Analysis of the Anatomical Variation of the Atrial Musculature May Predict the Success of Pulmonary Electrical Isolation

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PV reconnections may result from anatomical conduction gaps in the ablation lines or from failure to create transmural lesions, both of which may be undetected during the initial procedure. Such incomplete ablation lesions may lead to reversible injury, with loss of the left atrial (LA)-PV conduction immediately postablation, but recovery of that conduction and recurrence of AF thereafter.

In this issue of the Journal, Takigawa et al demonstrate that the manner of PV potential disappearance pattern during PVI is significantly related to the incidence of residual PV carina conduction and AF recurrence. They investigated more than 350 consecutive AF patients, which included approximately 70% with paroxysmal AF and 30% with long-standing persistent AF. They divided their patients into 3 groups according to the pattern of PV disappearance during PVI. They also performed pacing from the carina sites inside the encircling lines in the LA to confirm isolation of the carina region. From the long-term follow-up data, they found that there was a significant difference with regard to the recurrence of AF according to the PV disappearance pattern. They postulate that the mechanism of these patterns could be the variation in the distribution of the atrial musculature extensions from the LA into the PVs. When both the superior and inferior PVs were eliminated simultaneously, the ablation results were best. This finding was observed in relatively several cases in the middle of the ablation procedure for AF, and many investigators have recognized the various patterns of the disappearance of the PV electrograms during PVI. However, this study is the first to investigate its relationship to the clinical long-term results of the ablation treatment in a sophisticated fashion.

The authors of the present study did not perform a confirmation of the elimination of the dormant conduction between the PVs and LA by injecting adenosine after PVI, which might have had an influence on the reconnections of the PVs. If a sufficient amount of RF energy was delivered at the presumably dormant conduction area, the impact of the present study may have been outweighed.

Additional RF applications in the carina region were required for successful PVI, even though a complete continuous isolation lesion line formation was achieved in the antral area of the LA. In addition, failure to electrically isolate the PV carina is significantly associated with AF recurrence. As the authors describe, the Marshall vein may exert arrhythmogenic effects in terms of provoking AF episodes by connecting the LA and PVs as epicardial conduit tissue. The authors describe the encircling isolation line as neither continuous nor transmural; however, the Marshall ligament could contribute to an epicardial electrical connection between the LA and PVs that could not be obtained with successful transmural ablation of the LA wall. Additional RF applications in the carina region might abolish all the electrical connections associated with the Marshall ligament conduit tissue.

When bidirectional electrical disconnection is obtained, which is ascertained by pacing inside and outside the encircling line at the antrum, we can be sure that successful PVI has been accomplished. However, pacing in the carina region is also an important diagnostic method of investigating whether complete PVI has been achieved or not. In such cases, there is no electrical connection between the PVs and Marshall ligament that could result in a false electrical isolation of the PVs from the LA.

Kasai et al already demonstrated the presence of electrical connections between the distal CS musculature and LA myocardium, which may provide anatomic pathways or a substrate...
for reentry that can contribute to the initiation and maintenance of arrhythmias such as AF and atrial flutter. These studies suggest a limitation of the endocardial approach for achieving complete electrical isolation of the PVs from the LA.

The present authors also describe that a higher recurrence rate of AF after PVI was observed in larger sized LAs. They suggest that complete electrical isolation of the LA antrum, including the PV carina, was less likely to be achieved in a larger LA because the wider PVI lines were associated with a higher incidence of conduction gaps and epicardial breakthroughs into the carina because of the distance between the antral isolation line and PV ostium. The present study was unable to provide a relationship between the anatomical variation in LA musculature and the size of the LA. The distance between the PVI lines and carina location according to LA size may have an influence on the disappearance patterns of the PV potentials during the PVI procedure.

What remains unclear is the true mechanism of the 3 different patterns of disappearance of the PV potentials. The proposed mechanism remains speculative until further experiments are performed to confirm or refute this hypothesis. Notwithstanding the limitations of this study, including its retrospective nature and lack of the data on the use of an irrigated ablation system, the findings are quite provocative and retrospective nature and lack of the data on the use of an irrigated ablation system, the findings are quite provocative and retrospective nature and lack of the data on the use of an irrigated ablation system, the findings are quite provocative and retrospective nature and lack of the data on the use of an irrigated ablation system, the findings are quite provocative and retrospective nature and lack of the data on the use of an irrigated ablation system, the findings are quite provocative and retrospective nature and lack of the data on the use of an irrigated ablation system, the findings are quite provocative and retrospective nature and lack of the data on the use of an irrigated ablation system, the findings are quite provocative and retrospective nature and lack of the data on the use of an 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