

Intraoperative Transesophageal Echocardiography

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Intraoperative echocardiography in patients undergoing cardiac surgery was first described in 1972¹. Interest in intraoperative echocardiography has grown in recent years due to the extensive information provided by 2-dimensional (2-D) and color-flow Doppler imaging via the transesophageal approach². The value of this technique also has been verified in large clinical studies involving patients undergoing cardiac surgery^{3,4}. Intraoperative transesophageal echocardiography (TEE) is very useful in preoperative formulation of surgical plans and in immediate postoperative assessment of surgical results in patients undergoing valve surgery.

Introduction

This technique has proven to be valuable in assisting in the management of patients undergoing coronary artery bypass graft surgery (CABG) complicated by the presence of ischemic mitral regurgitation (MR)⁴. Significant MR is present in up to 20% of patients with coronary artery disease, and patient survival post-CABG directly correlates with the severity of the residual postoperative MR⁵. Although this may suggest an aggressive approach to ischemic MR during CABG with mitral valve repair/replacement, performing such a combined CABG and mitral valve procedure significantly increases operative mortality⁶. Therefore, the careful selection of patients subjected to combined procedures is imperative. Intraoperative TEE can provide accurate and timely information to guide the surgical approach to therapy of ischemic MR during CABG.

This technique has been used at Straub Clinic & Hospital since May 1991. In our manuscript we describe a case series of our initial experience in 31 patients undergoing intraoperative TEE to assist cardiac surgery. Although patient numbers are small, our early experience with this technique supports its usefulness in selected cardiac surgery patients.

Methods

Patients: Thirty-one patients undergoing cardiac surgery with intraoperative TEE between May 1991 and July 1992 were studied. Fourteen patients underwent surgery for prima-

ry valvular disease (12 mitral valve disease and 2 aortic valve disease with associated MR), 14 patients underwent CABG complicated with ischemic MR, and 3 patients underwent cardiac surgery for other indications (one acute Type I aortic dissection, one aortic valve endocarditis with sinus of valsalva fistula, and one atrial myxoma).

Intraoperative TEE: Two-dimensional and colorflow Doppler echocardiograms were obtained using a Hewlett-Packard 77020AC imaging unit and a 5.0 MHz single plane, esophageal-probe transducer. The probe was placed after general anesthesia induction and endotracheal intubation. Initial images were obtained prior to cardiopulmonary bypass (post-bypass) and followup images were obtained postcardiopulmonary bypass (post-bypass) prior to surgical closure. An effort to increase both preload and afterload through volume expansion was made when necessary to provide comparable loading conditions for pre- and post-bypass TEE. Standard 2-D views with colorflow Doppler imaging were obtained pre- and postoperatively and stored on high-fidelity videotape for later review.

Intraoperative Tee Interpretation: The pre- and post-bypass 2-D and colorflow images were all interpreted during the surgical procedure by a cardiologist and by a thoracic surgeon. All operative decisions then were made on line. Videotapes of all patients studied were reviewed off line for the final interpretation and the results are listed below. The severity of MR was graded 1+ to 4+ as previously described⁴.

Cardiac Catheterization Interpretation: Preoperative cardiac catheterization was performed 3 to 93 days (mean 25.7 days) before surgery in patients with primary valvular disease and 0 to 34 days (mean 11.4 days) before surgery in patients with CABG complicated with ischemic MR. The severity of MR was assessed from single plane ventriculography by consensus agreement of 2 cardiologists on a 0 to 4+ scale as previously described⁷.

Results

Primary Valvular Disease Surgery: The post-bypass TEE was utilized by the thoracic surgeon in 14 primary valvular disease operations. The information provided by post-bypass included the severity of MR and the amenability of the mitral valve for surgical repair. The severity of MR by preoperative angiography and post-bypass TEE are shown in Table 1. MR measured by post-bypass TEE showed excellent correlation

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with preoperative angiography in patients with primary valvular disease (none of 14 patients had significant discordance, ie $> 1+$ difference between post-bypass TEE and preoperative angiography).

Decisions regarding mitral valve repair versus replacement were made intraoperatively utilizing post-bypass TEE data and intraoperative valvular inspection. Five of 12 patients with primary mitral valve disease and 1 of 2 patients with primary aortic valve disease and concomitant MR successfully underwent mitral valve repair. All patients undergoing mitral valve repair had technically satisfactory results as judged by the surgeon and post-bypass TEE.

