Current, Competing and Emerging Technologies in the Ablation of Atrial Fibrillation

Vivek Y. Reddy, MD

Current, Competing and Emerging Technologies in the Ablation of Atrial Fibrillation

Vivek Y. Reddy, MD
Helmsley Trust Professor of Medicine
Director, Cardiac Arrhythmia Service
The Mount Sinai Hospital

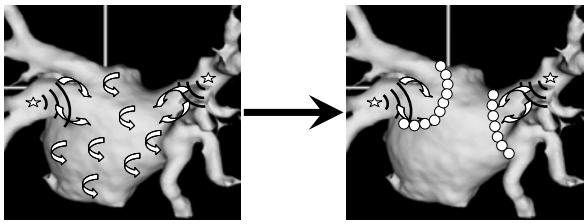
Disclosures

- Grant support and/or Consultant:
  - Biosense-Webster Inc, Cardiofocus Inc, Endosense Inc, Hansen Medical Inc, Magnetecs Inc, Medtronic-Cryocath Inc, Philips Inc, St Jude Medical Inc, Voyage Medical Inc
- I will be discussing off-label use of catheter ablation devices.

Outline

- What is the success rate of PV isolation?
- Ablation of Paroxysmal AF
  - Imaging
  - Improving point-to-point ablation
  - One-size-fits-all devices
- Ablation of Persistent AF

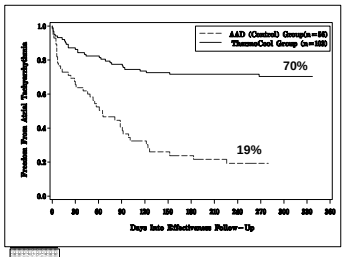
Paroxysmal AF: Catheter Ablation



Current, Competing and Emerging Technologies in the Ablation of Atrial Fibrillation

Vivek Y. Reddy, MD

Ablation *vs* Medications for PAF



Wilber et al, *JAMA*, 2010

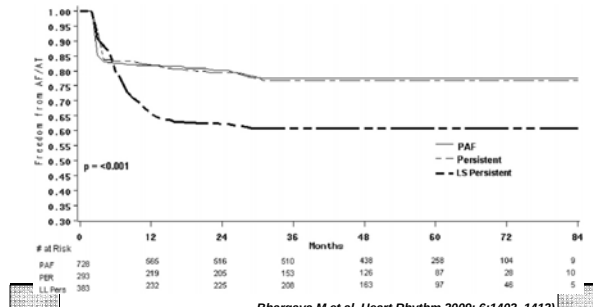
Safety

- Ablation Group (6.8%, n=103)
  - 1 pericarditis
  - 1 pulmonary edema
  - 1 pericardial effusion (no tx needed)
  - 5 vascular complications
  - No Stroke/Embolism, Tamponade, Atrio-Esophageal fistula, PV stenosis, or Phrenic nerve paralysis
- AAD group (17.9%, n=56)
  - 3 life-threatening ventricular arrhythmias
  - 7 disabling symptoms requiring drug withdrawal
- One death in Ablation group, at 284 days, due to acute MI.

Ablation *vs* AADs: 1 yr Success

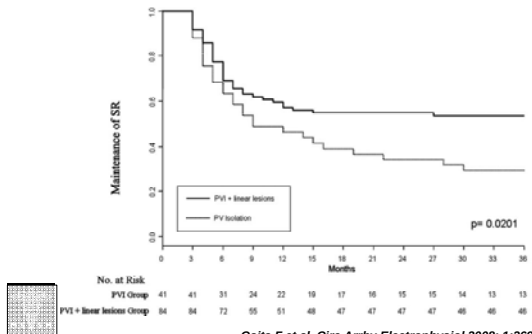
Study	AADs Success Rate	Ablation Success Rate	2nd Ablations	Still on AADs
A4	23%	89%	80%	0%
Thermocool IDE	17%	63%	13%	7%
STOP-AF	7%	70%	19%	12%
CABANA Pilot	38%	61%	21%	28%

Long-term Outcome after PVI: Single Procedure Outcome



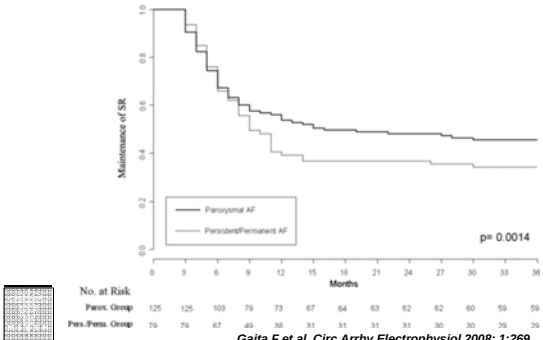
Bhargava M et al. Heart Rhythm 2009; 6:1403–1412)

Long-term Outcome after PVI: Single Procedure Outcome



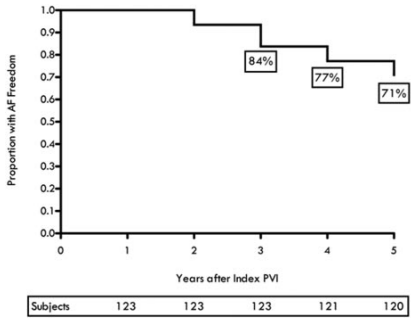
Gaita F et al. Circ Arrhy Electrophysiol 2008; 1:269

Long-term Outcome after PVI: Single Procedure Outcome



Gaita F et al. Circ Arrhy Electrophysiol 2008; 1:269

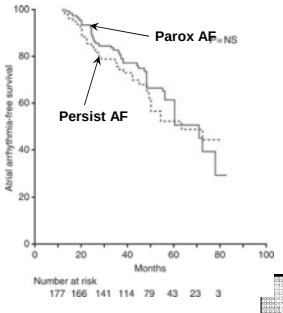
Long-term Outcome after PVI: After Initial "Success"



Tzou WS et al. Circ Arrhy Electrophysiol 2010; 3:237

Long-term Outcome after PVI: Late Recurrence

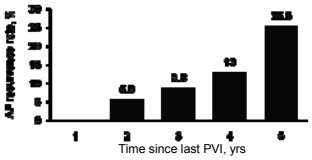
- n = 177 of 229 pts w/o recurrence in year one
- Follow-up 50 ± 13 mo (range 36 – 83 mo)
- 42% had recurrent AF
  - 13% at 2 yrs
  - 22% at 3 yrs
  - 35% at 4 yrs
  - 47% at 5 yrs
  - 55% at 6 yrs

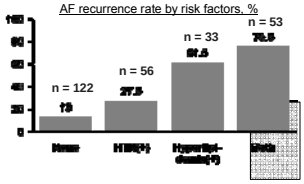


Bertaglia E et al. Europace: 12:181, 2010

Long-term Outcome after PVI: Late Recurrence

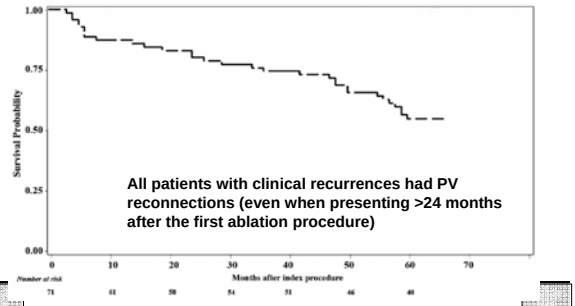
- n = 264 of 350 without recurrence in year one
- Follow-up 28 ± 12 months (up to 5 years)
- 23 (8.7%) recurrent AF
- Repeat ablation in 18/23
  - ≥ 1 PV reconnected in all patients





Shah AN et al. JCE 2008;19:661-7

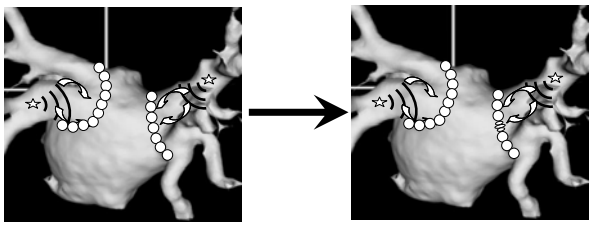
Long-term Outcome after PVI: Single Procedure Outcome



