

The Hybrid Approach: How to Increase Lesion's Transmurality

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THE HYBRID CONCEPT: WHY?

A paradigm shift currently taking place in CV surgery !

CORONARY DISEASE

VALVE DISEASE

AORTIC DISEASE

HYBRID EP-SURGICAL TREATMENT OF ATRIAL FIBRILLATION

WHY?

- Limited success of pharmacological therapies
- EP ablation: poor results at long term in persistent AF
- Surgical ablation: Cox-Maze procedure too invasive and complex

HYBRID EP-SURGICAL TREATMENT OF ATRIAL FIBRILLATION

The Heart Surgery Forum #2005-1125
8 (5), 2005 [Epub August 2005]
doi:10.1532/HSP98.20051125

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The Need of a Hybrid Approach for the Treatment of Atrial Fibrillation

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Giosuè Mascioli, MD,² Claudio Muneretto, MD¹

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HYBRID EP-SURGICAL TREATMENT OF ATRIAL FIBRILLATION

PAROXYSMAL



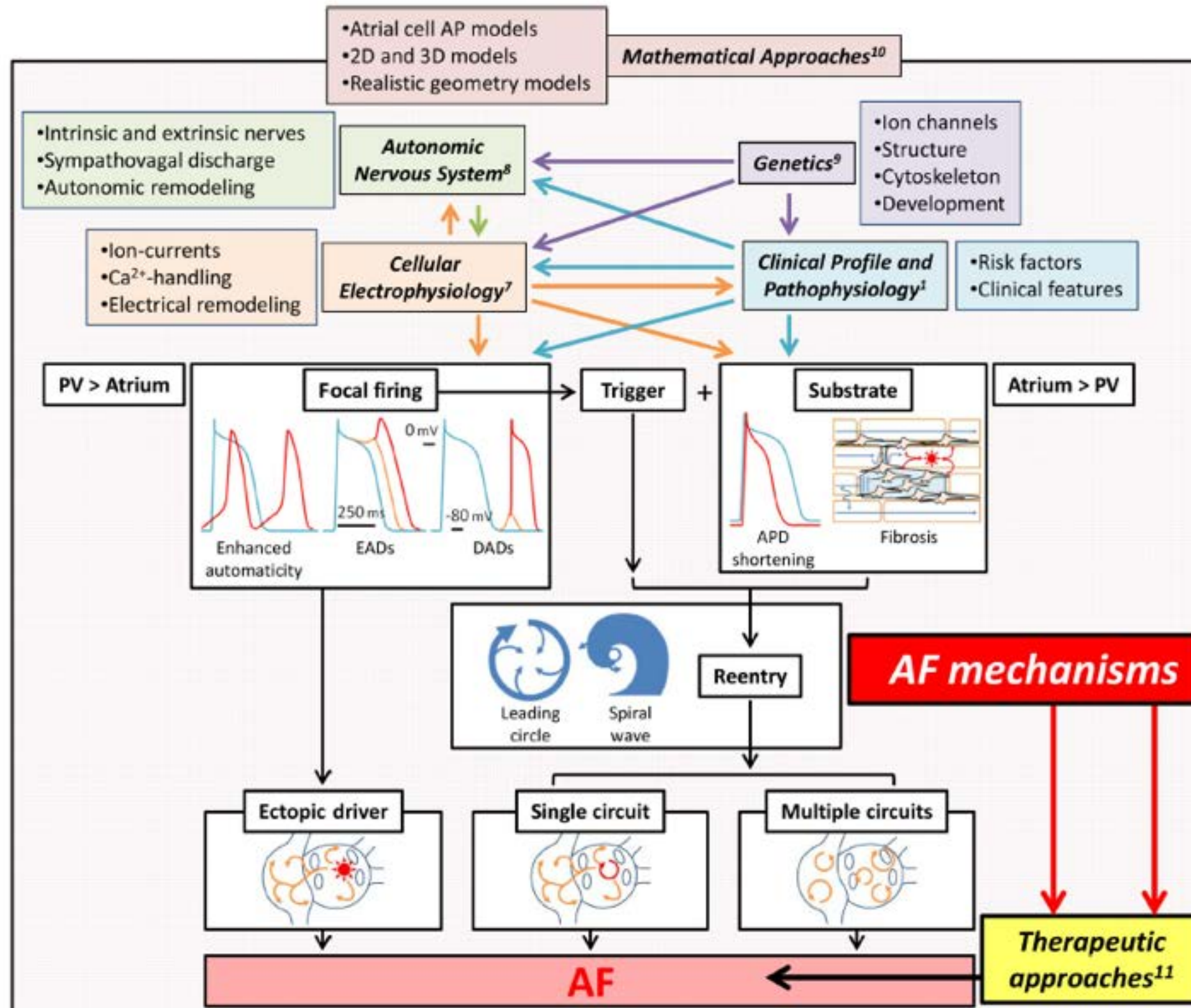
POTENTIALLY...

PERSISTENT



DEFINITELY !!!

Pathophysiology of AF: ...a real complex scenario...



Pathophysiology of AF: ...a real complex scenario...

Circulation **Arrhythmia and Electrophysiology**

JOURNAL OF THE AMERICAN HEART ASSOCIATION

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Learn and Live

Transmural Conduction is the Predominant Mechanism of Breakthrough during Atrial Fibrillation: Evidence from Simultaneous Endo-epicardial High Density Activation Mapping

Jens Eckstein, Stef Zeemering, Dominik Linz, Bart Maesen, Sander Verheule, Arne van Hunnik, Harry Crijns, Maurits A. Allessie and Ulrich Schotten

Circ Arrhythm Electrophysiol published online March 19, 2013;
DOI: 10.1161/CIRCEP.113.000342

Circulation **Arrhythmia and Electrophysiology**



American
Heart
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Rearrangement of Atrial Bundle Architecture and Consequent Changes in Anisotropy of Conduction Constitute the 3-Dimensional Substrate for Atrial Fibrillation

Bart Maesen, Stef Zeemering, Carlos Afonso, Jens Eckstein, Rebecca A.B. Burton, Arne van Hunnik, Daniel J. Stuckey, Damian Tyler, Jos Maessen, Vicente Grau, Sander Verheule, Peter Kohl and Ulrich Schotten

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***Pathophysiology of AF:
...a real complex scenario...***

...Longer duration of persistent AF...



3-D SUBSTRATE
(epi-endocardial activation)

EP ABLATION

Long-term results for persistent AF

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Heart Rhythm Disorders

Catheter Ablation for Atrial Fibrillation

Are Results Maintained at 5 Years of Follow-Up?

Rukshen Weerasooriya, BMEDSc(HONS), MBBS,*† Paul Khairy, MD, PhD,‡ Jean Litalien, MD,*
Laurent Macle, MD,‡ Meleze Hocini, MD,* Frederic Sacher, MD,* Nicolas Lellouche, MD,*
Sebastien Knecht, MD,* Matthew Wright, PhD, MD,* Isabelle Nault, MD,* Shinsuke Miyazaki, MD,*
Christophe Scavee, MD,* Jacques Clementy, MD,* Michel Haissaguerre, MD,* Pierre Jais, MD*
Bordeaux-Pessac, France; Crawley, Western Australia; and Montreal, Quebec, Canada

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Heart Rhythm Disorders

Catheter Ablation of Long-Standing Persistent Atrial Fibrillation

5-Year Outcomes of the Hamburg Sequential Ablation Strategy

Roland Richard Titz, MD, Andreas Rilling, MD, Anna-Maria Thum, Anita Arya, MD, Peter Wohlmuth,
Andreas Metzner, MD, Shibu Mathew, MD, Yasuhiro Yoshiga, MD, Erik Wissner, MD,
Karl-Heinz Kuck, MD, Feifan Ouyang, MD
Hamburg, Germany

Six Year Follow-Up After Catheter Ablation of Atrial Fibrillation: A Palliation More Than a True Cure

Antonio Sorgente, MD^{a,b,*}, Patricia Tung, MD^a, Jack Wylie, MD^a, and Mark E. Josephson, MD^a

Catheter Ablation for Atrial Fibrillation

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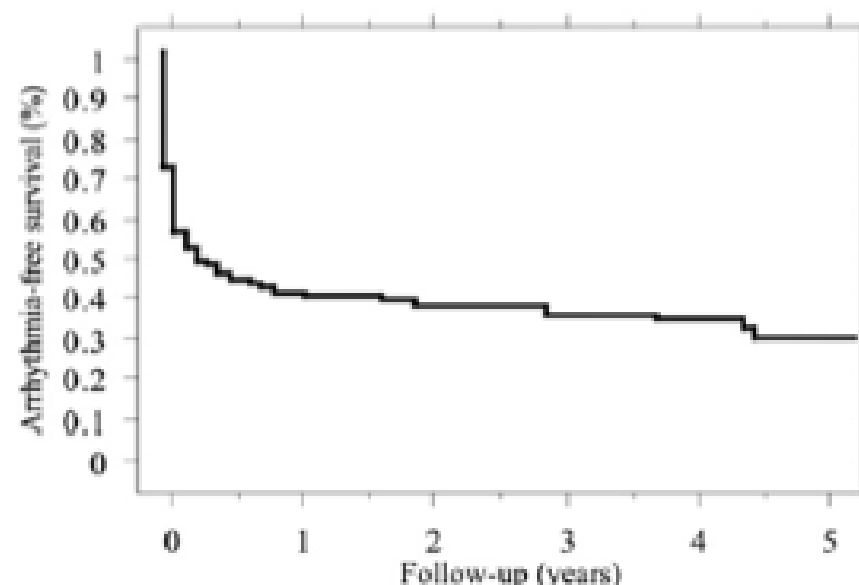


Figure 2 Single Procedure Success

Kaplan-Meier event-free survival curve after a single catheter ablation attempt.

