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Ablative Management of Atrial Tachycardias in Adults with Congenital Heart Disease



Natasja MS de Groot, MD, PhD
Department of Cardiology
Unit Translational Electrophysiology
Erasmus Medical Center, Rotterdam

Atrial TachyArrhythmias in Patients with Congenital Heart Disease

- ✓ high incidence of **atrial tachycardias** in patients with **surgically corrected congenital heart disease**
- ✓ risk of **atrial tachycardias** associated with **complexity** of congenital heart disease
number of **surgical** procedures
longer time after cardiac surgery
- ✓ **clinical problem**: improved life expectancy



Treatment of Post-Operative Atrial TachyArrhythmias

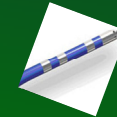
✓ anti-arrhythmic drugs



✓ anti-tachycardia pacing



✓ catheter ablation



Ablative Therapy

✓ possible **curative** treatment option

✓ localization of the arrhythmogenic substrate: difficult
- distortion of atrial anatomy
- extensive mapping prior to ablation: essential

✓ recurrences of AT after ablation

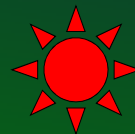


What is the Mechanism ?

-macro-reentry circuit



-focal activity



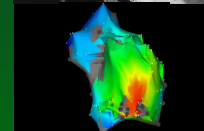
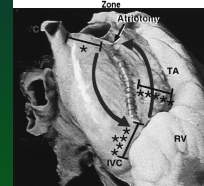
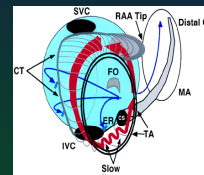
Post-Operative AT

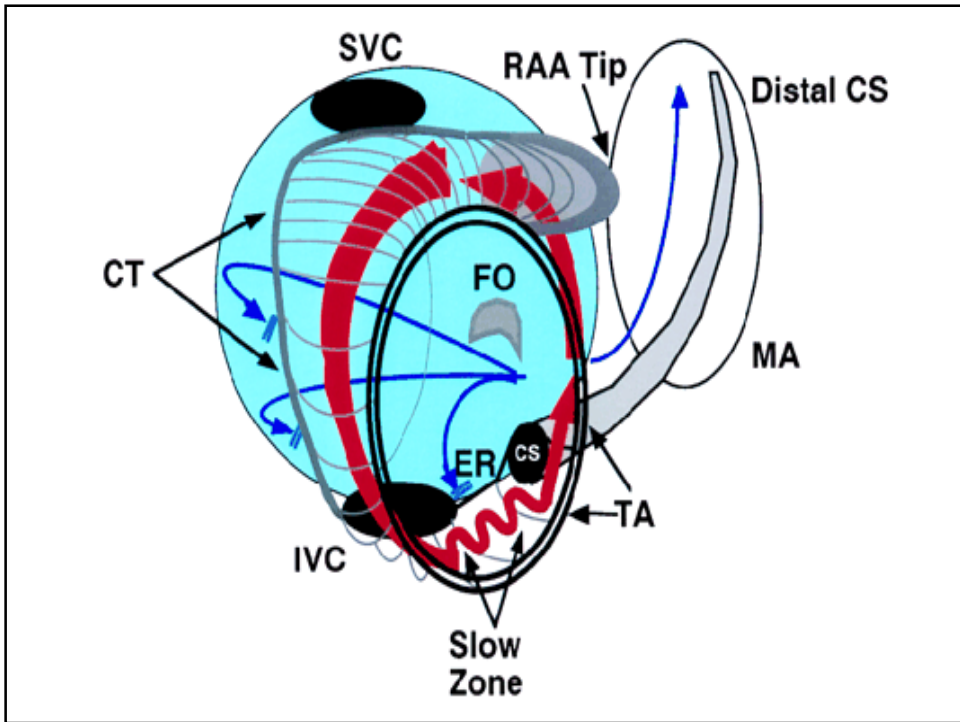
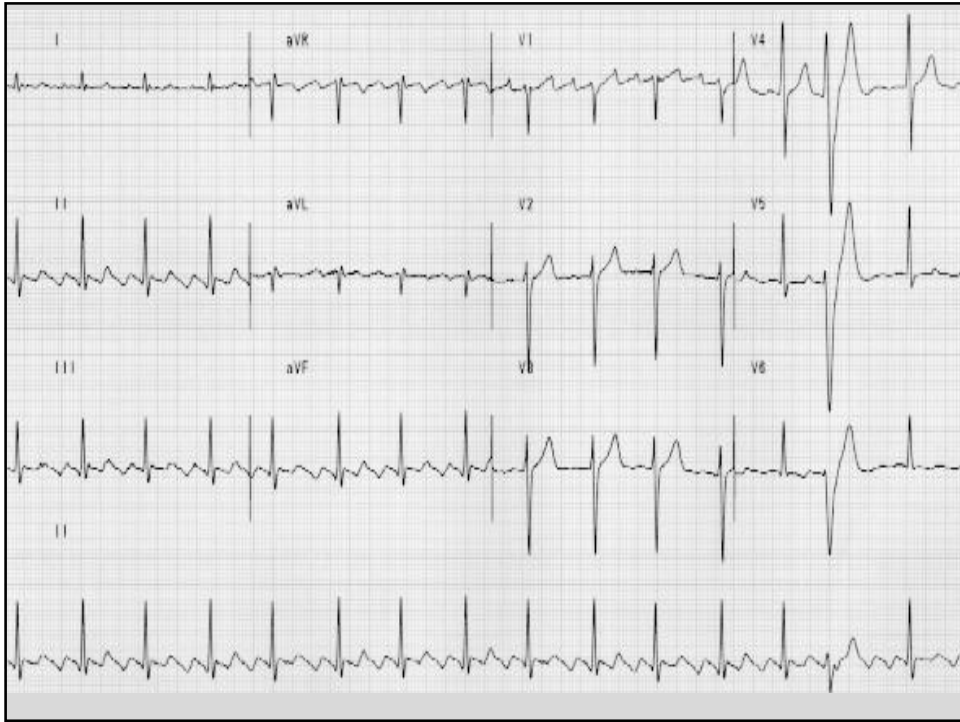
- atrial flutter
cavo-tricuspid isthmus dependent

