETING REPORT

# Abstract 9: 2-Year event rates of patients discharged from rapid access chest pain clinic after normal stress echocardiogram

Thomas J Turner, Conor Steele and Anita Macnab MBChB FRCP

University Hospital of South Manchester, Manchester, UK

## Aims

It is known that a normal stress echocardiogram (SE) carries a very high negative predictive value (NPV). We sought to determine the prognostic value of a negative SE when investigating patients for suspected angina in the setting of a contemporary rapid access chest pain clinic.

## Methods

Between 2013 and 2015, patients who were investigated with SE were identified from the clinic records. The type of SE the patient underwent, exercise (ESE) or dobutamine (DSE), was also recorded. Only those with normal resting echo and normal SE were followed up with a telephone survey in 2017. Major adverse cardiac events (MACE) in the 2 years post discharge were recorded. Medical records were searched for all hospital admissions and deaths.

## Results

In the 2-year study period, 1815 patients attended the clinic. Of these, 802 were investigated with SE, with 446 receiving a negative result. Out of these, 95 were not contactable, which left 351 patients (DSE = 147 vs ESE = 204) with follow-up data. Pre-test probability of angina was low in 171 (49%), medium in 102 (29%) and high in 78 (22%)

patients. Death occurred in nine patients, with only one being attributed to a cardiac cause. Overall, four MACE occurred (three events requiring revascularisation and one cardiac death). The MACE rate was 1 (0.28%) in the first year and 3 (0.85%) for the second year post discharge. The 2-year NPV for cardiac events was 98.86%. There was no significant difference between patients who received DSE and ESE (1 event (0.7%) in DSE group vs 3 events (1.5%) in ESE group;  $P=0.493$ ).

## Conclusion

Negative SE in patients confers a high NPV and thus indicates an excellent prognosis, even in a population with a high proportion of patients (51%) with a medium or high pre-test probability of angina.

## Declaration of interest

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

## Funding

This work did not receive any specific grant from any funding agency in the public, commercial or not-for-profit sector.

Received in final form 21 October 2019

Accepted 21 October 2019

MEETING REPORT

# Abstract 10: Echocardiography request and result reviewing behaviour: an audit of local practice

Anna Barton, Alan C Cameron BSc MBChB PhD and Piotr Sonecki

Queen Elizabeth University Hospital, Glasgow, UK

## Introduction

An echocardiogram result can be reviewed in several ways. Locally, a report is generated featuring detailed results and a summary report. Images are also available to review, predominantly in the hospital setting. We investigated how different staff groups reviewed the echocardiograms they had requested.

## Methods

A survey concerning echocardiogram requests, and result-reviewing behavior was circulated via email to medical and specialist nursing staff in Glasgow. All levels of medical, surgical, radiology, OBGYN, paediatric and GP trainees, and staff grades, GPs, consultants, and nurse specialists were included, totaling 2218 hospital staff and 266 GP practices. Responses were collected from 15/7/16 to 2/8/16.

## Results

Cardiologists ( $n=16$ ) were compared against hospital non-cardiology ( $n=126$ ) and GP staff ( $n=122$ ). Cardiologists requested 41.4 echocardiograms/practitioner/month, compared to 6.5 for hospital non-cardiology staff, and 1.3 for GPs. 100% of cardiologists always reviewed a summary report, compared to 94% of hospital non-cardiology staff and 93% of GPs, compared to 80%, 58% and 31% respectively for the detailed report, and 33%,

8% and 1% for images. No cardiologists described never reviewing any results, compared to 4% of hospital non-cardiology staff and 2% of GPs.

## Conclusion

Almost all respondents review at least one aspect of an echo report; however, most review the summary report alone. Cardiologists request the most scans and are most likely to review all aspects of the report. GPs request the least and are least likely to review a detailed report. Non-cardiology staff request the greatest proportion of all echocardiograms, and review a detailed report in >50% of cases. Non-cardiologists are unlikely to review images. It is reasonable for non-specialists not to review more detailed aspects of an echocardiogram; this emphasizes the need for any vital messages to be communicated to the referrer through the summary report to optimize the chance of being reviewed.

### Declaration of interest

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

### Funding

This work did not receive any specific grant from any funding agency in the public, commercial or not-for-profit sector.

Received in final form 21 October 2019

Accepted 21 October 2019

MEETING REPORT

# Abstract 11: Effectiveness and safety of stress echocardiography for detection of stress inducible, reversible myocardial ischaemia in Sandwell and West Birmingham Hospitals NHS Trust (SWBH)

Gyee Vuei Phang MBChB MRCP, Christos Voukalis MD MRCP, Hwee Phen Teh MBChB and Stavros Apostolakis MD PhD

Sandwell and West Birmingham NHS Trust, Birmingham, UK

## Aim

To assess whether stress echocardiography (SE) is safe and has satisfactory detection rate of ischaemia.

## Methods

We performed a retrospective study of a total of 426 patients who had SE within a period of 12 months (February 2015 to January 2016) for assessment of ischaemia. All patients were followed up for a mean period of 20 months. Collected data included mode of stressors, complications, management of the positive SE results and readmission of patients with chest pain with their subsequent management plan.

## Results

418 individuals completed the test and 8 tests were inconclusive. 78.9% had treadmill and 21.1% had dobutamine infusion as stressors. 99% of patients had no complications post-test; one patient suffered ventricular

tachycardia, one patient had non-ST elevation myocardial infarction, three patients experienced troponin-negative chest pain and one patient suffered from contrast allergy. No deaths were reported.

12.7% (55) had positive SE and 83.6% (363) had negative SE (Table 3). Of the 55 patients who had positive SE outcome, 51 patients underwent coronary angiogram and 56.5% (31) of them were diagnosed with flow-limiting coronary artery disease. Nineteen were managed with percutaneous coronary angioplasty, eight with coronary artery bypass graft and four conservatively (Table 4).

