Author's response to reviews

Title: The Extent of Papillary Muscle Approximation Affects Mortality and Durability of Mitral Valve Repair for Ischemic Mitral Regurgitation

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Author's response to reviews: see over
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Date: 24 April 2014

Author's response to reviews: see following pages
Reviewer's report

Title: The Extent of Papillary Muscle Approximation Affects Mortality and Durability of Mitral Valve Repair for Ischemic Mitral Regurgitation

Version: 1

Date: 7 March 2014

Reviewer: Robert WM Frater

Reviewer's report:

This is not a new subject. (The first presentation of annuloplasty to less than the normal systolic dimension of the annulus as a treatment for mitral insufficiency produced by ischemic ventricular disease was at the Berlin Conference on Ischemic Mitral Insufficiency in 1988). While this worked for acute myocardial ischemic mitral insufficiency it has been inadequate as a treatment for severe chronic ischemic mitral insufficiency. Failure of annuloplasty has been shown to occur once the ventricular diastolic and systolic dimensions reach a certain level. Professor Matsui and his colleagues recognized some years ago that the critical factor causing failure of annuloplasty to achieve correction and maintenance of correction of mitral insufficiency and correction of heart failure was papillary muscle displacement. They started writing on their efforts to incorporate papillary procedures in the surgery of myocardial ischemic mitral insufficiency about ten years ago. The present article summarises their experience and serves to illustrate the significant difficulties inherent in the subject. Kron (USA), Hvass (France), and Langer (Germany) are three authors who have presented papers on papillary repositioning for this condition. The series are small and the followups relatively short. Hvass has described encircling the papillary muscles at their bases (involving partly mobilising the muscles from the ventricular wall in some cases). He has tackled cases with ventricular dimensions that normally ensure the failure of “tight” annuloplasty alone and has reported significant improvement in mitral incompetence, ventricular function and congestive cardiac failure. By the criteria of Robert Dion, (end diastolic ventricular diameter of 65 mm and more is a contraindication), Hvass’ patients would not be offered tight annuloplasty because of the very high failure rate of annuloplasty alone once diastolic and systolic ventricular dimensions reach a certain level. A paper from Teheran presented at the STS in 2008 (Rashanali et al) showed that an interpapillary distance of 2.9 was a clear predictor of failure of tight annuloplasty. Despite work that shows the importance of papillary displacement in the consequences of myocardial ischemic mitral insufficiency and the possibility of improving the results of annuloplasty by papillary repositioning, the idea has simply not caught on. The present paper offers insight into why this should be so.
Let me start by stating that questions 1 to 5 and question 7 can all be answered affirmatively. I have a suggestion for the answer to Question 6 after the following comments.

In ten years the authors have built a series of 45 cases. This quite small number may be due partly due to the size of the institution and partly to the referral patterns for what is essentially an experimental procedure. All of these patients have the combination of coronary artery disease with myocardial ischemia, usually an area of infarction, ventricular dilatation and the added deleterious effect on the ventricle of mitral insufficiency. These multiple factors must produce a very heterogeneous group of patients. In addition variability of papillary anatomy.

The authors found papillary approximation very difficult to do via the left atrium through the aortic valve. In 13 cases they were able only to achieve approximation from the tips to the midpoint of the muscles. These patients had a better ejection fraction than the remaining 32. This suggests that the 13 did not have scarred left ventricular infarcts that enabled a trans ventricular approach in the other patients.

Question 1) Were these patients early cases chosen because their ventricular dimensions were smaller?

- No, they weren’t. Most early cases underwent PMA through an LV incision with overlapping left ventriculoplasty because PMA was initially adopted as an additional procedure to left ventriculoplasty for those with dilated cardiomyopathy. With early favorable experiences, we then adopted PMA through the mitral valve for those who were not indicated for left ventriculoplasty.

- We performed PMA for 127 patients with functional MR during the study period. Among them, 70 patients had ischemic MR. To assess correctly the prevalence of recurrence and reduce any biases, we excluded 25 patients from this study.

- The text regarding this was revised on page 6.

Question 2) Was there a learning curve that could have contributed to the higher mortality and poorer maintenance of mitral competence?

- No there was not. There was no significant difference in mortality between those who underwent surgery in the early (before 2006, N=18) and late (after 2007, N=27) eras (log-rank P=0.76). The rate of freedom from recurrence ≥2+ was also comparable between the groups (log-rank P=0.11).
• Text regarding this was added on page 15.

Question 3) Was the discharge status of ventricular function and mitral competence the same in these 13 patients as in the remaining 32.

• The LV end-diastolic diameter was significantly different between those with incomplete and complete PMA (57±6mm vs. 62±7mm, P=0.045), though the LV ejection fraction (34±10% vs. 37±13%, P=0.40) and MR grade (0.3±0.4 vs. 0.4±0.6, P=0.90) did not significantly differ before discharge.

Question 4) Was the ventricular scar in the 9 patients who did not have ventricular plasty too small to allow overlapping closure of the incision and consequent reduction of transverse ventricular dimension?

• Yes, it was. The ventricular scar was small in the 9 patients so ventriculoplasty was not indicated for them. However, the LV dimensions significantly decreased postoperatively in the 9 patients even without left ventriculoplasty.

