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USE OF DOPPLER TISSUE IMAGING M-MODE IN IDENTIFYING PATIENTS WITH LEFT VENTRICULAR HYPERTROPHY AND DIASTOLIC DYSFUNCTION

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Left ventricular hypertrophy (LVH) is a marker of adverse cardiovascular risk. Measures of diastolic dysfunction are used to distinguish between pathological and physiological hypertrophy. Pulse wave Doppler of mitral inflow (MIF) is commonly used in the identification of patients with diastolic dysfunction, but is subject to pseudonormalisation. Assessment of mitral annulus (MA) velocity has been proposed as a solution to this problem and we have previously reported the use of pulsed wave (PW) Doppler Tissue Imaging (DTI) in distinguishing individuals with different types of LVH.

DTI M-mode of the MA may offer further advantages over PWDTI due to superior temporal resolution. We have therefore compared DTI M-mode (E′, A′ and isovolumic relaxation time (IVRT)) with conventional MIF velocities (E, A and IVRT) in 125 subjects. The study population comprised three groups: normals, fell runners with LVH (the physiological group) and patients with hypertension (HTN) or hypertrophic cardiomyopathy (HCM) (the pathological group). A comparison between DTI M-mode of the medial MA and MIF is shown. E′ and IVRT′ distinguished reliably between the groups while MIF did not. DTI allows improved discrimination between pathological and physiological groups when compared to the conventional method of MIF.

	Normals (n=33)	Athletes (n=11)	HTN (n=70)	HCM (n=11)	ANOVA
Age	41±15	38±9	63±9	52±15	p<0.001
LVMI (g/m^2)	90±18	88±21	149±54	195±81	p<0.001
DTI: E′ (cm/s)	11.1±5.2	9.5±4.7	4.7±2.1	3.4±1.3	p<0.001
DTI: IVRT′ (ms)	77±15	78±15	82±29	146±53	p=0.002
MIF: E/A	1.5±0.5	1.6±0.6	0.9±0.4	1.6±1.0	p<0.001
MIF: IVRT (ms)	86±23	79±28	89±20	89±22	NS

A COMPARISON OF ESTIMATES OF LEFT VENTRICULAR MASS USING FUNDAMENTAL AND HARMONIC ULTRASOUND IMAGING

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Following recent guidelines, a hypertensive patient will usually be commenced on anti-hypertensive medication if left ventricular hypertrophy (LVH) is identified. Harmonic imaging (HI) is available on most modern echo machines and often produces clearer images than fundamental imaging (FI). However HI has been observed to cause thickening of the endocardium and this may alter estimates of left ventricular mass (LVM). If LVM differs between HI and FI then this may influence management. To investigate this effect, echos were performed on 101 individuals including 15 normals, 24 athletes, 54 hypertensives and 8 patients with hypertrophic cardiomyopathy. LV measurements were taken in duplicate. Two methods were used to measure LV dimensions—the Penn convention (Penn) and the American Society of Echocardiography recommendations (ASE).

LVM estimated with Penn were significantly higher with HI (p=0.001). With ASE, LVM showed a tendency to be greater with HI (not statistically significant). Correcting LVM for body surface area, LVH was defined as a LVM Index (LVMI) of 125g/m^2. HI resulted in 13 more individuals reaching criteria for LVH when using Penn and 6 more using ASE. HI may therefore overestimate LVM. If HI analysis is necessary due to image quality then ASE should be used in preference to Penn.

	Fundamental		Harmonics	
	Penn	ASE	Penn	ASE
IVS (cm)	1.1±0.4	1.2±0.4	1.1±0.4	1.3±0.4
LVID (cm)	5.3±0.6	5.2±0.6	5.4±0.6	5.3±0.6
PW (cm)	0.80±0.20	0.87±0.22	0.80±0.20	0.88±0.20
LVM (g)	218±94	215±81	236±101	224±82
LVMI (g/m^2)	120±54	118±48	129±56	123±47
Subjects with LVH	36%	34%	49%	40%

THE ROLE OF A DIGITAL ECHOCARDIOGRAPHY DATABASE IN AUDIT AND CLINICAL GOVERNANCE

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Digital echocardiography storage and reporting systems have recently become available. Their benefits include archiving, viewing and reporting echocardiographic studies, along with providing immediate retrieval and review facilities. In addition, comprehensive reports using pre-defined sentences or codes and free text can be generated. However, digital echo databases also have a potential role for clinical and management audit which, to date, have been largely unexploited. Since March 2000, our echo department has had a digital echo database (Enconcert™–Agilent Technologies) which has been networked to 4 ultrasound systems and 5 work stations. Using the database search software, Crystal Reports™, we have evaluated representative search parameters to establish the potential role of this system for audit. Each search took approximately 20 seconds. 4582 echo studies have been stored (4223 adult, 137 paediatric, 130 stress echos and 92 TOEs). 1701 were female (av. age 60.4), 1992 male (av. age 58.6), 24 other and 796 unknown. Examples of searches performed include: "coarctation"=2, "TR max vel>3m/s"=279, "LV thrombus"=1 large, 7 moderate, 4 small, "LVEDD>55 mm"=818.

The system has also been used to monitor the time taken between an echo being done and being reported. The average report time was 74 hours for these 8 users.