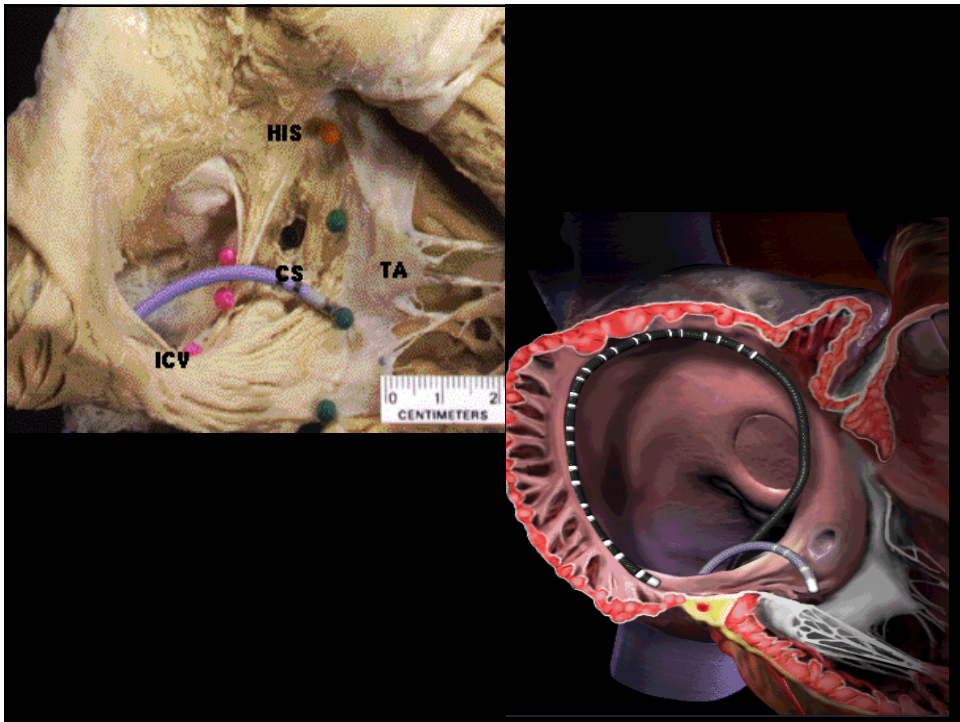
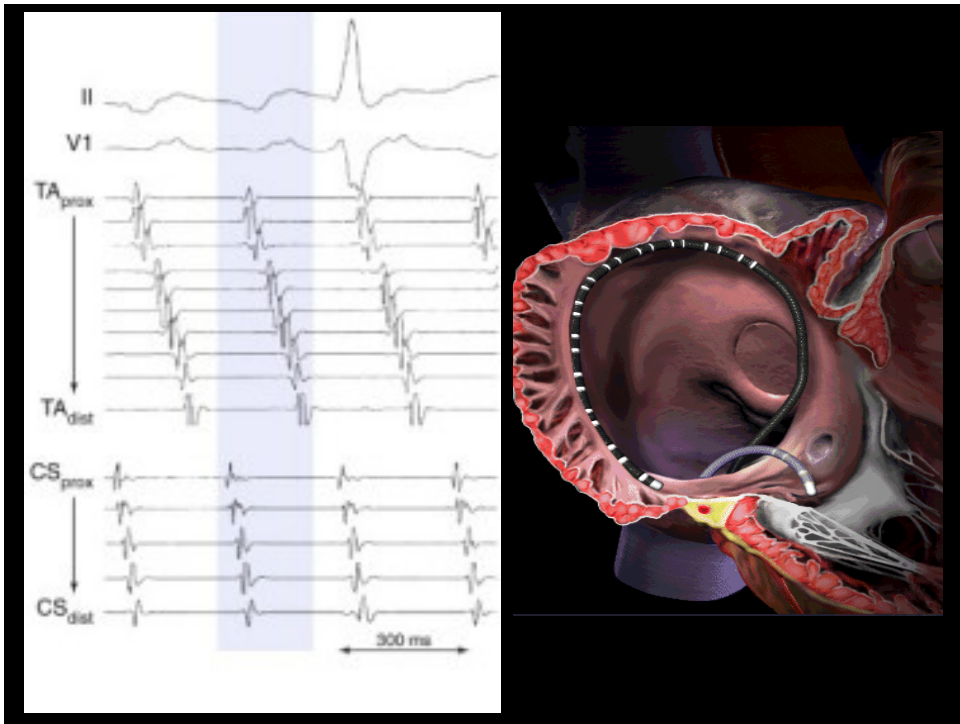
- intra-atrial reentrant tachycardias
reentrant circuit around
areas of scar tissue
anatomical structures
surgically created barriers
conduits/baffles

