echocardiograpy reports -what a family physician should know?

A Gandhi, M Gandhi, S Kalra

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Abstract

The objective of this review article is to help referring physicians structure their approach to extract clinically useful information from transthoracic echocardiography (TTE) reports. TTE is a reliable and versatile tool for the assessment of cardiac structure, function and path physiology. In clinical practice, TTE results are best interpreted with a view to underlying cardiac physiology and patients' clinical status. Knowing the inherent limitations of TTE will help referring physicians to interpret results and to avoid misdiagnoses based on false assumptions about the procedure. A structured approach to reading TTE reports can assist physicians in extracting clinically useful information from them, while avoiding common pitfalls.

INTRODUCTION

Transthoracic echocardiography (TTE) is a reliable and versatile tool for the assessment of cardiac structure, function and path physiology. It is very cost effective compared with competing technologies and has many new possibilities as to how this examination can be improved and provide more and better information.[1]

Referring physicians sometimes find reported results

difficult to apply clinically. Terminology can be arcane. The format of reports differs from one laboratory to another. Content can vary: because echocardiography is evolving, some institutions use methods not available at all centers.[2] This overview will help referring physicians structure their approach to extracting clinically useful information from TTE reports.

CONTENT OF TTE REPORTS

Date of procedure. The date of procedure must be checked as change is expected when a patient's clinical status changes as a result of worsening disease or in response to treatment.

Reason for the test Explaining why echocardiography was ordered directs the laboratory to specific techniques that can best answer a referring physician's question (Table 1)[2]. Sometimes the referring physician must provide data before a conclusion can be reached. Knowing the type and diameter of a prosthetic valve is prerequisite to quantifying its function. If trends in improvement or deterioration are of interest, consultants need results of previous studies.

Image quality With excellent, good, or satisfactory images, measurements in TTE are presumed accurate. Images characterized as technically difficult, fair, or poor can lead to erroneous conclusions. An error of only1 mm in measuring wall thickness for the left ventricle(LV) translates into a 15-g difference in the estimate of LV mass.[3] A report stating honestly that accurate data could not be obtained is preferable to a seemingly more "complete" analysis based on inaccurate measurements. Qualitative conclusions also depend on image quality. A statement that "no intracranial mass or thrombus was seen" implies no more than it states. It cannot be inferred with certainty from technically difficult TTE reports that no such lesion exists. When image quality is unsatisfactory, the reason should be indicated. Referring physicians can decide whether invasive and more costly transesophageal echocardiography would be justified to obtain better images.

Rate and rhythm Correct identification of common dysrhythmias has important implications for TTE. In atrial fibrillation, marked bradycardia or tachycardia (data commonly used to assess diastolic function of the LV) are often abnormal—not necessarily because of LV diastolic

dysfunction (DD). During TTE a rhythm strip is obtained. Sometimes cardiac rhythm is uninterpretable from a low-voltage rhythm strip, and a consultant might recommend a full electrocardiogram.

Chamber sizes A table often lists the measured chamber sizes (diameters) and compares them with normal values. Increased values indicate chamber dilation.

Hypertrophy The thicknesses of the interventricular septum and posterior LV wall are used to determine the presence of concentric LV hypertrophy or asymmetric septal hypertrophy. This practice can be misleading. Elderly patients often have a sigmoid-shaped septum that looks abnormally thick in most views[4] When asymmetric septal hypertrophy is identified, evaluation for dynamic LV outflow tract obstruction is required; specific comment regarding presence or absence of systolic anterior motion of the anterior mitral valve leaflet is expected. Because the mass of a normal heart correlates with the size of the patient, the LV mass index in g/m2 is useful,

because it relates LV mass to body surface area. Did laboratory staff measure the patient's height and weight, or did they merely ask the patient to estimate them? Inaccurate self-reporting leads to inaccurate calculations.

