Bipolar Radiofrequency Energy

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DISCLOSURE

- Speaker for AtriCure, Edwards Lifesciences, LivaNova
- Consultant for Medtronic
- Research and educational grants over the last 2 years:
  - AtriCure
  - Edwards
Surgical AF Ablation: The most important goal for an ablation device

- Create conduction block.
  - To do this you must consistently create transmural and continuous lesions.
  - Our laboratory and others have shown that gaps as small as 1 mm can conduct NSR and AF impulses.

Heart Rhythm 2008;5(9):1296-301.
Epicardial Surgical Ablation: What are we trying to do?

Unipolar Irrigated Suction-assisted RF Device

Only 18% of lesions were transmural!

Mode of RF Energy Application: Sensitivity to Convective Cooling

Unipolar

Surface Bipolar

Transmural Bipolar

fat

muscle

blood

fat

muscle

blood

fat

muscle

blood
Epicardial Bipolar Ablation Device
AtriCure Coolrail: Chronic Study

By mapping, none of the 12 linear lesions created demonstrated conduction block at 30 days!

Lee et al. J Thorac Cardiovasc Surg 2012
BIPOLAR RADIOFREQUENCY ABLATION

Atricure Bipolar Device

Medtronic Bipolar Device
Bipolar RF Device
Bipolar RF Energy

Most ablation by resistive heating.
Minimal effects of convective cooling.
Bipolar RF Ablation

Tissue Conductance
Irrigated RF Bipolar Clamps

- **Tissue heating**
- Heating driven deeper into the tissue as irrigation reduces surface impedance
- Lower impedance reduces microbubble formation
- Allows tissue heating to fully penetrate the tissue

Irrigation (facilitates energy flow)

Cell death
Transmurality Detection: Cardioblate® Bipolar Algorithm

- The algorithm customizes energy delivery based on the thickness of the tissue.

![Graph showing impedance (Z), ablation duration (t), and power (W)]
Surgical Ablation for AF: Advantages of Bipolar RF Ablation

- Reliable transmural lesions – 100% transmurality
  - Voeller et al. Innovations 2011;6:17

- Short ablation times
  - 10-20 seconds to circumferentially isolate PVs

- Focused delivery of energy
  - prevents collateral damage
Bipolar RF Ablation

- Ablate without unclamping until ablation time is less than 10 seconds
- 2-3 ablations for each lesion

Tissue Conductance
Technical Tips with Bipolar RF Ablation

- Fully mobilize the pulmonary veins
- Do not bunch tissue in the clamp –
  - perform individual PV isolation if needed
- Ablation duration and energy delivery is controlled by an algorithm based on conductance between the electrodes – avoid artificially decreasing conductance (i.e. air, fat, char)
Bipolar RF Ablation

Shortcomings

- Requires clamping - need to fold or penetrate target tissue
  - On the arrested heart, unable to complete lesions at the right and left atrial isthmus.
  - Limited to PVI only on the beating heart
  - You can not perform a Maze procedure with bipolar clamps only!!
Cryoablation Devices

2-3 cm long, reusable probes

10 cm long disposable probes

Lee, et al
Innovations 2010;5:281-286
Bipolar RF Ablation: Conclusions

- Atrial wall thickness is variable and architecture is complex with free running pectinate muscles and epicardial fat of varying thickness. These factors, combined with the heat sink effect has limited ablation efficacy.

- Bipolar RF ablation has been the most efficacious in the experimental laboratory, and has been the only energy source we have tested with 100% reliability.
Thank you for your attention!