6.1% (22) of the negative SE group had readmission with chest pain and/or acute coronary syndrome and underwent coronary angiogram, but only eight patients required revascularisation. There was no significant statistical difference between the dobutamine vs treadmill for detection of the negative SE. In contrast, for the detection of true positives, dobutamine was superior to exercise (*P* value, 0.009).

From the results, SE in our department has a sensitivity of 80%, specificity of 95%, positive predictive value of

**Table 3** Results of the stress echocardiography.

	Condition positive- Flow limiting CAD	Condition negative- Non-flow limiting CAD	Total (number)
Positive SE	31	20	51
Negative SE	8	355	363
Total (number)	39	375	414

**Table 4** Details of positive and negative stress echocardiography results.

Positive SE		Negative SE	
Flow limiting CAD	31	No re-admission following SE	341
Non-flow limiting CAD	20	Re-admission requiring angiogram with no flow limiting CAD	14
Angiogram not performed	2	Re-admission requiring revascularisation	8
Angiogram not done based on clinical grounds	2		
Total	55	Total	363

61%, negative predictive value of 98% and accuracy of 93% for detection of myocardial ischaemia.

## Conclusion

SE is a safe imaging modality with very low complication rate and is also efficient with an outstanding negative predictive value.

### Declaration of interest

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

### Funding

This work did not receive any specific grant from any funding agency in the public, commercial or not-for-profit sector.

Received in final form 21 October 2019  
Accepted 21 October 2019

MEETING REPORT

# Abstract 12: Right ventricular free wall thickness measured by echocardiography vs cardiac magnetic resonance imaging

Chih Wong MRCP MD<sup>1</sup>, Matthew M Y Lee MBChB MRCP<sup>1,2</sup> and Nicolas E R Goodfield MBChB<sup>1</sup>

<sup>1</sup>Glasgow Royal Infirmary, Glasgow, UK

<sup>2</sup>British Heart Foundation Glasgow Cardiovascular Research Centre, University of Glasgow, Glasgow, UK

## Background

The guidelines of the American Society of Echocardiography (ASE) on the assessment of the right heart recommends that fundamental imaging should be used to measure right ventricular (RV) free wall thickness when image quality permits to ‘avoid the increased structure thickness seen with secondary harmonic imaging’. However, no reference is provided. We could not find any data comparing RV free wall thickness measured by echocardiography vs. cardiac magnetic resonance imaging (CMR). We hypothesized that RV free wall thickness is overestimated by secondary harmonic imaging by echocardiography.

## Purpose

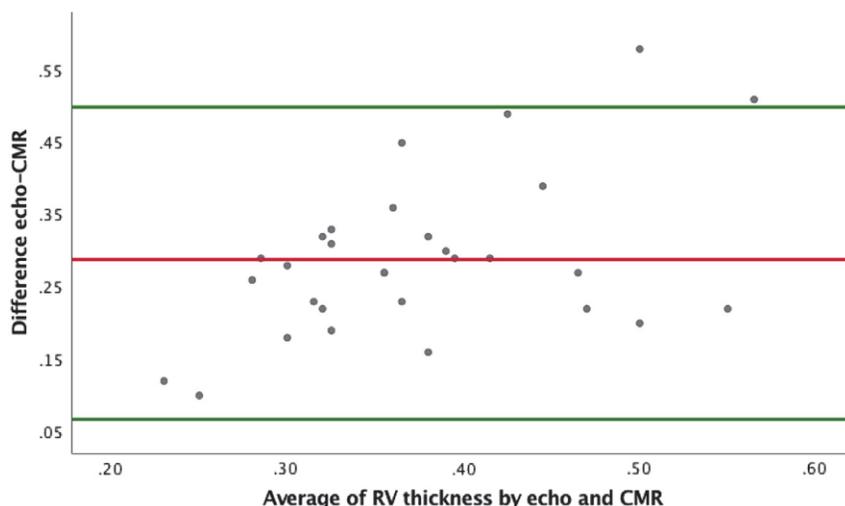
To compare RV free wall thickness measured by echocardiography vs CMR.

## Methods

Thirty near-consecutive patients who had both echocardiography and CMR performed in our center in the past 6 months were selected. RV free wall thickness was measured independently by C W and N E R G using echocardiography with secondary harmonic imaging; and by C W and M M Y L using CMR. Patients with significant RV hypertrophy (>1.0 cm) were excluded. The results were compared using the Bland–Altman Plot to measure agreement between them.

## Results

Among the 30 patients, the mean difference between echocardiography and CMR was 0.29 cm (standard deviation 0.11). The mean difference is statistically different from zero suggesting the measurements between echocardiography and CMR do not agree ( $P < 0.001$ ).



**Figure 5**  
Bland–Altman Plot comparing RV free wall thickness (cm) measured by echocardiography vs CMR.

Figure 5 illustrates the results using the Bland–Altman Plot showing the mean difference of 0.29 cm (red line) with 95% confidence interval of 0.07 to 0.50 cm (green lines). This confirms the lack of agreement between echocardiography and CMR, with discrepancies of up to 0.50 cm by echocardiography. This discrepancy is too large to accurately measure the RV free wall with a normal reference range of  $\leq 0.5$  cm.

## Conclusion

Compared to CMR, RV free wall thickness is overestimated by echocardiography using secondary

harmonic imaging. Fundamental imaging (as per ASE guidelines) should be used to measure RV free wall thickness.

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### Declaration of interest

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

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### Funding

This work did not receive any specific grant from any funding agency in the public, commercial or not-for-profit sector.