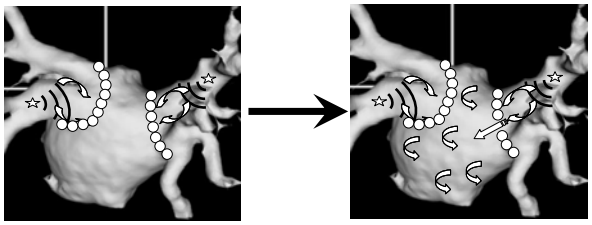
All patients with clinical recurrences had PV reconnections (even when presenting >24 months after the first ablation procedure)

Sawhney N et al. Am J Cardiol 2009; 104:366

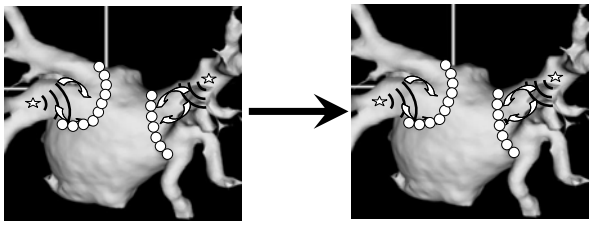
Paroxysmal AF: Why does ablation fail?



Paroxysmal AF: Why does ablation fail?



Paroxysmal AF: Why does ablation fail?

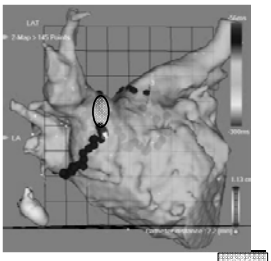


Current, Competing and Emerging Technologies in the Ablation of Atrial Fibrillation

Vivek Y. Reddy, MD

How often does PV reconnection occur?

- How frequent is PV reconnection?
- Pratola et al, *Circulation* 2008; 117:136
- PV encircling procedure for drug-refractory Atrial Fibrillation
- Repeat EPS in 20 pts
  - Persistent PV isolation: 37.5%
  - Persistent PV exit block: 48.7%



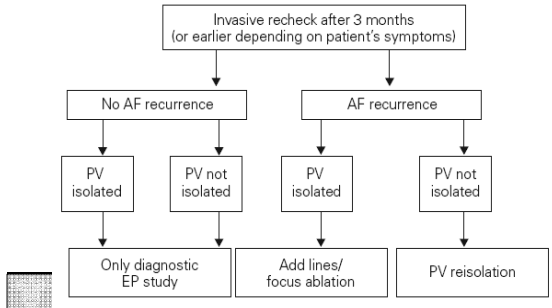
How often does PV reconnection occur?

- S.Willems et al, *JCE* 2010 (in press)
- Methodology:
  - 64 pts with PAF underwent PVI (Robotic Nav-Hansen + NavX)
  - Repeat pre-specified EPS performed in 40 pts at 3 months
- Persistent PV Isolation:
  - On a per vein basis: 57%
  - On a per patient basis: 23% (ie, pts with all PVs isolated)

Pattern of PV Reconduction during Follow-Up EPS in Patients with and without AF Recurrence

Reconducted PV	Free of AF Recurrence (n = 28)	AF Recurrence (n = 12)	P-Value
0 (%, (n))	32 (9)	0 (0)	
1 (%, (n))	21 (6)	0 (0)	
2 (%, (n))	29 (8)	58 (7)	
3 (%, (n))	11 (3)	33 (4)	
4 (%, (n))	7 (2)	8 (1)	
Mean	1.4	2.5	0.006

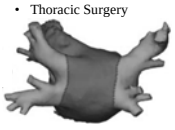
How often does PV reconnection occur? The GAP-AF Trial



Breithardt G et al. Herz 33:548-555, 2008

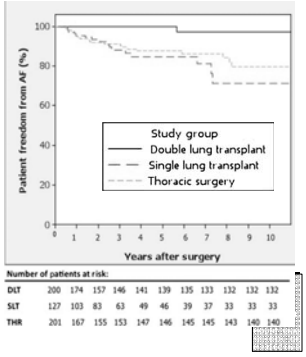
What if durable PV Isolation?

- Lee G et al, *Eur Heart J*, 2010
- AF after lung transplantation
  - Compare early & late AF
  - Retrospective analysis after:
    - Single Lung Transplantation
    - Double Lung Transplantation
    - Thoracic Surgery



- Early post-op AF:

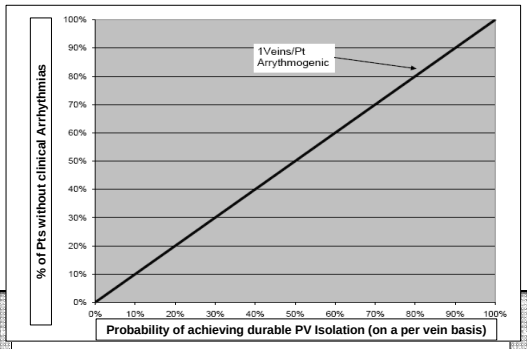
Double Lung	29%
Single Lung	28%
Thoracic Surg	14%



Current, Competing and Emerging Technologies in the Ablation of Atrial Fibrillation

Vivek Y. Reddy, MD

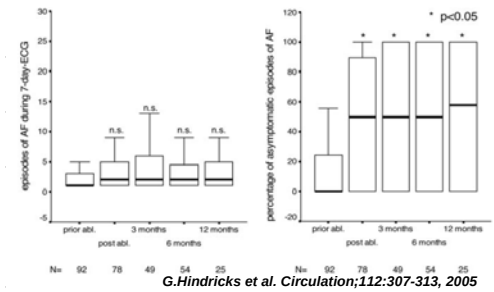
Importance of Durable PV Isolation



Model assumes: i) 4 PVs / pt, and ii) PVs are isolated individually

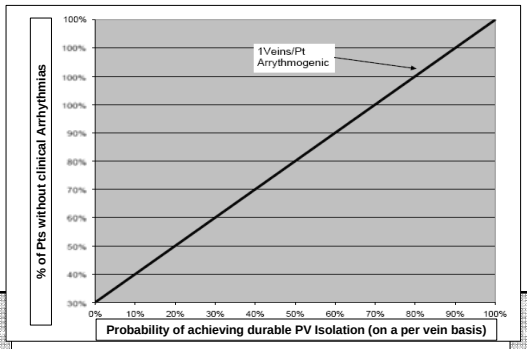
Why would there be a discordance between Durable PV Isolation and Clinical AF?

-
-



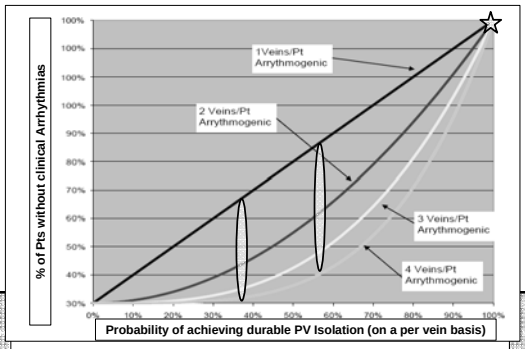
G.Hindricks et al. Circulation;112:307-313, 2005

Correlation of PVI & Clinical Success



Model assumes: i) 4 PVs / pt, and ii) PVs are isolated individually

Correlation of PVI & Clinical Success



Model assumes: i) 4 PVs / pt, and ii) PVs are isolated individually

Current, Competing and Emerging Technologies in the Ablation of Atrial Fibrillation

Vivek Y. Reddy, MD

How can we improve lesion formation?

How can we improve lesion formation?

