The catheter maze procedure for the treatment of chronic atrial fibrillation requires the creation of transmural, continuous linear atrial lesions. Attempts to drag a conventional radiofrequency ablation catheter across the atria in clinical as well as experimental studies have resulted in discontinuous lesions. Continuous linear lesions have been most difficult to create in trabeculated atrial muscle. Lesion discontinuities or gaps have resulted in reentrant atrial tachyarrhythmias in patients after ablation.

We have explored the use of a linear laser catheter for the creation of continuous atrial lesions. A linear laser system may offer a number of potential advantages over conventional radiofrequency catheter ablation: (1) the laser diffuser is a single flexible and compliant fiber that can create thin lesions; (2) continuous intimate contact between the catheter and the endocardium may not be essential for delivery of laser energy; (3) the laser diffuser is Teflon coated, is not directly heated during energy delivery, and thus is not prone to char formation on the catheter; and (4) laser energy delivery is not subject to disruption by rises in impedance.

We tested the feasibility of percutaneously creating a line of conduction block on the trabeculated anterior wall of the right atrium with a diode laser in a goat model.

These images (Figure) demonstrate that linear atrial conduction block can be effectively achieved by catheter ablation with thermal energy sources other than conventional radiofrequency current.
Left, At baseline, a high-density electrode plaque (112 electrodes) was placed on the right atrial epicardial surface. An endocardial pacing catheter was placed on the medial border of the right atrial appendage, and an isochronal map was generated (Prucka) during paced atrial rhythm at a cycle length of 400 ms. Earliest activation is displayed in red and latest activation in blue. Activation can be seen to spread rapidly (arrow) from the pacing site across the atrium along the longitudinal axis of a pectinate muscle. Middle, An ablation catheter with a 4-cm cold diffuser tip (CardioFocus) was introduced via the right femoral vein and aligned under fluoroscopy in a superior-inferior axis on the endocardial surface of the right atrial free wall. The high-density electrode plaque was removed, and the anterior right atrial wall was imaged with an infrared camera through the right lateral thoracotomy. Heat generated during laser ablation on the endocardial surface can be seen on the infrared image to radiate through the atrial wall in a linear configuration throughout the length of 4-cm diffuser. Right, After laser ablation, the high-density plaque was again placed on the epicardial surface of the right atrium, and another isochronal map was generated during pacing from the same site as baseline. Activation of the atrium after laser catheter ablation now demonstrates that linear conduction block has been achieved and is aligned with the superior-inferior orientation of the laser catheter.
Linear Atrial Ablation With a Diode Laser and Fiberoptic Catheter

David Keane and Jeremy N. Ruskin

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