CLINICAL UTILITY, SAFETY, ACCEPTABILITY AND COMPLICATIONS OF TRANSOESOPHAGEAL ECHOCARDIOGRAPHY (TEE) IN 901 PATIENTS

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ABSTRACT

Transoesophageal echocardiography (TEE) has earned an important role in the evaluation of patients with cardiovascular diseases. We report our TEE experience in 901 patients who had suboptimal transthoracic echocardiographic studies performed between September 1989 and June 1993. The patient-population consisted of 459 females and 442 males, with an ethnic distribution of Chinese 76.5%, Malays 12.7%, Indians 8.5% and Others 2.3%. The mean age was 48 years. The main indications for TEE were: cardiac source of embolism (27.5%); native valve pathology (19.1%); atrial septal abnormality (9.7%); infective endocarditis (8.3%); intracardiac masses (7.0%); prosthetic valve dysfunction (6.3%); congenital heart diseases (4.6%); aortic diseases (3.4%) and miscellaneous (14.1%). The majority of the studies were done on in- and out-patients, with only 1.2% performed in the intensive care area and 1% intraoperatively. 82.6% of TEE intubation were accomplished within one minute and most of the TEE studies were completed within twenty minutes. There were ten failures (1.2%). Major complications occurred in 5 patients (0.6%) but there was no mortality. 90.5% of the studies were considered by the operators as additionally-informative or useful for clinical decision making. In a subgroup analysis, 90.6% of the patients who had undergone TEE indicated their willingness for repeat studies if required and TEE was able to increase the sensitivity of detecting a potential cardioembolic source from 10.3% to 29.5%.

In conclusion, with increasing experience, TEE can be performed expeditiously and safely, with good acceptability by our local population. TEE provides useful or additional information that supplements standard transthoracic echocardiography in a wide-ranging spectrum of cardiac conditions.

Keywords: transoesophageal echocardiography, complications

SINGAPORE MED J 1995; Vol 36: 479-483

INTRODUCTION

Standard transthoracic echocardiography (TTE) has established an undisputable role in the evaluation of patients with cardiovascular disease. However the thoracic anatomy may impose restrictions on cardiac imaging by ultrasound, such as in the presence of obesity, emphysema and thoracic and skeletal deformities. The use of respirators and other adjunctive and miscellaneous equipment in the intraoperative or immediate post-surgical period also frequently renders TTE technically difficult, if not impossible. It was for these reasons that transoesophageal echocardiography (TEE) was introduced during the late 1970s. Since then, TEE has been shown to improve ultrasound diagnostic capabilities in various cardiovascular diseases compared with conventional, standard TTE[1,2]. We acquired our first TEE probe in September 1989 and are reporting our TEE experience in 901 patients.

MATERIALS AND METHOD

This was a prospective study of patients who had TEE performed in our echocardiographic laboratory between September 1989 and June 1993. All patients had prior comprehensive, standard TTE studies. Subsequent TEE was performed for specific indications in patients with no contraindications (Table I) to TEE. Only cardiologists familiar with standard echocardiography and with previous training in endoscopic intubation, as recommended by the American Society of Echocardiography, were allowed to perform the TEE studies. TEE was done either in the echocardiographic laboratory, intensive care area or the operating theatre.

Table I – Contraindications for TEE

Absolute contraindications
1. Lack of informed consent
2. Lack of expertise in intubation of TEE scope
3. Oesophageal obstruction
4. Upper gastrointestinal bleeding
5. Suspected oesophageal perforation
6. Gastric volvulus
7. Suspected neck injury
Relative contraindications
1. Severe cervical spondylosis
2. Oesophageal varices without bleeding
3. Zenker's diverticulum
4. Gastric herniation
5. Uncooperative patient

Technique of TEE study

Patients were fasted for at least four hours prior to their TEE studies. The procedure was carefully explained to the patient and written consent was obtained. Intravenous access was routinely obtained via a hand vein, to be used for intravenous administration of medication or as a life-line. A well-equipped resuscitation trolley and suction apparatus were always in the

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immediate vicinity.

Awake patients were placed in the left lateral, decubitus position facing the operator, with knees and head comfortably flexed. This was to ensure a stable position and smooth introduction of the TEE probe. All dentures were removed prior to the procedure. A topical anaesthetic agent, 10% xylocaine solution, was applied to the posterior pharyngeal wall in all our awake patients, with additional intravenous sedation using midazolam or diazepam in very anxious patients or those with suspected aortic diseases. We did not administer any drying agent nor did we discontinue anticoagulation prior to the TEE studies. Antibiotic prophylaxis was given only in those with a previous history of infective endocarditis and in the presence of prosthetic valves, obviously bad oral hygiene or immunocompromised states. The TEE probe was lubricated with sterile lubricant jelly just before insertion.