Received in final form 21 October 2019

Accepted 21 October 2019

MEETING REPORT

# Abstract 13: The use of left ventricle global longitudinal strain in the septic patient

Emma Lane BSc, David Slessor MBBS FRCEM FFICM and Richard Crawley BSc BMBS MRCP

Queen Alexandra Hospital, Portsmouth Hospitals NHS Trust, Portsmouth, UK

## Background

Sepsis-induced cardiomyopathy occurs in up to 14% of patients with sepsis, resulting in myocardial depression typically resolving after 7–10 days. Transthoracic echocardiographic (TTE) assessment of left ventricular ejection fraction (LVEF) is typically used to define sepsis-induced cardiomyopathy. Recent meta-analysis demonstrates that low LVEF was not associated with mortality in septic patients. Advanced echocardiographic techniques such as global longitudinal strain (GLS) have evolved for direct assessment of the myocardial function. This technique may be beneficial for the assessment of sepsis-induced cardiomyopathy.

## Primary objective

In critically ill patients with sepsis and septic shock, does GLS compared with LVEF identify more patients with myocardial dysfunction?

## Methods

Over a 4-month period, GLS and LVEF were performed retrospectively from standard study imaging, on patients admitted to the Intensive Care Unit with sepsis, as defined by Sepsis-3 Criteria. All images were performed on GE S70 machines by a British Society Echocardiography accredited sonographer.

## Results

Thirteen patients met the inclusion criteria and had adequate imaging to measure LVEF and GLS. Three patients had a reduced LVEF, whereas nine patients had a reduced GLS. This was a statistically significant difference ( $P=0.047$ ). Of the four patients who had a preserved LVEF and normal GLS, one patient was on inotropes and one patient had cirrhosis which is associated with a hyperdynamic circulation.

## Conclusion

Critically ill patients with sepsis were statistically significantly more likely to have low GLS compared with reduced LVEF. These data suggest that GLS in standard TTE could have value in the septic patient for early detection of LV dysfunction. With the use of advanced techniques, sepsis-induced cardiomyopathy may be more commonly diagnosed. It may help identify patients who are critically ill from sepsis and target treatment accordingly. Future studies should investigate whether a reduced GLS is associated with mortality.

## Declaration of interest

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

## Funding

This work did not receive any specific grant from any funding agency in the public, commercial or not-for-profit sector.

Received in final form 21 October 2019

Accepted 21 October 2019

MEETING REPORT

# Abstract 14: Physiologist-led dobutamine stress echocardiography: a service review

Theodoros Ntoskas MD, Farhanda Ahmad PgDMU and Paul Woodmansey MD FRCP

New Cross Hospital, Wolverhampton, UK

## Background

The DSE service has traditionally been a consultant cardiologist led service. However, with increasing demand, the expansion of DSE indications and to cut waiting times, a cardiac physiologist managed DSE service is running in our tertiary hospital. We audited the reason for the study, complications, safety and reliability, and validity of physiologist-led DSE services.

## Methods

Retrospective analysis of 333 patients undergoing stress echocardiography for inducible reversible ischemia, myocardial viability and valvular heart disease (VHD) over 6 months. Patients' case notes review after 18–24 months.

## Results

92% of all cases (306) were performed by physiologists. In 305 studies dobutamine was used (Table 5). The overwhelming majority of the referrals were for coronary artery disease (CAD) assessment (285). In 238 cases the study was uncomplicated. 67 patients developed dobutamine-related side effects including arrhythmias, nausea, vomiting, dizziness, vasovagal episodes, chest

**Table 5** Reason for study.

	Physiologist-led DSE (n = 305)
Inducible reversible ischaemia	284 (93.11%)
Valve assessment/contractile reserve	14 (4.59%)
Viability	5 (1.64%)
Dynamic LVOT gradient/HOCM	2 (0.66%)

DSE, Dobutamine stress echocardiogram.

**Table 6** Dobutamine stress echocardiography safety outcomes.

Complications during DSE	Physiologist-led DSE (n = 303)
No complications	236 (77.89%)
All arrhythmias	47 (15.51%)
Vasovagal episodes	8 (2.64%)
Nausea, vomiting, dizziness	7 (2.31%)
Severe shortness of breath	3 (0.99%)
Severe chest pain	1 (0.33%)
LVOT gradient increase	1 (0.33%)

DSE, Dobutamine stress echocardiogram; LVOT, left ventricle outflow tract.

pain and shortness of breath (Table 6). In only 16 out of 67 cases did the complications listed above lead to early termination of the study (Table 7). In two cases, urgent review from the on-call cardiologist registrar was needed because of severe vasovagal reactions. Of the 285 studies for CAD assessment, 244 were negative for ischemia, 28 were positive and 13 inconclusive (Table 8). Only 7 cases with negative DSE for ischemia were readmitted as an ACS or for unstable angina; in these cases an invasive coronary angiogram (CA) or another non-invasive functional test revealed CAD (a false-negative rate for CAD of 2.9%). 5 out of 28 cases, with echocardiogram

**Table 7** DSEs terminated early.

Cause of early termination	DSEs terminated early (n = 18)
Arrhythmia	5
Nausea, vomiting, dizziness	4
Vasovagal episodes	3
Severe SOB	3
Severe chest pain	1
Patient anxiety	1
Poor windows	1

SOB, Shortness of Breath.



**Table 8** Dobutamine stress echocardiography interpretation.

	True	False
Positive	23	5
Negative	237	7

evidence of inducible ischemia have subsequently undergone a CA, which showed unobstructed coronary arteries.

## Conclusion

In our hospital, the majority of DSE lists are led by physiologists. The above results demonstrate the reliability

and safety of this practice, and provide potential for the expansion of physiologist led DSE services in other hospitals.

### Declaration of interest

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

### Funding

This work did not receive any specific grant from any funding agency in the public, commercial or not-for-profit sector.

