Clinical Utility of Transoesophageal Echocardiography in Low Resource Environments: The Jamaican Experience

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ABSTRACT

Objective: *To provide the first detailed review of the indications and clinical utility of transoesophageal echocardiogram (TEE) in the Caribbean.*

Design and Methods: *Data for patients who had TEE performed at the Heart Institute of the Caribbean over a three-year period were abstracted and reviewed. Information gathered included demographic data, indications for the procedure, findings and clinical recommendations. The effect of age and sex on these variables was assessed using the Chi-square or Fishers Exact tests. Significance was set at a* $p \leq 0.05$.

Results: *Of the 116 procedures performed between 2005 and 2008, medical records were reviewed for 107 (50 male, 57 female) patients. The patients ranged in age from 15–86 years with a mean age of 45.4 ± 18.5 years. With the exception of four patients, all attempted TEE were completed. The most common indications for the procedure were valvular heart disease (41.1%), strokes (17.8%), shunts (10.3%) and infective endocarditis (11.2%). Less common indications included arrhythmias, cardiac masses, aortic dissection and shortness of breath. Transoesophageal echocardiogram altered the treatment course in about 30% of all patients including 66.6% of patients referred for suspected infective endocarditis. Furthermore, TEE resulted in recommendation for surgery in 43% of patients referred for evaluation of severity of valvular disease. Minor complications occurred in two persons. No severe complications or deaths occurred as a result of the procedure.*

Conclusions: *Transoesophageal echocardiogram has been most commonly performed to evaluate valvular heart disease in Jamaica without any major complications resulting from the procedure. It provides additional information that supplements transthoracic echocardiography in a wide range of clinical conditions. Measures should be put in place to make TEE more widely available and accessible in Jamaica.*

Keywords: Cardiac imaging, Caribbean, transoesophageal echocardiogram

Utilidad Clínica de la Ecocardiografía Transesofágica en Medios de Bajos Recursos: La Experiencia Jamaicana

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RESUMEN

Objetivo: *Ofrecer un primer examen detallado de las indicaciones y utilidad clínica del ecocardiograma transesofágico (ETE) en el Caribe.*

Diseño y Métodos: *Por un período de tres años, se examinaron y resumieron datos de pacientes a los cuales se les realizó un ETE en el Instituto de Cardiología del Caribe. La información recogida incluyó datos demográficos, indicaciones para el procedimiento, hallazgos y recomendaciones clínicas. Se evaluó el efecto de la edad y el género en estas variables usando las pruebas Chi-cuadrado y el test exacto de Fisher. La significatividad fue establecida en* $p \leq 0.05$.

Resultados: *De los 116 procedimientos realizados entre 2005 y 2008, se revisaron las historias clínicas de 107 pacientes (50 varones, 57 hembras). La edad de los pacientes fluctuó de 15 a 86 años para una*

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edad promedio de 45.4 ± 18.5 años. Con la excepción de cuatro pacientes, todos los ETE planificados fueron realizados. Las indicaciones más comunes para el procedimiento fueron los casos de enfermedad valvular cardíaca (41.1%), accidente cerebrovascular (17.8%), shunts o desviaciones (10.3%) y endocarditis infecciosa (11.2%). Las indicaciones menos comunes incluyeron las arritmias, las masas cardíacas, la disección aórtica y la disnea. El ecocardiograma transesofágico alteró el curso del tratamiento en aproximadamente el 30% de todos los pacientes, incluyendo el 66.6% de los pacientes remitidos por sospecha de endocarditis infecciosa. Además, a partir del ETE se derivaron recomendaciones de cirugía para 43% de los pacientes remitidos para evaluación de la severidad de la enfermedad valvular. Se presentaron complicaciones menores en dos personas. No se produjeron complicaciones severas o muertes como resultado del procedimiento.