1. Image-Guidance
2. Lesion Indexing
3. Lesion Validation

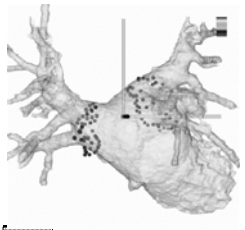
Improving point-to-point ablation

4. Contact Sensing Strategies
5. Remote Navigation

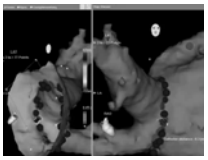
One-size-fits-all devices

6. Cryo-Balloon
7. Visually-guided Laser Balloon
8. Curvilinear Catheters

CT/MR Image-Guided Therapy



Z.Malchano / V.Reddy, MGH, 2003



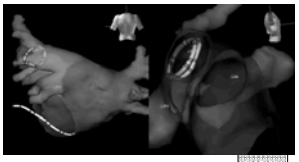
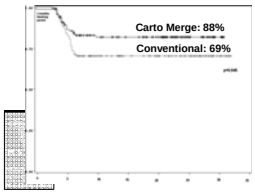


Image-Guided Therapy: Clinical Data

Procedural Characteristics

	Group 1*	Group 2†	P
Fluoroscopy time (minutes)	56 ± 18	45 ± 12	<0.0001
Procedural duration (minutes)	170 ± 20	150 ± 23	<0.0001
Mean total energy delivered (J)	76,550 ± 12,400	67,270 ± 11,800	<0.0001
Mean RF delivery times (min)	49 ± 13	46 ±14	= 0.08
Mean radiation exposure (uGray*m²)	28,775 ± 5,540	21,340 ± 2,355	<0.001
Effective biological dose (mSv)	78 ± 14 (first 60 cases) 65 ± 11 (last cases)	44 ± 5	<0.001

*Radiation times of the ablation procedure and the CT scan acquisition.
†Radiation times of the ablation procedure including the venography.



290 pts Randomized to:

Image-Guided (145, parox:73%)

or

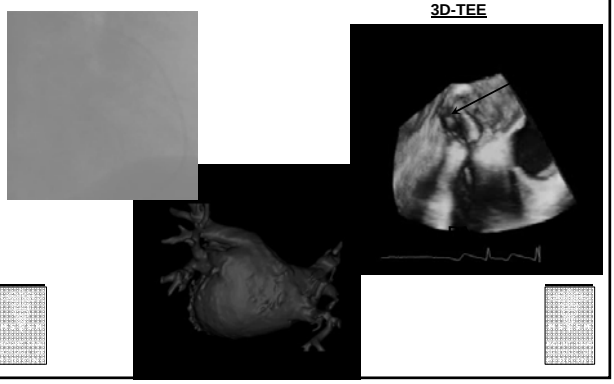
Conventional (145, parox: 69%)

Della Bella et al, JCE 20:258 (2009)

Current, Competing and Emerging Technologies in the Ablation of Atrial Fibrillation

Vivek Y. Reddy, MD

Advances in 3D Imaging



Radiation: Estimated Cancer Risk

		Lifetime Attributable Risk (%)	
	Effective Dose (mSv)	All Cancer Incidence	All Cancer Mortality
BMI <25 kg/m^2	15.2 ± 7.9	0.100 ± 0.060 (1/1,000)	0.060 ± 0.033 (1/1,666)
BMI 25-30 kg/m^2	26.8 ± 11.6	0.158 ± 0.080 (1/633)	0.100 ± 0.048 (1/1,000)
BMI ≥30 kg/m^2	39.0 ± 14.7	0.247 ± 0.083 (1/405)	0.149 ± 0.049 (1/671)
All patients	25.0 ± 13.8	0.156 ± 0.090 (1/641)	0.095 ± 0.053 (1/1,053)

Ector et al, *JACC* 50:234, 2007

Radiation Exposure to Staff

Table 1

Orthopedic Complications

Author (reference #)	Methods	Findings
Ross (1)	Survey of interventional cardiologists (852 surveys, 385 responses), orthopedists (577 surveys, 131 responses) and rheumatologists (978 surveys, 198 responses)	Increased spine problems in interventionalists (75% incidence) as compared to orthopedists and rheumatologists
Goldstein (3)	Survey of 1600 interventional cardiologists (424 responses)	Prevalence of orthopedic complaints: Spine 42% Hip, knee, ankle 28% Spine problem limited work in 1/3
Machan (12)	Survey of interventional radiologists (308 responses)	60% reported spine complaints; in 25%, spine problems limited work
Moore (13)	Survey of 608 radiologists (236 responses)	50% prevalence of back pain

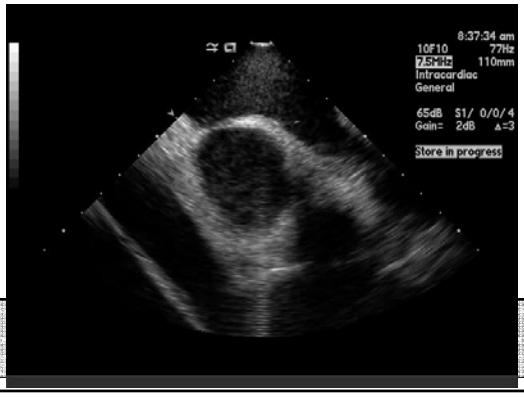
Table 2

Cancer Incidence

Author (reference #)	Methods	Findings
Finkelstein (10)	Report of a case cluster	Brain cancer in 2 interventionalists
Preston (21)	Review of solid cancers in atomic bomb survivors	Radiation dose response for nervous system tumors. Exposure to dose < 1 Sv associated with increased risk
Matanoski (23)	Cohort study of mortality in radiologists over a 50 y period	Excess cancer risk among radiologists consistent with other physicians (especially for leukemia and lymphoma)
Carozza (25)	Case control study of occupation and glioma	Physicians at increased risk of glioma
Andersen (26)	Population based study of occupation and cancer incidence	Brain cancer increased among physicians in general. No breakdown by specialty.

Klein et al, *Radiology 2*50:538, 2009

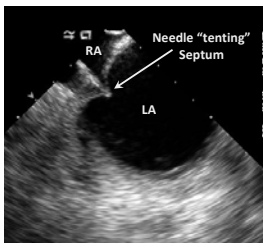
Fluoroless Transseptal Puncture-1

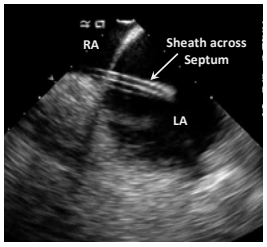


Fluoroless Transseptal Puncture-2

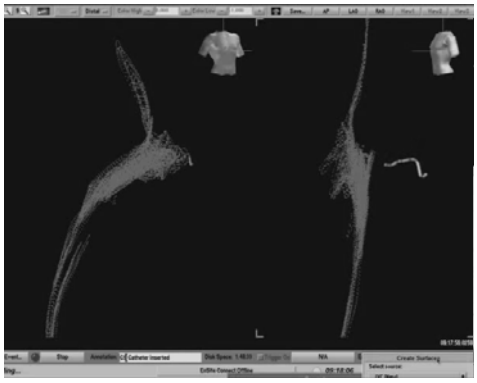
Fluoroless Transseptal Puncture-3

Fluoroless Transseptal Puncture





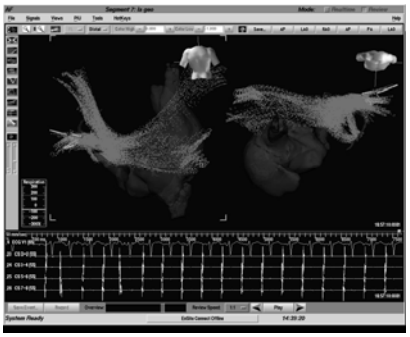
Fluoroless Navigation: RA / CS



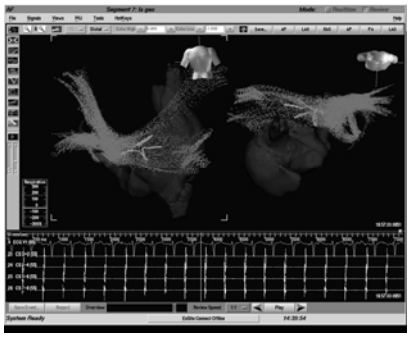
Current, Competing and Emerging Technologies in the Ablation of Atrial Fibrillation