Question 5) Did the infarct in the 9 cases that did not have a formal ventricular plasty, involve the bases of the papillary muscles so that bringing them completely together would in fact achieve a reduction in ventricular dimension and volume achieved in the 22 cases that had a formal overlapping plasty?

• Yes, we think so. We adopted PMA for those with displacement of the papillary muscle approximation (interpapillary muscle distance ≥30mm), which means the existence of a scar lesion at the base of the papillary muscles. Therefore, the condition was the same for this point between those with and without ventriculoplasty.

Question 6) I am asking these questions in order to be sure that the clear benefit of the complete approximation cases can be attributed entirely to the approximation and not also to the concomitant ventricular plasty?

• It was difficult to distinguish the effects of approximation (PMA) and left ventriculoplasty (LVP) in this retrospective study because of the small sample size and heterogeneity of the ventricular conditions and surgical procedures. Although we added comparisons between those with complete PMA/LVP+ and those with complete PMA/LVP-, and found no significant differences in mortality and durability of repair between them, there was an inherent difference in ventricular scar size, which could affect the outcomes. Thus, left ventriculoplasty might improve the results of those with large
ventricular scars and diminish the possible difference in outcomes between those with complete PMA/LVP+ and complete PMA/LVP-. However, there was still a significant difference in mortality between those with incomplete PMA and those with complete PMA/LVP- (log-rank P=0.047). Therefore, concomitant left ventriculoplasty to some extent influences the outcomes of complete PMA cases but does not significantly affect our conclusions.

- Text regarding this was added and revised on page 14.

Question 7) If the authors see my questions as reasonable, will they still want to emphasize only complete papillary approximation as the mechanism for improvement?

- We really appreciate your kind comments and questions. Your comment is quite reasonable and we also think it may be difficult to conclude that only complete PMA affected the outcomes from our data because of the small number of cases. However, as mentioned above, the difference in the outcomes between complete and incomplete PMA may be predominantly caused by complete PMA rather than concomitant left ventriculoplasty and the learning curve of this procedure.

I believe this is an excellent contribution to the understanding and to the treatment of ischemic mitral insufficiency and heart failure. Although mitral insufficiency is known to reduce the survival of patients with heart failure, correcting the insufficiency does not result in automatic improvement of survival. Restoration of ventricular dimensions towards normal seems to need to be added to correction of mitral insufficiency.

This contribution should lead to an expansion of surgical treatment of this condition.

It is particularly notable for having been carried out by a single team with a single leader over a long period of time.

I am not a statistician. The numbers are small. Whatever the statistics show the numbers will have to be much larger for this form of surgery to be accepted by the majority of cardiac surgeons who confine their treatment to “tight” annuloplasty and ignore the poor long term results. It is important to encourage the pursuit of these efforts.

**Level of interest:** An article of importance in its field

**Quality of written English:** Acceptable

**Statistical review:** Yes, but I do not feel adequately qualified to assess the statistics.

**Declaration of competing interests:**
I have met Professor Matsui in the USA and in Japan. I have absolutely no competing interests.
Reviewer's report

Title: The Extent of Papillary Muscle Approximation Affects Mortality and Durability of Mitral Valve Repair for Ischemic Mitral Regurgitation

Version: 1

Date: 20 February 2014

Reviewer: Lorenzo Menicanti

Reviewer's report:

This paper describes the experience on a group of 45 patients treated between 2003 and 2012 with mitral annular plasty and approximation of papillary muscles, the conclusion was "complete papillary muscles approximation could be associated with lower postoperative mortality and higher durability of mitral repair for ischemic mitral regurgitation." I think the data published in this paper do not fully support this conclusion because this paper presents some important weakness: The number of patients is low: 45 patients treated in 9 years. The left ventricle anatomical situation is very different, there are 13 patients without an anterior scar, 9 that presented this scar but, probably because was not big enough, the Surgical Ventricular Restoration was not indicated, and 23 in which SVR was performed. The diameters of left ventricle are not different in the three groups, that means because the ejection fraction is different that the volume of this group of patients are different. To link the survival and mitral recurrence to the technique used: complete or incomplete papillary muscles approximation could be completely misleading if the volumes pre and post intervention are not fully analyzed because the differences in outcome can be determined only by the volume of LV.

- We sincerely appreciate your kind and suggestive comments.
- We performed PMA for 127 patients with functional MR during the study period. Among them, 70 patients had ischemic MR. To correctly assess the prevalence of recurrence and reduce any biases, we excluded 25 patients from this study. Accordingly, the text was revised on page 6.
- Although the number of study subjects is small, there was no learning curve that could affect the outcomes. Neither the mortality rate nor that of freedom from recurrence of MR significantly differed between those in the early (before 2006) and late (after 2007) eras (log-rank P=0.76 and 0.11, respectively). Text regarding this was added on page 15.
- We added data for the LV end-systolic volume index (LVESVI) in Table 3. Neither pre- nor postoperative LVESVI values significantly differed among the 3 groups.
Complete PMA has a similar concept to your “papillary muscle imbrication” procedure in terms of approximation and stabilization at the base of the papillary muscles (Reference #26 was added).

Level of interest: An article of limited interest

Quality of written English: Acceptable

Statistical review: No, the manuscript does not need to be seen by a statistician.

Declaration of competing interests: no conflict of interest