



Standardization in maze procedure: a step towards a better future

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It is a well-known fact that patients with atrial fibrillation (AF) have an increased chance of stroke (1), heart failure (2) and death (3). Speaking about stroke rate, the sole presence of non-valvular AF increases this rate by 5-fold, and when it is about valvular-AF, the stroke rate goes up by more than 17-fold (4). In addition, patients with preoperative AF undergoing cardiac surgery have a worse outcome and long survival rate (5,6). Musharbash *et al.* (7) have demonstrated that by performing the maze procedure in a selected group of patients with preoperative AF, survival rate is better when comparing with those having AF which was left untreated at the moment of concomitant cardiac surgery. In fact, this is the central core of the discussion in this paper.

Current guidelines for the surgical treatment of AF from the STS have improved the class of recommendation as well as the level of evidence for each of the surgical indications for AF (8). Most of them are now an indication Class I Level of Evidence A or B, or IIa B, depending on the specific situation surrounding a given case with AF. However, trends for surgical ablation for AF in 2014 do not go beyond 48.3% of patients having preoperative AF undergoing concomitant cardiac surgery in USA (9). Surprising as it may seem, this rate is clearly too low, and the question is what is going on, if we have the proper tools in our hands.

The maze procedure needs to be accurately performed in order to get the best results. Cox *et al.* (10) have described a success rate superior than 90% in recovering sinus rhythm. Schaff *et al.* (11), Schill *et al.* (12), Ad *et al.* (13), all of them have reported the same sinus rhythm conversion rate after maze higher than 85% at 1 year follow-up. Even though evidence is in favor of the maze procedure in eliminating

AF, the weight of the evidence has been low or moderate to identify strong conclusions in terms of morbidity or mortality (14,15). However, we must not fall into the error to lightly analyze these numbers. When all the tricks of the trade are not well-known, things can turn out wrong. And here is where the trouble begins. The first thing we should bear in mind is that the maze procedure must always be performed as a full bi-atrial lesion pattern, regardless the underlying pathology causing the AF. Dr. Cox *et al.* have described it in a flawless way (16). And this is my first criticism: judging from my experience, many surgeons just perform a “left-sided” maze, with no touching the right atrium. As a general rule, the lower the number of incisions or burn lines in the maze procedure, the lower the success after maze.

Another important issue is the way of anchoring the incisions or lines on the native mitral and tricuspid annuli as well as each one with the others. This is especially true when it is all about the mitral line over the mitral isthmus. The mitral isthmus region is a real challenge for the inexperienced surgeon. Using bipolar radiofrequency ablation or “cut-and-sew” plus cryolesion in this anatomic area is an absolute must. The innermost extreme of the mitral line over the mitral annulus is almost impossible to be exclusively performed by means of the bipolar radiofrequency clamp. This area is so thick that there is no guarantee that the bipolar clamp can deliver radiofrequency energy through the full thickness of tissue of more than 2 cm in depth. In addition to this, there are some striated muscle fibers crossing over the external surface of the coronary sinus which can conduct the electric impulse between both atria (17), which may give rise to

postoperative peri-mitral flutter up to 15–20% of cases when cryoablation is not performing from outside the heart over the coronary sinus (18,19). Alternatively, unipolar RF ablation can be applied on the mitral line from inside the heart. However, one cannot be sure about the transmuralty nor the uniformity of the burn line (20).

Another alive issue is the way of performing the maze procedure. In respect thereof, we need to understand once and for all that there are only three possible ways to properly perform the maze procedure: (I) cut-and-sew plus cryoablation over critical areas (coronary sinus from outside the heart, and mitral and tricuspid annuli from inside the heart), (II) cryoablation alone all along the whole procedure, and (III) bipolar RF ablation plus cryoablation over critical areas. There is no other possible way to correctly perform the maze procedure (21). Incredible though it may seem, one can still find an enormous heterogeneity when comparing several studies about maze procedure. In other words, briefly speaking, there is a lack of standardization for the maze procedure. As a result, common findings in some meta-analyses or systematic reviews do not reflect what is really happening with these patients after maze procedure. Moreover, while close attention needs to be paid to long term survival after maze, a full and true standardization in surgical technique should be a priority.

On the other hand, another important worrying issue is the fact that most of the times the researchers working in a given group are not cardiac surgeons. As a consequence, there is not an adequate material selection in terms of appropriateness of the procedure due to the lack of surgical knowledge. For example, we cannot include a series in which unipolar RF ablation was used to do most of the burn lines into another one utilizing exclusively cryothermia or cut-and-sew. The same is applied to the type of lesion pattern used. Left-sided maze, partial maze, mini-maze, excluding/resecting or not the left atrial appendage should not be included in the same series containing true maze cases consistent in a full bi-atrial lesion pattern, with left atrial appendage removal made under the principles we stated out above. The bottom line of all this is a bias result. We need much more randomized control trials following a highly precise, very well-standardized surgical protocol (with no changes as far as possible) in order to get stronger conclusions. This is the only way to obtain enough material for true meta-analyses.

With this framework, we should recognize the capital importance of this article by Musharbash *et al.* (7). What is truly important here is the final outcome achieved by

this group. This article has made very clear that long-term survival of patients having AF is much better when the maze procedure is performed. Kaplan-Meier analysis was in favor of the maze procedure group ($P=0.004$). Ten year survival was 62% *vs.* 42% ($P=0.014$) for maze procedure *vs.* untreated AF, respectively. Another striking fact in this article was the comparison of patients (previously matched to those underwent maze procedure) between those with untreated AF and those without preoperative AF. Multivariate analysis using a Cox-proportional hazards model found out AF as a predictor of mortality with hazard ratio of 1.38 (95% CI, 1.04–1.83, $P=0.025$).

This article exemplifies the strength generated by following a very specific working line with no or minimum changes. Dr. Cox's pioneering works go all the way back to the end of 80s. Indeed, the main principles of the maze procedure have been preserved intact as since its inception and are still upheld at Barnes-Jewish Hospital, in St. Louis, Mo. Not surprisingly, the authors working under the direction of Dr. Damiano Jr. have found out excellent outcomes in this series (4).

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Footnote

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