Vivek Y. Reddy, MD

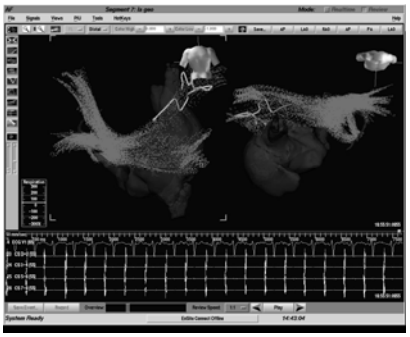
LA Geometry: Multi-spline Catheter



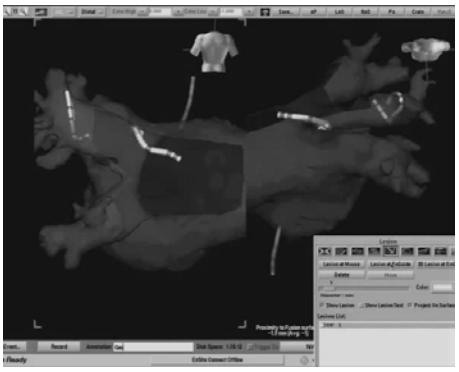
LA Geometry: Multi-spline Catheter



LA Geometry: Multi-spline Catheter



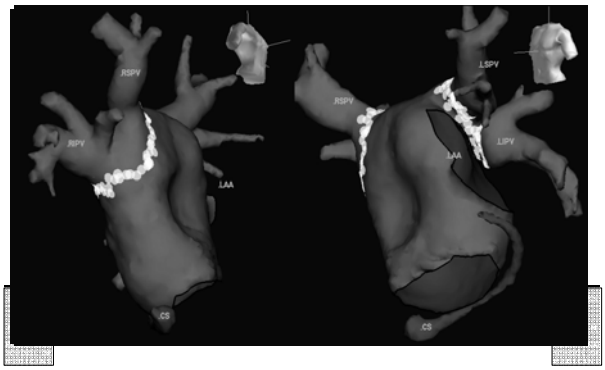
Where is the transseptal sheath?



Current, Competing and Emerging Technologies in the Ablation of Atrial Fibrillation

Vivek Y. Reddy, MD

Fluoro-less AF Ablation



Procedural Details

Parameter	Value
No. of TS punctures	1 (18 pts), 2 (2 pts)
Catheter used, Circular/Flower	70% / 30%
Time for RA geometry, min	5.5 ± 2.6 (2 – 11)
Time for LA geometry, min	22 ± 10 (8 – 40)
CT Registration used, n	11 pts (55%)
Time for CT Registration, min	19 ± 8 (9 – 34)
No. of RF Lesions	49 ± 18 (15 – 101)
Total Time of RF Delivery, min	53 ± 18 (18 – 104)
Success of Isolating Lesion Sets	38/39 (97%)
Time from first to last lesion, min	113 ± 44 (42 – 217)
Total Procedure Time, min	244 ± 75 (125 – 454)

V.Reddy et al *Heart Rhythm* (accepted)

How can we improve lesion formation?

1. Image-Guidance
2. Lesion Indexing
3. Lesion Validation

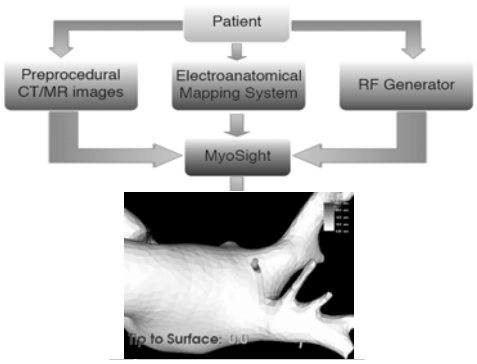
Improving point-to-point ablation

4. Contact Sensing Strategies
5. Remote Navigation

One-size-fits-all devices

6. Cryo-Balloon
7. Visually-guided Laser Balloon
8. Curvilinear Catheters

Can we improve lesion tracking?

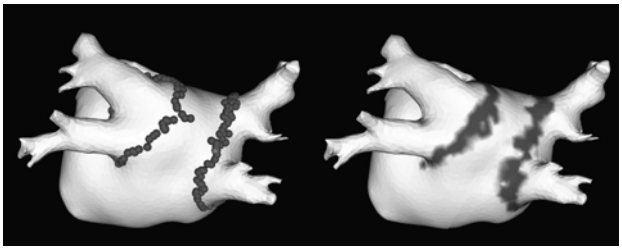


R.Vijaykumar / A.Locke / V.Reddy, *Heart Rhythm* 2010

Current, Competing and Emerging Technologies in the Ablation of Atrial Fibrillation

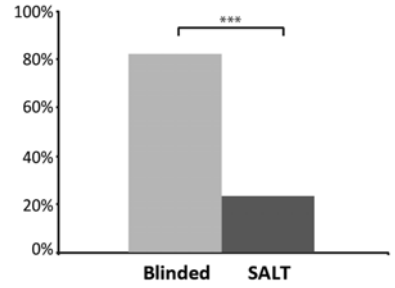
Vivek Y. Reddy, MD

Spatially Accurate Lesion Tracking (SALT)



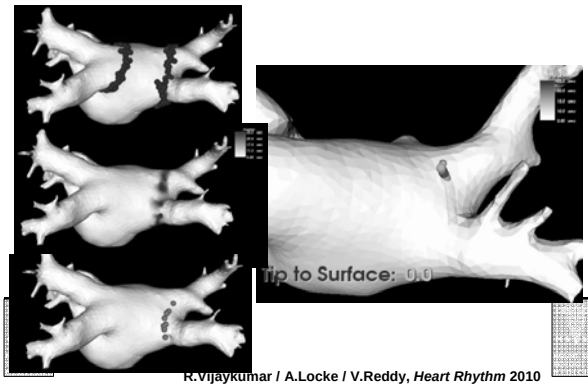
R.Vijaykumar / A.Locke / V.Reddy, *Heart Rhythm* 2010

Additional Ablation Required after the Initial Circumferential Lesion Set



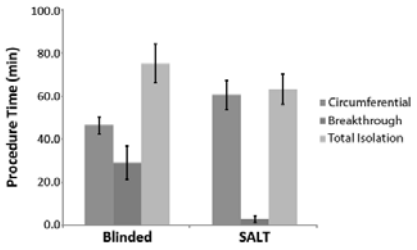
R.Vijaykumar / A.Locke / V.Reddy, *Heart Rhythm* 2010

Pepper to Identify Gaps



R.Vijaykumar / A.Locke / V.Reddy, *Heart Rhythm* 2010

Effect of SALT on Procedural Parameters

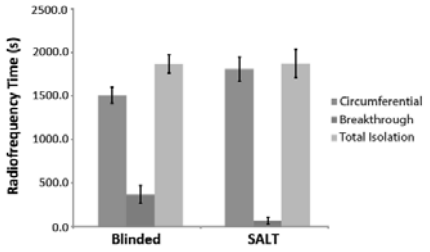


R.Vijaykumar / A.Locke / V.Reddy, *Heart Rhythm* 2010

Current, Competing and Emerging Technologies in the Ablation of Atrial Fibrillation

Vivek Y. Reddy, MD

Effect of SALT on Procedural Parameters



R.Vijaykumar / A.Locke / V.Reddy, *Heart Rhythm* 2010

How can we improve lesion formation?

1. Image-Guidance
2. Lesion Indexing
3. Lesion Validation

Improving point-to-point ablation

4. Contact Sensing Strategies
5. Remote Navigation

One-size-fits-all devices

6. Cryo-Balloon
7. Visually-guided Laser Balloon
8. Curvilinear Catheters

Can Pace-Capture Facilitate Ablation?

Anatomical Encircling
- Irrigated RF Catheter
- PV potentials hidden
- Ipsilateral PVs as pairs

↓

Render Non-Capturable
- Pace-Capture on lines
- More RF till non-capture

↓

Un-blind Operator
- Assess whether isolation
- More RF if not isolated

- 30 PAF patients (2 centers)
- After anatomical encircling, PVI occurred in 19/60 (32%)
- After PC, PVI in 57/60 (95%)
- More RF: PVI in 60/60(100%)

- Even after PVI, additional sites of pace-capture in 30/60 (50%)

D.Steven / V.Reddy / G.Michaud, *Heart Rhythm*, 2009 (in press)

How can we improve lesion formation?

