Incidence and clinical correlates of pulmonary vein luminal loss after laserballoon pulmonary vein isolation

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Introduction: Pulmonary vein isolation (PVI) using visually guided laserballoon (VGLB) is an effective treatment modality for paroxysmal atrial fibrillation. Data are sparse regarding the pulmonary vein (PV) luminal loss after PVI with VGLB. This study sought to clarify the occurrence, as well as anatomical and clinical correlates of PV luminal loss after PVI with VGLB.

Methods: Consecutive patients with paroxysmal atrial fibrillation who underwent PVI using VGLB were screened. Each patient underwent contrast-enhanced computed tomography (CT) scanning before the index PVI, and was offered another CT scanning at 6-month following the procedure, regardless of the symptoms. All patients who underwent the second CT scanning were included in the present analysis. Pulmonary vein cross sectional area (CSA) was calculated before and after the procedure. We defined 25-49%, 50-74% and 75-100% luminal loss as mild, moderate and severe PV narrowing.

Result: In 24 patients, a total of 92 PVs including three left common PVs were analyzed. There was a significant variation in the % reduction in CSA, and the greatest reduction was observed in the right superior PV (left superior PV: 29 [95% confidence interval: 21-37] %, left inferior: 26 [18-34] %, right superior: 52 [44-59] %, right inferior: 36 [28-43] %; p<0.0001). Two right superior PVs and one right inferior PV suffered severe narrowing. Ostial CSA at baseline differed significantly according to the severity of PV narrowing (no narrowing: 1.9 [Interquartile range: 1.6-2.2] cm², mild: 2.8 [1.7-3.2] cm², moderate-severe: 4.4 [3.3-5.0] cm², p<0.0001). On receiver operating characteristic (ROC) curve analysis, a cutoff value of CSA of 3.24 cm² best predicted moderate or severe PV narrowing (sensitivity: 80%, specificity: 84%, area under the curve [AUC] = 0.85. The distance from each PV ostium to the narrowest segment also differed significantly (no narrowing: 0 [0-0] mm, mild: 1.0 [0-2.0] mm, moderate-severe 2.0 [1.5-4.5] mm, p<0.0001). Average laser energy dose was significantly higher in PVs with moderate-severe narrowing compared to those with mild narrowing (9.5±0.2W vs 8.7±0.2W, p = 0.007). On ROC curve analysis, cutoff value of 8.9W best predicted moderate or severe PV narrowing (sensitivity: 76%, specificity: 57% AUC = 0.67). On multivariate analysis, baseline PV CSA remained the single significant predictor of PV luminal loss (p=0.0015, Odds ratio = 2.4 [1.4-4.8] per 1cm² increase). None of the patients exhibited any signs or symptoms of PV stenosis during follow-up.

Conclusion: The PV CSA at baseline, distance from the PV ostium to the narrowing segment and laser power delivered were associated with the severity of PV narrowing after PVI using VGLB. These results suggested that caution should be paid for determining the balloon size and titration of laser power particularly when a large PV is targeted with VGLB.