Conclusiones: *El ecocardiograma transesofágico se ha realizado más frecuentemente con el propósito de evaluar la enfermedad valvular cardíaca en Jamaica, sin que se hayan presentado mayores complicaciones como resultado de su empleo. Por otra parte, este procedimiento ofrece información adicional que sirve de complemento a la ecocardiografía transtorácica en una amplia gama de condiciones clínicas. Deben tomarse medidas para que el ETE tenga una mayor disponibilidad y accesibilidad en Jamaica.*

Palabras claves: Imaginología cardíaca, Caribe, ecocardiograma transesofágico

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INTRODUCTION

Data from multiple sources indicate that the global pandemic of cardiovascular diseases has a disproportionate impact on low resource nations of the world (1). Low and middle-income countries accounted for nearly 80 per cent of the 36.1 million deaths caused by non-communicable diseases according to the World Health Organization (2). In Latin America and the Caribbean, the cardiovascular disease burden mirrors that in other developing nations. Available data suggest that cardiovascular disease is currently the leading cause of death in almost every country in the area, with 31% of deaths attributed to cardiovascular disease (3). In the Caribbean and Latin America, cardiovascular diseases and associated co-morbidities will be responsible for three times more deaths and disability by 2025, affecting mainly individuals in their mid-life years (4), disrupting the future of families, undermining social structures and depriving nations of workers in their most productive years thus precipitating economic decline and underdevelopment. Ironically, these are countries with limited resources and limited access to advanced technologies and treatment modalities to mitigate the complications resulting from the associated cluster of cardiovascular diseases. Wide-scale adoption and availability of safe and proven techniques for cardiovascular diagnosis and treatment such as transoesophageal echocardiogram (TEE) will improve the quality of care for patients in the region and improve the management of cardiovascular diseases and quality of life while decreasing premature death and disability. It is therefore necessary to document our initial experience with this procedure in a regular and sustained basis in the Caribbean. Transthoracic echocardiography (TTE) has established an undisputable role in the evaluation of patients with cardiovascular disease. However, TTE does have its limitations particularly with visualization of the heart in the presence of chronic obstructive pulmonary disease, obesity, thoracic and skeletal deformities. The use of mechanical ventilators and other adjunctive equipment during the peri-operative period renders transthoracic imaging difficult. These limitations have led to the development of an oesophageal transducer with the introduction of TEE in the late 1970s. Since then, TEE has improved the ultrasound diagnostic capabilities compared to conventional TTE. We were the first to use the multiplane TEE probe in Jamaica and we are reporting our experience in 116 patients. The aim of this study was to review the indications for and determine the impact of TEE on the clinical management of patients referred to the Heart Institute of the Caribbean between 2005 and 2008.

SUBJECTS AND METHODS

The Heart Institute of the Caribbean, established in 2005, is a state-of-the-art comprehensive cardiac diagnostic and treatment facility located in Kingston, Jamaica, and is the only such centre dedicated to cardiovascular care in the English-speaking Caribbean. The Heart Institute of the Caribbean has been dedicated to preventing and treating heart and blood vessel diseases through appropriate use of leading-edge technology, research and education. A TEE database was established at The Heart Institute of the Caribbean in 2005 and reports for TEE performed at the institution between 2005 and 2008 were reviewed. From each TEE report, patient demographic information, indications for the procedure, findings at the time of evaluation, clinical recommendations and reported complications were abstracted. Summary data for the patients who underwent the procedure were obtained and the relationship between the indications

for the procedure and age and sex were examined (Table 2). To assess the impact of TEE on the management of the patients who had been referred, the outcome of each procedure was classified as either positive or negative for the disease condition that was being investigated. The Fishers Exact and Chi-square tests were used to compare groups and explore trends across age and sex categories. Analysis was performed using SPSS and a *p*-value of less than 0.05 was considered significant.

RESULTS

Patient demographics

One hundred and sixteen persons had TEEs performed between 2005 and 2008. Of that number, data were obtained from 107 reports (92% of the participants). The entire TEE at the facility had been performed by one of three cardiologists trained in cardiac imaging and endoscopic intubation as recommended by the American Society of Echocardiography. Patient population consisted of 50 males and 57 females. The average age of the patients was 45.4 ± 18.5 years (47.2 ± 20.4 years in men and 43.8 ± 16.8 years in women). Most were over 18 years old at the time of the procedure with the youngest patient being 15 years old (Table 1).