1. Image-Guidance
2. Lesion Indexing
3. Lesion Validation

Improving point-to-point ablation

4. Contact Sensing Strategies
5. Remote Navigation

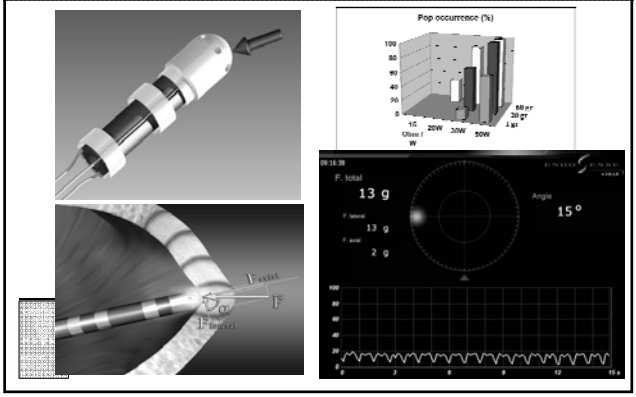
One-size-fits-all devices

6. Cryo-Balloon
7. Visually-guided Laser Balloon
8. Curvilinear Catheters

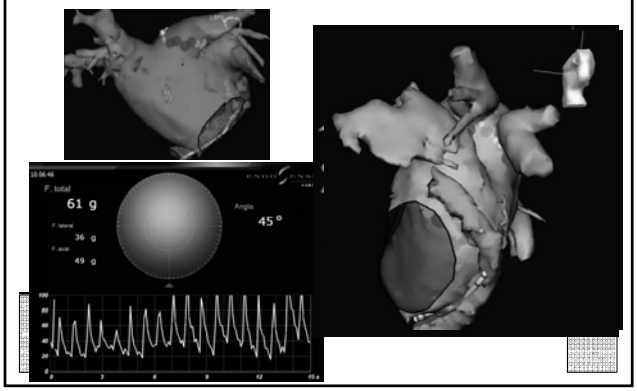
Current, Competing and Emerging Technologies in the Ablation of Atrial Fibrillation

Vivek Y. Reddy, MD

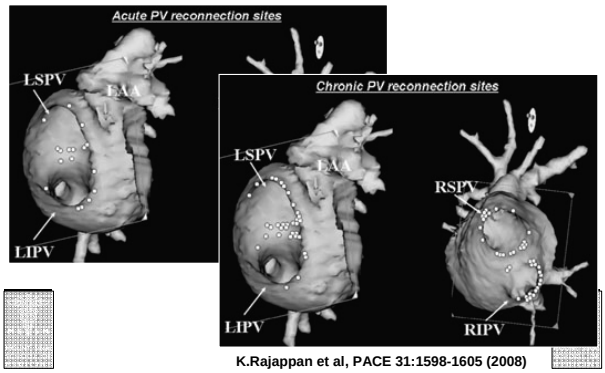
Detecting Contact Force



Example of High Force



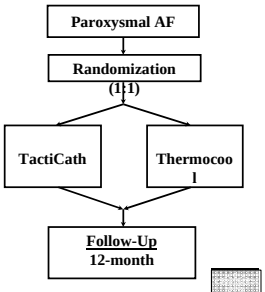
PV reconnections have a characteristic spatial distribution



K.Rajappan et al, PACE 31:1598-1605 (2008)

TOCCASTAR

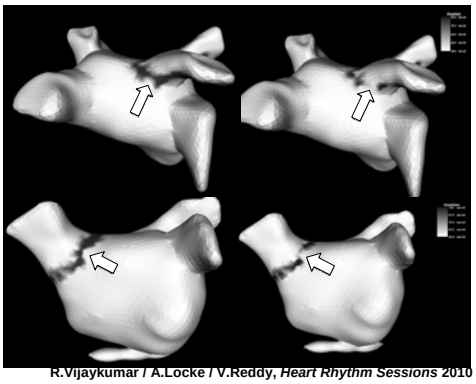
- Randomized FDA-IDE Trial
  - Centers: US & Europe
  - PI: Vivek Reddy
  - Compare TactiCath to Thermocool ablation catheter for AF ablation
- Non-inferiority Study
- Endpoints:
  - 1º Efficacy:
    - 12-mo AF/AT free rate off AADs
  - 1º Safety: Procedure-related events
  - Secondary Endpoints:
    - Number of gaps after encircling lesions
    - Total duration of RF Energy required
    - Time to achieve PV Isolation



Current, Competing and Emerging Technologies in the Ablation of Atrial Fibrillation

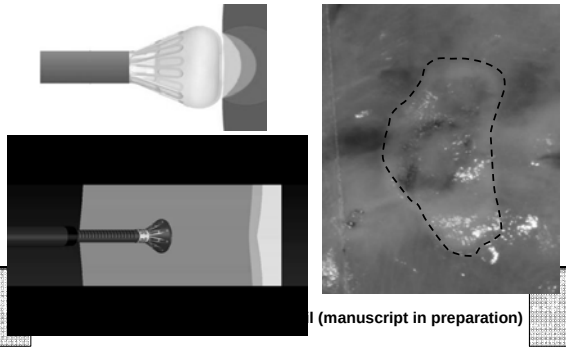
Vivek Y. Reddy, MD

Pepper *vs* Force-Pepper



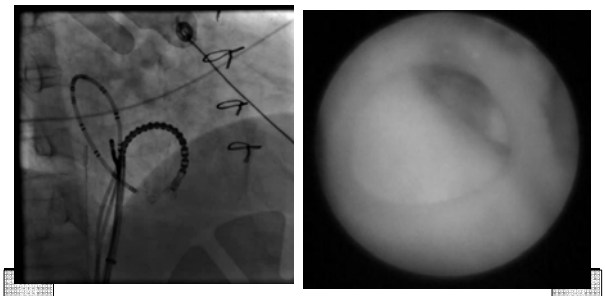
R.Vijaykumar / A.Locke / V.Reddy, *Heart Rhythm Sessions* 2010

In Vivo Visually-Guided Spot Ablation



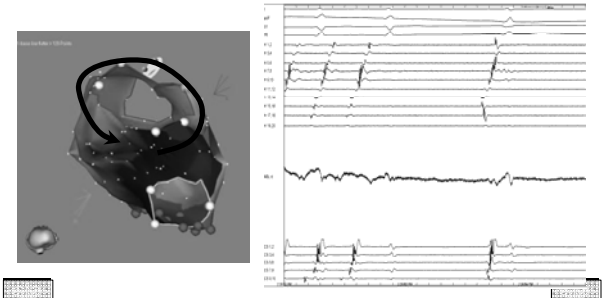
l (manuscript in preparation)

In Vivo Visually-Guided A.Flutter Ablation



V.Reddy / P.Neuzil (manuscript in preparation)

In Vivo Visually-Guided A.Flutter Ablation

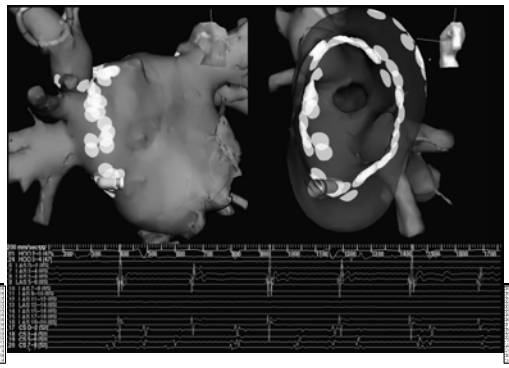


V.Reddy / P.Neuzil (manuscript in preparation)

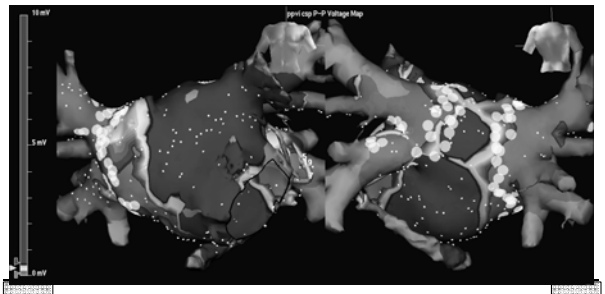
Current, Competing and Emerging Technologies in the Ablation of Atrial Fibrillation

Vivek Y. Reddy, MD

In Vivo Visually-Guided AF Ablation



In Vivo Visually-Guided AF Ablation



How can we improve lesion formation?

