

Transoesophageal echocardiography, why and when?

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Echocardiography has become an important diagnostic tool in cardiovascular disorders. In a majority of patients, images of diagnostic quality can be obtained by experienced sonographers using the transthoracic approach, especially with multi-frequency transducers and by utilising harmonic imaging. Transthoracic echocardiography (TTE) is non-invasive, comparatively simple to use and widely available. However, even with state of the art equipment, transthoracic images are of suboptimal quality in approximately 10% of subjects, due to body habitus, obesity, COPD, immobility or limited echo access, and furthermore, there are specific areas in which transoesophageal echocardiography (TOE) can provide additional diagnostic information, regardless of whether transthoracic images are adequate or not. TOE provides an unobstructed view of the heart from the oesophagus and stomach and provides images of superior quality, as higher frequency transducers can be used with resultant improved image resolution. TOE provides a unique perspective on posterior cardiac structures and has allowed reliable visualisation of the atria, their appendages, the venae cavae and pulmonary veins for the first time in echocardiography.

The technique is relatively new. TOE using M mode echo was first introduced by Frazin et al. in the mid-70s, but it did not gain widespread use because of the inherent limitations of M mode imaging. With developments in the field of 2D imaging and with the availability of smaller probes with colour and spectral Doppler, TOE became increasingly used in hospital practice during the late 1980s and early 1990s.

Native valve disease

TOE is used as an adjunct to TTE and Doppler in assessing valvular function. An important example of the incremental value of TOE is found in the assessment of mitral regurgitation (MR). Quantifying the severity of MR is difficult because diagnostic criteria are poorly

Indications for TOE

- Suspected endocarditis
 - Vegetations
 - Paravalvular abscess
- Prosthetic valvular disease
- Native valvular disease
- Aortic disease
 - Dissection
 - Atheromatous plaque
 - Thrombus
- Cardioembolic source
- Congenital heart disease
- Non-diagnostic transthoracic images
- Intra-operative assessment of valve repair
- Monitoring haemodynamics in critical care
- Interventional procedure
 - ASD closure
 - Balloon valvotomy
- Early cardioversion

defined. The oesophageal approach provides an excellent window to study the morphology of the mitral valve and allows detailed interrogation of the left atrium to map the full extent of the regurgitant jet. This is important in patients with eccentric jets, which are routinely underestimated by TTE. Severe MR may result in systolic reversal of flow in pulmonary veins detectable with pulsed-wave Doppler, or quantifiable using the PISA (proximal isovelocity surface area) technique to calculate effective valve regurgitant orifice area and regurgitant volume. TOE is ideally suited to evaluate all these findings due the proximity of the probe to these structures.

Stenotic mitral valves are well displayed and evaluated on TTE, but the left atrial appendage, a frequent site of thrombus, is not adequately seen. TOE offers the opportunity to examine the inter-atrial septum prior to attempting or during trans-septal approach for balloon

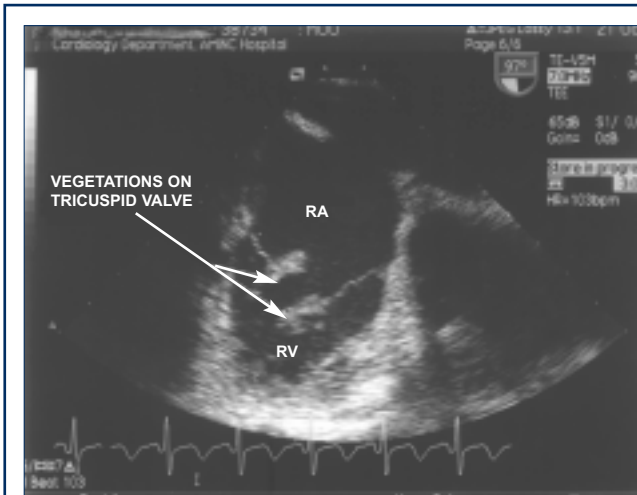


Figure 1. Tricuspid valve vegetations in an intravenous drug user. RA: right atrium; RV: right ventricle.

