ORIGINAL ARTICLE

PEROPERATIVE TRANSESOPHAGEAL ECHOCARDIOGRAPHY: CLINICAL BENEFIT DURING CARDIAC SURGERY

Sadqa Aftab[1], Shams Rashdi[1], Abdul Bari[2], Mudassir Iqbal Darr[2] and Aftab Mehmood[1].

ABSTRACT

Objective: To evaluate the benefit of peroperative Transesophageal echocardiography (TEE) during cardiac surgery.

Design: An observational analytic study.

Place and duration of study: This study was carried out in the department of Cardiac Surgery Civil Hospital, Dow Medical College Karachi and Dow University of Health Sciences, from April 2001 to May 2007.

Subject and Methods: In 385 patients undergoing cardiac surgery, preoperative transesophageal echocardiography was performed according to ASA guidelines.

Category 1 in which TEE considered useful, and category 11 are those where TEE is potentially useful but indications are less clear. All TEE examination was reviewed by cardiologist and anesthesiologist. For each patient, the diagnostic decision making and patient care was assessed using three criteria 1) Change in medical therapy; 2) Change in surgical procedure; 3) Confirmation of suspected diagnosis.

Results: TEE had greater utility in category 1 than in category 11 indications 17/70 (25%) versus 57/315 (18%) respectively. The nature of the clinical benefit was as follows: modification of medical therapy in 23/74 (31.08%), modification of planned surgical intervention in 49/74 (66.2%), confirmation of a diagnosis in 2/74 (2.70%). The benefit on therapy was (23.3%) in valvular replacement, (12.6%) in coronary artery bypass surgery and (5%) in congenital heart disease and intracardiac tumors.

Conclusion: present study validate the usefulness of the ASA practice guidelines, demonstrating a greater benefit of TEE on clinical management for category I indications than for category II. The TEE was more useful in diagnostic decision making in valvular replacement rather than other procedures.

Keyword:Transesophageal Echocardiography, Cardiac Surgery, Perioperative benefit.

INTRODUCTION

Echocardiography was introduced in the operating room in 1970, with its initial application involving epicardial echocardiography. The use of transesophageal echocardiography during surgery was first reported in 1980 and did not become common place until high frequency transducer and color Doppler imaging became available in mid 1980's.[1]

The improved quality of image enabled anesthesiologist and surgeons to use TEE intraoperatively to diagnose myocardial ischemia, confirm adequacy of valve reconstruction and other surgical repair, determine the cause of hemodynamic disorders and other intraoperative complications, and provide diagnostic information that could not be obtained preoperatively.[2,3]

Real time access to this information has enabled surgeons to correct inadequate repair before patient leave the operating room, has reduced the need of reoperation and has facilitated the prevention and early treatment of perioperative complications.[4,5]

Several indications for perioperative TEE have become

1. Department of Anesthesiology and Surgical Intensive Care Unit, Civil Hospital Karachi, Dow University of Health Sciences. Karachi, Pakistan.
2. Department of Cardiac Surgery Civil Hospital Karachi, Dow University of Health Sciences, Karachi, Pakistan.
Correspondence. Dr. Sadqa Aftab, Associate Professor Anesthesia, SICU and Pain Management, Civil Hospital, Dow University of Health Sciences, Karachi, Pakistan.
E-mail: sadqaaftab@yahoo.com
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well established and include evaluation of valvular function intra and postoperatively, evaluation of mitral valve repair and prosthetic valve surgery, assessment of global left ventricular function and regional wall motion abnormalities, to assess congenital heart repairs requiring bypass, to see optimal deairing after open heart surgery and evaluation of life threatening conditions requiring immediate intervention.[6] However, its routine use in the management of patients undergoing coronary artery bypass surgery remains controversial.[7]

In 1996, guidelines for perioperative transesophageal echocardiography were published jointly by the Task Force Commission of American Society of Anesthesiologist (ASA) and society of cardiovascular Anesthesiologists. These guidelines were developed to define categories of indications for TEE in the perioperative setting.[8,9] (Table: 1)

The usefulness of intraoperative TEE in clinical management of patients undergoing cardiac surgery has been evaluated only in few studies in our country. The purpose of this study was to review the benefit of perioperative TEE in our clinical practice and to determine the usefulness of category based TEE indications.

PATIENT AND METHODS:

Following departmental approval and informed consent from patients, TEE examination was performed in 392 patients from April 2003 to May 2007 and recorded and analyzed on a data sheet. Category I, II and III indications were defined according to the ASA guidelines on perioperative TEE. For example intraoperative repair of mitral valve or congenital heart repairs are considered category I indications and example of category II indications include assessment of valve replacement, evaluation of removal of cardiac tumor and in patient with increased risk of myocardial ischemia or infarction. The TEE examination were done using a multiplane 5 MHZ transducer (Toshiba power vision 5000) each examination comprised four chamber view and short axis transgastric view, color Doppler interrogation of mitral, aortic and tricuspid valve was also performed. A second opinion by a cardiologist was requested for confirmation and for more specific examinations.

