

Early experiences of intra-operative trans-oesophageal echocardiography (TEE) in mitral valve repair

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Summary

Whenever possible Mitral valve repair should be performed instead of Mitral valve replacement. It is important to assess the adequacy of the repair during the operation so that any corrective steps may be taken immediately. We present three cases of Mitral valve repair in which the intraoperative TEE was used to assess the adequacy of the repair. There was good correlation of the immediate post bypass TEE findings and early post operative transthoracic echocardiographic findings. Intraoperative TEE is a useful tool in the early assessment of Mitral Valve Repair.

Key words: Mitral valve repair, Transoesophageal echocardiography.

Introduction

Successful Mitral Valve repair for Mitral insufficiency was first described in 1957 by Lillehei¹ and Merendino². However with the development of prosthetic valves in 1961, most interest in Mitral Valve repair waned in favour of the more predictable results of valve replacement.

With the increasing use of prosthetic valves, the predictable early results were soon found to be offset by significant long term problems. A better understanding of Mitral Valve function and pathology as well as the improved results obtained has led to a renewed interest in Mitral Valve repair. Currently, it is widely accepted that whenever possible Mitral Valve repair should be performed instead of Mitral Valve replacement. However the technical difficulty of the procedure may result in an inadequate or imperfect repair which may require modification or even abandonment of the procedure in favour of valve replacement^{3,4}. Various methods have been employed to allow surgeons to assess the adequacy of the repair procedure during the operation⁵⁻⁷. The increasing availability of ultrasound imaging equipment has given surgeons the opportunity to better assess the results of Mitral Valve repair intra-operatively so as to modify their operative procedure or strategy. We present our early experience with the use of intra-operative trans-oesophageal echocardiography (TEE) in three cases of Mitral Valve repair.

Methods

All patients were positioned and put under anaesthesia in the usual manner after which the TEE probe was introduced "blindly". Pre repair examination was performed and images of the Mitral Valve obtained as baseline images as well as used for comparison with preoperative transthoracic echocardiography (TTE) images. After pre-repair imaging, the patient was put on cardiopulmonary bypass and cooled to 28 degrees Celsius. Aortic cross clamping with cold hyperkalaemic blood cardioplegia

was administered. The operative repair in all three cases was done through the left atrial approach. After exposure of the Mitral Valve the Mitral Valve was assessed visually for morphological changes as well as by injecting saline into the arrested left ventricle to assess the amount of regurgitation. The repair was then performed. The oesophageal probe was left in place for the rest of the operation. After Mitral Valve repair any residual Mitral regurgitation was initially assessed by direct vision and forceful injection of saline into the left ventricle. When the repair was deemed adequate the left atrium was closed and the operation completed in the conventional manner. After discontinuance of cardiopulmonary bypass, valve competence was assessed by standard methods (palpation, haemodynamic monitoring) after which echocardiographic examination of the repaired valve was used to assess the result of the repair. In all cases the machine used was the Aloka SSD 870 with the Aloka 5228-5 trans-oesophageal probe for adults. Before hospital discharge all patient underwent TTE pulsed echo doppler studies to detect the presence or absence of Mitral regurgitation.

Results

Case 1 NPC

A 24 year old Chinese waitress was admitted to the National University Hospital in January 1991 for exertional dyspnoea increasing in severity for two to three days prior to admission. She was diagnosed to have rheumatic valve disease at the age of 18 and had been followed up by a cardiologist at another hospital. She had three previous admissions for infective endocarditis. Her last echo-cardiogram done one year earlier showed moderate to severe Mitral regurgitation. She was being treated with Digoxin 0.25 mg daily and Warfarin 1 mg daily. On admission she was tachypnoeic, and in atrial fibrillation. Her apex beat was displaced to the 6th left intercostal space, mid-axillary line and there was a grade 4/6 apical pan-systolic murmur radiating to the axilla. She had raised jugular venous pulse and bilateral pitting pedal oedema. There were scattered crackles in both lung bases. ECG showed atrial fibrillation with a ventricular rate of 134/min. Chest X-ray showed marked cardiomegaly with a prominent pulmonary artery and left atrium.

She was treated with diuretics and digoxin, with resolution of her cardiac failure. A TTE done showed ruptured chordae tendineae of the anterior Mitral leaflet and a flail anterior Mitral Valve leaflet. Colour doppler studies showed moderately severe Mitral regurgitation and moderate Tricuspid regurgitation. Cardiac catheterisation done showed severe mitral regurgitation with pulmonary hypertension and a systolic pulmonary pressure 60mmHg. At operation, the patient was found to have gross cardiomegaly and inspection of the Mitral Valve revealed severe Mitral regurgitation with elongated chordae and prolapse of the anterior Mitral leaflet. The Mitral annulus was also dilated. There was severe Tricuspid regurgitation from annular dilatation. Mitral Valve repair was performed with anterior leaflet shortening, transection and repair of the chordae and insertion of a Duran flexible annuloplasty ring size 27 mm. Tricuspid annuloplasty was also performed with a 25 mm annuloplasty ring. After the patient had come off cardiopulmonary bypass, a repeat TEE showed mild residual Mitral Valve regurgitation and minimal Tricuspid regurgitation. A week after the operation the patient developed haemolytic jaundice. A postoperative 2-D TTE showed mild to moderate Mitral regurgitation with minimal Tricuspid regurgitation. The localized regurgitant jet was noted to be of high velocity of 380 cm/s. In view of the persistent haemolysis, a Mitral Valve replacement was performed from which the patient recovered uneventfully.