The TEE probe was either introduced through a well-placed bite-guard or under the guidance of the operator's fingers before positioning the bite-guard. At about the 20cm mark, the patient was asked to swallow. Together with a little forward pressure, the probe was advanced into the oesophagus and finally into the stomach. Throughout the study, an assistant helped to ensure proper positioning of the bite-guard, allayed the patient's anxiety, monitored the depth mark of the inserted probe, and constantly observed the patient's general condition and respiratory status.

Two different commercially available machines (Hewlett Packard Sonos 1000 and Acuson 128XP) were used. Standard tomographic planes were obtained using the single-plane, or bi-plane TEE probes[3]. The images were videotaped in the VHS system.

RESULTS

A total of 901 patients underwent TEE studies between September 1989 and June 1993. The patient-population consisted of 459 females and 442 males, with an ethnic distribution of 689 (76.5%) Chinese, 114 (12.7%) Malays, 77 (8.5%) Indians and 21 (2.3%) Others. The mean age was 48 years old (range 13 to 86 years old). The main indications for TEE are summarised in Table II. TEE studies were performed on 463 (51.4%) ambulatory in-patients and 360 (39.9%) ambulatory out-patients. Only 11 (1.2%) patients and 9 (1.0%) patients had their TEE done in the intensive care area and the operating theatre, respectively. One hundred and twenty-two (13.5%) patients needed additional intravenous sedation such as midazolam, diazepam or morphine prior to the TEE studies. These were very anxious patients or those suspected of having aortic dissection or aortic aneurysm. At the time of the procedures, 107 (11.9%) patients who were on intravenous heparin or oral anticoagulation for thromboembolic diseases or prosthetic valves continued to have the medication. Antibiotic prophylaxis, given according to AHA/ACC recommendations, were administered to only 114 (12.7%) patients.

Table II - Indications for TEE in 901 patients

Indications	*No*	*(%)*
Cardiac source of embolus	248	(27.5)
Native valve pathology	172	(19.1)
Atrial septal abnormality	87	(9.7)
Infective endocarditis	75	(8.3)
Intracardiac masses	63	(7.0)
Prosthetic valve dysfunction	57	(6.3)
Congenital heart disease	41	(4.6)
Aortic diseases	31	(3.4)
Miscellaneous	.127	(14.1)

The TEE probe was successfully and easily introduced within one minute into the oesophagus in 744 (82.6%) patients. However, there were ten failures (1.2%) and three aborted studies (0.3%) which occurred predominantly during our early experience. Successful TEE was performed in 847 (94.2%) patients, and the TEE study time was within twenty minutes in 85% of the patients. Major complications occurred in five (0.6%) patients. These included buckling of the transducer probe in two patients, gastrointestinal mucosal contusion and bleeding in one, cerebrovascular accident in one and dislocation of the jaw in the remaining one patient who subsequently admitted to a preceding history of recurrent jaw dislocation. There was no mortality directly related to the TEE procedures. Ninety-one percent of the TEE studies were considered by the operators to be useful or to provide additional information necessary for confirmation or exclusion of diagnosis. In a subgroup analysis, 203 patients were asked whether they would undergo another TEE study if necessary. One hundred and eighty-four (90.6%) patients indicated their willingness to do so, while only 19 (9.4%) patients refused repeat studies. Seventy-eight patients who developed ischaemic stroke or transient ischaemic attacks had computed tomographic scans and transthoracic echocardiographic studies. Transthoracic echocardiography revealed a possible cardiac source of embolus in only eight (10.3%) patients, while TEE demonstrated this in twenty-three (29.5%) patients.

DISCUSSION

TEE is a valuable complementary technique to standard TTE. For example, TEE is superior to TTE when evaluating prosthetic valves, especially in the mitral position and has been shown to provide 48% additional information on mitral prosthetic malfunction in 'normal' TTE studies[4,5]. TEE had also been shown to provide valuable and additional information on morphologic conditions and flow pathology in aortic valve prostheses[6]. In addition, the sensitivity and specificity of TEE for the diagnosis of aortic dissection are 99% and 88% respectively, compared with 83% and 100% for computed tomography and 88% and 94% for angiography. TEE also allows not only visualisation of the intimal flaps and tears but also differentiation of true and false lumens, detection of pericardial effusion, left ventricular function and assessment of aortic regurgitation[7,8]. In the study of infective endocarditis, the clinical value of TEE was shown to provide better image quality, especially when the vegetations were small. Atrial septal abnormality and intracardiac masses were all better seen with TEE. In our study, 90.5% of the TEE studies were considered by the operators to be informative or useful for clinical decision making.

