



Minimally invasive mitral valve repair: for every patient, for every surgeon or still a work in progress?

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The history of minimally invasive (MI) cardiac surgery started with coronary artery bypass surgery (1), but the term “minimally invasive” was defined as “an intervention that does not require median sternotomy or the use of cardiopulmonary bypass”. The subsequent application of the same concept to mitral valve (MV) surgery changed the meaning of MI, from “no sternotomy, no cardiopulmonary bypass” to “no full sternotomy”. Partial sternotomy, in fact, has been and is still used and cardiopulmonary bypass, of course, is part of the procedure. In general MI became minimally access. But a sentence in the last paragraph of the paper from Calafiore *et al.* (1), written in 1996, sounds as a prophecy: “Future generation of cardiac surgeons, especially those in training, will have to become familiar with minimally invasive cardiac procedures, especially MICAB.” The interest in MI coronary artery bypass is again increasing (2,3) and MI valve surgery is continuously expanding. The trend in MIMV surgery has been studied by Paparella *et al.* (4) in a multicenter study. They found that the MI approach became more frequent from 2011 (27.5%) to 2017 (71.7%), with a similar early mortality in subjects paired by propensity score. Cardiopulmonary bypass time and cross-clamping time reduced progressively over time.

However, if the benefits of MIMV surgery in terms of reduced intensive care and in-hospital stay, reduced rate of atrial fibrillation, less transfusion rate, lower readmission rate are now clear (4-7), a more comprehensive analysis identifies a few weak points. Most of the cases are

concentrated in a few Institutions, where the results are optimal (8). On the other side a low surgical volume is considered to affect the quality of the surgical results (8,9), as low volume Centers concentrate most of the complications. An analysis of the trends in less invasive MV operation in US showed that 26% of the Centers performed at least one procedure per year, but the median was 3 (10). Some complications appeared to occur more in MIMV surgery, as bleeding (9,10), aortic dissection (11), stroke (10,11), phrenic nerve palsy (11) and in a recent paper it has been reported that the ejection fraction was reduced in patients who underwent MIMV repair if compared with propensity matched pairs undergone median sternotomy (12). However, most of these complications are related to the most critical part of MIMV surgery: the learning curve. A study indicated that 75 to 125 procedures were necessary to master the technique and that to maintain the skill is necessary at least 1 case per week (13). Another study reported that the number of operations necessary to overcome the learning curve was 60 for MV replacement and 90 for MV repair (14). It is then clear that the limit to the expansion of the technique is not only to perform the surgery or to choose the patient, but also to maintain the necessary expertise, impossible in low volume Centers. As a consequence, a MI approach, even if used since long time (15) to correct both degenerative (4) and functional (16) mitral regurgitation (MR), still is not the procedure of choice for MV repair.

Which is the contribution of the paper by Axtell *et al.* (17) to our knowledge? The Authors report optimal outcome after minimally MIMV repair as result of careful patient selection. Axtell *et al.* (17) performed a MI approach in more or less one third of their cases, excluding patients with a greater comorbidity burden, a previous median sternotomy, more than mild aortic insufficiency, peripheral vascular disease, MV calcifications, and any associated procedures (with the exception of PFO closure and left appendage closure). Predicted mortality was very low (mean STS score 0.37%, 0.24–0.59). The Authors selected very carefully the MV pathology as well, as most of the patients had posterior leaflet prolapse and in only 7 the anterior leaflet was prolapsing. Four patients needed isolated annuloplasty, whereas in all the remaining artificial chords were implanted. This is an example of how a strict control of all the variables brings to an extraordinary result: no early mortality and a 3-year survival of 100% without any valve-related reoperation.

Echocardiographic results were good, but somehow confusing. In the abstract it is stated that “At 3 years, freedom from recurrent at least moderate mitral regurgitation was 100%”. This statement is coherent with what written at pag 8 “At 3 years, freedom from more than moderate recurrent mitral regurgitation was 100%”, even if the definition of failure of repair is different. But at pag 9 it is written that “At one year, 11% of patients had trace to mild MR and no patients had moderate or severe MR”, in conflict with what reported in Table 4 where, out of the 35 patients who had an echocardiographic evaluation after 1 year from surgery, 1 had moderate MR. It is not clear why the Authors emphasized in the text the absence of any moderate or more residual MR even 3 years after surgery. Even a single patient with moderate MR after 1 year is still a good result, even if the control was performed in only 1/3 of the patients. We do not know how many patients had an echocardiogram at 3 years (surely only a few), to support the statement that none had moderate or more residual MR, and why the Authors did not report this data in Table 4. A statement not supported by data casts shadows on a report that, per se, is a lesson of caution and of respect for the patient. Pursuing a philosophy of “zero all” (zero mortality, zero reoperations, zero MR return) is not important, but can be only misleading.

Nevertheless, this study shows how a careful selection of patients, in combination with an optimal surgical technique, can bring to excellent results. However, if MI surgery is not for all the patients, it is not as well for all the surgeons.

It is still a work in progress, to be widely adopted when results can be reasonably good without any risk increase for the patients. Under this aspect this paper can have the potential danger to demonstrate that MIMV repair is easy and can be done always with great results, pushing to forget that behind these outcomes there is a lot of work and study. The paper does not state why the report starts from January 2014, if that one was the date when the Authors thought that the learning curve was completed and which were the results before that date. Surgery was performed by a single surgeon, evidently very experienced in MV repair, who carefully chose patients for MIMV repair. Under this conditions results can be only outstanding, but cannot be reproduced except if all the steps are completed.

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Footnote

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