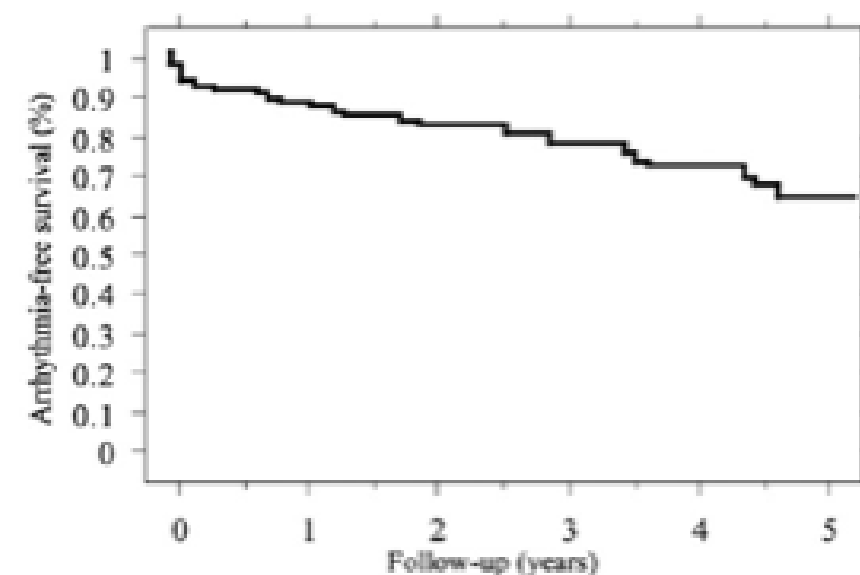


Figure 3 Multiple Procedure Success

Kaplan-Meier event-free survival curve after the last catheter ablation attempt.

Catheter Ablation of Long-Standing Persistent Atrial Fibrillation

5-Year Outcomes of the Hamburg Sequential Ablation Strategy

JACC Vol. 60, No. 19, 2012
November 6, 2012:1921-9

Tilz et al.
5-Year Outcomes After Long-Standing-AF Ablation

1925

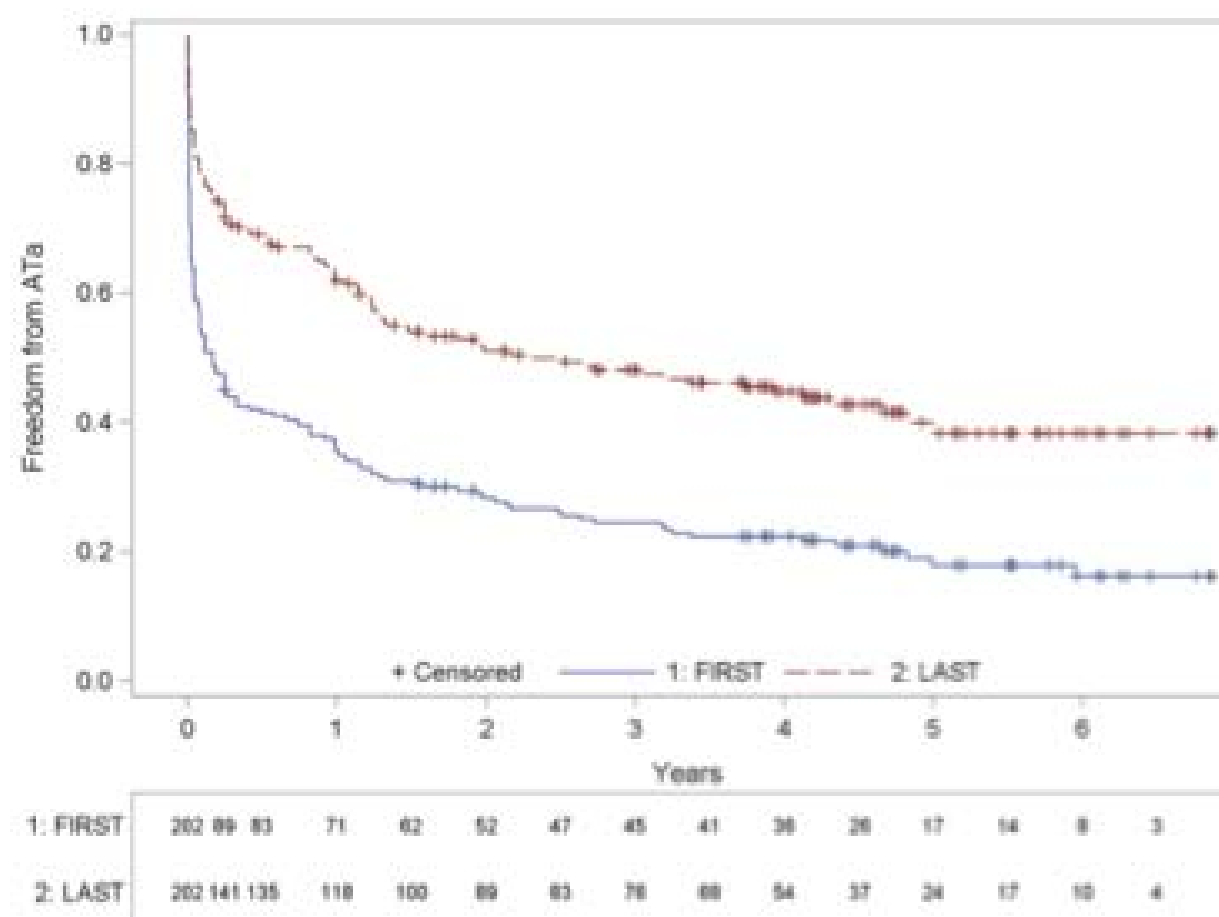
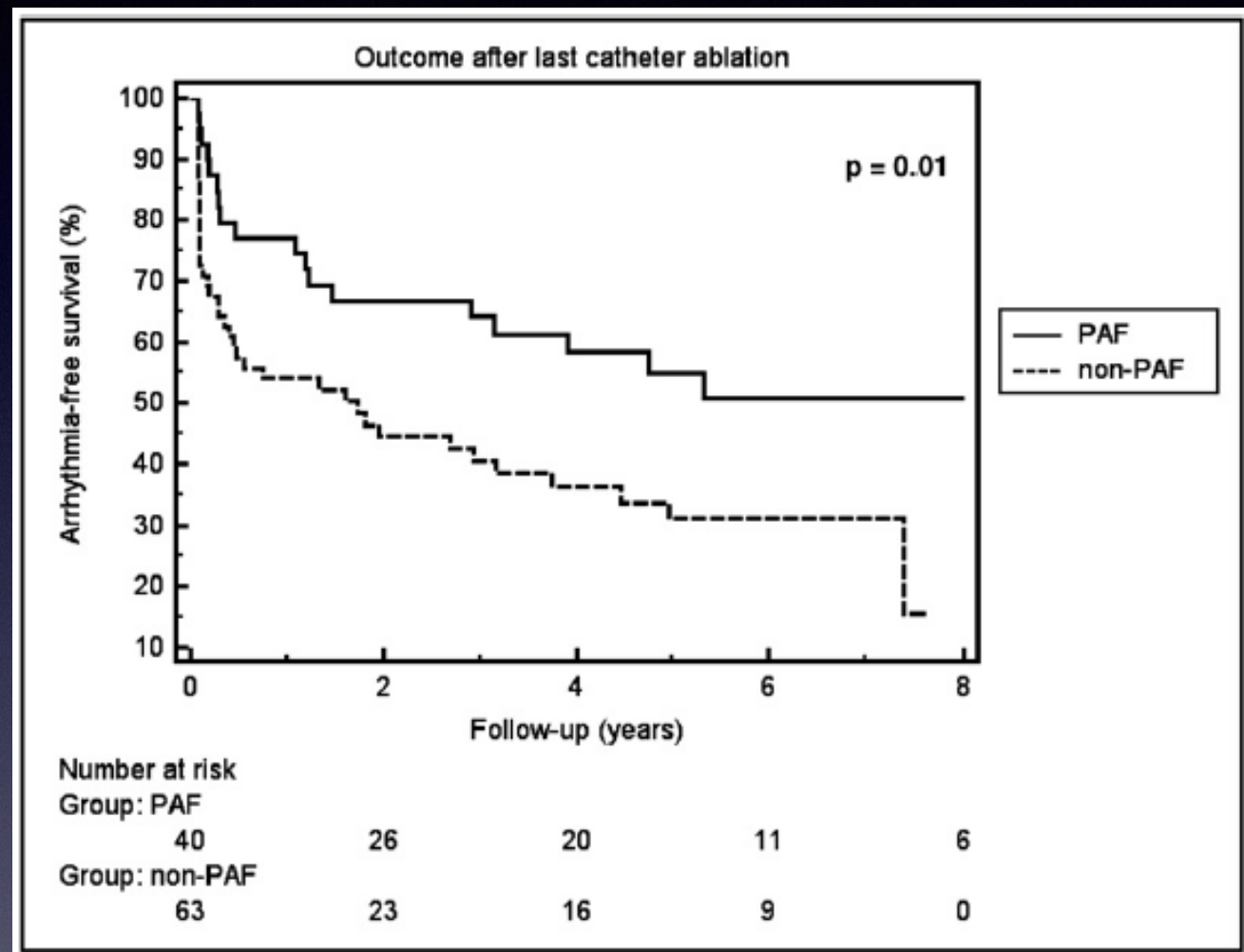
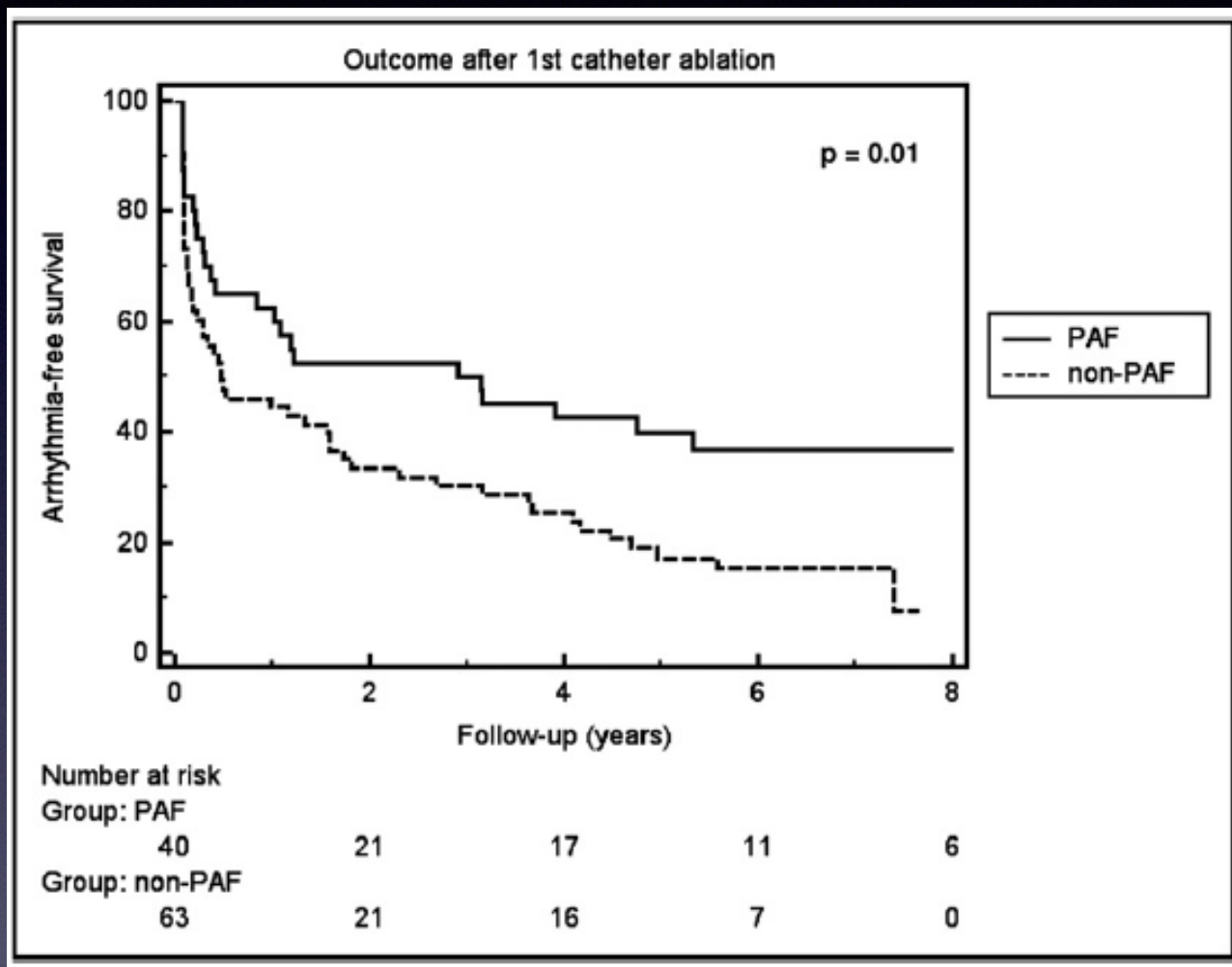