- focal atrial tachycardia

- (atrial fibrillation)








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Intra-Atrial Reentrant Tachycardias


Reentry Circuit ?

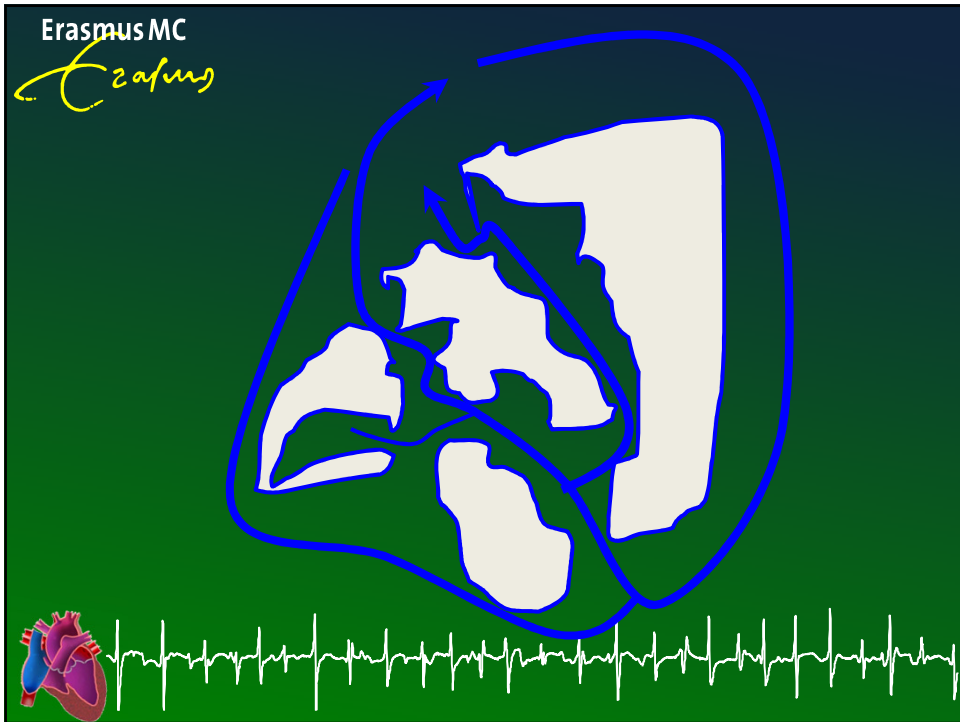
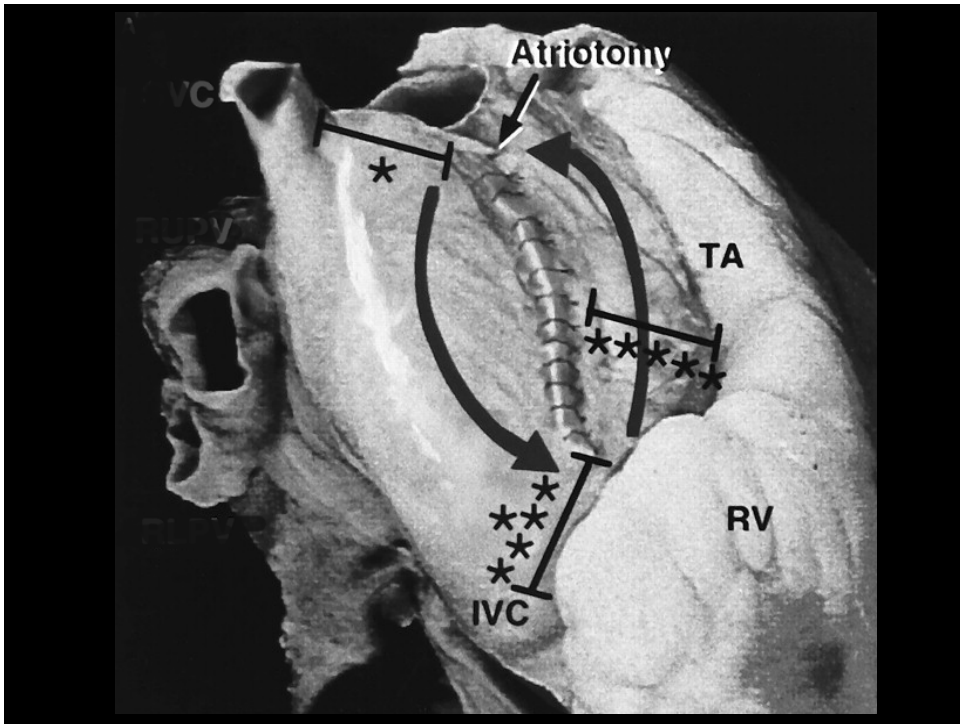