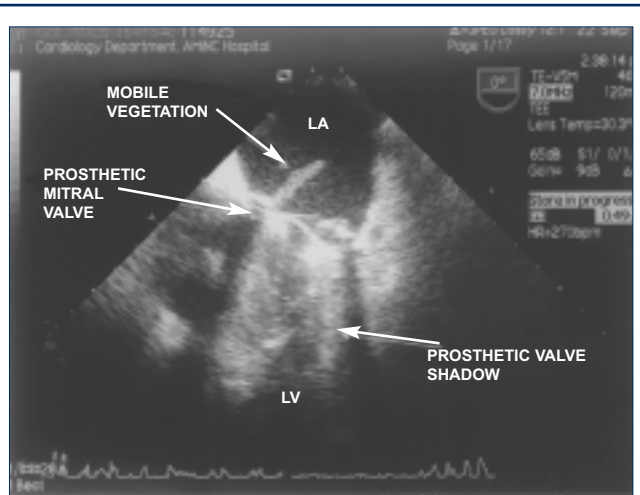


Figure 2. Large mobile vegetations on the atrial side of the mitral valve prosthesis.

valvuloplasty. Two-dimensional TTE can exclude aortic stenosis if normal leaflet separation is present, but it relies on Doppler methods to estimate the valve gradient. The pressure gradient estimated by the Doppler method is influenced by left ventricular function, volume status and coexisting aortic regurgitation. TOE with its higher image resolution allows direct planimetry of the aortic valve area. TOE does not offer any advantage over TTE for recognition and quantification of aortic regurgitation, unless transthoracic views are poor, but can be of use in defining the aetiology of the aortic regurgitation and studying the aortic root.

Prosthetic valves

It is important to obtain a baseline TTE after prosthetic valve surgery in every patient. Doppler and M mode interrogation provide valuable information about the

function of the prosthetic valve, especially when there is intermittent dysfunction. However, assessment of the prosthetic valve may be difficult by TTE because of the acoustic shadowing caused by prosthetic material and poor sensitivity for small vegetations, thrombi or abscesses. TOE provides a unique series of imaging planes, which can reliably demonstrate both normal prosthetic valve function and distinguish thrombus or vegetation from suture material or innocent fibrin strands.

Infective endocarditis

Early diagnosis is important for the clinical outcome in infective endocarditis since mortality increases with delay. Diagnosis of infective endocarditis is mainly based on clinical features and blood culture findings and if these are non-specific or absent then the diagnosis relies

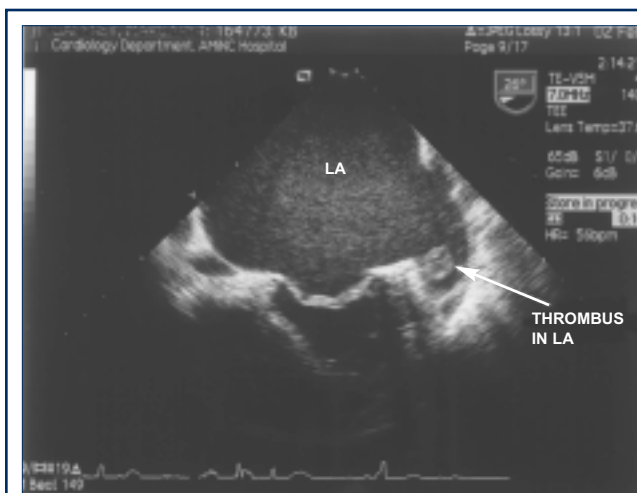


Figure 3. Clot in the left atrial appendage (LAA). Note the smoke-like spontaneous echo-contrast.



Figure 4. Longitudinal transoesophageal echocardiogram of the descending aorta of a patient with extensive atherosclerosis.

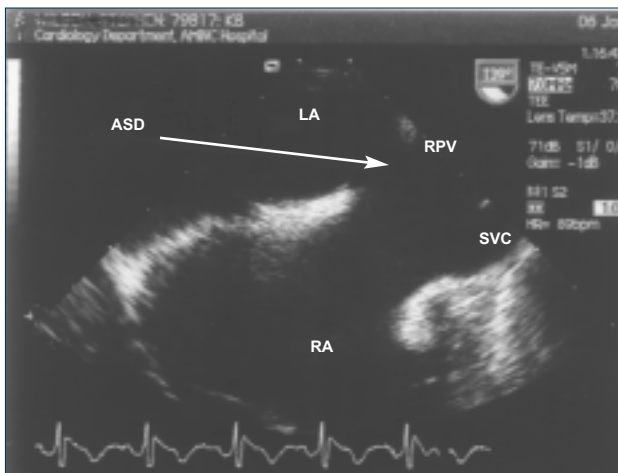


Figure 5. Atrial septal defect sinus venosus type. RPV: right pulmonary vein; SVC: superior vena cava.