Table 1: Distribution of referrals for transoesophageal echocardiography by age and sex

Age Group	Male (%) (n =50)	Female (%) (n =57)
≤ 20 years	5 (10)	2 (3.5)
21–30	7 (14)	10 (17.5)
31–40	12 (24)	14 (24.6)
41–50	5 (10)	12 (21.1)
51–60	5 (10)	7.0 (12.3)
61–70	5 (10)	8.0 (14)
≥ 71	11 (22)	4.0 (7)

p-value, 0.190

Referral patterns and adverse outcomes

The Heart Institute of the Caribbean started offering TEE in 2005, the same year it was established. Just over half the patients (54%) were referred by private practitioners. The cost of the TEE was subsidized by the Heart Institute of the Caribbean for one third of the participants. The TEE procedure was completed in 96% of the participants but had to be aborted in four persons: two patients were uncooperative, one patient had difficulty with intubation and in the fourth patient, oesophageal webs prevented the probe from being advanced into position. A limited study was performed in two patients – due to retching during the procedure in one patient and tachycardia in the other. Two patients experienced hypotension, thought to be related to the procedure.

INDICATIONS

The most common indication for TEE was valvular heart disease (41.1%), with mitral valve disease or suspicion of mitral valve diseases accounting for over 70% of these cases. Eighteen per cent of the procedures were to look for a cardiac source of stroke and 10.3% were being investigated for shunts. There was no sex difference in the procedures carried out for these indications (Table 2).

Table 2: Indications for transoesophageal echocardiography by sex

Indication	Male (%) (n = 50)	Female (%) (n = 57)	Total no of studies (%) [n = 107]
Infective endocarditis	7 (14)	5 (9)	12 (11.2)
Valvular heart disease	16 (32)	28 (49)	44 (41.1)
Aortic aneurysm	3 (6)	0 (0)	3 (2.8)
Stroke	8 (16)	11 (19)	19 (17.8)
Congenital heart disease	1 (2)	2 (4)	3 (2.8)
Shunts	5 (10)	6 (11)	11 (10.3)
Cardiac masses	2 (4)	2 (3.5)	4 (3.7)
Arrhythmias	3 (6)	0 (0)	3 (2.8)
Others	5 (10)	3 (5.3)	8 (7.5)

Impact of transoesophageal echocardiograms

The impact of TEE was assessed according to the indications listed below (Table 3).

Table 3: Impact of transoesophageal echocardiography for major clinical indications

Indication	patients referred	(+ve) impact n (%)
Infective endocarditis	12	8 (66.6)
Valvular heart disease*	44	7/16 (43)
Aortic aneurysm	3	1 (33.3)
Stroke	19	9 (47)
Shunts**	11	3 (27.2)
Cardiac masses	4	2 (50)
arrhythmias	3	0 (0)

*7 out of 16 patients with established valvular heart disease prior to the procedure were referred to surgery based on TEE findings. In the remaining 28 patients, TEE confirmed the valvular defects in 81% of patients.

**Intracardiac shunts were found in an additional 7 patients who were referred for other indications.

***Valvular heart disease*:** Of the 44 patients who had TEE for valvular heart disease, 16 had established valvular disease prior to study. Of these 16 patients, surgical repair of the affected valve(s) was recommended in seven, while continuation of medical treatment and serial evaluation was recommended in eight patients. One patient was considered inoperable. Of the remaining 28 patients, valvular defects were confirmed in 81%.

Stroke: Transoesophageal echocardiography identified a cardiac source for a stroke (left atrial appendage) in 9 (47%) who had this procedure performed for this indication.

Shunts: Less than one third of the persons suspected of having shunts had these confirmed by TEE (one ventricular septal defect, one atrial septal defect and one patent foramen ovale). Seven other persons had incidentally discovered shunts on TEE while having the procedure performed for other indications: two had atrial septal defects, two had ventricular septal defects and three each had a patent foramen ovale discovered.

Infective endocarditis: About two-thirds of those investigated for infected endocarditis were found to have positive echocardiographic findings for endocarditis.

Arrhythmias: No structural abnormalities were identified in patients who had the study performed for evaluation of arrhythmias.

Aneurysm: Three patients had TEE for this indication. One patient was found to have an ascending thoracic aneurysm on TEE, located near to the aortic root.

Cardiac mass: Four patients had the TEE performed for evaluation of atrial masses (thrombi or tumours). Of these, two patients were found to have evidence of thrombus. In one patient, this thrombus was located in the left atrial appendage while the other was discovered in the right atrium.