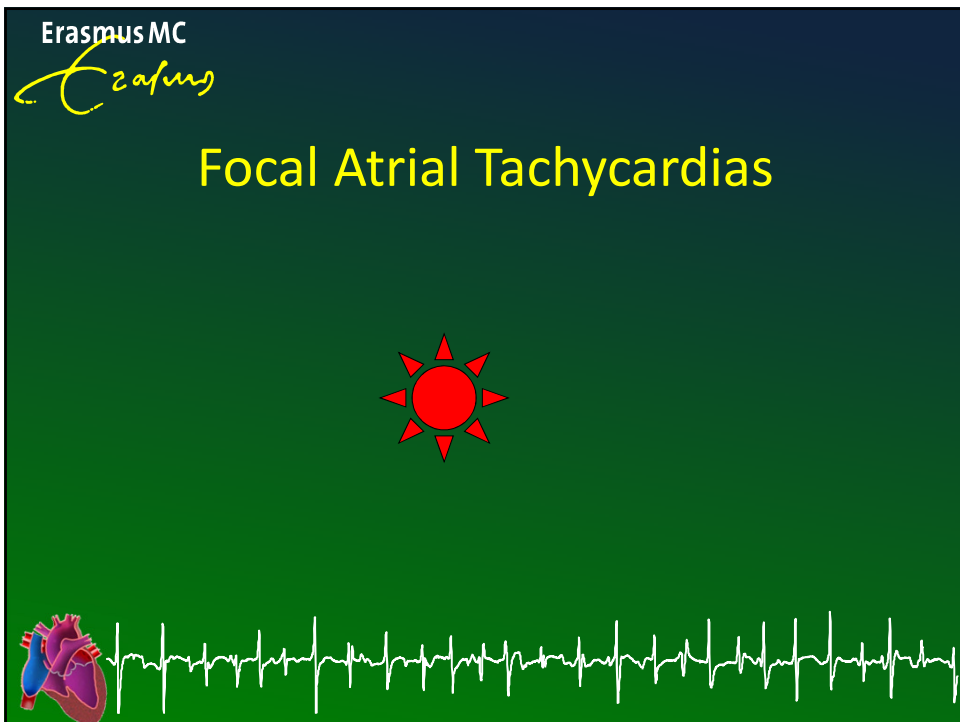
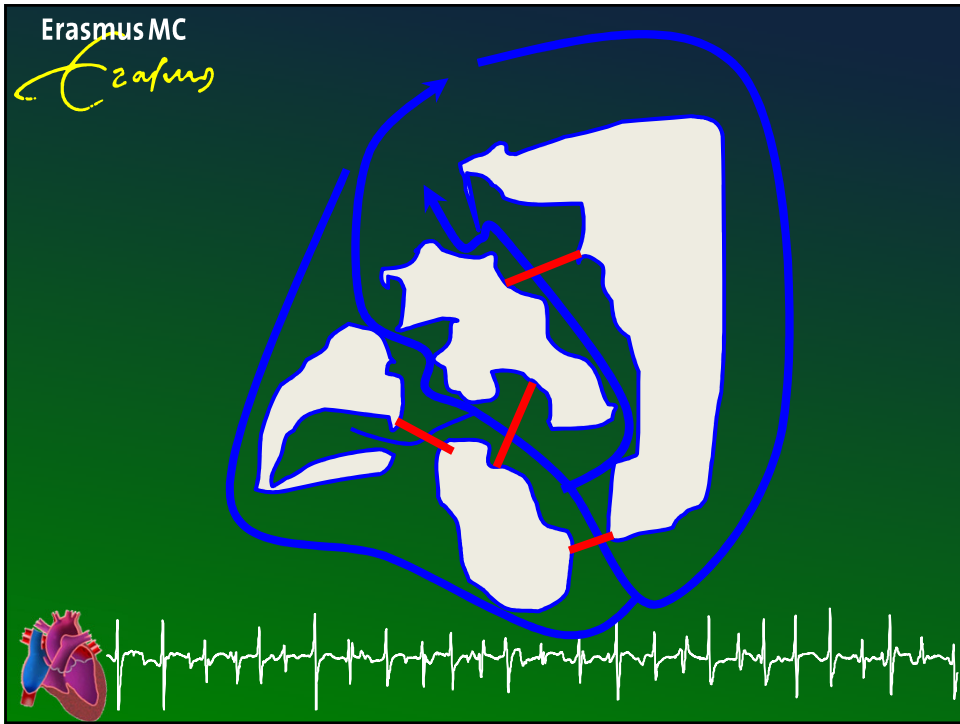
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Incisional Reentrant Tachycardias

- reentrant circuit around
- areas of scar tissue
- anatomical structures
- surgically created barriers
- conduits/baffles