Left ventricular systolic function Left ventricular systolic performance has long been known to indicate severity of heart disease and to predict cardiovascular morbidity and mortality. A TTE report usually classifies LV ejection fraction (LVEF) from normal (grade 1) through severely decreased (grade 4). Most laboratories quantify LVEF. For normal hearts, the Teicholz equation is reasonably accurate.[5] When infarction has caused regional wall motion abnormalities, the "disc method" using Simpson's rule is preferred.[1] Reports should indicate which method was employed. How LVEF should be interpreted depends on a patient's clinical status and cardiac condition. While LVEF in the range of 40% to 55% is abnormal, it often has little clinical significance.[6] In moderate or severe mitral regurgitation, however, even a nominally "normal" LVEF of 60% can indicate inadequate LV performance. Left ventricular ejection fraction is a misleading indicator of LV function. It neither reflects myocardial contractility nor measures cardiac performance. Most importantly, LVEF depends on preload and afterload, both of which can change dramatically within hours. Stroke volume, cardiac output, cardiac index, and the LV index of myocardial performance, also known as the "Tei Index," are increasingly reported as more reliable quantifiers of LV systolic function.[7] Higher values on the index of myocardial performance are associated with more severe LV disease and poorer prognosis.[8] When LV systolic function is impaired, the report will indicate whether the chamber was globally hypokinetic, typical of cardiomyopathy, or whether regional wall motion abnormalities were seen, the result of myocardial infarction. To localize and classify LV regional wall motion, the American Society of Echocardiography divides the LV into 17 segments.[2] The LV wall motion score index might be reported. Higher scores indicate more dysfunction. In many US laboratories, intravenous "bubble" contrast is used routinely to outline the LV chamber when the endocardium is poorly outlined. In Canada, financial constraints often preclude this approach.

Figure 1

Table 1. Common queries and concerns in transthoracic echocardiography

Q: Left ventricular ejection fraction was different in another recent echocardiogram. Which study was correct?
A: Probably both. The LVEF depends on preload and afterload, both of which can change dramatically and quickly according to a patient's clinical condition.
Q: Does this patient have pericarditis?
A: Uncomplicated pericarditis has no pathognomonic features in TTE. Transthoracic echocardiography can show complications of pericarditis, such as a large pericardial effusion, or occasionally can reveal occult etiology, such as an intracardiac tumour.
Q: Does this patient have congestive heart failure?
A: Congestive heart failure is a clinical diagnosis. The lungs are not viewed via TTE, although pleural effusion is sometimes identified as an incidental finding. Congestive heart failure makes TTE technically difficult, because ultrasound waves propagate poorly through pleural effusions and because patients with dyspnea and orthopnea cannot cooperate with positioning for the test.
Q: Is antibiotic prophylaxis required?
A: The consultant reporting TTE usually sees a digital image, not the patient. While antibiotic prophylaxis is sometimes recommended, the absence of such advice does not necessarily mean that prophylaxis is unnecessary. This clinical judgment is the responsibility of referring physicians with reference to current guidelines and with knowledge of the patients to whom the guidelines apply.
Q: Mitral valve prolapse was reported for previous echocardiography but not now. Which test was wrong?
A: Probably neither. Echocardiographic criteria for diagnosing mitral valve prolapse are more stringent now than they were in the past.
Q: Is this patient fit for surgery?
A: The TTE evaluates only some aspects of the cardiovascular system. It detects valvular lesions and assesses ventricular function at rest. It can show evidence of previous infarction, but it cannot detect myocardial ischemia.
Q: This patient had a stroke. Is the source a cardiac embolism?
A: With satisfactory images, TTE is the modality of choice to demonstrate intraventricular mass or thrombus; generally it does not image the left atrial appendage adequately. When TTE is technically difficult, when the left atrial appendage must be examined (in atrial fibrillation), or when patent foramen ovale must be excluded as a source of cryptogenic stroke, transesophageal echocardiography is preferred.
Q: Murmur. Please assess.
A: When more than 1 valve abnormality is demonstrated, clinical assessment is needed to identify the source of a particular murmur. Functional murmurs exist without serious valve disease.
Q: Can you rule out aortic aneurysm?
A: Transthoracic echocardiography routinely images the aortic root. The ascending aorta and the aortic arch are viewed when possible, although precise measurements might be unobtainable in technically difficult studies. The descending aorta is not viewed adequately. Computed tomography of the thorax and abdomen, and abdominal ultrasonography, are the imaging modalities of choice when aortic aneurysm is suspected.
TTE—transthoracic echocardiography.

Left ventricular diastolic function Diastolic dysfunction is an

important factor in clinical heart failure.[9] Left ventricular DD usually precedes development of LV systolic dysfunction. Where LV systolic dysfunction exists, diastolic function is inevitably abnormal. The presence and severity

of DD are strong predictors of future nonvalvular atrial fibrillation in the elderly.[10] Independent of systolic function, DD of any degree is a strong predictor of all-cause mortality.[11] Modern echocardiography either reports diastolic function as normal or grades DD by class (1 through 4).[12] Class 1 DD (impaired myocardial relaxation) was formerly called "mild DD," an expression that is obsolete and misleading. In one series, class 1 DD was associated with an 8-fold increase in all-cause mortality within 5 years.[11] Mortality increases with the severity of DD.Increased left atrial (LA) volume is a morphologic expression of DD, reflecting LV end diastolic pressure.[13] It predicts development of atrial fibrillation.[14] Size of the left atrium is usually represented by the transverse diameter of the chamber, although this measurement often underestimates the volume of an enlarged left atrium.