All TEE examination and data sheets were reviewed by anesthesiologist and cardiologist. In the review, the clinical benefit of TEE on current therapy or patient management was noted. This was further classified using three criteria 1) TEE findings altered medical therapy, for instance, adding an inotrope or volume expansion 2) TEE findings altered surgical management, such as unplanned intervention or return to cardiopulmonary bypass 3) TEE findings confirmed a suspected diagnosis.

Statistical analysis was done using SSPS version 10, statistic on patients, modification in therapy are given in percentages.

Table 2: Indications for Perioperative Transesophageal Echocardiography

Category I Supported by strongest evidence or expert opinion	Intraoperative evaluation of acute, persistent and life threatening hemodynamic disturbances Intraoperative use in valve repair, congenital heart surgery requiring cardiopulmonary bypass, repair of hypertrophic obstructive cardiomyopathy, endocarditis, unstable patient with suspected aortic aneurysm, to assess valve function in in repair of aortic dissection, evaluation of pericardial window procedures and in intensive care for unstable patients
Category II Supported by weaker evidence and expert consensus	Use in patients with risk of myocardial ischemia or infarction, increased risk of hemodynamic disturbances, assessment of valve replacement, assessment of repair of cardiac aneurysm, evaluation of removal of cardiac tumor, detection of foreign bodies, detection of air emboli during cardiotomy, heart transplant operation and upright neurosurgical procedures, intracardiac thrombectomy, for suspected cardiac trauma, suspected acute thoracic aortic dissection aneurysm or disruption, detection of aortic atheromatous disease or other source of aortic emboli, pericardectomy, pericardial effusion or pericardial surgery, evaluation of anastomotic sites during heart or lung transplantation, monitoring placement and function of assist devices
Category III Little current scientific or expert support	Intraoperative evaluation of myocardial perfusion, coronary artery anatomy or graft patency, use during repair of cardiomyopathies other than obstructive cardiomyopathy, for uncomplicated endocarditis during non cardiac surgery, monitoring emboli on orthopedic surgery, assessment of repair of thoracic aortic injuries, for uncomplicated pericarditis, evaluation of pleuropulmonary diseases, monitoring placement of intraaortic balloon pumps, automatic implantable defibrillators, or pulmonary artery catheters, intraoperative monitoring of cardioplegic administration

RESULT

During the six year period, 1300 cardiac surgical procedures were performed and TEE was used in 385(29.6%) patients.

Using the ASA guideline, 70(18.2%) of patient had category I indications and 315(81.8%) patient had category II indications. No category III indications were observed in our cardiac surgical procedures.

Among 385 patients, TEE finding caused therapeutic modifications in 74(18.9%) patients (Table 2). The clinical benefit was greater in category I indications where it altered therapy in 24.3% of the time compared with category II indications where therapy was modified only in 18.1% of the time. The diagnostic decision making was greater in patients with valve replacement in23.3% than in patient with coronary artery bypass surgery in12.6% and in patients with congenital heart disease or intracardiac

comprising tumors 5%.
The most frequent reason for changing clinical management was altered surgical management in 49 (66.2%) patients, followed by modification of medical therapy in 23 (31.08%) patients and confirmation of suspected diagnosis in 2 (2.70%) patients.

Table 3. The decision making in altering the surgical procedure was greater in category I than in category II, and benefit in changing medical therapy was greater in category II than in category I

Table 2: Transesophageal echocardiography examination data

No of patients	Total number	Modification in therapy (%)
Category I	70(18.2%)	17(24.3%)
Category II	315 (82.8%)	57(18.1%)
Number of surgical procedures	385	74(18.9%)
Revascularization procedure		
CABG	79 (21%)	10(12.6%)
Valvular surgery		
Valve repair	50 (13%)	
Valve replacement		
AVR	29 (8%)	
MVR	150 (39%)	
DVR	37 (10%)	
Total	266 (69%)	62(23.3%)
Other surgical procedures		
ASD closure	28 (7%)	
Tumor resection	12 (3%)	
Total	40 (10%)	2(5%)

Table 2: Summary of therapeutic modifications related to the use of tranesophageal echocardiography in 385 patients

Modification	Total number
Altered medical therapy	
Adding inotrope or volume expansion	
CABG	5
Valvular surgery	18
Total	23(31.08%
Altered surgical management	
Return on bypass for	
Revision of CABG	5
Modification of planned surgery	
Surgical exploration for hemodynamic instability	19
Valve replacement or repair	15
Valvular replacement cancelled	10
Total	49(66.2%)
Confirmed a suspected diagnosis	2(2.70%)
Total	74

DISCUSSION

The utility of intraoperative tranesophageal has become increasingly more evident as anesthesiologists, cardiologist and surgeons continue to appreciate its potential application as an invaluable diagnostic tool and monitor cardiac performance for the management of cardiac surgical patients.[10]

A present study reviewed our experience, to determine benefit of perioperative TEE in category based TEE indications according to the ASA guidelines in patients undergoing cardiac surgery. It was found that TEE was used more frequently for category II (82%) than for category I (18.58%) indications. However, the benefit was greater in category I indications, changing therapy in 25% of the patient, compared with 18% for category II indications.