1. Image-Guidance
2. Lesion Indexing
3. Lesion Validation

Improving point-to-point ablation

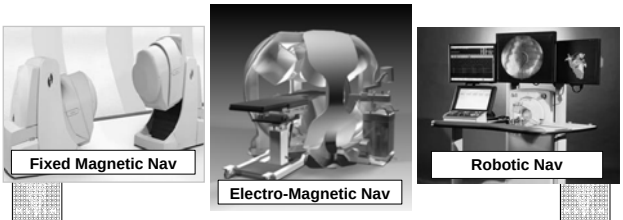
4. Contact Sensing Strategies
5. Remote Navigation

One-size-fits-all devices

6. Cryo-Balloon
7. Visually-guided Laser Balloon
8. Curvilinear Catheters

Remote Navigation Systems

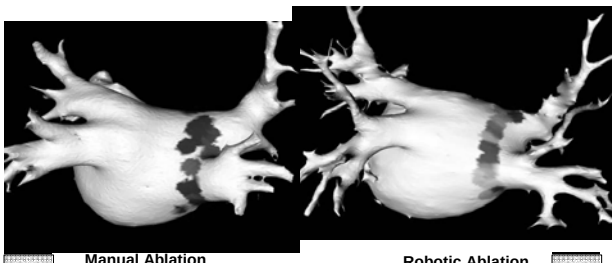
- Magnetic Navigation: Fixed Magnets (Stereotaxis)
- Magnetic Navigation: Electro-Magnets (Magnetecs)
- Robotic Navigation (Hansen Medical)



Current, Competing and Emerging Technologies in the Ablation of Atrial Fibrillation

Vivek Y. Reddy, MD

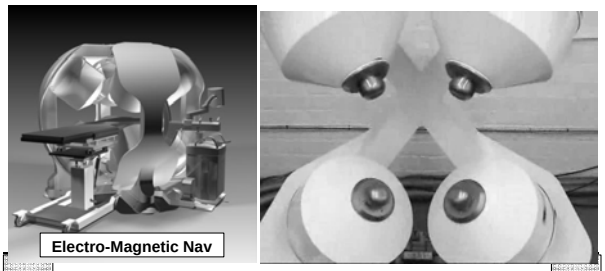
Stability of Remote *vs* Manual Ablation



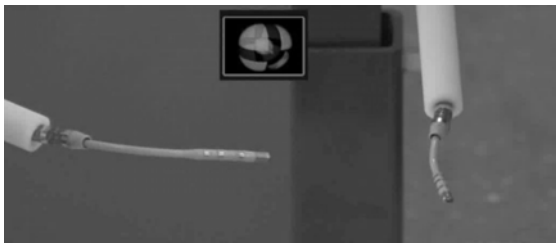
Manual Ablation

Robotic Ablation

Electro-Magnetic Navigation



Electro-Magnetic Navigation



Electro-Magnetic Navigation

Current, Competing and Emerging Technologies in the Ablation of Atrial Fibrillation

Vivek Y. Reddy, MD

How can we improve lesion formation?

1. Image-Guidance
2. Lesion Indexing
3. Lesion Validation

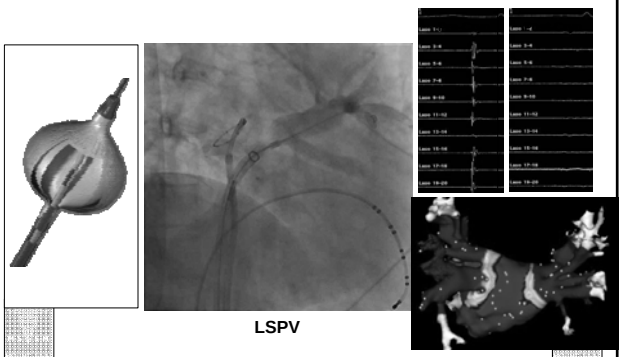
Improving point-to-point ablation

4. Contact Sensing Strategies
5. Remote Navigation

One-size-fits-all devices

6. Cryo-Balloon
7. Visually-guided Laser Balloon
8. Curvilinear Catheters

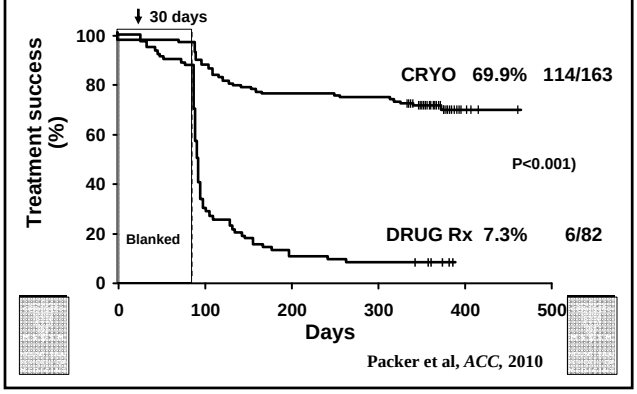
Cryoballoon Ablation



Clinical Outcome

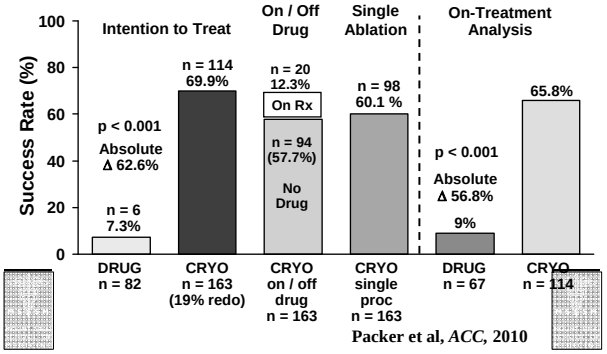
Study	N	Follow-Up	Freedom from AF	
			Paroxysmal	Persistent
Reddy et al, AHA 2005	20	12 mo	84%	---
Klein et al, *Heart Rhythm* 2008	21	6 mo	86%	---
Neumann et al, *JACC* 2008	293 / 53	12 mo	74%	42%
Linhart et al, HRS 2008	20	3 mo	50%	---
VanBelle et al, Cardiostim 2008	100	12 mo	64%	---
Koch et al, GCS 2008	28 / 12	8.8 mo	43%	42%
Packer et al, STOP-AF	163	12 mo	69.9%	---

STOP-AF US IDE Trial



Packer et al, *ACC*, 2010

STOP-AF: Success by Analysis Method



Packer et al, *ACC*, 2010

STOP-AF: Adverse Events

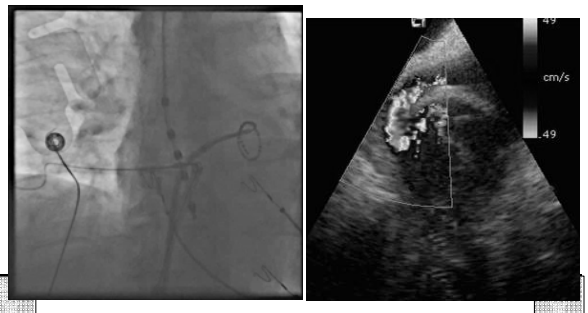
Type of Adverse Event	CRYO (n = 163)		DRUG (n = 82)	
Stroke	4	2.5%	1	1.2%
TIA	3	1.8%	1	1.2%
Tamponade	1	0.6%	1	1.2%
Myocardial infarction	2	1.2%	0	0.0%
Hemorrhage requiring transfusion	3	1.8%	1	1.2%
New atrial flutter	6	3.7%	13	15.9%
Atrial esophageal fistula	0	0.0%	0	0.0%
Death	1	0.6%	0	0.0%
New or worsened AV fistula	2	1.2%	0	0.0%
Pseudoaneurysm	1	0.6%	1	1.2%
Phrenic nerve palsy	22	13.5%	6	7.3%
Persistent phrenic nerve palsy	4	2.5%	0	0.0%
PV stenosis	5	3.1%	2	2.4%

Packer et al, *ACC*, 2010

STOP-AF: Problems with the Cryoballoon

- Efficacy: Chronic PVI
- Safety Considerations
  - Tamponade
  - Stroke
  - Phrenic Nerve Paralysis
  - Pulmonary Vein Stenosis

What if there is a gap??