Received in final form 21 October 2019

Accepted 21 October 2019

## MEETING REPORT

# Abstract 15: Does RV-E/e' correlate with other echocardiographic indices of right atrial pressure?

Andrew J Fletcher MSc, Shaun Robinson MSc and Bushra S Rana MBBS FRCP

Royal Papworth Hospital Foundation Trust, Cambridge, UK

## Background

Inferior vena cava (IVC) size and collapsibility upon inspiration, plus right atrial (RA) size, are commonly assessed during transthoracic echocardiography and are recommended to guide estimation of right atrial pressure (RAP). The ratio of right ventricular (RV) early diastolic filling velocity (E) to early diastolic tricuspid annular tissue velocity (e'), called RV-E/e', is a surrogate of RV filling pressure and is another echocardiographic parameter which can be used to estimate RAP. Studies of RV-E/e' suggest that it is strongly and positively correlated with invasively measured RAP, but less is known about its relationship with other echocardiographic parameters used to estimate RAP.

## Aim

We sought to determine whether RV-E/e' is correlated with IVC size, IVC collapsibility upon inspiration or with RA size when assessed with transthoracic echocardiography.

## Methods

Data were collected retrospectively in consecutive patients in whom RV E velocity, RV e' velocity, RA volume indexed to body surface area, IVC size and IVC collapsibility were assessed using transthoracic echocardiography

(inclusion criteria). Patients with inter-atrial/ventricular communication, previous heart transplantation or at least moderate tricuspid/pulmonary regurgitation (TR/PR) were excluded. Images were obtained using Philips IE33 ultrasound machines by British Society of Echocardiography accredited cardiac physiologists as part of routine clinical service. Statistical analysis of normality and correlation were undertaken using SPSS. Significance was assumed for  $P < 0.05$ .

## Results

Data from 138 patients was collected. Three patients were excluded due to inter-atrial communication, 7 for previous heart transplantation and 25 for at least moderate TR/PR. Hence 103 patient's data were analysed. Demographic and clinical details are presented in [Table 9](#). RV-E/e' was not statistically significantly correlated with IVC size ( $r = -0.17$ ,  $P = 0.088$ ), IVC collapsibility ( $r = -0.06$ ,  $P = 0.524$ ) or with RA size ( $r = -0.13$ ,  $P = 0.202$ ).

## Conclusion

RV-E/e' does not correlate with other echocardiographic parameters commonly used to estimate RAP in patients with a variety of pathologies.

**Table 9** Demographic and clinical information ( $n = 103$ ).

Parameter	Subclass (if applicable)	Number (%) or mean ( $\pm$ s.d.)
Sex	Male	65 (63%)
	Female	38 (37%)
Heart rate (bpm)		68 ( $\pm$ 13, range: 40–100)
Blood pressure (mmHg)	Systolic	137 ( $\pm$ 21)
	Diastolic	77 ( $\pm$ 12)
Body surface area (m <sup>2</sup> )		1.94 ( $\pm$ 0.22)
Rhythm	Sinus	87 (84%)
	Ventricular paced	6 (6%)
	Atrial fibrillation/flutter	10 (10%)
RA size	Normal	59 (57%)
	Mildly dilated	26 (25%)
	Moderately dilated	17 (17%)
	Severely dilated	1 (1%)
Primary clinical diagnosis	Valvular heart disease	23 (22%)
	Pulmonary hypertension	19 (18%)
	Ischaemic heart disease	15 (15%)
	Cardiomyopathy	12 (12%)
	None (with normal heart)	11 (11%)
	Lung disease	5 (5%)
	Atrial arrhythmias	4 (4%)
	Cancer	2 (2%)
	Pacemaker/defibrillator	2 (2%)
	Obesity	2 (2%)
	Sarcoidosis	2 (2%)
	Adams Oliver	1 (1%)
	Aortic aneurysm	1 (1%)
	Hypertension	1 (1%)
	Myotonic dystrophy	1 (1%)
Unexplained syncope	1 (1%)	
Systemic sclerosis	1 (1%)	

**Declaration of interest**

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

**Funding**

This work did not receive any specific grant from any funding agency in the public, commercial or not-for-profit sector.

Received in final form 21 October 2019

Accepted 21 October 2019

MEETING REPORT

# Abstract 16: A time-course of right ventricular remodeling in response to pulmonary endarterectomy in patients with chronic thromboembolic pulmonary hypertension

Liam Batchelor BSc MSc and Shaun Robinson MSc

Royal Papworth Hospital Foundation Trust, Cambridge, UK

## Introduction

Pulmonary endarterectomy (PEA) is a potentially curative procedure for chronic thromboembolic pulmonary hypertension (CTEPH). Currently, little echocardiographic data exists regarding anatomical and functional remodelling of the right ventricle (RV) post-PEA, and whether pre-surgical haemodynamics influence recovery.

## Methods

Forty patients ( $n=40$ ) who underwent PEA surgery for CTEPH were retrospectively sampled in a reverse chronological methodology. Patients underwent transthoracic echocardiography pre-surgery, and 3 and 12 months post surgery. Patients were categorised according to the presence (PH+) or absence (PH-) of PH post surgery (Tables 10 and 11).