Twenty patients (2.2%) had their TEE performed in the operating theatre or intensive care area. The technique of TEE probe insertion is slightly different from that of the awake patient. In the unconscious or anaesthetised patient, absence of the swallowing reflex renders the advancement of the probe slightly more difficult. On the other hand, the absence of gag reflex and the presence of the endotracheal tube make vomiting and accidental intubation of the trachea less likely complications. Under these circumstances, maintaining the probe in the midline position during introduction is mandatory. Rarely will one need to use the laryngoscope for introduction of the probe under direct vision. TEE examination in critically ill patients has been shown to be not only safe but also informative[9,10].

Our complication rate (0.6%) and failure rate (1.2%) for probe intubation are comparable to that of the European multicentre survey that involved more than 10,000 examinations[11]. Our patient who developed contusion of the oesophageal mucosa and gastrointestinal bleeding was later found

to have thrombocytopenia. The bleeding stopped with conservative medical treatment. The patient who developed ischaemic stroke during TEE examination was an elderly man who presented to the cardiothoracic unit for arterial embolisation. TTE revealed a possible intracardiac thrombus and hence TEE was scheduled. The ischaemic stroke presumably was also an embolic episode. This could be related to the manipulation of the TEE probe resulting in the dislodgement of a residual intracardiac thrombus[12]. However, it could also be due to a coincidental new arterial embolisation as the patient's initial presentation was arterial embolisation to the lower limb. There was some difficulty in inserting the probe in two patients due to buckling within the lumen of the oesophagus, but further advancement of the probe into the stomach allowed it to be easily withdrawn. No further complication was encountered. Our experience in TEE did not result in any death directly related to the procedure. There was one reported death in the European multicentre survey, and one unexpected death in the Mayo Clinic experience.

Our patients' tolerance to the TEE procedure was surprisingly good as attested to by the fact that 184 (90.6%) of a subgroup analysis of 203 patients indicated their willingness for repeat studies if required. This indicates that TEE is an acceptable and well tolerated procedure by our local patients.

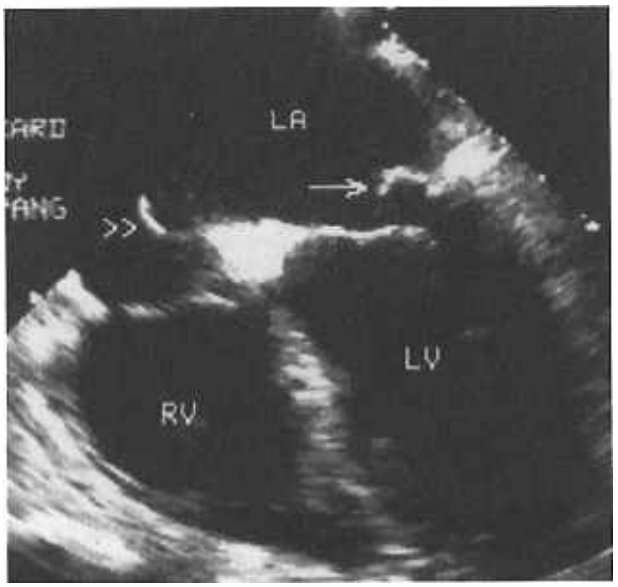
TEE was superior to TTE in the detection of a possible cardiac source of embolism[13]. Our subgroup analysis demonstrated that TEE was able to increase the sensitivity of detecting a potential cardioembolic source from 10.3% to 29.5%. Additional findings that were not seen by TTE included atrial septal aneurysms, spontaneous echo contrast in the left atrium or left ventricle, atrial septal defects, endocarditis, mitral valve prolapse and atherosclerotic plaques in the ascending aorta. The association between spontaneous echocardiographic contrast and a history of arterial embolisation has been increasingly recognised[14].

Antibiotic prophylaxis was not routinely administered to all our patients. They were given only to high risk subgroups such as those with prosthetic valves, a previous history of infective endocarditis, obviously bad oral hygiene or immuno-compromised states. The American Heart Association guidelines[15] on endocarditis prophylaxis include antibiotic prophylaxis for upper gastrointestinal endoscopy when the procedure is associated with biopsy. Upper gastrointestinal endoscopy without biopsy is considered a procedure in which endocarditis has developed 'rarely',if ever. There has been one case report which suggested a temporal relationship between TEE and the development of bacterial endocarditis[16], as well as a small series with data that supported a high risk of bacteremia during TEE[17]. In these instances the organisms that were isolated were not susceptible to the antimicrobial prophylaxis recommended by the American Heart Association and the final recommendation from the authorities is still pending. We did not encounter infective endocarditis in our TEE series.

