New techniques in medicine

Transoesophageal echocardiography

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Summary

Transoesophageal echocardiography gives unparalleled views of the posterior structures of the heart. It is the investigation of choice for the diagnosis of acute dissection of the aorta, in patients with endocarditis, management of the hypotensive patient in the intensive care unit, and in the search for a potential cardiac source of thromboembolism. However, it is a semi-invasive procedure, and proper training is required to carry it out safely, to ensure that maximum information is obtained at the time of examination, and to avoid diagnostic pitfalls.

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Figure 1 Thrombus present in the left atrial appendage (LAA)

Transthoracic echocardiography has become one of the most useful techniques in cardiology. However, it is not always possible to get good views via the chest, especially of the posterior structures, the mitral valve and left atrium. The idea of looking at the heart from the oesophagus is not new and in 1976, Frazin *et al* described their initial experience with an ultrasound transducer that was passed into the oesophagus but the transducer was unstable.¹ In the 1980s the ultrasound transducers were attached to flexible endoscopes, giving easier positioning of the probes and the development of transoesophageal echocardiography (TOE). Further advances have occurred and now probes are smaller and capable of multiplane viewing by mechanically or electronically rotating the scanning plane through 180°.

The transoesophageal echocardiographic examination

Like upper gastrointestinal endoscopy, TOE is an invasive procedure and should only be performed by those who have received adequate training. The advantage of TOE is that it can be performed virtually anywhere, in wards, outpatients, the operating room or in Accident and Emergency departments. The patient should fast for at least four hours before and it is important to exclude any history of dysphagia or gastro-oesophageal disease. In most patients the study can be done without any premedication. Patients with suspected aorta dissection or those who are uncooperative, may need sedation. Usually antibiotic prophylaxis is not necessary. A pulse oximeter probe and automated blood pressure device are usually recommended. The risk associated with TOE is low. In the European multicentre study,² out of 10 419 TOE examinations, the probe could not be inserted successfully in only 1.9%, and the examination had to be interrupted because of the patient's inability to tolerate the probe, primary cardiac or bleeding related complications in 0.9%. One patient died during the procedure (mortality 0.01%).

Although the aim of the study should be to answer the main clinical question posed, it is important to do a complete examination of all regions of the heart and the great vessels. The usual scanning planes, horizontal and vertical, are illustrated in figure 1.

Pitfalls of TOE

Because endocardial structures are seen so clearly with TOE, some normal variations may be misdiagnosed as pathological. The most common pitfalls are listed below:

- Atrium muscular trabeculations and irregularities are seen in the walls of both atrial appendages. These muscle ridges are usually small, reflectile and typically multiple. They have to be distinguished from thrombus which is characteristically of a different texture than the atrial wall and more echo refractile with uniform consistency. Tumours which extend into the atria also have a different echo density. On occasion, the origin of the pulmonary veins are encircled by tissue that may appear mass-like in some sections. The wall separating the left atrial appendage from left upper pulmonary vein in certain sections can look particularly globular and therefore like a mass mimicking a left atrial tumour. In the right atrium the orifice of the superior and inferior vena cava often has muscle bundles that can appear mass-like.
- Atrial septum. Occasionally fat-laden masses are found in the septum around the fossa ovalis. In older patients the fat in this area can be up to 1 cm thick and occasionally larger.
- Tricuspid annulus. Fatty tissue is often present at the free wall at the end of the tricuspid annulus. Occasionally this is quite large and can produce a mass-like effect. It is important not to misinterpret this as a tumour or a ring abscess.
- Aortic valve. If the aortic valve leaflets are cut obliquely, then the normal valve appears to have a mass which may be incorrectly thought to be a

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Indications for TOE in endocarditis

- blood cultures ‘negative’ with high clinical suspicion
- prolonged clinical course
- persistent fever or raised CRP
- lack of response to antibiotic therapy
- deteriorating haemodynamics/ increasing valvular regurgitation
- prosthetic valve endocarditis

Box 2

Diagnosis of acute aortic dissection

Advantage of TOE

- readily available
- rapid
- performed at bedside
- no intravenous agent
- low cost

Disadvantage of TOE

- operator dependent
- invasive

Box 3

Figure 4 Examples of dissection of the aorta showing the true lumen (TL) and large false lumen (FL) divided by the intimal flap

