

TRANSESOPHAGEAL ECHOCARDIOGRAPHY (TEE), A WINDOW TO THE HEART IN PEDIATRIC CARDIOLOGY AND PEDIATRICS

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TEE offers an excellent view of the heart because the ultrasonic beam is unobstructed by lung or chest wall. Physicians performing this examination technique need a specific level of expertise and must be aware of the invasive character in small children. A thorough knowledge of the natural history of defects, interventional techniques, palliative and corrective surgical approaches, long term sequelae and potential complications of the examination is mandatory. The author focuses on indications, imaging technique, and applications of TEE to the anatomic and hemodynamic assessment of the patient with congenital heart disease. Selected examples illustrate this fascinating diagnostic tool which has become important in the management of the severely compromised child on the ICU and the OR.

Descriptors: TRANSESOPHAGEAL ECHOCARDIOGRAPHY; CONGENITAL HEART DISEASE

INTRODUCTION

Transthoracic echocardiography has become the primary non-invasive diagnostic tool in the assessment of congenital heart disease and hemodynamics in children. Further, this technique is part of a pediatric cardiologist's diagnostic tools for congenital heart disease in adult patients who appear in yearly rising numbers. The rapid development and refinement of interventional procedures in the catheter laboratory and operating room have led to more complex diagnostic questions that need to be answered before or during the procedures. The transesophageal window for imaging the heart is ideal because of its direct retrocardiac position without intervening structures that limit image quality. Over the past ten years the utility of TEE in pediatric patients has been well documented (1, 4, 6-9, 10, 12).

TECHNIQUE

Technical development has led to multiplane (scan plane operator directed from 0° to 180°) pediatric ultrasound probes with a maximum width of 8-10 mm. These probes can be passed in patients weighing as little as 2.5 kg. Further, new and even smaller probes designed for intracardiac application could be used as transesophageal transducers in neonates. Probe passage is uncomfortable and either requires patient cooperation or, especially in neonates and infants deep sedation/endotracheal intubation. The use of anaesthetic spray or gel in the conscious patient is helpful. In adults dental fixtures must be removed. The use of prophylactic antibiotics to prevent bacterial endocarditis is generally not recommended although it may be used in the high-risk patient. After introduction into the esophagus, the probe is passed to a retrocardiac position where excellent images of the heart can be obtained. The probe can be manipulated by advancing/withdrawing/rotating and flexing of the transducer.

Generally, it is useful to follow a standard basic examination sequence:

- distal aortic arch, descending aorta,
- basal short axis scan of great vessels,
- basal short axis scan of aortic valve,
- long axis scan of left ventricular outflow tract,
- long axis scan of mitral valve and left ventricle,
- basal short axis scan of left atrium/appendage, left pulmonary veins,
- imaging of the interatrial septum, right pulmonary veins,
- long axis scan of tricuspid valve, right ventricle at the level of the anterior mitral valve leaflet,
- long axis scan of tricuspid valve, right ventricle at the level of the coronary sinus,
- transgastric short axis mid-chamber scan of right and left ventricles.

Other standard sequences may just as well be adopted (2, 5). Specific variations of standard planes are useful, shorter problem-orientated examinations may be applied in certain settings (i.e. intraoperative, during interventional catheter procedure, hemodynamic monitoring).

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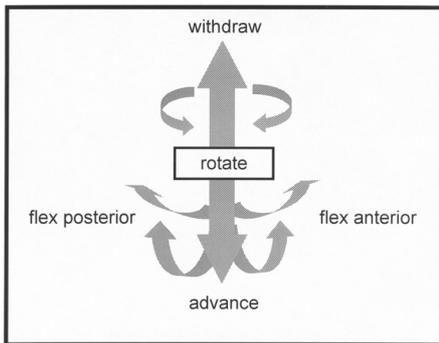