Figure 3 Single and Multiple Procedure Outcomes

Kaplan-Meier event-free survival curve after the first procedure (blue line) and after the last procedure (red line). Plus sign (+) indicates censored. Numbers at bottom indicate patients at risk. ATa = atrial tachyarrhythmia.

Six Year Follow-Up After Catheter Ablation of Atrial Fibrillation: A Palliation More Than a True Cure

Antonio Sorgente, MD^{a,b,*}, Patricia Tung, MD^a, Jack Wylie, MD^a, and Mark E. Josephson, MD^a



3, and 1 had 4 catheter ablations. Freedom from all atrial arrhythmias was present in 23% of patients at 6 years after a single procedure and in 39% of patients after the last procedure. No clinical predictors of AF recurrence were recognized after a single proce-

THE HYBRID CONCEPT: POTENTIAL ADVANTAGES?

- Improving outcomes (especially in persistent AF)
- Reducing procedural risks (either percutaneous/surgical)
- Allowing for epicardial AND endocardial lesions
- Suitable for a minimally invasive approach
- Delivering an effective lesion set (tailored to specific AF substrate)

HYBRID APPROACH: PROCEDURAL ALGORITHM

EP before SURGERY

EP + SURGERY

SURGERY before EP

***HYBRID APPROACH:
PROCEDURAL ALGORITHM
SURGERY before EP***

ADVANTAGES

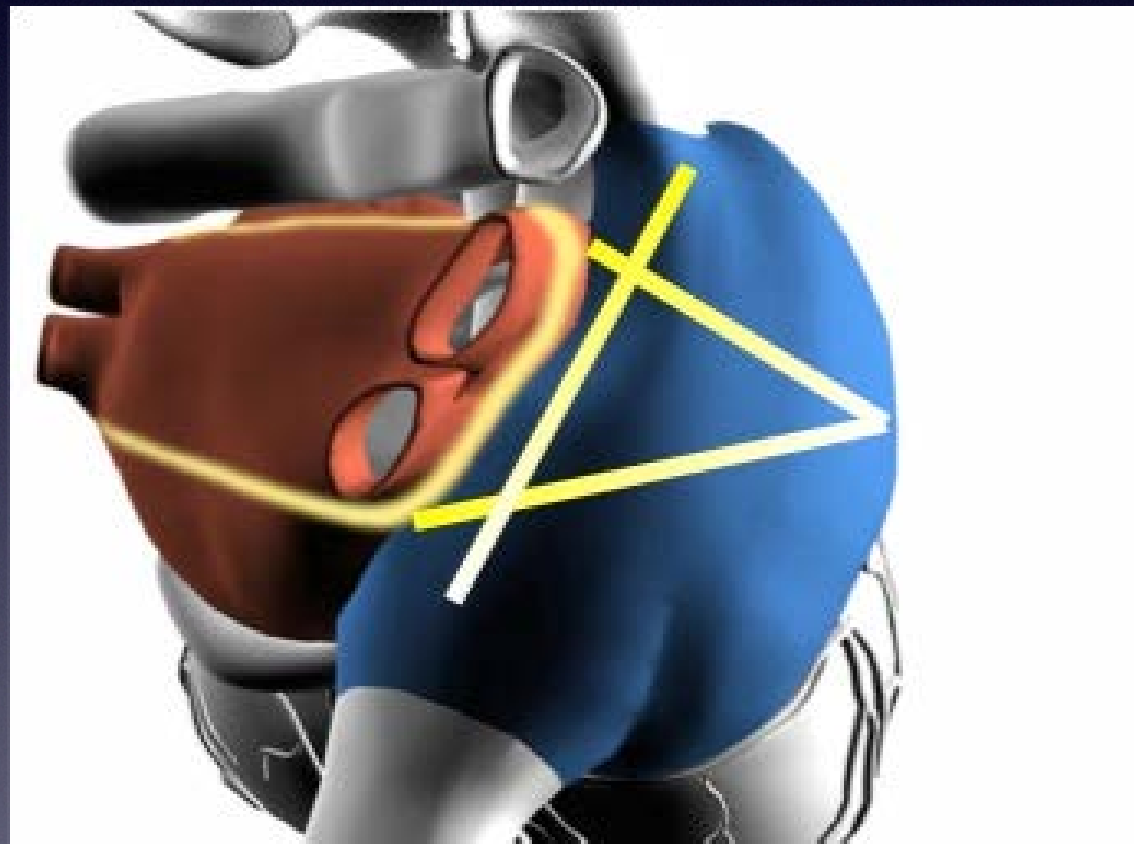
- Faster procedure
- Ablation of the ganglionated plexi
- Delayed EP procedure reduces false positive/negative findings
- EP procedure targeted to gaps or additional areas

DOWNSIDES

- 2 separated procedures required

HYBRID LESION SET

THE “BRESCIA” SURGICAL LESION SET



SURGICAL TECHNIQUE

Innovative Monolateral Approach for Closed-Chest Atrial Fibrillation Surgery

Gianluigi Bisleri, MD, and Claudio Muneretto, MD

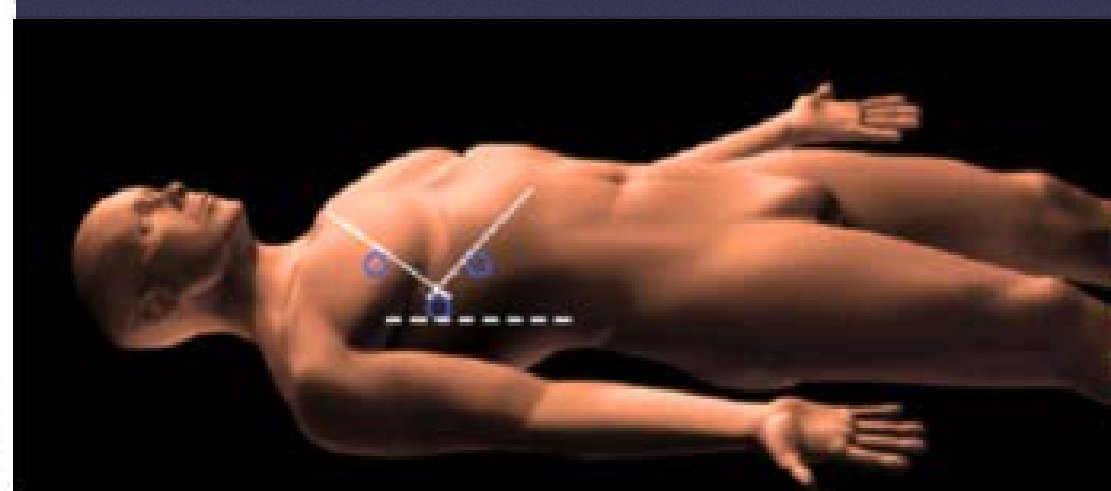
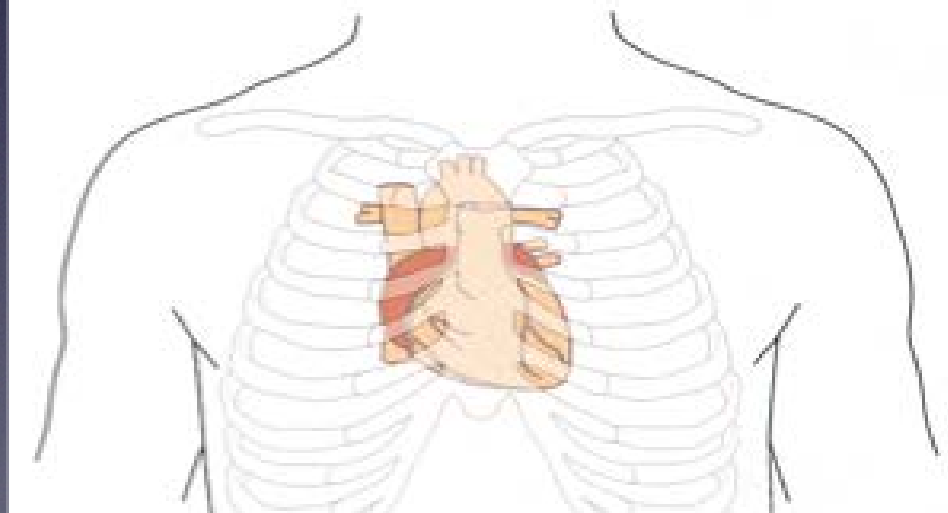
Division of Cardiac Surgery, University of Brescia Medical School, Brescia, Italy