CABG with ischemic MR: Fourteen patients undergoing CABG with ischemic MR had intraoperative TEEs performed. The results of MR severity measured by preoperative angiography and by post-bypass TEE are shown in Table 2. The post-bypass TEE exhibited significant discordance ($> 1+$ difference) from preoperative angiography in 6 of 14 patients. Two of these 6 patients underwent combined CABG with mitral valve surgery.

These patients all consented to CABG with or without mitral valve repair/replacement. The decision to perform mitral valve surgery was made using post-bypass TEE data and intraoperative valvular inspection. Five of the 14 patients underwent concomitant CABG with mitral valve repair or replacement. One patient initially underwent CABG without mitral valve surgery. Post-bypass TEE data in this patient revealed 3+ MR and the surgeon then elected, after bypass, to perform a mitral valve repair.

There were no complications associated with the intraoperative TEE in any of the 31 patients.

Discussion

Interest in intraoperative echocardiography has greatly increased recently due to the growing numbers of complex surgical procedures being performed and to the usefulness provided by intraoperative TEE. Our series describes the value of this technique in assisting the management of selected cardiac surgery patients. Intraoperative TEE was of the greatest value in assessing patients undergoing possible mitral valve repair and patients undergoing CABG complicated with ischemic MR. The technique provided valuable information in formulating the surgical plan, in assessing immediately the operative results, and in identifying patients at risk for postoperative complications.

Mitral valve repair is proving to be a viable alternative to valve replacement in selected patients with MR⁸. By understanding the mechanism of MR and by assessing the valvular and subvalvular apparatus, the surgeon can successfully undertake valve repair in many patients. Post-bypass TEE can provide essential information to aid in surgical planning by assessing the feasibility of valve repair. Post-bypass TEE is of equal importance. First, post-bypass TEE is superior to previous methods in assessing residual MR⁹. This is extremely important since the degree of residual MR directly correlates with postoperative mortality⁸. Second, other postoperative complications following mitral valve repair, such as left ventricular outflow obstruction and left ventricular dysfunction,

are readily identified by post-bypass TEE. The timely recognition of postoperative complications should allow for prompt measures in corrective management; this should improve surgical results.

The use of intraoperative TEE in patients undergoing CABG with ischemic MR has recently been described⁴. MR occurs in up to 20% of patients with coronary artery disease and in up to 50% of patients with acute myocardial infarction. The MR that has not been corrected, after CABG, is an independent predictor of long-term survival⁵. Since operative mortality increases with combined CABG and mitral valve surgery, careful selection of patients for a combined procedure is imperative. Sheikh et al⁴ showed that post-bypass TEE resulted in a change in the operative plan in 11% of patients undergoing CABG with ischemic MR. Therefore, the assessment of MR severity at the time of surgery is helpful in planning the operative procedure. At our hospital, patients are routinely asked to consent to CABG with or without mitral valve replacement/repair, thereby relying on the post-bypass TEE data for management decisions.

In our series, 6 of 14 patients exhibited significant discordance between preoperative angiography and prebypass TEE. This discordance was not seen in the patients with primarily valvular disease. Our experience is similar to larger studies documenting discordance measured by angiography and TEE in patients with ischemic MR⁴.

Although the cause of the discordance seen in ischemic MR is unclear, multiple explanations have been suggested. First, the severity of ischemic MR can be very labile depending on the degree of ischemia at the time of measurement. Second, although attempts were made to measure MR at comparable preload and afterload parameters, differences in loading conditions may have contributed to the discordance seen. Finally, although previous studies comparing Doppler techniques to cardiac catheterization in MR measurement have reported good correlations¹⁰, differences in the 2 techniques also could have affected the results.

Intraoperative TEE can provide valuable information in other selected cardiac surgery patients, such as in the repair of aortic dissection and in the repair of congenital heart disease. Additionally, postbypass TEE is helpful in detecting postoperative left ventricular dysfunction and residual intracardiac air, allowing for implementation of immediate corrective measures.

In our series, we have shown the value of intraoperative TEE in the management of selected cardiac surgery patients. These data support previous larger clinical trials^{3,4}. The technique provides timely information with minimal risk to the patient and is performed without interruption of the operative procedure or the intrusion of equipment into the operative field.

Intraoperative TEE should be considered in all cases of possible mitral valve repair and in all cases of CABG with significant ischemic MR.

ACKNOWLEDGEMENTS

The authors would like to gratefully acknowledge Irene Yamachika LPN for her assistance in data correlation and Cathy L. Ow MD for her critical review of the manuscript.

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