**Table 10** Main anthropometric and physiological measures.

Parameter	All patients ( $n = 40$ )	PH- ( $n = 26$ )	PH+ ( $n = 14$ )
Age (years)	59 ± 14	59 ± 14	58 ± 14
Height (m)	1.72 ± 0.10	1.70 ± 0.09	1.76 ± 0.10
Mass (kg)	83.7 ± 18.7	84.7 ± 18.4	81.8 ± 20.0
BSA (m <sup>2</sup> )	2.0 ± 0.2	2.0 ± 0.2	2.0 ± 0.3
Gender (male/female)	28/12	18/8	10/4
WHO functional class			
II	10 (25%)	8 (31%)	2 (14%)
III	25 (62.5%)	15 (58%)	10 (72%)
IV	5 (12.5%)	3 (11%)	2 (14%)
6MWD (m)	332 ± 116	332 ± 115	330 ± 123
Pre-assessment mPAP (mmHg)	43 ± 10	40 ± 9	50 ± 10 <sup>a</sup>
Pre-surgery mPAP (mmHg)	49 ± 14	45 ± 13	58 ± 12 <sup>a</sup>
Post-surgery mPAP (mmHg)	24 ± 7	21 ± 3	31 ± 6 <sup>a</sup>
Pre-assessment PVR (dyn/s/cm <sup>-5</sup> )	635 ± 284	527 ± 208	850 ± 300 <sup>a</sup>

<sup>a</sup>Significant difference between groups ( $P < 0.01$ ).

**Table 11** Jamieson surgical thromboembolic classification.

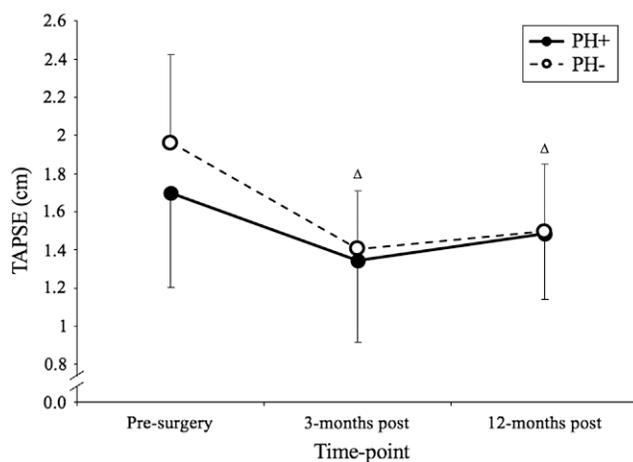
Parameter	All patients ( $n = 39$ ) <sup>a</sup>	PH- ( $n = 25$ ) <sup>a</sup>	PH+ ( $n = 14$ )
Different disease on each side <sup>b</sup>			
Type I	0	0	0
Type II	5 (13%)	3 (12%)	2 (14%)
Type III	7 (18%)	3 (12%)	4 (29%)
Same disease on each side <sup>c</sup>			
Bilateral Type I	6 (15%)	3 (12%)	3 (21%)
Bilateral Type II	13 (33%)	11 (44%)	2 (14%)
Bilateral Type III	8 (21%)	5 (20%)	3 (21%)

<sup>a</sup>Disease classification not available for one patient. <sup>b</sup>Patients were categorised with the highest disease type. <sup>c</sup>Disease types were similar on each side.

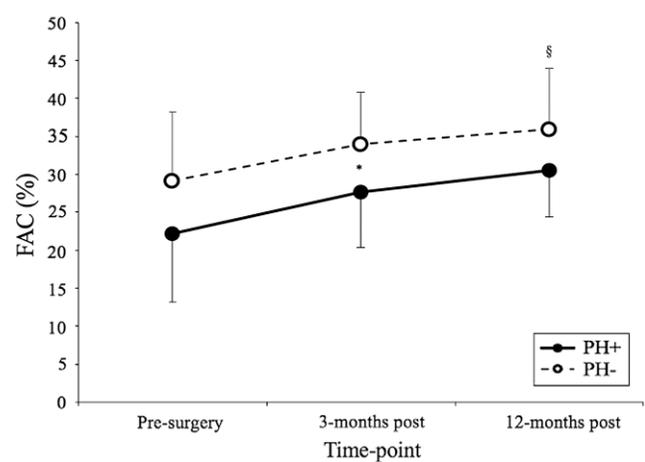
**Table 12** Echocardiographic measures for PH– and PH+ groups pre and post surgery.

Parameter	Pre surgery		3 months post surgery		12 months post surgery	
	PH–	PH+	PH–	PH+	PH–	PH+
RV basal (cm)	4.5 ± 0.8	5.2 ± 0.9 <sup>a</sup>	3.9 ± 0.7 <sup>b</sup>	4.5 ± 0.9 <sup>a</sup>	4.0 ± 0.5	4.6 ± 0.9 <sup>a</sup>
RV mid (cm)	3.5 ± 0.7	4.4 ± 0.6 <sup>c</sup>	3.0 ± 0.6 <sup>b</sup>	3.3 ± 0.7 <sup>d</sup>	3.0 ± 0.5 <sup>b</sup>	3.3 ± 0.7 <sup>d</sup>
RV long (cm)	7.6 ± 0.7	8.5 ± 1.2 <sup>a</sup>	7.2 ± 0.8	7.9 ± 0.9 <sup>a</sup>	7.4 ± 0.9	8.1 ± 1.1 <sup>a</sup>
iRAA (cm <sup>2</sup> /m)	13.1 ± 5.5	17.1 ± 4.6	10.1 ± 3.0	12.7 ± 4.5	11.2 ± 3.5	12.8 ± 3.5
RV–RA (mmHg)	61 ± 24	68 ± 19	28 ± 12 <sup>d</sup>	48 ± 24 <sup>a</sup>	26 ± 10 <sup>d</sup>	39 ± 17 <sup>a,e</sup>
PAT (ms)	84 ± 16	72 ± 15	106 ± 20 <sup>d</sup>	96 ± 25 <sup>b</sup>	110 ± 17 <sup>d</sup>	95 ± 18
Els	1.3 ± 0.4	1.7 ± 0.7	1.0 ± 0.1 <sup>d</sup>	1.2 ± 0.2 <sup>c</sup>	1.0 ± 0.0 <sup>d</sup>	1.2 ± 0.2 <sup>c</sup>
Eld	1.1 ± 0.1	1.3 ± 0.2 <sup>c</sup>	1.0 ± 0.0 <sup>d</sup>	1.1 ± 0.1 <sup>d</sup>	1.0 ± 0.0 <sup>d</sup>	1.1 ± 0.1 <sup>a,d</sup>