Surgical treatment of atrial fibrillation recently gained new popularity since the introduction of different energy sources as an alternative to the original cut-and-sew technique. Recently an innovative approach for closed-chest thoracoscopic epicardial pulmonary veins isolation has been described for patients suffering from lone atrial

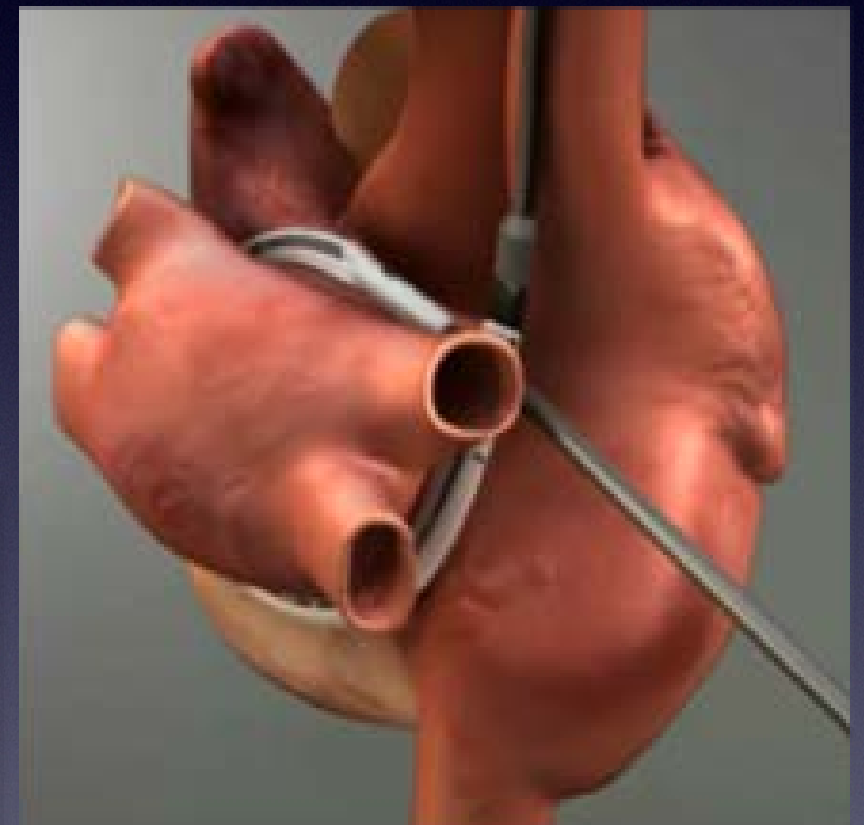
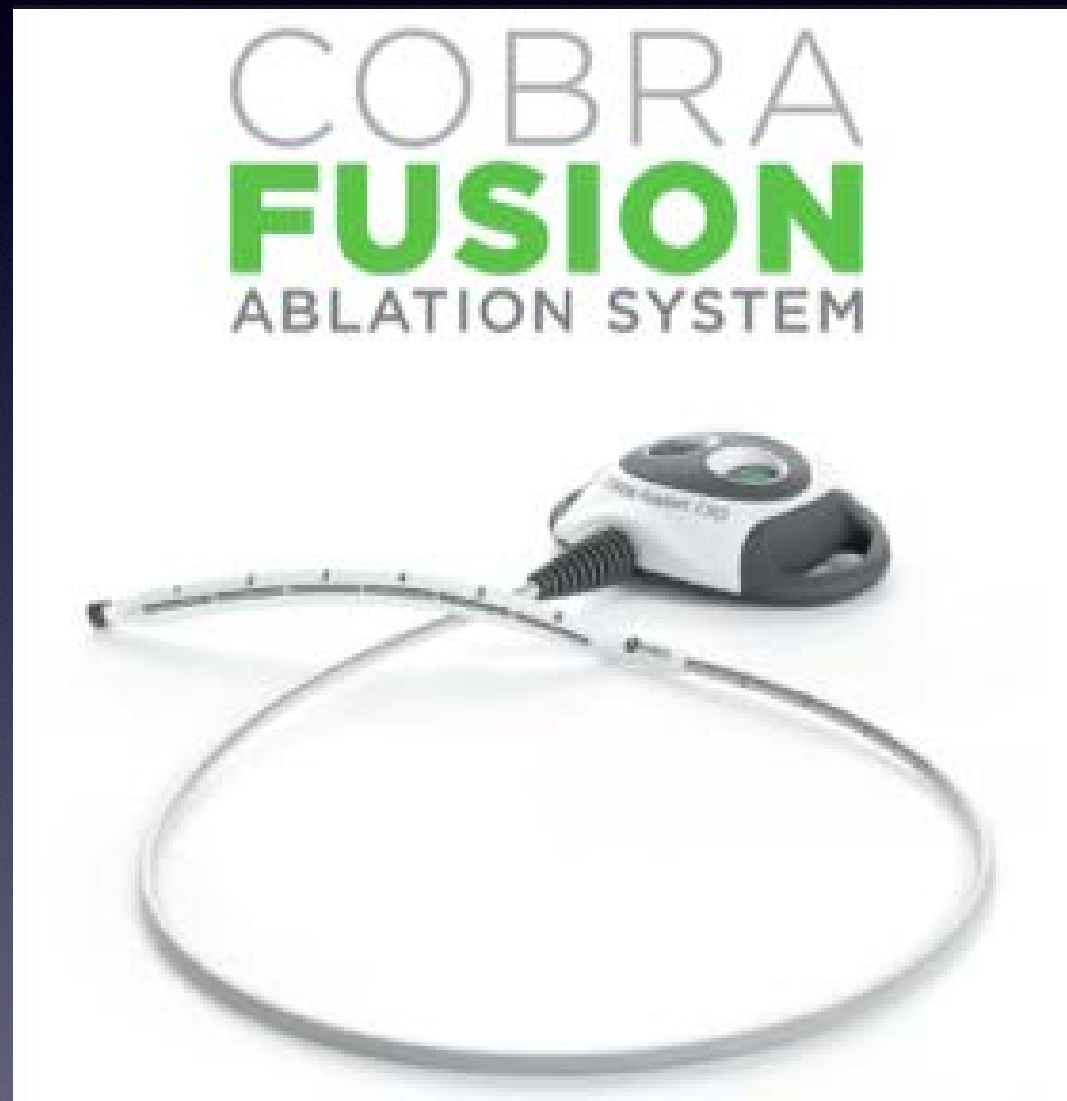
fibrillation. Nevertheless in an effort to further reduce the invasiveness of closed-chest atrial fibrillation surgery, we developed a novel monolateral approach for thoracoscopic arrhythmia surgery.

(Ann Thorac Surg 2005;80:e22-5)

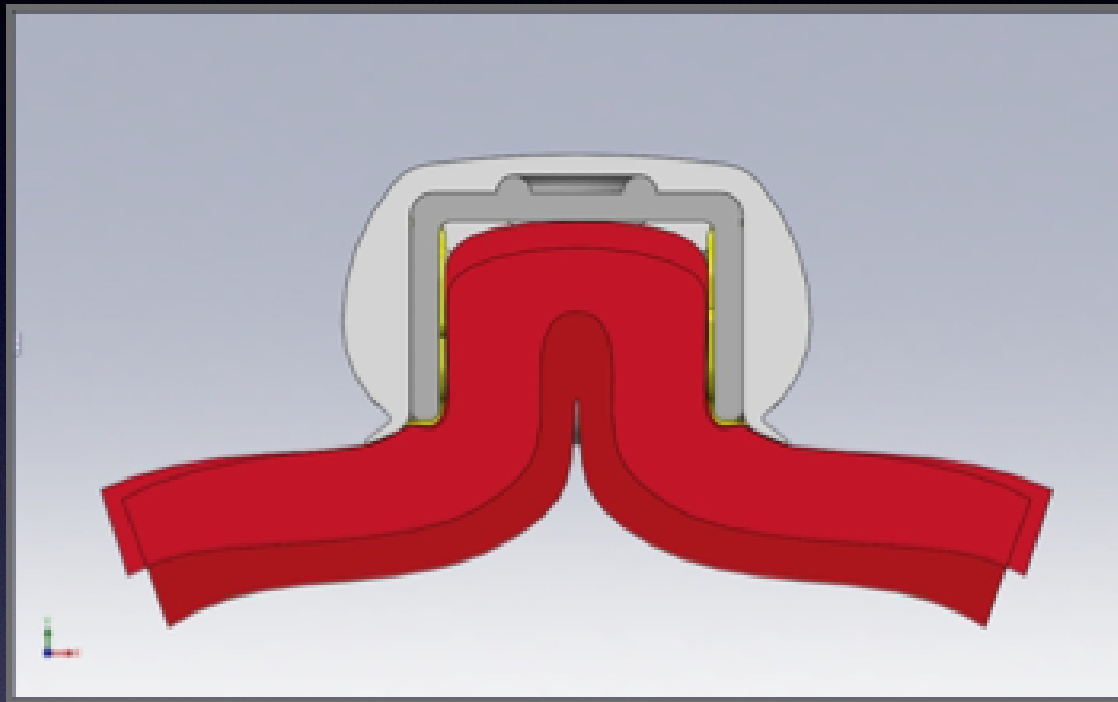
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SURGICAL TECHNIQUE