***Other indications*:** Other indications for TEE included evaluation of shortness of breath (4), syncope (1), cardiomyopathy (2) and preparation for cardioversion (1). One patient with shortness of breath had right ventricular dysfunction consistent with acute pulmonary embolism while another had pulmonary hypertension. Other studies were unremarkable for pathology related to their indication.

DISCUSSION

Jamaica, like many developing countries, is experiencing an epidemiological transition (5, 6). Chronic non-communicable diseases including cardiovascular diseases are responsible for nearly half the deaths in the island. Cardiovascular disease was the leading cause of death among hospitalized patients, accounting for 33% of deaths (7). With the changing disease pattern and increasing prevalence of cardiovascular diseases in Jamaica and the wider Caribbean, it is expected that TEE will play an even greater role in the evaluation of patients with cardiac diseases.

The main indications for TEE in our series were valvular heart disease, stroke, infective endocarditis and shunts. In more than half of the patients, significant pathology was identified, and in most cases the findings from TEE contributed significantly to the clinical management of the patient. Transoesophageal echocardiography altered the treatment course in about 30% of all patients including 66.6% of patients referred for suspected infective endocarditis. Furthermore, TEE resulted in recommendation for surgery in 43% of patients referred for evaluation of severity of valvular disease. Except for hypotension and tachycardia in two patients, there were no major complications from the procedure.

Transoesophageal echocardiography offers a higher sensitivity and specificity in the evaluation of valvular heart disease (8) and in those cardiac conditions that predispose to embolic stroke (9) and when imaging those structures that are difficult to view *via* the chest wall. Current evidence supports the view that TEE should be performed routinely in patients who have had transient ischaemic attack (TIA) or stroke of unknown cause (10). The diagnostic yield of TEE for a cardiac source of emboli in patients with unexplained stroke or transient ischaemic attacks is high with potential lesions identified in over 50% of the studies (11). Transoesophageal echocardiography is the procedure of choice for diagnosing infective endocarditis in both native and prosthetic valves (8, 12). It is superior to TTE in detecting small vegetations less than 5 mm and identifying complications such as paravalvular abscesses, fistulae, perforations, prosthetic valve dehiscence and paravalvular regurgitation (13). A negative TEE in a patient with suspected infective endocarditis virtually rules out an infection of the native valve, except in a very early phase of the disease when vegetations may not be detected. Bayer *et al* reported a sensitivity of 76% to 100% and specificity of 94% for TEE for diagnosing infective endocarditis (14).

Transoesphageal echocardiography is a semi-invasive procedure and is applicable in a wide population of patients. It is, however, contraindicated in persons who suffer from conditions affecting the oesophagus including strictures, lacerations, spasms and diverticulae. It is relatively contraindicated in persons with large diaphragmatic hernia, atlantoaxial disease, upper gastrointestinal bleeding and patients who have received extensive radiation (15). In our review, only one patient suffered from one of these conditions that would prevent the procedure from being performed. Potential complications seen are infection, toxic drug reaction from anaesthesia and oesophageal perforation. Complications are usually mild as in slight bleeding from the oesophagus but severe complications like methaemoglobinaemia have been rarely reported (16). No major complications occurred in any of our patients.

Unfortunately, despite its usefulness, low complication rate and versatility, TEE is not widely available in most low resource environments and has limited accessibility in Jamaica and the English-speaking Caribbean. There are several reasons for this including: (i) limited availability of equipment and trained personnel in either the public or private facilities in the region (ii) restricted movement of skilled manpower in the region to support enhanced service

delivery and (iii), low level of awareness of providers and patients of the clinical utility of this procedure.

In summary, TEE can be performed safely in low resource settings with minimal complications. The experience at the Heart Institute of the Caribbean proves that this technique can play an integral role in improving the quality of care and the management of patients with cardiovascular diseases and can be made widely available to patients even in low resource economies. Despite the rising prevalence of cardiovascular diseases in the region, the paucity of capital, skilled personnel and equipment has created an unfortunate mix of circumstances that has made this essential procedure inaccessible to patients in the region. We believe, however, that through careful planning, judicious use of resources, ease of recruitment of trained professionals into the region, this procedure could be made available and affordable to millions of patients in the region and would have significant impact in positively affecting health outcomes for many patients and thus improve quality of life.

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