ENDOCARDITIS

The diagnosis of infective endocarditis still depends on the combination of clinical signs and blood cultures. However, the demonstration of vegetations can support the diagnosis or, in cases where the blood culture is negative, indicate a search for unusual organisms. TOE is substantially better than transthoracic echocardiography for the detection of vegetations. In one study of patients with endocarditis confirmed by surgery or at autopsy, vegetations were detected by transthoracic echocardiography in 58% and by TOE in 90%.¹¹ Shively *et al* reported that TOE had a sensitivity and a specificity of 94 and 100%, respectively, for the detection of vegetations.¹² TOE cannot rule out the presence of endocarditis completely but the probability of the disease is very low if a TOE examination is completely normal. Moreover, the size of vegetations is important and some studies have indicated that vegetations >10 mm in diameter have a greater risk of embolism.¹¹ TOE is also superior to transthoracic echocardiography for the detection of abscesses. In the study by Daniel *et al* the sensitivity and specificity for the detection of abscesses was 87 and 95% for TOE and 28 and 99% for transthoracic echocardiography.¹³ TOE therefore is indicated in patients where there is a clinical suspicion of endocarditis and a transthoracic echocardiogram or blood cultures are inconclusive, in all patients with a prolonged clinical course, persistent signs of infection or lack of response to antibiotic therapy, deteriorating haemodynamics or increasing regurgitation, and in patients with prosthetic valve endocarditis.

AORTIC DISSECTION

TOE is now the diagnostic tool of choice.^{14,15} Nienaber *et al*¹⁶ compared computed tomography (CT), magnetic resonance imaging (MRI) and TOE, the sensitivities for detecting proximal aortic dissection were similar at 98.3, 97.7, and 93.8%, respectively. In this particular study, the specificity of TOE (77%) was lower than CT (87.1%) or MRI (97.8%) mainly as a result of false-positive findings in the ascending aorta. MRI and TOE were better than CT for identifying the entry side or aortic regurgitation. However, the results with multiplane TOE are likely to be better and in other studies TOE has been shown to have a sensitivity and specificity of 99 and 98%, respectively, for diagnosis of aortic dissection, compared with 88 and 94%, respectively, for angiography (table).¹⁷ TOE has the advantage of being portable and usually readily available, so that these patients can be studied in the intensive care unit, if necessary. The hallmark of a dissection on a TOE is the intimal flap (figure 4). Occasionally in the longitudinal view it can be seen to be undulating and there may be systolic expansion of the true lumen and compression of the false lumen. The false lumen may contain contrast echos due to the low velocity flow and variable amounts of thrombus are seen. In addition, with TOE, the degree of aortic regurgitation (in Type A dissection), presence of pericardial effusion, left ventricular function and involvement of the coronary arteries by the dissection can be assessed.

PROSTHETIC HEART VALVES

Studies have demonstrated that TOE is superior to transthoracic echocardiography for the assessment of prosthetic valves and provides more anatomical and functional information.¹⁸⁻²⁰ Degeneration of the leaflets of biological valves, attachment of thrombi or vegetations can be seen more clearly and the differences between transvalvular and paravalvular leaks can be more reliably differentiated.

TOE IN THE INTENSIVE CARE UNIT

The use of TOE in critically ill patients in the intensive care unit is increasing, especially in patients with unexplained hypotension. In a study by Foster and

Table TOE and suspected dissection of the aorta (from ref 17)

	TOE	CT	Aortography
Sensitivity	+++	++	++
Specificity	++/+++	+++	+++
Site of intimal tear	++	+	++
Presence of thrombus	+	++	+++
Presence of aortic regurgitation	+++	—	+++
Pericardial effusion	+++	++	—
Branch vessel involvement	+	+	+++
Coronary artery involvement	+	—	++

+++ = excellent; ++ = good; + = fair and — = not detected.

Schiller of TOE in 69 critically ill patients, unexpected findings were identified in 25% which led to treatment changes in 17% of the patients.²¹ Similarly Oh *et al*²² found that TOE demonstrated the cause of illness in 59% of 51 patients in the intensive care unit who had inadequate transthoracic echocardiograms and in 24% of these, the findings of TOE led to cardiac surgery.

TOE DURING SURGERY

Interoperative TOE with colour-Doppler has replaced traditional procedures for the assessment of the adequacy of mitral and tricuspid valve repair.²³ In addition, TOE is increasingly used for assessment of left ventricular function and the early detection of myocardial ischaemia during and immediately after cardiac or noncardiac surgery.^{24,25}

CONGENITAL HEART DISEASE

With the availability of smaller probes, TOE is increasingly used in children and adults with congenital heart disease. In children the use of TOE must be balanced against the requirement for heavy sedation and the fact that the current probes are not ideal. In particular, cyanotic patients or those with low cardiac output should be monitored very carefully during the TOE procedure.

OTHER CONDITIONS

TOE is very useful for detecting and assessing atrial tumours, including tumours spreading into the pulmonary veins. Another area which is of research interest is the detection of coronary artery blood flow. Proximal segments of the coronary arteries can be visualised by colour flow Doppler with TOE and with pulsed Doppler coronary blood flow and coronary flow reserve estimated.²⁶

Conclusion

TOE is an extremely useful tool for the assessment of cardiac patients. The main indications for its use are the diagnosis of acute dissection of the aorta, assessment of patients with endocarditis and searching for a potential cardiac source of embolism and for these particular conditions TOE is now the investigation of choice.

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