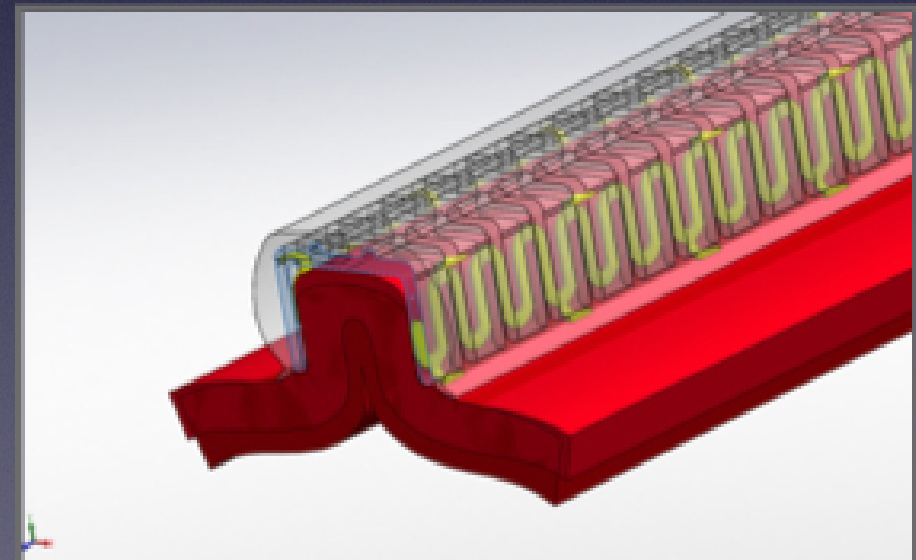


COBRA FUSION DEVICE



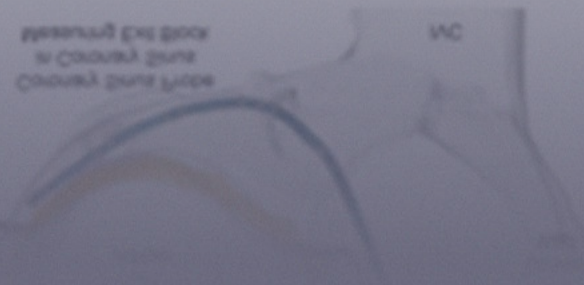
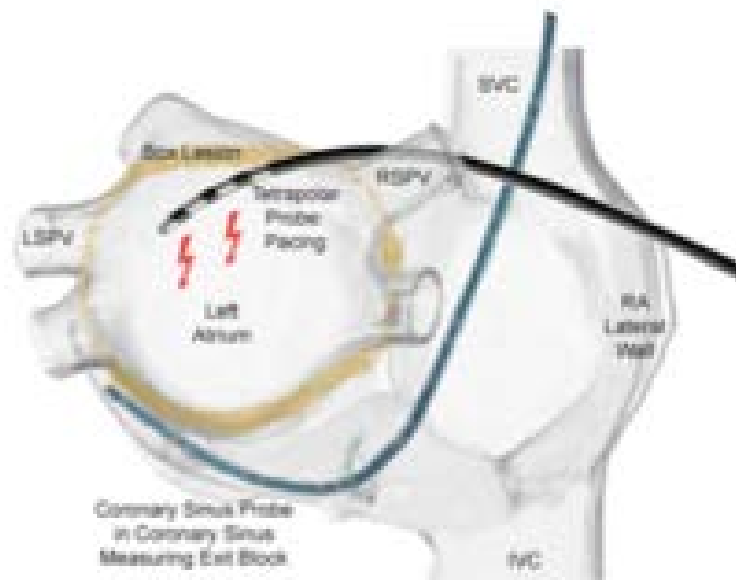
*Draws tissue out of
cooling blood flow path*

*Overcomes the last obstacles of epicardial
ablation to achieve bipolar clamping with
a linear suction probe*

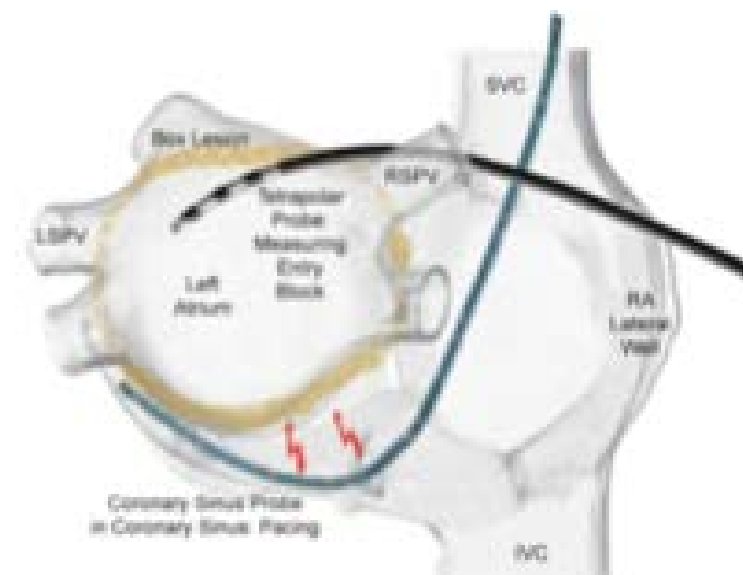


Intraoperative testing of surgical lesions

EXIT BLOCK



ENTRANCE BLOCK



RHYTHM MONITORING

Implantable loop recorder



Definition of success:

- Monthly AF burden $< 0.5\%$ (< 1.36 hrs.)
- AF episode duration < 5 mins

SURGICAL TECHNIQUE



CLINICAL EXPERIENCE

Successful Treatment of Lone Persistent Atrial Fibrillation by Means of a Hybrid Thoracoscopic-Transcatheter Approach

Claudio Muneretto, MD,* Gianluigi Bisleri, MD,* Luca Bontempi, MD,†
Faisal H. Cheema, MD,‡ and Antonio Curnis, MD†

(Innovations 2012;7: 254–258)

Durable staged hybrid ablation with thoracoscopic and percutaneous approach for treatment of long-standing atrial fibrillation: A 30-month assessment with continuous monitoring

Claudio Muneretto, MD,^a Gianluigi Bisleri, MD,^a Luca Bontempi, MD,^b and Antonio Curnis, MD^b
(J Thorac Cardiovasc Surg 2012;144:1460-5)

European Journal of Cardio-Thoracic Surgery (2013) 1–5
doi:10.1093/ejcts/ezt115

ORIGINAL ARTICLE

Hybrid approach for the treatment of long-standing persistent atrial fibrillation: electrophysiological findings and clinical results[†]

Gianluigi Bisleri^a, Fabrizio Rosati^a, Luca Bontempi^b, Antonio Curnis^b and Claudio Muneretto^{a,*}

STUDY POPULATION

- 74 pts with persistent AF
 - 62 Long Standing Persistent AF
- Mean age: 63.6 ± 9.2 yrs.
- LA dimensions: 49.2 ± 5.6 mm
- Average AF Duration: 48 months

INTRAOPERATIVE DATA

- Mean ablation time: 32 ± 7 minutes
- Mean overall procedural time: 98 ± 16 mins
- Entrance block confirmed in 69/74 pts (93.2%)
- Exit block confirmed in 72/74 pts (97.2%)

EARLY OUTCOME

- Early extubation in the OR
- Conversion to sternotomy for bleeding: 1 pts
- No ICU stay
- No postoperative major complications (phrenic nerve palsy: 1 pt.)
- Hospital mortality : 0%



Hybrid approach for the treatment of long-standing persistent atrial fibrillation: electrophysiological findings and clinical results[†]

Gianluigi Bisleri^a, Fabrizio Rosati^a, Luca Bontempi^b, Antonio Curnis^b and Claudio Muneretto^{a*}

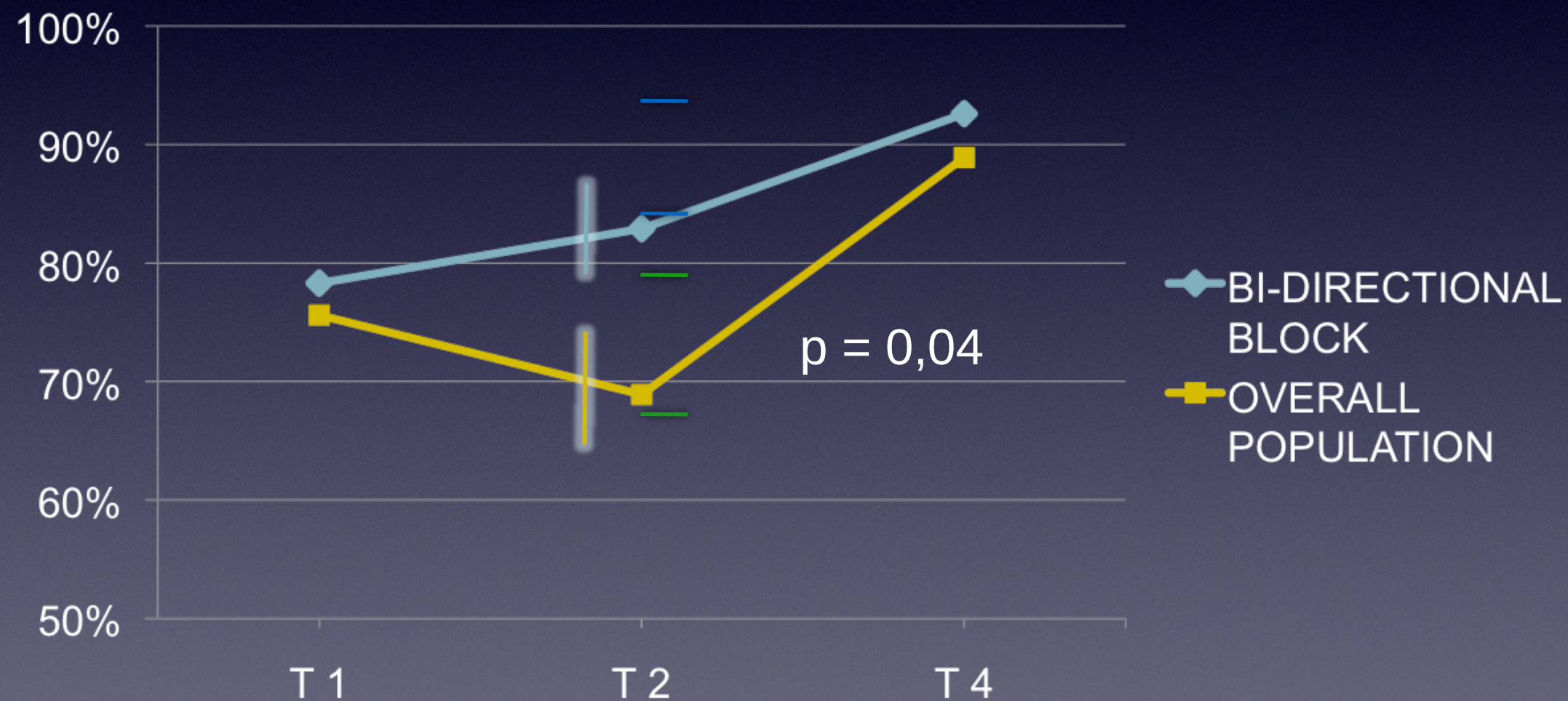
^a Division of Cardiac Surgery, University of Brescia Medical School, Brescia, Italy