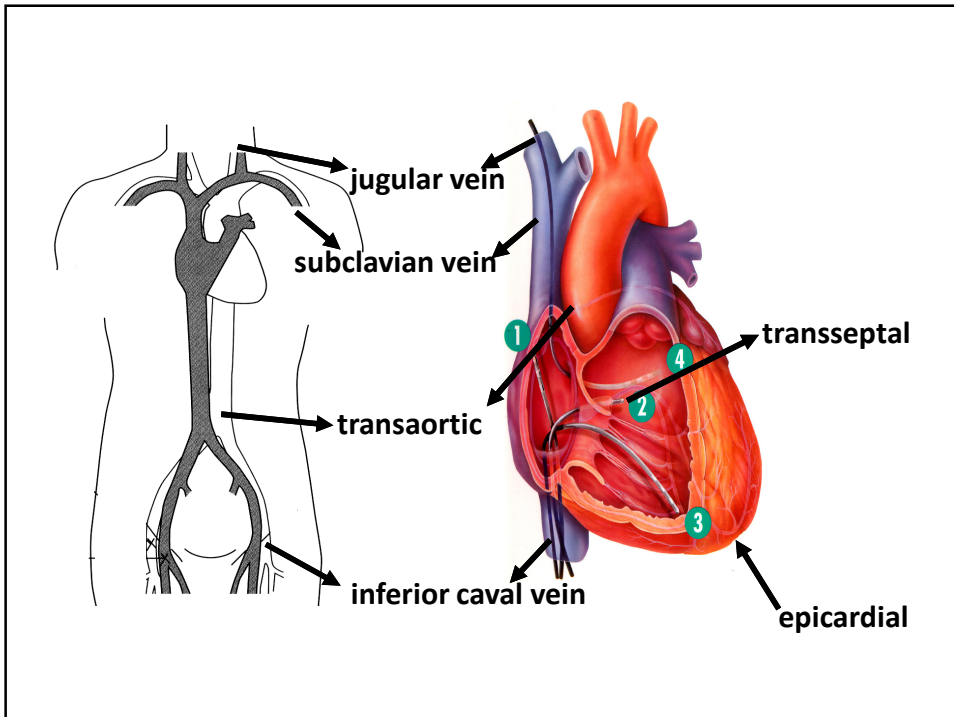


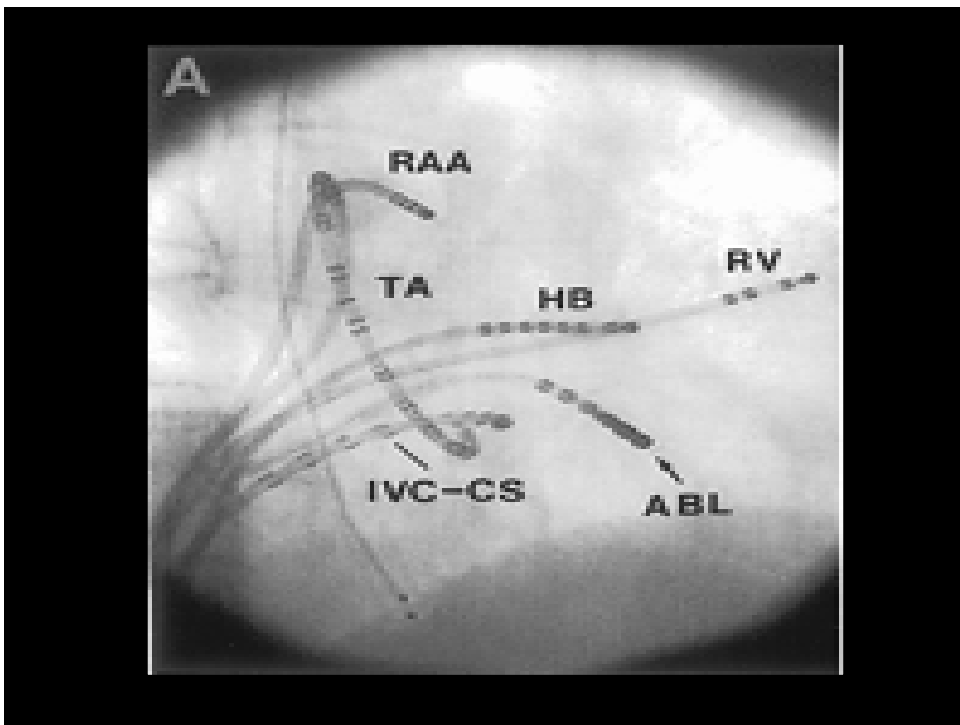