CONCLUSION

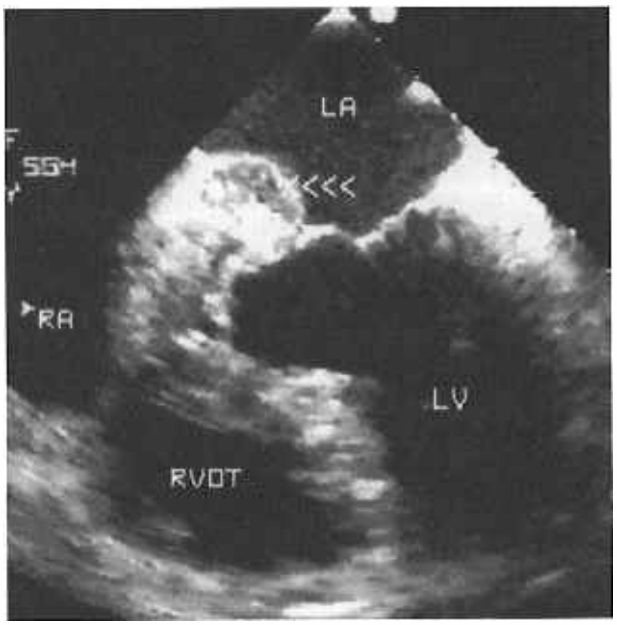
TEE has opened a new 'window' to the heart. The procedure is semi-invasive, but its portability, widespread availability, instantaneous diagnostic capability, freedom from radiation and relatively low cost make it a very attractive imaging technique

Fig 1 - Transoesophageal echocardiographic four-chamber view demonstrating flail posterior mitral leaflet which was not clearly seen by transthoracic echocardiogram due to shadowing artifact. Severe mitral regurgitation was later confirmed by colour flow doppler (not shown). The white arrow indicates the flail leaflet. There is associated atrial septal aneurysm as indicated by double arrows.



LA: Left atrium; LV: left ventricle; RV: right ventricle.

Fig 2 - Two dimensional echocardiographic TEE representation of a para-aortic abscess (arrow) due to staphyloccocal prosthetic valve endocarditis.

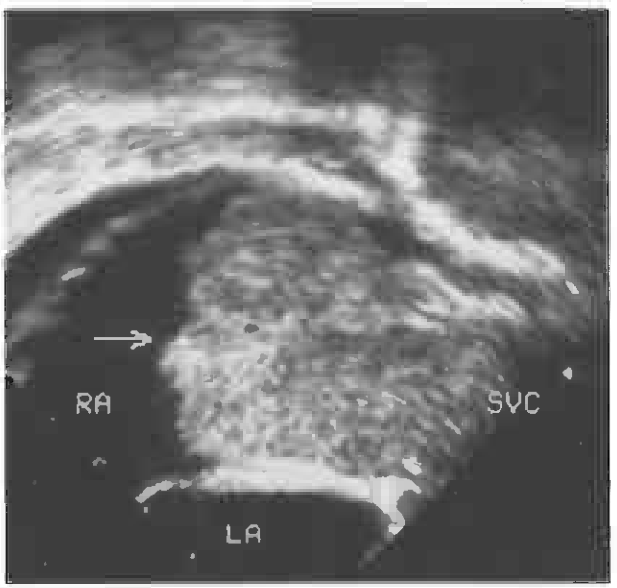


LA: left atrium; LV: left ventricle; RVOT: right ventricular outflow tract; RA: right atrium.

Fig 3 - Transoesophageal echocardiographic image showing perforation (arrow head) of a degenerated bioprosthetic valve (Hancock Valve) in a patient who presented with acute pulmonary oedema.

LA: left atrium; LV: left ventricle.

Fig 4 - Transoesophageal echocardiographic image in longitudinal view demonstrating clearly not only the presence of a tumour mass (arrow), but also its extension into the superior vena cava, in a patient presenting with SVC obstruction. Transthoracic echocardiogram was suboptimal due to gross oedema.



RA: right atrium; LA: left atrium; SVC: superior vena cava.