Technology such as this allows for unlimited database queries to be performed on a regular and automatic basis. This has tremendous potential benefit for clinical audit and should allow for improved quality control in echo departments.

HIGH SPATIAL RESOLUTION REAL TIME PERFUSION IMAGING DURING STRESS ECHOCARDIOGRAPHY

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Real time perfusion imaging systems with high spatial resolution are now available (Cadence™ Imaging Acuson.). High spatial resolution potentially facilitates the separate evaluation of endocardial and epicardial perfusion. High temporal resolution allows high frame rates which enhances its use during stress echocardiography. We have evaluated the potential role of this form of perfusion imaging in 15 patients (11 male, 4 female, av. age 60.9) undergoing stress echocardiography for the determination of reversible ischaemia. Perfusion imaging was performed using apical four and two chamber views during 0.3 ml bolus injections of the contrast agent Optison™. We hypothesised that normally perfused myocardial segments would show homogenous transmural perfusion at both rest and stress during the peak and decay portions of the contrast bolus. Whereas stress

induced ischaemia would result in homogenous transmural perfusion at peak with early appearance of an endocardial perfusion defect during the decay curve. This appearance manifests itself as a distinct dark endocardial rim appearing as the contrast concentration decreases. 5 patients with stress induced wall motion abnormalities were classified as showing reversible ischaemia. In these 5 patients, all demonstrated perfusion evidence of subendocardial ischaemia. In the 10 patients with normal stress echocardiograms, 1 developed evidence of sub endocardial ischaemia and the remainder were normal. In all patients, this evaluation was possible using bolus injections. This new technology has the potential benefit of allowing detection of stress induced sub endocardial ischaemia which should be an earlier and more sensitive marker of ischaemia than wall motion or wall thickening abnormalities. It has the added benefit of being utilised with bolus contrast injections which are easier and cheaper than continuous infusions. Further studies including comparison with coronary angiography and other perfusion techniques are warranted.

TELEMEDICINE AND STRESS ECHOCARDIOGRAPHY: IMAGE QUALITY AND CONFIDENTIALITY IMPLICATIONS

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Aims: E-mail transmission of stress echocardiogram (SE) images for remote review using non-specialist software may result in compression of data with loss of image clarity as well as violation of confidentiality. We aimed to assess image quality and confidentiality issues for e-mail transmission of SE studies to such a remote site.

Methods: Twenty SE studies, previously assessed for image quality and wall motion abnormality, were selected using the MedArchive program (version 2.0, Selectronics UK) on a Compaq V 75 PC and Professional Work Station AP200 monitor. Standard parasternal and apical images were stored in ".avi format" tagged with individual numerical codes instead of names. Each study (4 quad screens) was then sent by e-mail to the same individual who had originally assessed them. Windows Media Player 7 (Microsoft Corp.) was used to grade image quality (poor, moderate, good) and wall motion at the remote site on a desktop PC (300MHz processor, 128MB RAM) with a 14" SVGA monitor.

Results: Studies varied between 5.2 and 7.8MB in size. Image quality grading matched in all but 3 cases (good quality on MedArchive system and moderate quality on Media Player 7). Wall motion abnormality assessment matched in all cases—12 left anterior descending, 3 right coronary/posterior descending, 3 circumflex, 2 no ischaemia. Transmission failed on one occasion due to limited mail-box space at the remote site. This study was successfully retransmitted after generating the necessary space.

Conclusions: E-mail transmission of stress echocardiography studies and subsequent review using non-specialist software provides image quality suitable for accurate interpretation, while confidentiality is easily maintained using number codes instead of patient names.

FLOW PROPAGATION VELOCITY IS REDUCED IN ASYMPTOMATIC SURGICALLY REPAIRED TETRALOGY OF FALLOT PATIENTS

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Asymptomatic (surgically repaired) tetralogy of Fallot (TOF) patients have echocardiography performed for either routine follow up or for deterioration in symptoms. The usual finding is of right ventricular (RV) dysfunction with varying degrees of pulmonary stenosis/regurgitation. The left ventricle (LV) is often of unremarkable size and visually has satisfactory function. However subtle disturbances of LV function may co-exist. We therefore studied LV filling by conventional (transmitral flow velocities) and by mitral flow propagation velocity profiles (Vp). The later has previously been reported to be less pre-load dependant and no more complex or time consuming to undertake.

Method: 9 asymptomatic surgically repaired TOF patients were studied and compared with 6 age matched controls. Echocardiography was performed using a Vingmed VividFive. Data was obtained from the apical 4 chamber view and analysed off line with echopac. Transmitral Doppler peak E and A velocity, E deceleration time (E DT), E:A ratio and Vp were averaged for 3 cardiac cycles.

Results: Results are expressed as mean (±SD). There was no statistical difference between Peak E velocity, E DT or E:A ratio. However Vp was significantly lower in the TOF patients (42.9±5.4cm/s v 54.2±4.8cm/s, $p<0.005$).

Conclusion: Despite being asymptomatic and with apparently normal transmitral flow patterns, the flow propagation velocity patterns were significantly reduced indicating abnormal LV filling. This may be the consequence of LV damage during ischaemic arrest at surgical repair, or from abnormal inter ventricular septal movement from RV dilatation or foreign material in the septum as a result of ventricular septal defect repair.