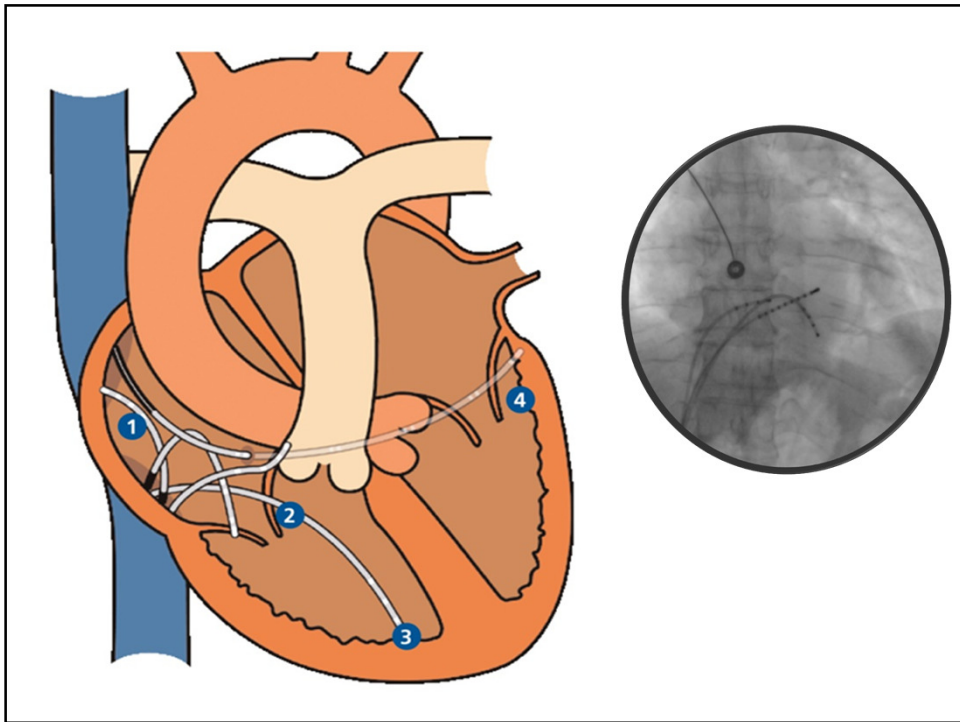