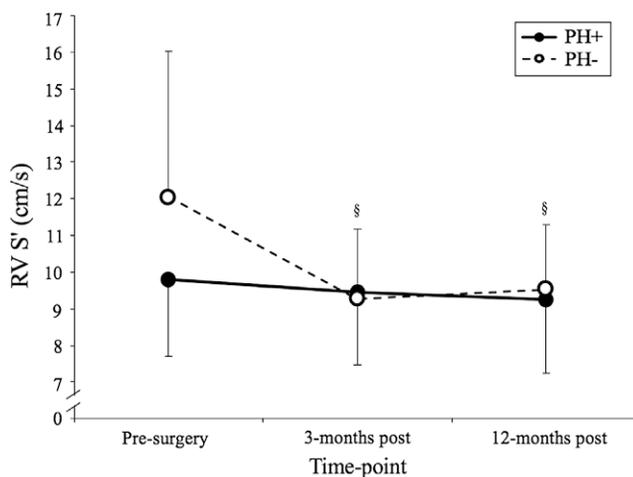
<sup>a</sup>Significant difference between groups ( $P < 0.05$ ); <sup>b</sup>significant difference compared to pre-surgery ( $P < 0.05$ ); <sup>c</sup>significant difference between groups ( $P < 0.01$ ); <sup>d</sup>significant difference compared to pre-surgery ( $P < 0.01$ ); <sup>e</sup>significant difference from 3 months post surgery to 12 months post surgery ( $P < 0.01$ ).



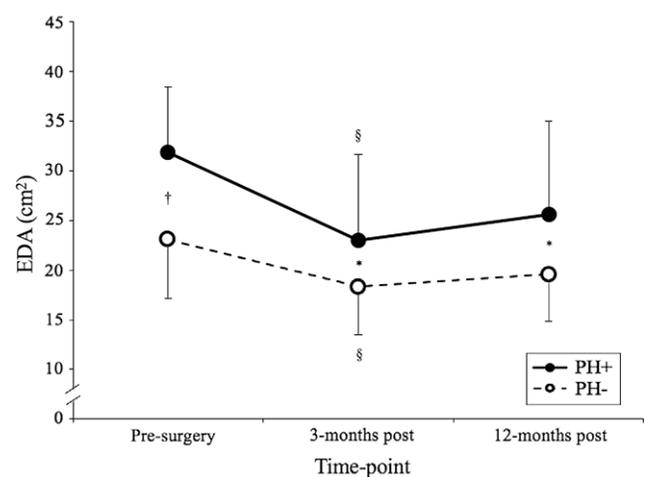
**Figure 6** TAPSE measures in PH– and PH+ groups pre- and post-PEA. <sup>§</sup>Sig dif compared to pre surgery ( $P < 0.01$ ).



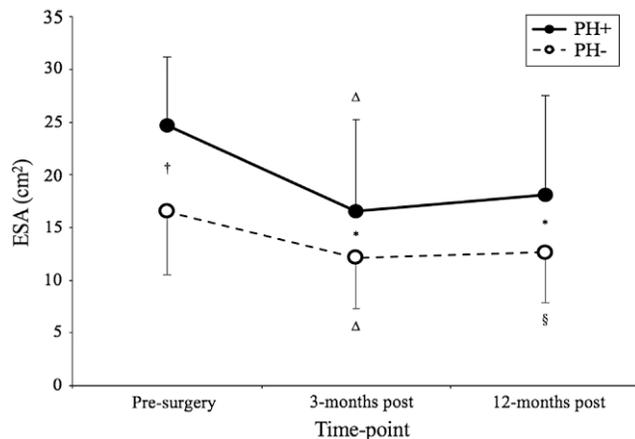
**Figure 8** FAC measures in PH– and PH+ groups pre- and post-surgery. <sup>§</sup>Sig dif compared to pre-surgery ( $P < 0.05$ ). <sup>\*</sup>Sig dif between groups ( $P < 0.05$ ).



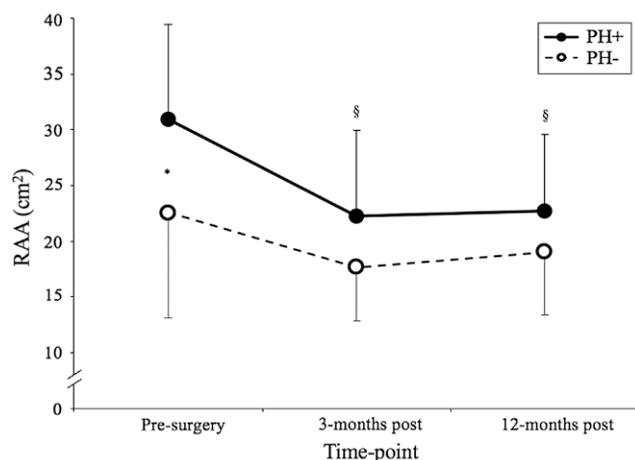
**Figure 7** RV S' measures in PH– and PH+ groups pre- and post-surgery. <sup>§</sup>Sig dif compared to pre-surgery ( $P < 0.05$ ).



**Figure 9** EDA measures in PH– and PH+ groups pre- and post-surgery. <sup>§</sup>Sig dif to pre-surgery ( $P < 0.05$ ). <sup>†</sup>Sig dif between groups ( $P < 0.01$ ). <sup>\*</sup>Sig dif between groups ( $P < 0.05$ ).