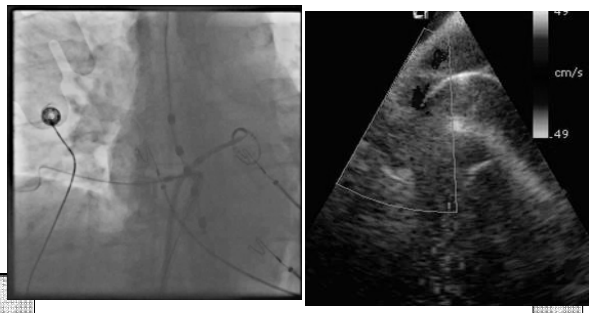


H.Ahmed / P.Neuzil / V.Reddy, *JCE* (in press)

Current, Competing and Emerging Technologies in the Ablation of Atrial Fibrillation

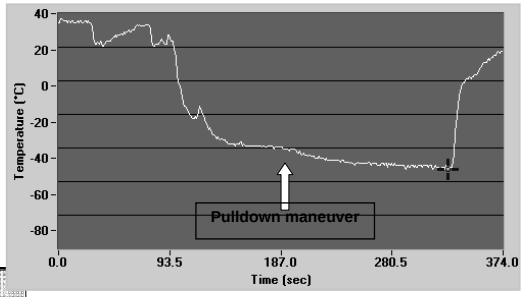
Vivek Y. Reddy, MD

What if there is a gap??



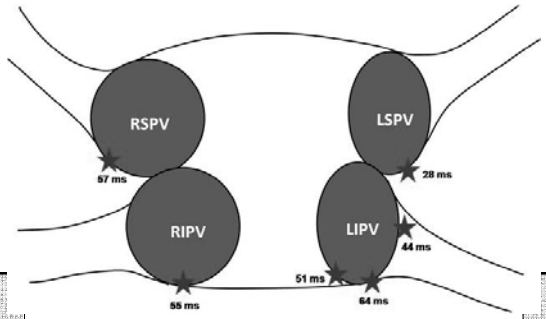
H.Ahmed / P.Neuzil / V.Reddy, *JCE* (in press)

Pulldown: Effect on Balloon Temp



H.Ahmed / P.Neuzil / V.Reddy, *JCE* (in press)

Where are the chronic breakthroughs?



H.Ahmed / P.Neuzil / V.Reddy, *JCE* (in press)

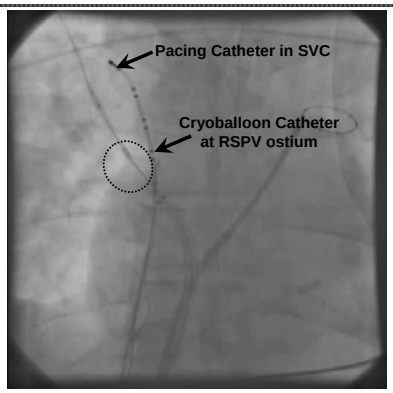
STOP-AF: Problems with the Cryoballoon

- Efficacy: Chronic PVI
- Safety Considerations
  - Tamponade
  - Stroke
  - Phrenic Nerve Paralysis
  - Pulmonary Vein Stenosis

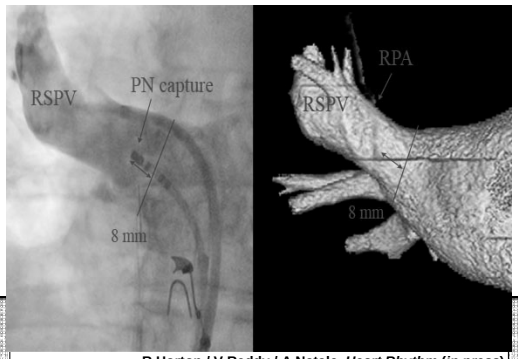
Current, Competing and Emerging Technologies in the Ablation of Atrial Fibrillation

Vivek Y. Reddy, MD

Minimizing Phrenic Nerve Injury

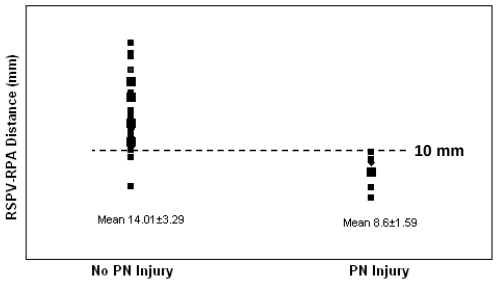


Imaging the Phrenic Nerve?



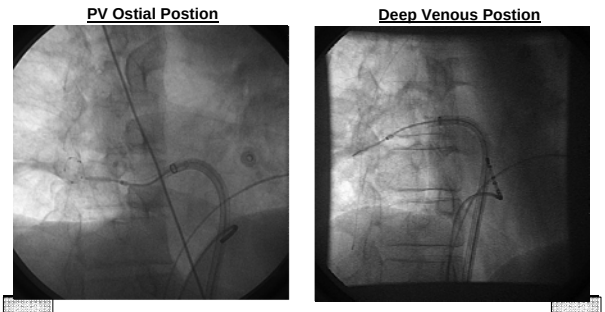
R.Horton / V.Reddy / A.Natale, *Heart Rhythm* (*in press*)

Which patients with PN Injury?



R.Horton / V.Reddy / A.Natale, *Heart Rhythm* (*in press*)

Why PV Stenosis after cryoballoon ablation?

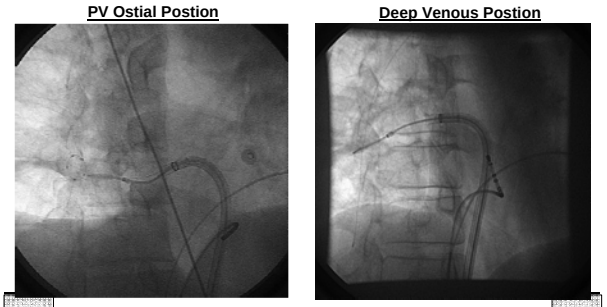


Courtesy of B.Schumacher

Current, Competing and Emerging Technologies in the Ablation of Atrial Fibrillation

Vivek Y. Reddy, MD

Why PV Stenosis after cryoballoon ablation?



Courtesy of B.Schumacher

How can we improve lesion formation?

1. Image-Guidance
2. Lesion Indexing
3. Lesion Validation

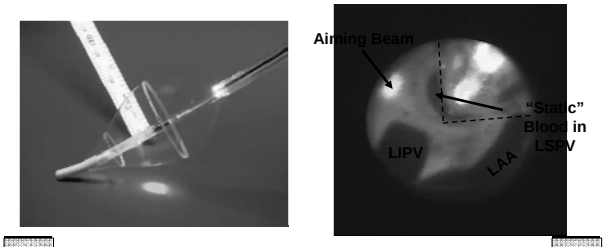
Improving point-to-point ablation

4. Contact Sensing Strategies
5. Remote Navigation

One-size-fits-all devices

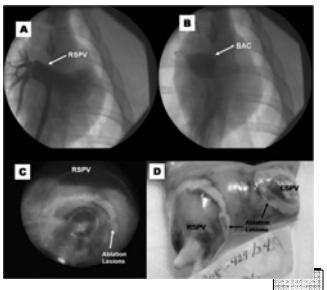
6. Cryo-Balloon
7. Visually-guided Laser Balloon
8. Curvilinear Catheters

Visually-Guided Ablation



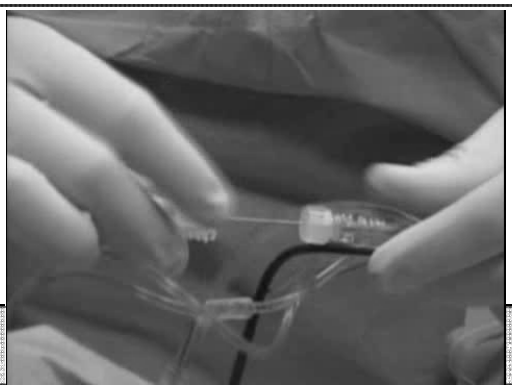
Pre-Clinical Evaluation

- 17 Normal Pigs
  - 22 PVs targeted
  - 17 RSPVs, 5 LSPVs
- PV Isolation at 1st map
  - 21/22 (95%) PVs isolated
  - No PV stenosis/thrombus