Right ventricle When there is no comment on function of the right ventricle, it is presumed normal by visual assessment. A few laboratories report the right-sided index of myocardial performance. This ratio is analogous to the Tei Index for LV performance.

Valvular regurgitation Most reports of valvular insufficiency are based on visual assessment. This common method of classifying regurgitation as trivial (or trace), mild, moderate, or severe is subjective, imprecise, and

frequently misleading. Visualization by colour Doppler depends on the velocity of the jet, not the volume of blood. A small, high-velocity jet through a small orifice could thus appear to be more severe than a much larger, but slower, blood volume regurgitating through a larger orifice.[15]

An increasing number of laboratories quantify valvular regurgitation using the effective regurgitant orifice and the regurgitant volume of blood.[16] Some reports refer to this as the "PISA" method (proximal isovelocity

surface area).[17]

Valvular stenosis Mitral and aortic stenoses are graded as mild, moderate, or severe, based on the maximum velocity, peak gradient across the valve, and estimated cross-sectional area of the orifice. These data are usually

reported. Pulmonary stenosis can be indicated by an increased pressure gradient across the valve.

Intracardiac mass or thrombus Clots and masses in the LV are seen best by TTE.[1] The left atrial appendage is poorly visualized. Transesophageal echocardiography has better sensitivity than TTE for detecting an intraatrial

embolic source in stroke.[18,19] Suspect echogenic features that could represent anatomic structures, unusual artifacts, primary or secondary cardiac tumours, thrombi, or vegetations will also be reported. Technically difficult TTE images often cannot differentiate between lesions and artifacts. Reporting physicians will point out any concerns, possibly recommending transesophageal echocardiography for clarification.

Septal defects The location and size of atrial and ventricular septal defects will be reported. Unless the sonographer is specifically looking for a suspected atrial septal defect, images might not be obtained from the subcostal window, the best view for detecting it.[20] Contrast echocardiography can be helpful when a septal defect is suspected on clinical grounds but is not visible via TTE.

Right ventricular systolic pressure When failure on the right side of the heart is suspected, it is helpful to estimate the right ventricular systolic

pressure or pulmonary systolic pressure. Measurements are often elevated by obesity and hypertension, not just by pulmonary hypertension.

Pericardium The location of pericardial effusion and its size (trace, small, medium, or large) will be reported. Small pericardial effusions are often physiologic. If an effusion is reported, referring physicians want to know whether there is evidence of tamponade, although this is ultimately a clinical diagnosis, not an echocardiographic one.

Aorta The diameter of the aortic root is measured routinely. Sometimes it is possible to identify dilation of the ascending aorta, the arch, or the descending aorta. Aortic dissection is an emergency requiring immediate contact between reporting and referring physicians

Incidental findings Unsuspected congenital cardiac abnormalities are discovered occasionally. Incidental findings might require investigation using other imaging modalities. Pleural effusions are often seen on the left.

Intrahepatic lesions are sometimes identified and extrinsic

masses compressing the heart are sometimes revealed

Summary of findings The limitations of TTE are implicit, but they might be stated in the conclusions if the questions asked by referring physicians are known. For example, if a laboratory is asked to rule out cardiac embolism in a patient with atrial fibrillation and a recent stroke, the report might remind the referring physician that the left atrial appendage is not visible on TTE and that transesophageal echocardiography is recommended. When myocardial ischemia is suspected in a patient scheduled for surgery, a technician might suggest a nuclear medicine study or stress echocardiography. Follow-up echocardiography could be suggested. Advice

concerning treatment exceeds the mandate of a laboratory report, but many referring physicians appreciate recommendations for prophylactic antibiotics, when indicated. When TTE report conclusions fail to address the reason the procedure was ordered, chances are high that the reason was never stated on the requisition. Physician-to physician discussion can answer many queries and concerns often raised about this procedure (Table 1).

CONCLUSION

One imaging test cannot substitute for history taking and physical examination. In conjunction with clinical knowledge about the patient and a basic understanding of cardiac physiology, however, TTE is essential for cardiovascular evaluation and follow up. This brief review has outlined a structured approach to reading TTE reports and has addressed many issues encountered by referring physicians who receive these documents. Echocardiography is, however, evolving rapidly. Future development of innovative techniques and consequent changes and improvements in the reports that referring physicians receive from TTE procedures are sure to come.

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Author Information

Arun Gandhi, MD
Assistant Professor, Deptt of Medicine, MMIMSR, MULLANA

Meenu Gandhi, MD
Consultant Dermatologist, Mahabir Dal Hospital

Sanjay Kalra, DM
Bharti Research Institute of Diabetes and Endocrinology (BRIDE), Bharti Hospital