Figure 1
Operator directed movements of the TEE probe

Slika 1.
Pravci pokretanja sonde za TEE

INDICATIONS

Since transesophageal echocardiography is invasive and rarely adds significant information in neonates and children, its primary utility for pediatric cardiologist and intensivists lies in monitoring surgical or interventional procedures. In complex congenital heart disease with unusual morphology in the outlet-tract or valvar/subvalvar region the surgeon may feel more comfortable with as detailed information as possible before planning surgery. In contrast to intracardiac structures, extracardiac lesions like coarctation or branch pulmonary artery stenosis can be more difficult to visualise because of interfering pulmonary tissue. Without doubt, intraoperative TEE is extremely helpful in identifying details during: repair of Fallot, palliation of complex single-ventricle, closure of ventricular septal defects and reconstruction of valves. Also, intraoperative TEE may be helpful in monitoring cardiac function during and after weaning from extracardiac circulation. Interventional procedures modifying congenital heart disease also benefit from the transesophageal view. Device-closure of septal defects is almost invariably performed with the help of TEE where correct placement of implants is mandatory. Finally, this technique is being used in the pediatric intensive care unit when bandages, chest tubes, open sternum or other obstacles obstruct clear view of cardiac morphology, hemodynamics or postoperative surgical complications.

Table 1
Author's experience of complications in pediatric TEE using a multiplane pediatric probe. Unselected consecutive patients 2000-2002.

Tablica 1.
Iskustva autora o komplikacijama u pedijatrijskoj TEE uporabom višepovršinske pedijatrijske sonde. Neselektirani uzastopni bolesnici 2000. - 2002.

	n	mean weight (kg)	range weight (kg)	median weight (kg)	failure to advance	vascular obstruction
cathlab conscious sedation	289	23,9	2,4 - 74	15,0	2	0
intraoperative intubated	152	13,0	2,5 - 126	9,8	0	1

COMPLICATIONS

There is no significant morbidity or mortality associated with TEE in the pediatric population. In our own experience failure of passage occurs in less than 1%. We do not examine patients with previous esophageal surgery. Early termination of the examination because of airway obstruction, vascular compression have been reported (11). It is important to keep in mind that removal of the ultrasound probe may result in inadvertent extubation.

IMPLICATIONS

TEE can alter patient management in the operating room in different ways: Identification of additional diagnostic information leading to modification of the surgical approach. We try to avoid this situation by using TEE as additional information in about 30% of our diagnostic cardiac procedures. Identification of relevant residual structural abnormalities in the operating room. Identification of hemodynamic or functional abnormalities requiring alterations of medical management (3, 9).

OUTLOOK

Three-dimensional echocardiography was first developed using transesophageal ultrasound probes and computer based reconstruction. Meanwhile real-time three-dimensional transthoracic matrix probes have been introduced. This may become the door next to the window.

LITERATURE

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Sažetak

TRANSEZOFAGEALNA EHOKARDIOGRAFIJA (TEE), PROZOR U SRCE U PEDIJATRIJSKOJ KARDIOLOGIJI I PEDIJATRIJI

Martin AG Lewin

TEE nudi izvrstan pogled u srce jer prolaz ultrazvučnog snopa nije opstruiran plućima ili torakalnim zidom. Liječnik koji izvodi ovu vrstu pretrage mora imati specifični nivo poznavanja ove vještine te mora biti svjestan invazivnog karaktera ove metode u male djece. Uz ovo je obvezatno dobro poznavanje prirode defekta, intervencijskih tehnika, palijativnih i korektivnih kirurških pristupa, dugoročnih posljedica i mogućih komplikacija. Autor se usredotočuje na indikacije, slikovnu pretragu i primjene TEE u svrhu anatomske i hemodinamske procjene pacijenta s kongenitalnom srčanom bolesti. Birani slučajevi ilustriraju ovo fascinirajuće dijagnostičko sredstvo koje je postalo važno u menadžmentu teško kompromitirane djece u JILD i operacijskim salama.

Deskriptori: TRANSEZOFAGEALNA EHOKARDIOGRAFIJA; KONGENITALNA SRČANA BOLEST