**Figure 10** ESA measures in PH– and PH+ groups pre- and post-surgery. <sup>Δ</sup>Sig dif compared to pre-surgery ( $P < 0.01$ ). <sup>§</sup>Sig dif to pre-surgery ( $P < 0.05$ ). <sup>†</sup>Sig dif between groups ( $P < 0.01$ ). \*Sig dif between groups ( $P < 0.05$ ).



**Figure 11** RAA measures in PH– and PH+ groups pre- and post-surgery. <sup>§</sup>Sig dif compared to pre-surgery ( $P < 0.05$ ). \*Sig dif between groups ( $P < 0.05$ ).

**Table 13** Inter- and intra-rater statistics.

Parameter	Inter-rater		Intra-rater	
	ICC	CI (95%)	ICC	CI (95%)
TAPSE	0.977	0.909–0.994	0.994	0.976–0.999
RV S'	0.989	0.954–0.997	0.995	0.981–0.999
FAC	0.867	0.466–0.967	0.953	0.811–0.988
EDA	0.958	0.831–0.990	0.982	0.928–0.996
ESA	0.951	0.804–0.998	0.987	0.946–0.997
RV basal	0.834	0.331–0.959	0.993	0.971–0.998
RV mid	0.913	0.652–0.979	0.989	0.958–0.997
RV long	0.918	0.668–0.980	0.986	0.942–0.996
RAA	0.994	0.977–0.999	0.997	0.989–0.999
PAT	0.936	0.718–0.986	0.977	0.887–0.995
Els	0.896	0.582–0.974	0.977	0.914–0.995
Eld	0.928	0.710–0.982	0.972	0.886–0.993

## Results

Fourteen PH+ ( $n=14$ ) and twenty-six PH– ( $n=26$ ) patients were included in analysis (Table 12). Longitudinal functional parameters (RV S'; tricuspid annular plane systolic excursion (TAPSE)) were reduced at 3 and 12 months in the PH– group compared to pre surgery (Figs 6 and 7). Fractional area change (FAC) was significantly increased in the PH group at 12 months compared to pre surgery ( $29.1 \pm 9.2$  to  $35.9 \pm 8.1\%$ ) ( $P=0.049$ ) (Fig. 8). PH+ measures of RV systolic function (RV S'; TAPSE; FAC) did not significantly change compared to pre-PEA. RV end-diastolic (EDA) (Fig. 9) and end-systolic (ESA) (Fig. 10) areas were significantly different between groups at all time-points ( $P < 0.05$ ). After 12 months, PH-ESA remained significantly lower compared to pre surgery ( $16.5 \pm 5.3$  to  $12.6 \pm 3.7$  cm<sup>2</sup>) ( $P=0.019$ ). No significant changes in PH+ RV areas were present at 12 months compared to pre-PEA. Pre-surgery pulmonary vascular resistance (PVR) showed significant ( $P < 0.01$ ), moderate correlations with changes in EDA ( $r=-0.540$ ), ESA ( $r=-0.577$ ), and right atrial area ( $r=-0.538$ ) to 3 months post PEA (Fig. 11 and Table 13).

## Conclusion

This study suggests longitudinal function remains reduced one-year post-PEA regardless of post-surgical PH status, with gradual PH recovery of radial function. Although both groups EDA and ESA reduced significantly within three-months, only PH ESA reductions from pre-surgery were sustained at 12 months. Future research should establish whether anatomical and functional differences post-PEA are associated with symptomatic outcomes.

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**Declaration of interest**

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

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**Funding**

This work did not receive any specific grant from any funding agency in the public, commercial or not-for-profit sector.

Received in final form 21 October 2019

Accepted 21 October 2019

MEETING REPORT

# Abstract 17: Assessment of left atrial size by echocardiography: applying clinical guidelines in health and disease

**Brogan McAdam and Caroline J Coats**

Golden Jubilee National Hospital, Glasgow, UK

## Objective

Left atrium (LA) enlargement is an important predictor of cardiovascular morbidity and mortality. LA size is estimated by 2D echocardiography using several methods. We assessed if discrepancies between methods occurred more commonly in different types of heart disease. A secondary aim was to audit local adherence to BSE guidelines.

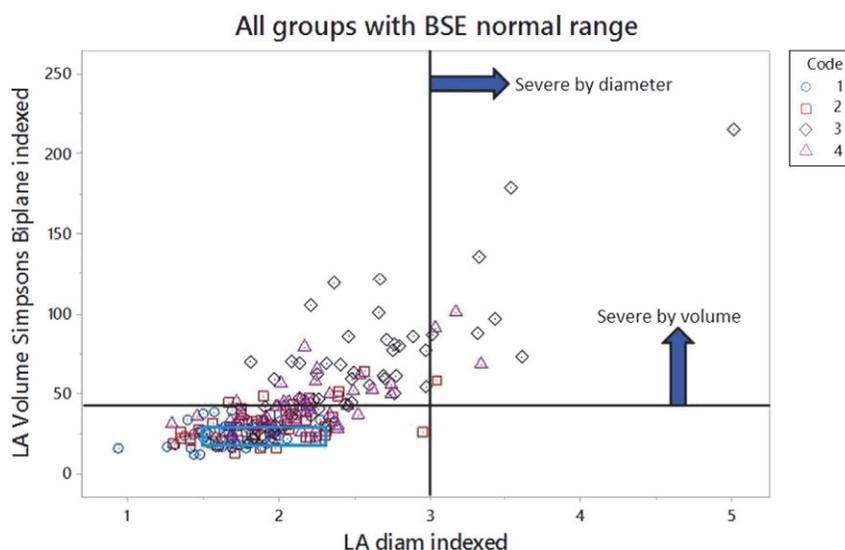
## Methods

LA size was measured in 218 consecutive subjects who met the inclusion/exclusion criteria at our hospital between January and June 2015. Four groups were compared: 1, normal ( $n=66$ ); 2, isolated aortic stenosis, AS ( $n=49$ ); 3, isolated moderate/severe mitral regurgitation, MR ( $n=50$ ); and 4, severe left ventricular dysfunction,

SLVSD ( $n=53$ ). LA size was assessed as recommended by BSE using LA antero-posterior diameter (APD) and LA volume (LAV) measured using (a) area-length (AL) and (b) Simpson's biplane method. Severity categories were assigned according to BSE and EACVI/ASE guidelines.