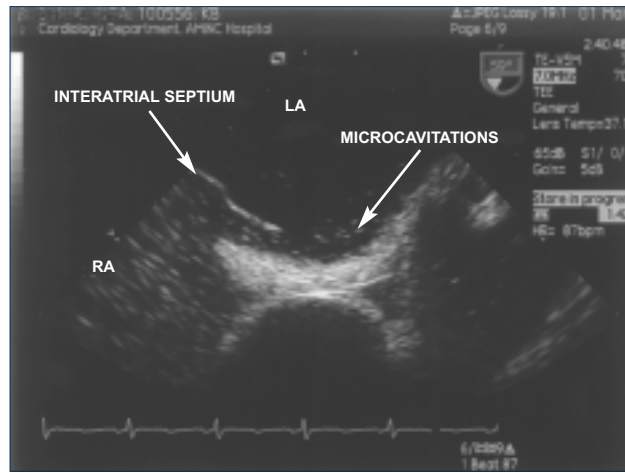


Figure 6. Patent foramen ovale (PFO): intravenous injection of the agitated saline contrast, with passage of echogenic contrast material from the right atrium to left atrium.

on the demonstration of vegetations on echocardiography (Figure 1). TOE has been found to be superior to TTE in many studies and vegetations as small as 1 to 2mm can be seen on TOE. TOE was of incremental value in patients in whom TTE suggested intermediate probability of infective endocarditis. Patients with suspected prosthetic valve endocarditis should have a TOE because reverberations and attenuation produced by the prosthetic material makes it difficult to see small echodensities on the valve. Better characterisation of vegetations on prosthetic valves (Figure 2) and significant improvement in the diagnosis of abscesses associated with endocarditis allows the institution of aggressive therapy, including early surgery.

TOE is of value in identifying non-valvular sites of infective endocarditis e.g. pacing wires, VSD patches or on aortic graft. It is important to remember that small

echodensities on the valve do not always mean an infective vegetation. Other possibilities include old and healed vegetations, strands, myxomatous valves or thrombi. TOE is the best available technique for distinguishing these pathologies.

Cardioembolic source

A significant number of stroke patients (22-39%) have a potential cardioembolic source. The role of TOE and TTE in diagnosing structural abnormalities in stroke patients has been evaluated in many different studies. TOE has been shown to be superior to TTE in detecting possible sources. It images structures which cannot be seen clearly on TTE, e.g. interatrial septum, left atrial appendage, aortic atheroma and spontaneous echo contrast. Left atrial thrombus is the most commonly

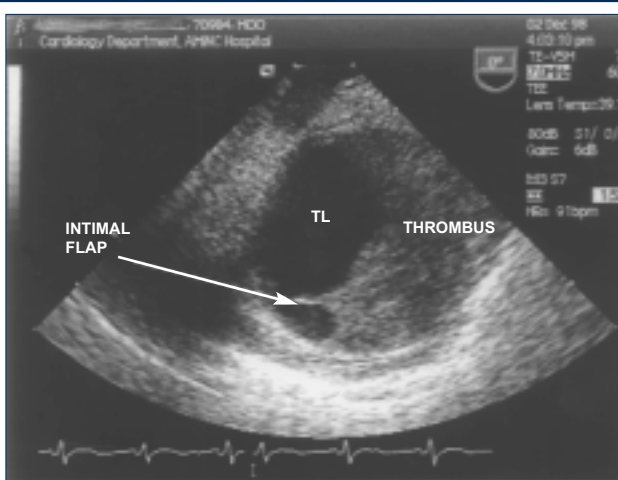


Figure 7. Transverse transoesophageal view of descending aorta in a patient with dissection. Note the thrombus formation in the dissected aorta.

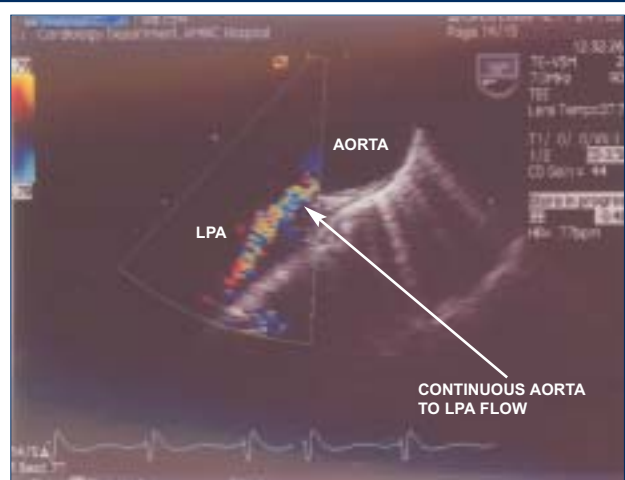


Figure 8. Patent ductus arteriosus: transverse view of the descending thoracic aorta just distal to the aortic arch demonstrating flow from the aorta into left pulmonary vein (LPA). The colour Doppler helps identify the patent ductus.

identified cardiac source of emboli (Figure 3).