Case 2 SCK

A 47 year old Chinese man was admitted to the National University Hospital, Singapore with effort dyspnoea. He was in NYHA class III. He was a known case of adult polycystic kidney disease and had progressed to end-stage renal failure ten months prior to admission. He was on chronic haemodialysis three times a week for the past ten months. Cardiac catheterisation confirmed severe Mitral

regurgitation (grade 4) and normal coronary arteries. Intraoperatively, a two-dimensional TEE and colour-flow mapping showed Mitral Valve prolapse of the anterior leaflet with severe Mitral regurgitation and left ventricular hypertrophy. Inspection of the Mitral Valve at the time of operation revealed gross cardiomegaly with a dilated Mitral annulus. A triangular segment of the anterior leaflet was resected and resutured followed by annuloplasty with a 31mm Duran flexible annuloplasty ring. Intraoperative TEE with Doppler echocardiography colour-flow mapping was performed after the patient was taken off cardiopulmonary bypass and demonstrated minimal regurgitation with good coaptation of the Mitral Valve leaflets. The repair was considered satisfactory. A postoperative TEE was done and showed minimal Mitral regurgitation similar to that seen in the TEE. He subsequently did well and was discharged on the 13th postoperative day.

Case 3 AL

A 57 year old Chinese woman with end stage renal failure and on haemodialysis since 1987 and a known history of rheumatic heart disease was referred with a diagnosis of Mitral and Tricuspid regurgitation. She was in NYHA Class II. Two dimensional TTE done in September 1989 showed severe Mitral stenosis with mild regurgitation, Aortic regurgitation, Tricuspid regurgitation. At operation, she was found to have a dilated left atrium with a tense pulmonary artery. Inspection of the Mitral valve showed commissural fusion and calcification of the anterior lateral commissure. There was retraction of the anterior papillary muscle. A Mitral commissurotomy, anterior papillotomy, commissural decalcification and pericardial patching to that area of defect was performed. A Duran flexible Mitral ring size 25 mm was inserted. The Tricuspid annulus was also found to be dilated and Tricuspid annuloplasty was performed with the insertion of a size 31mm Duran annuloplasty flexible ring. Intra-operative TEE with colour flow mapping was done after the patient had come off cardiopulmonary bypass and showed the Mitral Valve leaflets to be pliable with good coaptation, trivial regurgitation and no doming. A post-operative TTE showed similar findings. The patient's postoperative recovery was uneventful and she was discharged on the 12th postoperative day.

After repair, all three patients had a small amount of regurgitation when saline was injected into the arrested ventricle. However on discontinuance of Cardiopulmonary bypass none of the patients had a palpable thrill or a significant "V" wave. TEE showed good pliable valves with good apposition in all cases. However in all the three cases a minimal amount of regurgitation was seen. The postoperative TTE findings correlated well with the intra-operative TEE findings in all cases.

Discussion

It is now accepted that whenever possible precise Mitral Valve repair is preferable to Mitral Valve replacement. One of the most daunting problems facing the surgeons is to be able to evaluate accurately the success of the repair so that complete and accurate correction of the Mitral Valve can be accomplished at the time of operation. Conventional methods for assessing the adequacy of the repair include, forceful saline injection into the left ventricle⁵, filling of the left ventricle through a stab incision in the apex⁶, perfusion of blood into the Aortic root proximal to the cross clamp⁷, palpation for a post bypass thrill, and measuring left atrial pressures. All the above methods have well known limitations, the first three methods assess the function of the Mitral Valve in the arrested ventricle where the geometry and the dynamics of the ventricle are unphysiological and the latter methods, being indirect measurements, are imprecise. The improvements in echocardiographic imaging technology and the widespread use of echocardiography make the use of intra operative echocardiography the logical instrument in assessing post repair Mitral Valve morphology and function.

In 1972 Johnson reported the use of echocardiography to evaluate the results of Mitral Valve surgery⁸. Sheikh⁹ reported on the TEE findings of 154 patients with cardiac valve procedures and found that pre-

bypass intraoperative findings revealed unsuspected findings in 12% of the patients that led to some modification of the planned operation. We found that our TEE findings correlated well with our preoperative and postoperative TTE findings. Sheikh⁹ in the similar study quoted above also found that an inadequate repair was detected in 7% of the patients by TEE which resulted in the re-institution of cardiopulmonary bypass with revision of the repair of valve replacement. Mindich¹⁰ reported the use of Epicardial 2D contrast echocardiography in mitral valve surgery where re-exploration and re-repair of the Mitral Valve or replacement was done solely on echo findings. Maurer¹¹ and colleagues using intra operative colour doppler also reported Mitral regurgitation in patients in whom repair was thought to be good by the fluid filling technique which failed to detect residual Mitral insufficiency. In our 3 cases we detected minimal Mitral regurgitation with the TEE which was not apparent by palpation of the left ventricle or by haemodynamic monitoring. The degree of regurgitation was considered to be compatible with an adequate repair. The post operative TTE confirmed the same findings.

In case 1 although the post operative TTE showed mild to moderate regurgitation which was not haemodynamically significant, the persistence of haemolysis compelled us to replace the valve at a re-operation. Why haemolysis should occur in the presence of a haemodynamically insignificant regurgitation after valve repair is speculative as only seven cases have been reported in literature. Two reasons that may explain the haemolysis in this case are the presence of a high velocity jet of 380 cm/s causing turbulence or the presence of a non endothelialized prosthetic ring.

In summary, there was good correlation of the immediate post bypass TEE findings and early post operative transthoracic echocardiographic findings. Intra-operative TEE is a useful tool in the early assessment of Mitral Valve repair, as it provides a physiological and functional assessment of the repaired valve.

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