S.Dukkipati / P.Neuzil / A.d'Avila / V.Reddy , *Circ Arrhy* (in press)

In vivo Visually-Guided Ablation



Pretreatment PV Sizes

	Mean ± SD	Min, Max
LSPV (mm)	19.9 ± 3.2	(15, 27)
LIPV (mm)	19.8 ± 3.3	(15, 30)
RSPV (mm)	22.7 ± 3.3	(17, 30)
RIPV (mm)	20.8 ± 3.3	(13, 26)
LCPV (mm)	27.8± 5.8	(20, 35)
RCPV (mm)	27.5± 0.7	(27, 28)

Procedural Details

	Mean ± SD	Min, Max
Procedure Time (hh:mm)	3:16 ± 0:38	(2:16, 4:32)
Fluoroscopy Time (min)	19 ± 10	(7, 64)
Ablation time (hh:mm)	1:40 ± 0:27	(0:46, 2:27)

Safety

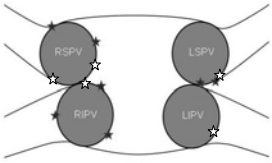
- No Device Related Adverse Events
  - 1 occurrence new onset atrial flutter
- No clot, char or steam pops
- No PV stenosis

Current, Competing and Emerging Technologies in the Ablation of Atrial Fibrillation

Vivek Y. Reddy, MD

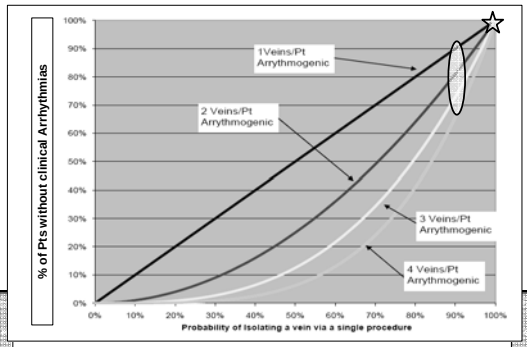
Is Visually-Guided ablation permanent?

- Study in Prague:
  - Ablation in 40 pts
  - EP study at 10 weeks in all patients (regardless of sxs)
  - 33 pts came for 2nd procedure at 11.1±0.9 wks
- Results:
  - 33 patients → 127 PVs
  - Persistent Isolation
    - 113/125 PVs (90%)



S.Dukkipati / P.Neuzil / A.d'Avila / V.Reddy , *Circ Arrhy* (in press)

Correlation of PVI & Clinical Success



Model assumes: i) 4 PVs / pt, and ii) PVs are isolated individually

How can we improve lesion formation?

1. Image-Guidance
2. Lesion Indexing
3. Lesion Validation

<u>Improving point-to-point ablation</u>

4. Contact Sensing Strategies
5. Remote Navigation

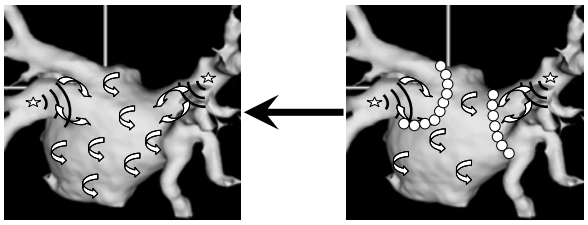
<u>One-size-fits-all devices</u>

6. Cryo-Balloon
7. Visually-guided Laser Balloon
8. Curvilinear Catheters

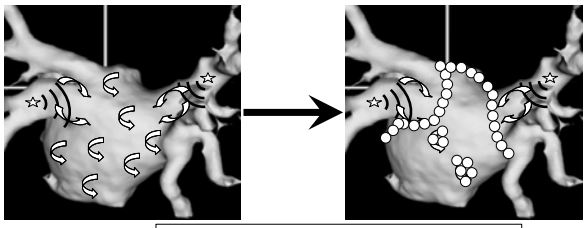
Linear Ablation Technologies

What about Persistent AF?

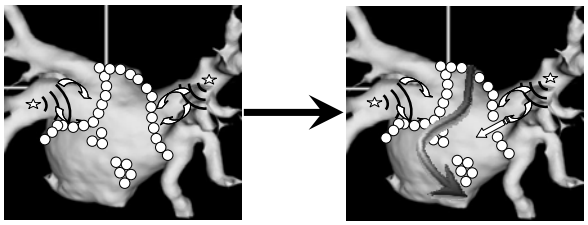
Persistent AF: Catheter Ablation



Persistent AF: Catheter Ablation



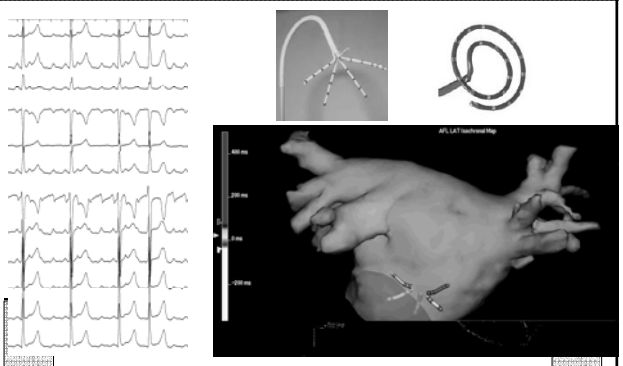
Persistent AF: Why does ablation fail?



Current, Competing and Emerging Technologies in the Ablation of Atrial Fibrillation

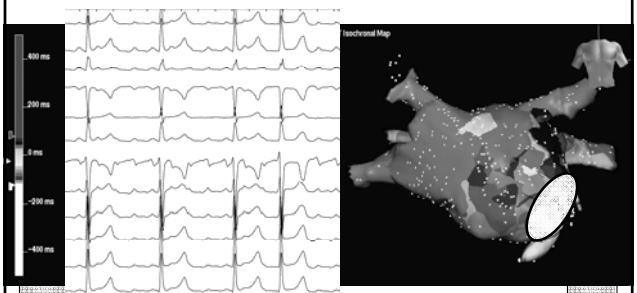
Vivek Y. Reddy, MD

Atypical Flutter: Multielectrode Mapping



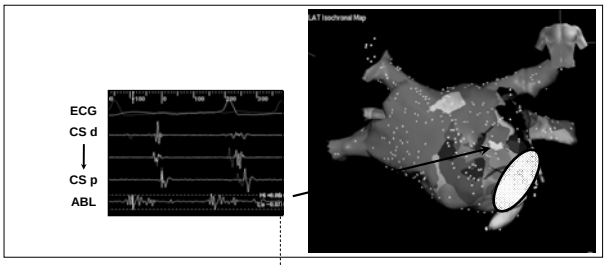
Patel & Reddy, *Circ-Arry*, 2008;1:14-22.

Propagation of CCW PMI AFL (250 ms)



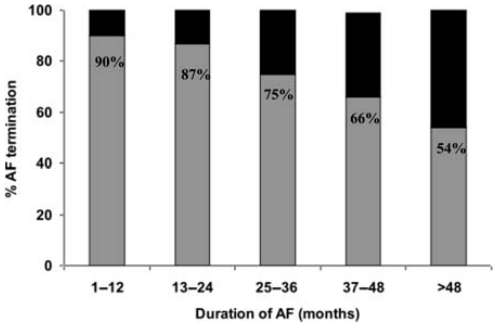
Patel & Reddy, *Circ-Arry*, 2008;1:14-22.

EGMs at Anterior MV Annulus



Patel & Reddy, *Circ-Arry*, 2008.

Persistent AF Ablation: Outcome



O'Neill et al, *Eur Heart J*, 2009;30:1105.

Final Thoughts

- Improving AF Ablation:
  - Need to achieve durable PV Isolation
  - PVI alone in persistent AF?
- Catheter Ablation of Paroxysmal AF
  - Goal is permanent PV Isolation
  - New technology is quite promising
    - Improving Point-by-Point Ablation
    - Remote Navigation
    - Balloon Ablation
- Persistent AF ablation
  - Ideally, ablate while still paroxysmal
  - Good outcome – but with multiple procedures