TEE had profoundly affected valvular heart surgery by providing the surgical team with a definitive evaluation of their intervention in the operating room where any needed revisions can be accomplished immediately.[11,12] In a study of 154 patients undergoing valve surgery, intraoperative TEE documented unsatisfactory repairs in 10 patients (6%) requiring immediate further surgery.[13] In present study Mitral valve assessed, before and after repair by TEE, the valve morphology, the presence and severity of mitral regurgitation and valve dysfunction. Intraoperative echocardiography revealed a successful mitral valve repair in 50 patients, except 5 (10%) in whom, for persistence of severe mitral regurgitation after repair valve replacement was performed.

In valvular surgery among study patients, the most frequent pre cardiopulmonary bypass finding that influence surgical decision making was change in preoperatively diagnosed valve pathology, as mitral valve was repaired in 10 patients and planned valve replacement was omitted. In another 10 patients double valve replacement (mitral and aortic valve) was performed instead of planned single mitral valve replacement.

Transesophageal echocardiography provides useful information after valve replacement,Allows immediate assessment of operative results,[14] it reliably detects periprosthetic leaks (surprisingly common). Although moderate or severe periprosthetic leaks patient.[15] should almost always undergo immediate repair before chest closure in.

In present study valve malposition was diagnosed in 19 patients after valve replacement, which was the cause of hemodynamic instability.

In addition to its valuable role in altering surgical management in valve surgery, TEE have a benefit during coronary artery surgery, and used as a continuous monitor for regional and global ventricular function and in detecting new regional wall motion abnormalities associated with possible graft kinking or occlusion.[16]

In a study of 50 patients, TEE identified two patients in whom new Segmental wall motion abnormalities provided the only immediate sign of unsuspected graft occlusion and prompted graft thrombectomies.[17]

In present study, a revision of previously placed grafts was required in 5 cases out of 79 patients who underwent coronary artery bypass surgery.

TEE reveals changes in Left ventricular preload, an end diastolic cross section area of less than 12 cm^2 indicates hypovolemia. However, when a volume challenge increases End diastolic cross section area, then stroke volume also increases.[18]

During acute hypotension, qualitative estimates of LV filling and ejection serve as the practical guide for administration of fluids, inotropes, and vasopressors. For example, Severe hypovolemia is easily recognized as a marked decrease in Left ventricular end diastolic cross section area and a marked increase in LV ejection.[19]

In present study, intraoperative TEE examination contributed to medical management in 5 patients undergoing coronary artery bypass surgery, and in 18 patients undergoing valvular surgery by monitoring ventricular function for detecting hypovolemia and hypervolemia, TEE helped in decision making regarding modification in inotropic support and volume therapy.

TEE can reveal unsuspected cardiovascular disease and the need for major changes in management.[20] For example, in a study five of 182 patients scheduled for coronary artery surgery, intraoperative TEE detected unsuspected mitral regurgitation so severe that unscheduled mitral valve repair was performed.[21]

In the present study TEE provided useful information for confirmation of suspected diagnosis, in one out of 12 cases of left atrial myxoma, where the prebypass examination revealed severe mitral valve insufficiency due to invasion of mitral valve by myxoma, that leads to change in surgical procedure i.e. excision of myxoma and mitral valve replacement. In another case TEE detected a small ventricular septal defect rather than subaortic membrane which was diagnosed by transthoracic echocardiography.
Unplanned surgical intervention (45.9% vs. 20.2%) as a result of the TEE examination was more common in category I than II. In altering medical therapy 17.5% in category I and 13.5% in category II.

These results, obtained prospectively in group of patients from a single centre, support the greater benefit of TEE on medical management for category I than category II indications. As secondary findings that present study document, was that TEE influenced most often surgical therapy (66.2%) followed by changes in medical therapy (31.08%) and in confirming a suspected diagnosis (2.07%).

Intraoperative TEE examination was not performed in all patients, specific reason why intraoperative TEE was not performed in the remaining 915 cardiac surgical patients was not available from the data. However in the institution where the study was conducted, intraoperative TEE for valvular surgery was performed on surgeons preference, while in patient undergoing coronary artery artery bypass surgery TEE examination was only done when preoperative ejection fraction was less than 40%.

CONCLUSION

Present study conclude a greater benefit of TEE on clinical management for category I indications than for category II. The TEE was more useful in diagnostic decision making in valvular replacement rather than other procedures.

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