## Results

There was good correlation between the biplane AL and Simpsons LAV methods ( $r=0.984$ ,  $P<0.001$ ), although LAV was higher using the AL method ( $42.26 \pm 28.81$  mL/m<sup>2</sup>) compared with Simpsons ( $39.27 \pm 26.68$  mL/m<sup>2</sup>,  $P<0.001$ ). When the indexed LA diameter and LAV by AL method were assigned a BSE severity category 57% showed discrepancies, compared to 50% with Simpson's biplane



**Figure 12**  
All groups with BSE normal range.

method and 32% when applying the 2015 ASE/EACVI guidelines. Discrepancies were greatest in patients with MR and SLVSD and least in the normal group (72, 75, 18% respectively) (Fig. 12). 94% of clinical reports derived LAV from the monoplane AL method and only 3% reported severity category using APD.

## Conclusion

The discrepancy between LA diameter and volume measurements is greatest in patients with LVSD and MR. If the BSE were to adopt the 2015 ASE/EACVI guidance and normal ranges, it may help standardise

LAV measurement and avoid misclassification of LA size by physiologists.

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### Declaration of interest

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

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### Funding

This work did not receive any specific grant from any funding agency in the public, commercial or not-for-profit sector.

Received in final form 21 October 2019  
 Accepted 21 October 2019

MEETING REPORT

# Abstract 18: Identifying pacemaker patients who may be eligible for a device upgrade as a result of the NICE TA314 guidance

Louise C Mayall BSc MRes MSc, Keith Pearce BSc and Niall G Campbell PhD MRCP

Manchester Foundation Trust, Manchester, UK

## Background

There is increasing evidence to suggest that long-term right ventricular (RV) apical pacing is associated with adverse outcomes such as progressive left ventricular (LV) dysfunction, heart failure and a significantly increased risk of mortality. The NICE TA314 guidance recommends the implantation of cardiac resynchronisation therapy (CRT) for patients with LV systolic dysfunction and an associated LV ejection fraction of 35% or less in order to restore electrical and mechanical synchrony.

## Aims

- To identify the percentage of RV-paced patients who are eligible for an upgrade to CRT based on the NICE TA314 guidance.
- To determine whether patients with high percentages of RV apical pacing were more likely to be eligible for an upgrade to CRT.

## Methods

Patients who were attending pacemaker outpatient clinics underwent a pacemaker check, a resting 12-lead electrocardiogram, a symptom assessment and a

transthoracic echocardiogram in order to assess their eligibility for an upgrade to CRT.

## Results

There was no significant difference between the percentage of patients who were eligible for an upgrade in the <40% paced and the ≥40% paced groups ( $n=45$ ). 18% of patients were eligible for a device upgrade.

## Conclusion

This study has identified patients who meet the NICE TA314 eligibility criteria, thus allowing the NHS to focus its resources where they will achieve the greatest benefit.

## Declaration of interest

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

## Funding

This work did not receive any specific grant from any funding agency in the public, commercial or not-for-profit sector.

Received in final form 21 October 2019

Accepted 21 October 2019



MEETING REPORT

# Abstract 19: The effects of hand-grip exercise on cardiac function during bike stress echocardiography in healthy adults

Hannah Garnett PhD MSc BSc, Martin Stout PhD MSc BSc and Keith Pearce BSc

Wythenshawe Hospital, Manchester University NHS Foundation Trust, Manchester, UK

## Background

Bike stress echocardiography (BSE) is routinely used as a non-invasive test for functional myocardial ischaemia in patients experiencing angina-like chest pain. Myocardial ischaemia is diagnosed when reduced coronary blood flow results in regional wall motion abnormalities, which can be quantified using strain analysis. In current practice, patients are asked to perform a hand-grip exercise when leg fatigue develops to help ensure they reach their target heart rate (THR).

## Aims

This study aimed to identify whether there is a difference in cardiac workload or duration of a satisfactory test, following isotonic bike exercise and isometric hand-grip exercise (IHGE) in combination, compared to isotonic bike exercise alone in healthy adults.

## Methods

A repeated-measures design was used in which healthy adult volunteers were exercised to 85% of their THR using isotonic bike exercise alone in one session and isotonic bike exercise in combination with an IHGE in another session. Echocardiographic images and blood pressure were recorded throughout exercise and recovery. Systolic global longitudinal strain (GLS) and ejection fraction (EF) were calculated from echocardiogram images to assess cardiac workload and volumes.

## Results

There was no significant difference in the response of GLS ( $n=20$ ) or EF ( $n=24$ ) to isotonic bike exercise alone when compared to isotonic exercise with an IHGE. There was also no significant change in the time taken to reach peak exercise, or to recover to a heart rate  $<100$  bpm between the two exercise protocols ( $n=20$ ).

## Conclusion

The addition of a hand-grip exercise to isotonic bike exercise had no effect on the cardiac workload or duration of a satisfactory BSE in healthy adults. Further work is now warranted to investigate whether an IHGE can increase the number of participants achieving a satisfactory BSE in a patient population, and potentially improve the sensitivity of BSE in detecting coronary artery disease.

### Declaration of interest

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

### Funding

This work did not receive any specific grant from any funding agency in the public, commercial or not-for-profit sector.

Received in final form 21 October 2019

Accepted 21 October 2019