^b Division of Cardiology, University of Brescia Medical School, Brescia, Italy

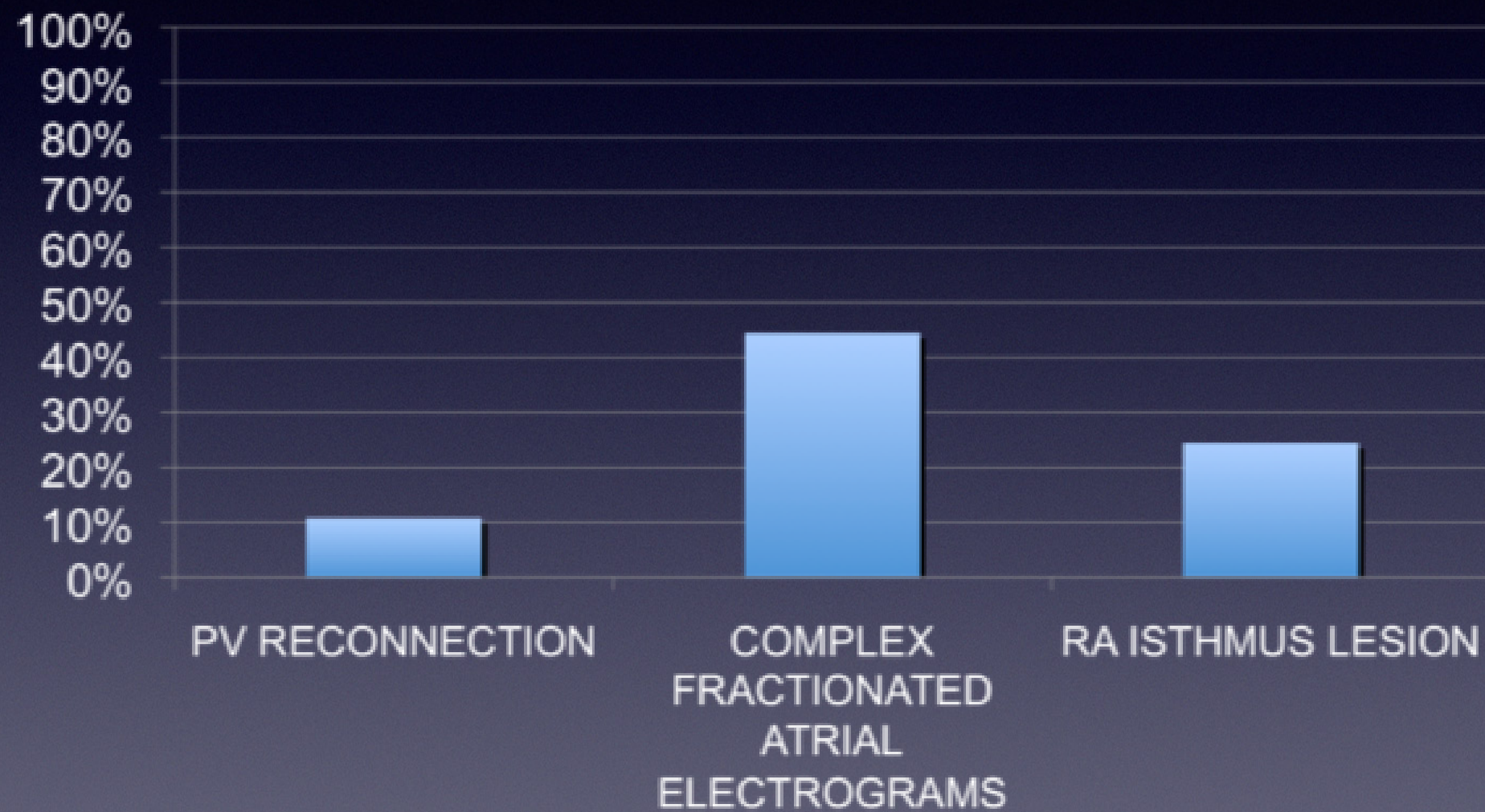
European Journal of Cardio-Thoracic Surgery (2013) 1–5

doi:10.1093/ejcts/ezt115

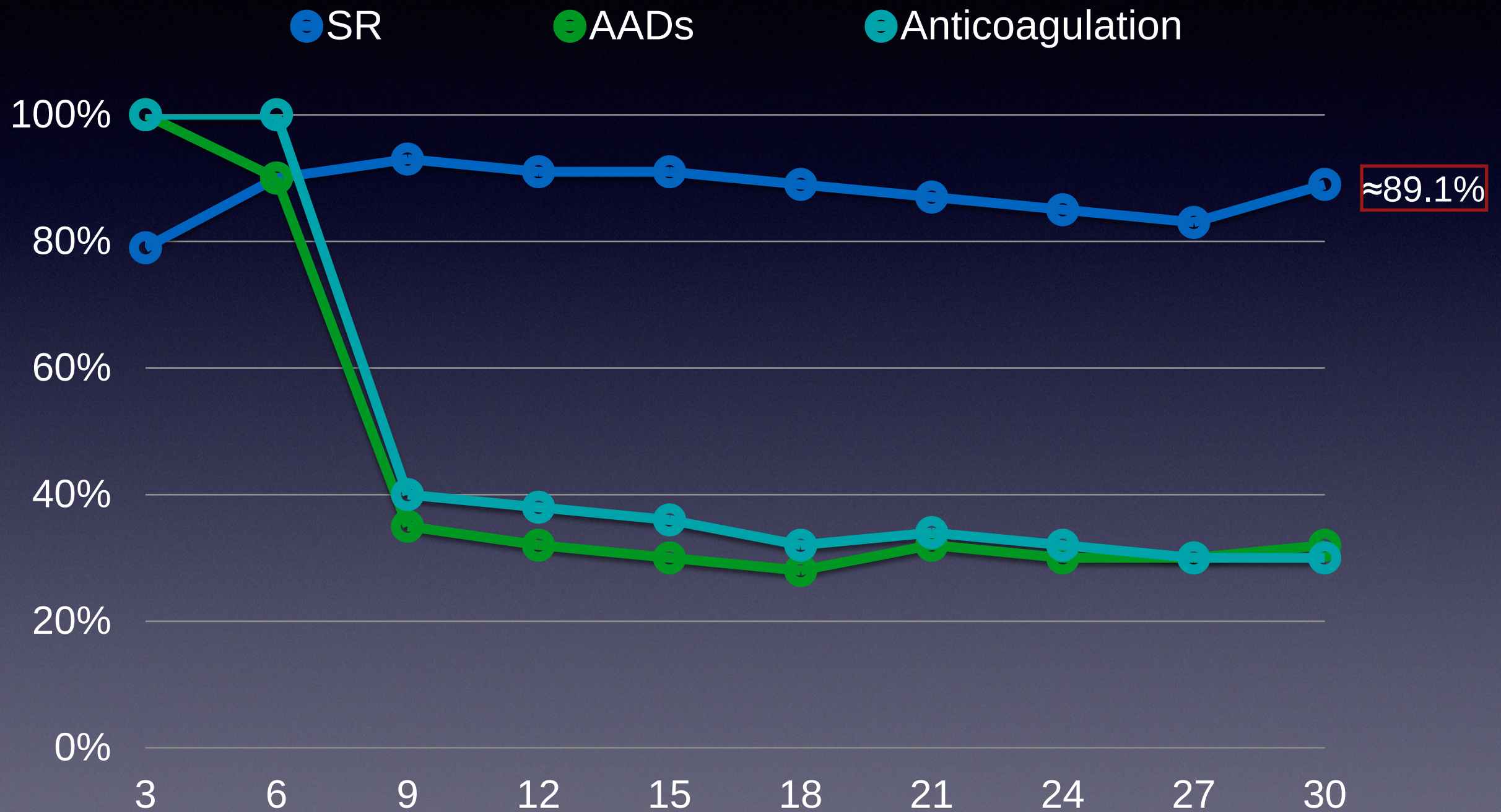
Conduction Block and Rhythm outcome Freedom from AF



2nd Step: Staged EP intervention



Rhythm trend over time



CONCLUSIONS

- The Double-Isolation Lesion set is highly effective in persistent AF
- The Estech Cobra Fusion could achieve at least unidirectional conduction block in all patients
- Intra-operative adoption of standard EP end-points improves surgical results
- The sequential staged, hybrid approach allows for a tailored AF treatment according to the specific patients' needs

...going hybrid??...



FUTURE PERSPECTIVES

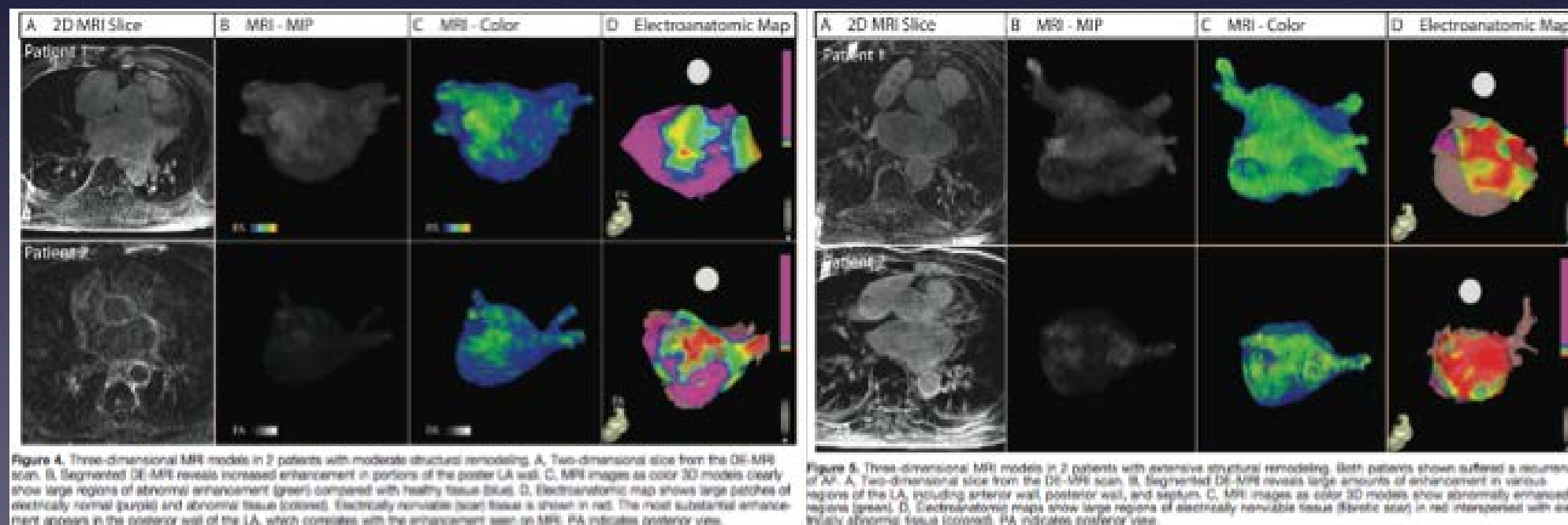
- Atrial remodeling ?
- Atrial function ?
- LAA?

