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**Distortion of right superior pulmonary vein anatomy by balloon catheters as a contributor to phrenic nerve injury.**

[Okumura Y](#), [Henz BD](#), [Bunch TJ](#), [Dalegrave C](#), [Johnson SB](#), [Packer DL](#).

Translational Cardiac Electrophysiology Laboratory, Division of Cardiovascular Disease, Department of Internal Medicine, Health Sciences Research, Mayo Clinic, Rochester, Minnesota, USA.

**Abstract**

**INTRODUCTION:** Cryothermal, HIFU, and laser catheter-based balloon technologies have been developed to simplify ablation for AF. Initial enthusiasm for their widespread use has been dampened by phrenic nerve (PN) injury. The interaction between PN and pulmonary vein (PV) geometry contributing to PN injury is unclear. **METHODS AND RESULTS:** After right thoracotomy, the PN course along the epicardial right atrial surface was mapped directly in 10 dogs. The location of the PN and its relationship with the right superior (RS) PV, and potential RSPV surface distortions after balloon inflation were established by electroanatomic mapping. In 5 dogs, the PN was captured within the RSPV, but could not be stimulated in the remaining 5 dogs. The distance between the RSPV and the PN was significantly shorter in the captured group than in the noncaptured group (6.3 +/- 3.1 mm vs 10.2 +/- 3.2 mm,  $P < 0.001$ ). Importantly, 96% of the captured sites within the RSPV were observed at a distance  $>5$  mm into the PV. The inflated balloon surface anteriorly extended 5.6 +/- 3.7 mm outside the PV diameter, with distortion of anatomy narrowing the distance from the balloon surface to the PN to 4.8 +/- 2.3 mm. (Distance of the original RSPV-to-PN: 9.4 +/- 2.7 mm,  $P < 0.001$ .) **CONCLUSION:** PN injury with balloon technologies may stem from anatomic distortion of the PV orifice/PN relationship, through increasing contact or shortening the relative distance between the ablation site and the PN, even without displacement of the balloon into the PV. These data are important in the refinement of these technologies to improve procedural safety.