Fig 5 - Transoesophageal echocardiographic picture demonstrating a large thoracic aneurysm, lined by a partially lysed thrombus (#).

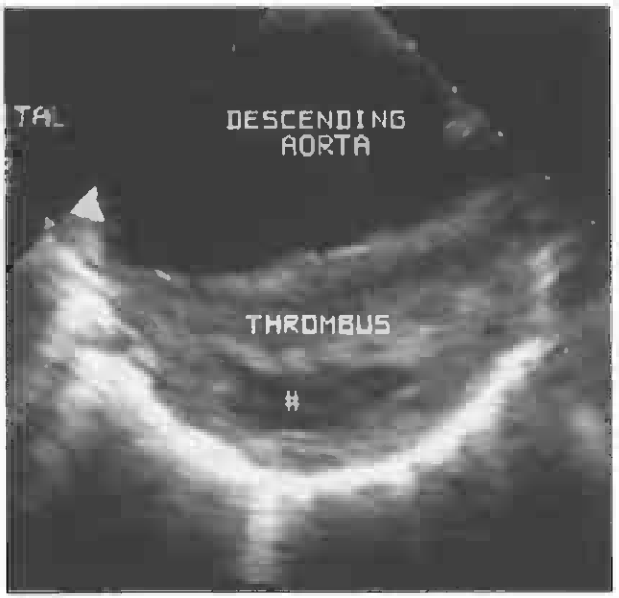
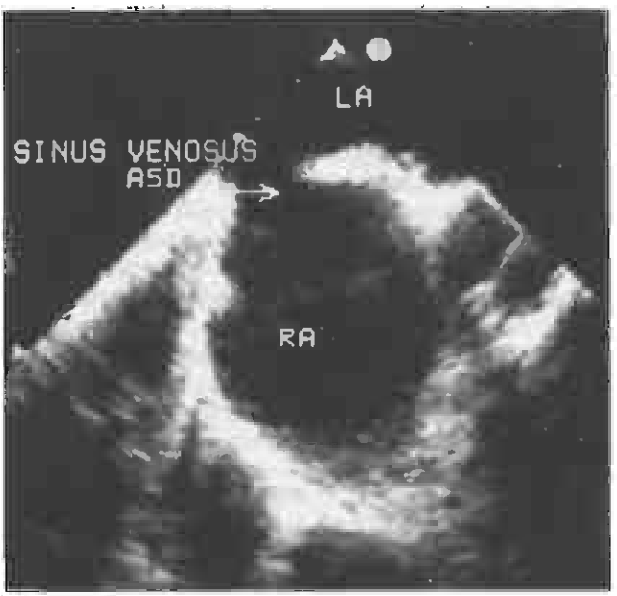
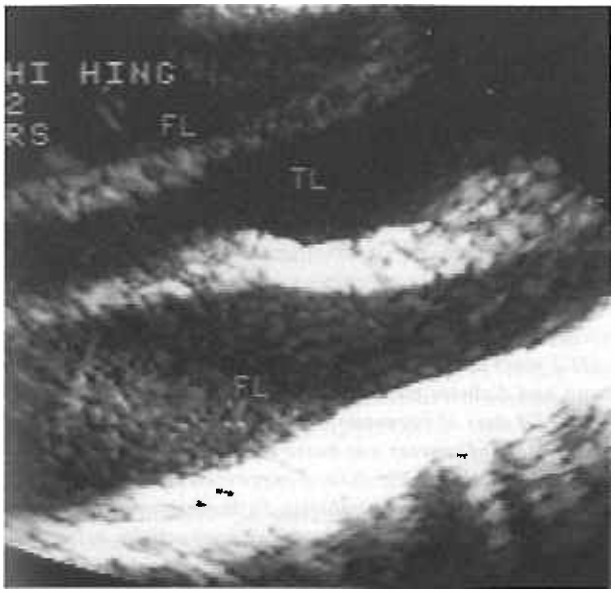


Fig 6 - A transverse plane transoesophageal image from a patient with sinus venosus atrial septal defect. The defect, which is clearly seen in this transoesophageal image, is not demonstrated by the transthoracic echocardiogram.



RA: right atrium; LA: left atrium; ASD: atrial septal defect.

Fig 7 - Transoesophageal echocardiographic, transverse image of the aortic arch shows 'triple lumens' created by a circumferential dissection of the thoracic aorta.



TL: true lumen; FL: false lumen.

for all patients. Our study has demonstrated that, with increasing experience, TEE can be performed expeditiously and safely, with good acceptability by our local patients. It provides useful or additional information in the majority of patients with a wide spectrum of cardiac conditions.

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