ATRIAL REMODELING

UTAH classification

Detection and Quantification of Left Atrial Structural Remodeling With Delayed-Enhancement Magnetic Resonance Imaging in Patients With Atrial Fibrillation

Robert S. Oakes, BS; Troy J. Badger, MD; Eugene G. Kholmovski, PhD; Nazem Akoum, MD; Nathan S. Burgon, BS; Eric N. Fish; Joshua J.E. Blauer, BS; Swati N. Rao; Edward V.R. DiBella, PhD; Nathan M. Segerson, MD; Marcos Daccarett, MD; Jessiciah Windfelder, NP; Christopher J. McGann, MD; Dennis Parker, PhD; Rob S. MacLeod, PhD; Nassir F. Marrouche, MD



ATRIAL FUNCTION

ECHO

Parameters	Normal
LA AP diameter	30-40 mm
LA Area	20 cm ²
LA max volume	44 ± 10 ml
LA min volume	22 ± 8 ml
LA pre A volume	30 ± 8 ml
E wave	≤50 cm/s
A wave	>10 cm/s
E/A ratio	0,75 – 2,0
LA total EF	50 %
LA active EF	53 %
LA passive EF	32 %

4D-MRI

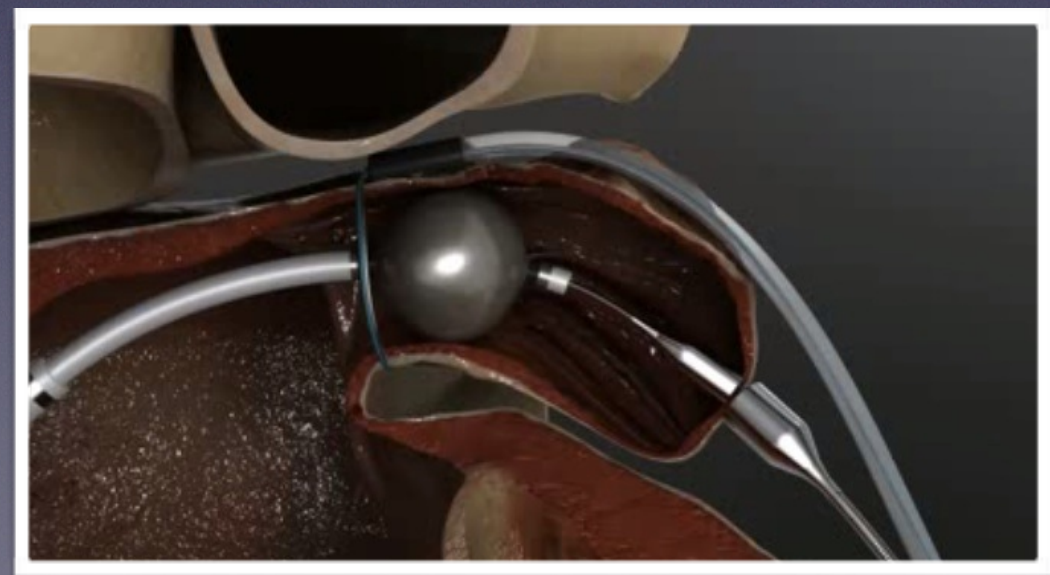
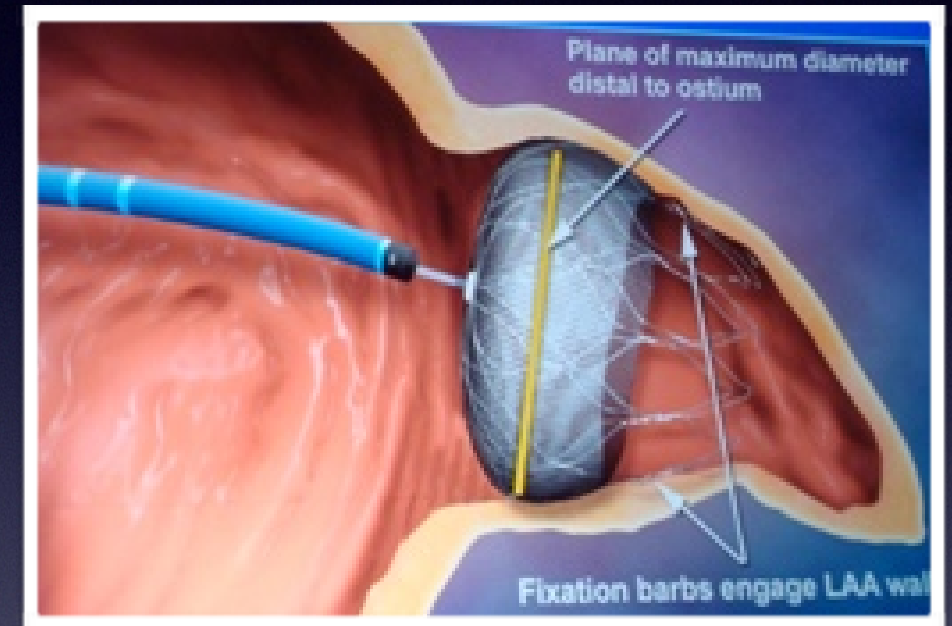


LAA

SURGERY



TRANSCATHETER



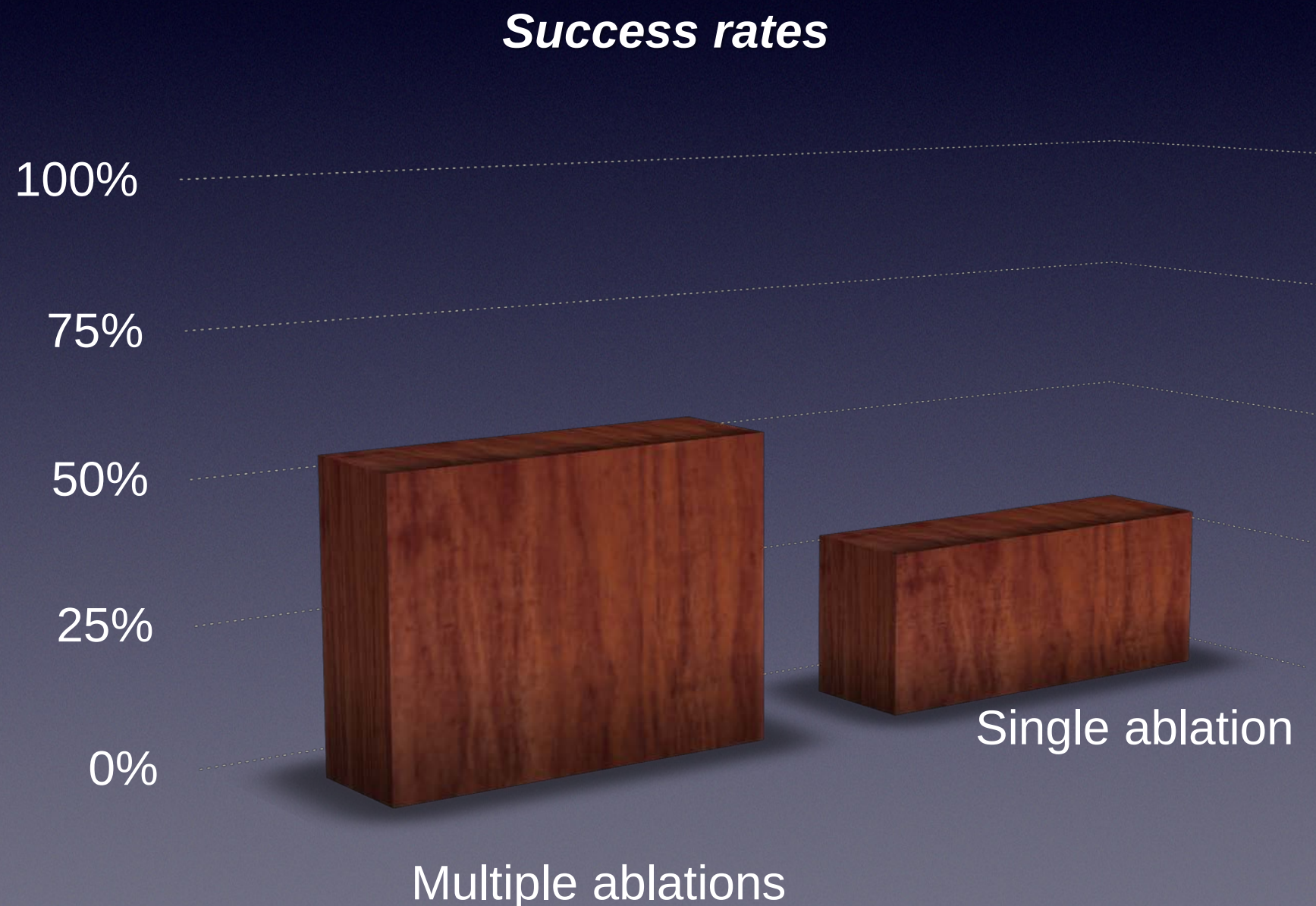
LAA

Do we need to treat the LAA in all patients?...

- 4.8 x increased risk of stroke in AF
- 80% of pts with AF do NOT have thrombus
- 50% of strokes in AF are NOT from the LAA
- Warfarin reduces stroke risk by 60%
- LAA exclusion often incomplete !!!
- Incomplete LAA exclusion associated with ↑ stroke risk
- N° needed to treat to reduce stroke risk: 30 !!!!!!!

