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TRANSESOPHAGEAL ECHOCARDIOGRAPHY: USEFULNESS INCREASING

Transesophageal echocardiography (TEE) represents the latest advance in ultrasound technology to improve the diagnosis of cardiovascular disease. Although ultrasonic transducers were applied to the end of a gastroscope as early as 1976, the popularity of TEE has blossomed since 1987, with the advent of color-flow imaging, improved phased-array technology, and an increased clinical awareness of the potential contributions of echocardiography to cardiac diagnosis.

From its position in the esophagus, TEE has improved access to the heart compared with transthoracic echo (TTE), which is shielded from the heart by the ribs and lung. The improved resolution of TEE is particularly evident for structures in the posterior part of the mediastinum and for those posterior to dense reflectors such as prosthetic valves or cardiac calcification, which impair the image quality of TTE.

TEE has been applied with great success in three different arenas: the diagnostic echocardiographic laboratory, the operating room, and the intensive care unit.

DIAGNOSTIC TEE IN THE ECHOCARDIOGRAPHY LAB

TEE has been useful in the workup of such abnormalities as prosthetic valve dysfunction, native valvular disease, cardiac masses and thrombi, endocarditis, thoracic aortic pathology, and diastolic dysfunction, as well as in patients whose TTE readings are of suboptimal quality. At our institution, referrals for TEE have remained relatively constant, at about 5% of our volume of TTE studies, which itself has increased by 20% per year to its current level of 14,000 studies per year.

TEE is performed after the patient has fasted 6 to 8 hours and has received an appropriate explanation of the procedure. Intravenous access is required for light sedation and (in high-risk patients) antibiotic prophylaxis. Anesthesia consists of local pharyngeal spray and a small amount of a benzodiazepine, a narcotic, or both, for sedation and amnesia. Most cooperative patients can assist by swallowing the probe, with minimum discomfort. A gloved finger is sometimes useful to keep the probe in the midline while passing the crucial triage level of about 18 to 20 centimeters, to avoid the valleculae on the sides of the hypopharynx. The patient should be in the left lateral decubitus position, and suction should be available to avoid pooled secretions and gagging. A liberal amount of water-soluble lubricant is required to eliminate air between the transducer tip and the esophageal mucosa.

Although the passage of the scope is well tolerated by most patients, the procedure is contraindicated in those with significant esophageal pathology. The probe should not be forced in situations where there is resistance. We monitor the electrocardiogram, blood pressure, and blood oxygen saturation, all of which are the responsibility of an assistant not involved in the imaging itself.

Complications of the procedure have included minor events such as hoarseness, sore throat, or arrhythmias. Very rarely, major complications have been reported such as cardiac arrest, esophageal perforation, and death. Resuscitation equipment must be available.

USES OF TEE IN THE OPERATING ROOM

Intraoperative TEE performed by anesthesiologists or cardiologists has become a useful intraoperative means for optimizing surgical results. In noncardiac surgery, the ability to directly visualize left ventricular size is a better means of assessing intravascular volume status than the pulmonary capillary wedge pressure.

In addition, the inotropic effects of medications, and the wall-motion abnormalities resulting from myocardial ischemia can be determined by direct observation of the left ventricular images. TEE observation of the left ventricle, electrocardiographic monitoring of cardiac rhythm, arterial blood pressure monitoring, and Swan-Ganz catheter monitoring of pulmonary arterial pressure and cardiac output are complimentary measures that provide a sophisticated continuous hemodynamic appraisal.

Intraoperative echocardiography has been applied extensively to cardiac surgery, particularly in patients undergoing nonprosthetic valve surgery. We have used epicardial echocardiography and TEE during valve repair for every known valvular abnormality, many types of congenital heart surgery, myectomy for hypertrophic cardiomyopathy, and repair of periprosthetic regurgitation. In addition, intraoperative TEE is useful when difficulty is encountered in weaning the patient from cardiopulmonary bypass.

In patients undergoing valve repair for mitral or aortic regurgitation, the "pre-pump" intraoperative TEE is extremely useful in "designing" the surgery itself. The operative team must understand the *mechanism* of valvular dysfunction to enable a successful repair. This appraisal includes two-dimensional echocardiographic structural evaluation of leaflet motion, and color-flow imaging evaluation of the origin and direction of the regurgitant jet. Often, intraoperative echocardiography can improve the understanding of the mechanism obtained by preoperative transthoracic imaging.

After valve repair and weaning from the cardiopulmonary bypass machine, intraoperative TEE is performed to identify patients with suboptimal results or failed valve repair. Of 1484 patients having "post-pump" TEE after valve repair for mitral regurgitation from 1987 to 1992, 105 (7.1%) underwent further surgery during the same thoracotomy after echocardiographic determination of the presence and mechanism of persistent problems. Of these, about 70% underwent further repair, and the remainder underwent prosthetic valve replacement; all left the operating room with successful valvular surgery.

TEE IN THE INTENSIVE CARE UNIT

TEE is very safe, even in critically ill patients, if certain precautions are taken. In particular, patients with tenuous cardiopulmonary stability should be intubated before the TEE study is started. TEE is

particularly useful in evaluating ventilator patients or those in whom TTE offers suboptimal visualization of the anatomy. TEE can determine the reason for hypotension by determining the presence of pericardial effusion, tamponade, ventricular dysfunction, or acute valvular abnormalities. The images of the cardiac chambers and valves are often useful in determining the cause of pulmonary edema. TEE can be useful in the evaluation of patients with chest pain, particularly to determine the presence of a thoracic aortic dissection. No other procedure can reliably make this diagnosis as quickly, thus avoiding delays which can cost patients' lives. TEE can diagnose the presence and location of intimal flaps and tears, aortic insufficiency, hemopericardium, and the involvement of the coronary ostia in the dissection.

CONCLUSION

TEE provides a dramatic and useful method of cardiac imaging, which adds immeasurably to diagnosis in selected patients evaluated in the echocardiography laboratory. Intraoperative TEE provides a "safety net" for detection of failed valve repair that allows further surgery to be performed during the same thoracotomy. In the intensive care unit, TEE is useful in critically ill patients to enable rapid diagnosis and appropriate management.

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SUGGESTED READING

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MENOPAUSE: MANAGING THE ASSOCIATED RISKS

Menopause is an excellent time to reassess a female patient's health habits and the need for health maintenance measures.