Left atrial spontaneous echo contrast may occur in hypercoagulable states and has been identified as an independent risk factor for thromboembolic events. There is a strong and independent association between atherosclerotic disease of the aortic arch and the risk of ischaemic stroke. This association is particularly strong for the noncalcified projecting plaques of size 4mm or more (Figure 4). The thoracic aorta is a difficult structure to image using conventional techniques, but can be almost completely visualised from the transoesophageal approach.

Atrial septal defect can be diagnosed using TTE. However, the ultrasonic beam does not penetrate the interatrial septum perpendicularly, and echo dropout may give false positive results. The accurate diagnosis of sinus venosus defect or partial anomalous pulmonary venous connection is quite difficult in adults using transthoracic windows (Figure 5). Approximately 30% of the population have patent foramen ovale (PFO). This condition has been reported to be associated with paradoxical thromboembolism. TOE has a higher sensitivity for detecting a PFO (99%) than TTE (76%) does. Right to left shunting can be easily confirmed by intravenous injection of agitated saline mixed with blood (Figure 6).

Management decisions in patients with potential cardioembolic sources should be based on clinical judgement rather than findings based on the echocardiogram alone. TOE should not be performed as a routine diagnostic procedure in all patients with suspected systemic embolism. Clinical features and findings on TTE should be used to identify patients in whom TOE will have a significant diagnostic yield. TOE is indicated in younger patients with otherwise unexplained events or in patients who have an abnormal TTE. TOE should only be requested if a positive finding is likely to affect the management of the patient.

Aortic dissection

Aortic dissection is a medical emergency and early diagnosis is vital. Angiography, TOE, CT scan or MRI can all confirm the diagnosis (Figure 7). The diagnostic modality of choice depends on the availability of the various imaging techniques. If TTE can be performed in the A&E, then it is worthwhile as it may show a flap in the aortic root or pericardial fluid. The sensitivity and specificity of TOE for the diagnosis of dissection are 99% and 98%, respectively, while those for CT scan are 83% and 100%, respectively. The advantage of TOE is that it can be performed at the bedside in an unstable patient.

The distal ascending aorta is difficult to visualise from the oesophagus and the distal abdominal aorta can not be examined using TOE. If there is a doubt about the diagnosis on TOE, confirmation should be obtained by further imaging with MRI or a CT scan.

Congenital heart disease

TTE provides good images in a majority of paediatric patients. In complex congenital heart diseases and in patients with a history of previous surgery, TOE provides potentially better assessment of the intracardiac morphology in postoperative situations and in virtually all cases provides superior diagnostic information (Figure 8).

Early cardioversion

TOE is being increasingly requested prior to early cardioversion. A study by Klein et al. of 126 patients showed that TOE guided cardioversion with short-term anticoagulation is feasible and safe. The use of TOE may allow early cardioversion and may decrease the risk of embolism. The one advantage with the conventional approach of 3-week delay was that 31% of the patients in conventional therapy group reverted spontaneously to sinus rhythm. Larger trials are awaited for further confirmation of their findings.

Intraoperative use

Intraoperative guidance TOE is valuable in valve repair, allowing the surgeons to evaluate and refine operative technique. It also provides immediate feed back on the outcome.

Complications

Rare complications of TOE include pharyngeal and oesophageal injury, hematemesis, aspiration, laryngospasm, respiratory depression, hypotension, hypertension and arrhythmia. All of the above are minimised by adequate patient preparation, cautious use of sedation and per-operative monitoring. Mortality rate reported in one series was 0.0098%.

Conclusion

Transthoracic approach should not be ignored, and its use is mandatory in helping to select patients who may require TOE, thus reducing the number of unnecessary semi-invasive examinations. When the diagnosis is in doubt or certain questions remain unanswered, TOE should be performed. It is a safe procedure, even in critically ill patients, and can be performed at the patient's bedside.

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