EP ABLATION

Long-term results for persistent AF



GENETICS IN AF

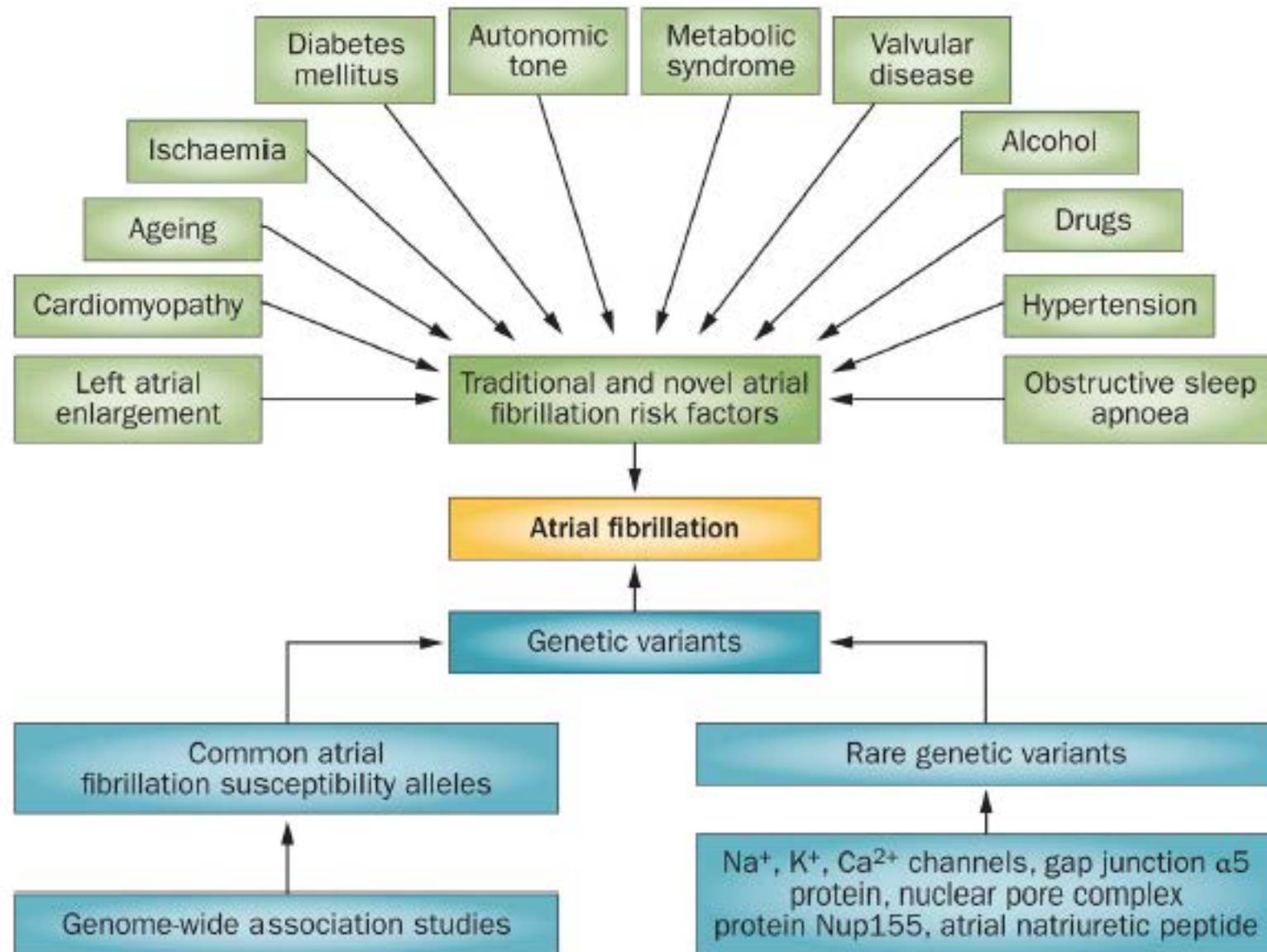
- ↓ atrial refractory period
- ↑ atrial action potential duration
- Abnormal cell-to-cell impulse propagation

GENETICS IN AF

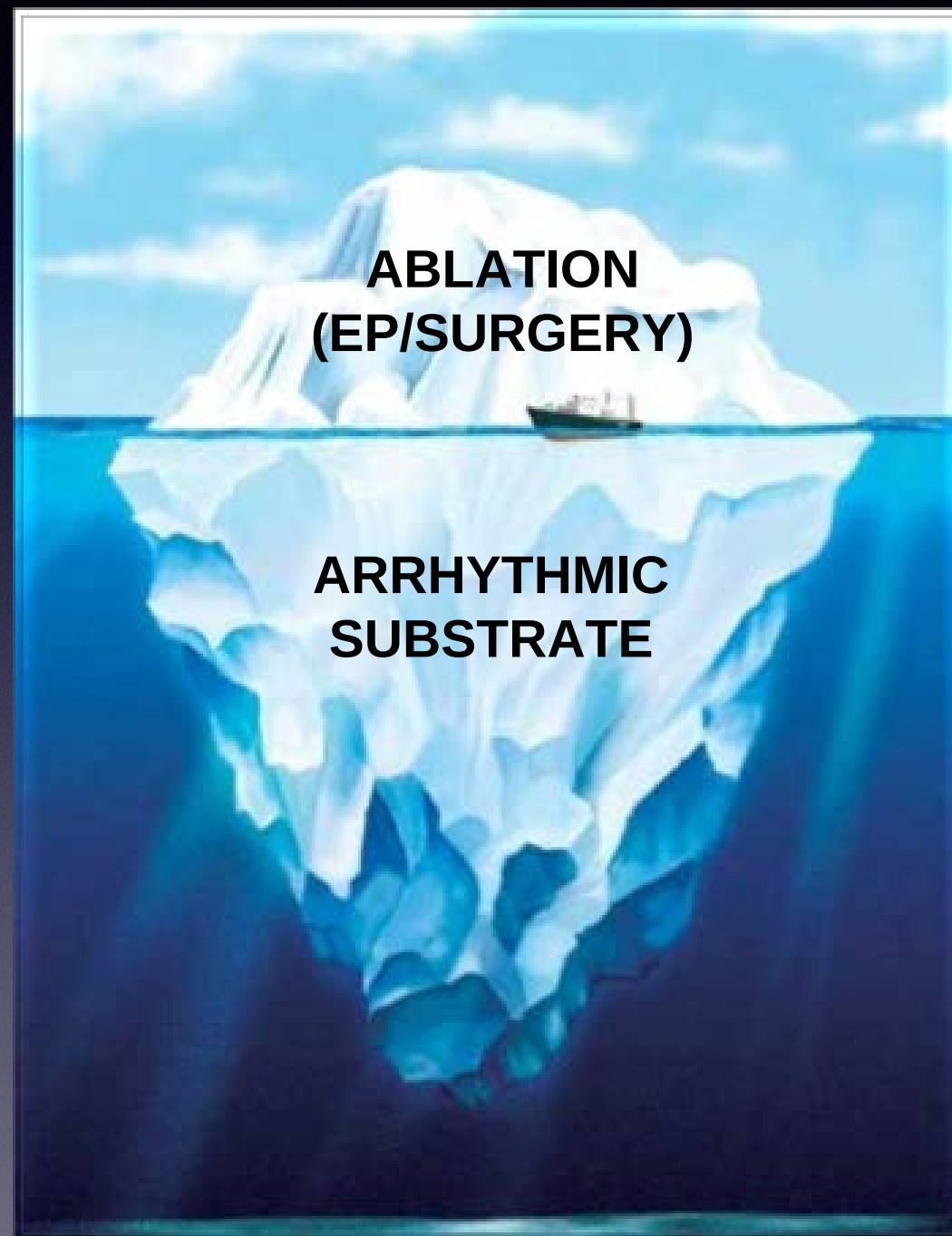
Gene	Mode of inheritance	Effect on function	Physiological effect	Associated phenotypes
<i>KCNQ1</i> ^{25,30,54,120-126}	Autosomal dominant	Gain-of-function	↓ Atrial APD	Prolonged QT interval
<i>KCNE1, KCNE2</i> ^{40,127,128}	Autosomal dominant	Gain-of-function	↓ Atrial APD	Frequent premature atrial contractions
<i>KCNE5</i> ^{40,128}	Autosomal dominant	Gain-of-function	↓ Atrial APD	None
<i>KCNJ2</i> ^{39,129,130}	Autosomal dominant	Gain-of-function	↓ Atrial APD	None
<i>GJA5</i> ^{56,63,131}	Somatic mutations Isolated lone AF cases	↓ Electrical cell-to-cell coupling	Regions of heterogeneous conduction	None
<i>KCNA5</i> ^{41,49-51}	Autosomal dominant	Loss-of-function	↑ Atrial APD, EADs, TA	None
<i>SCN5A</i> ¹³²⁻¹³⁶ <i>SCN1B/2B/3B</i> ¹³⁷⁻¹⁴¹	Autosomal dominant Autosomal dominant	Gain-of-function Loss-of-function	↑ Atrial APD EADs, TA	Hypertrophic cardiomyopathy and dilated cardiomyopathy
<i>SCN10A</i> ¹⁴²	Autosomal dominant	Enhanced late I_{Na}	↑ APD, EADs, TA	Slow ventricular rates
<i>CACNA1C</i> ¹⁴³ <i>CACNB2</i> ¹⁴⁴	Autosomal dominant	Loss-of-function	↑ APD, EADs, TA	None
<i>NPPA</i> ^{26,29,120,145,146}	Autosomal dominant	Gain-of-function	↓ Atrial APD	Atrial myopathy
<i>NUP155</i> ¹⁴⁷	Autosomal recessive	Loss-of-function of the nuclear protein transport (heat shock protein 70)	↓ Trafficking of Ca^{2+} -handling proteins and ion channels	Sudden cardiac death

SNP	Locus	Closest gene	Functional effect	Minor/major allele	MAF (%)	Relative risk, 95% CI	P value
rs2200733	4q25	<i>PITX2</i>	Development of pulmonary vein myocardial sleeve	C/T	13.1	1.71, 1.54-2.21	6.1×10^{-41}
rs10033464	4q25	<i>PITX2</i>		G/C	25.8	1.42, 1.13-1.77	3.1×10^{-11}
rs7193343	16q22	<i>ZFHX3</i>	Unknown	T/C	17.6	1.25, 1.17-1.30	1.8×10^{-15}
rs13376333	1q21	<i>KCNK3</i>	Calcium-activated potassium channel	T/C	29.5	1.56, 1.38-1.77	6.3×10^{-12}

GENETICS IN AF



THERAPEUTICAL OPTIONS IN AF



THERAPEUTICAL OPTIONS IN AF