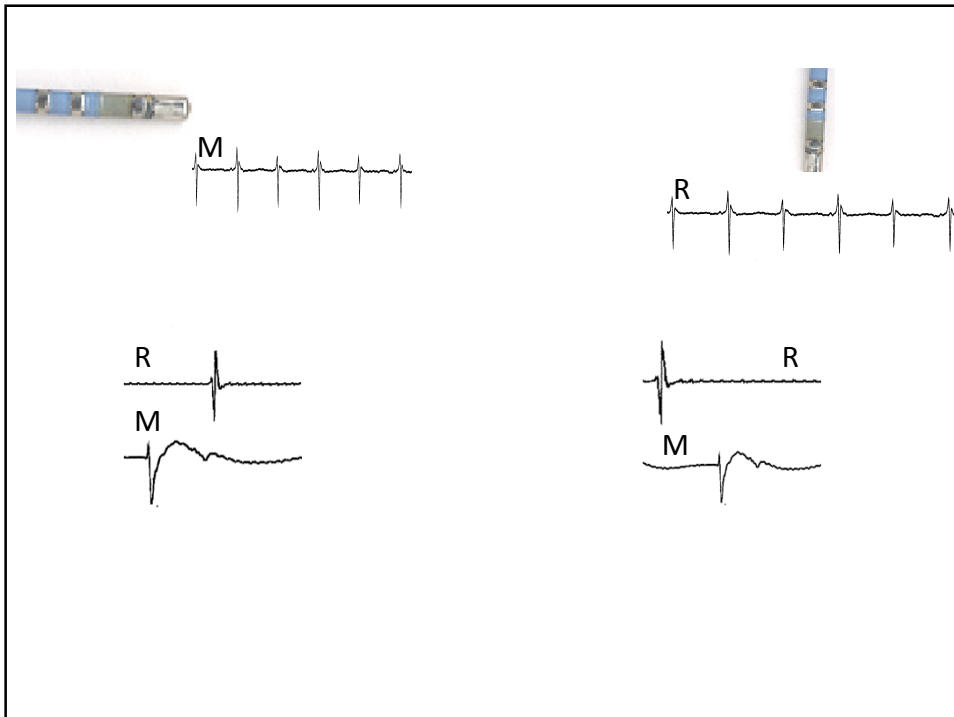
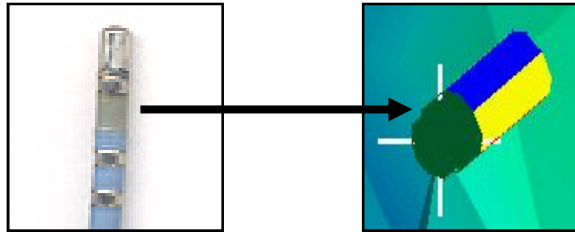
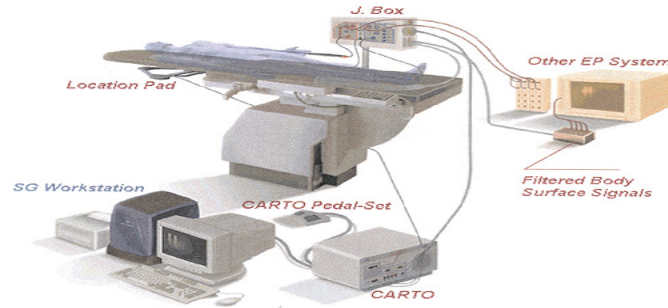
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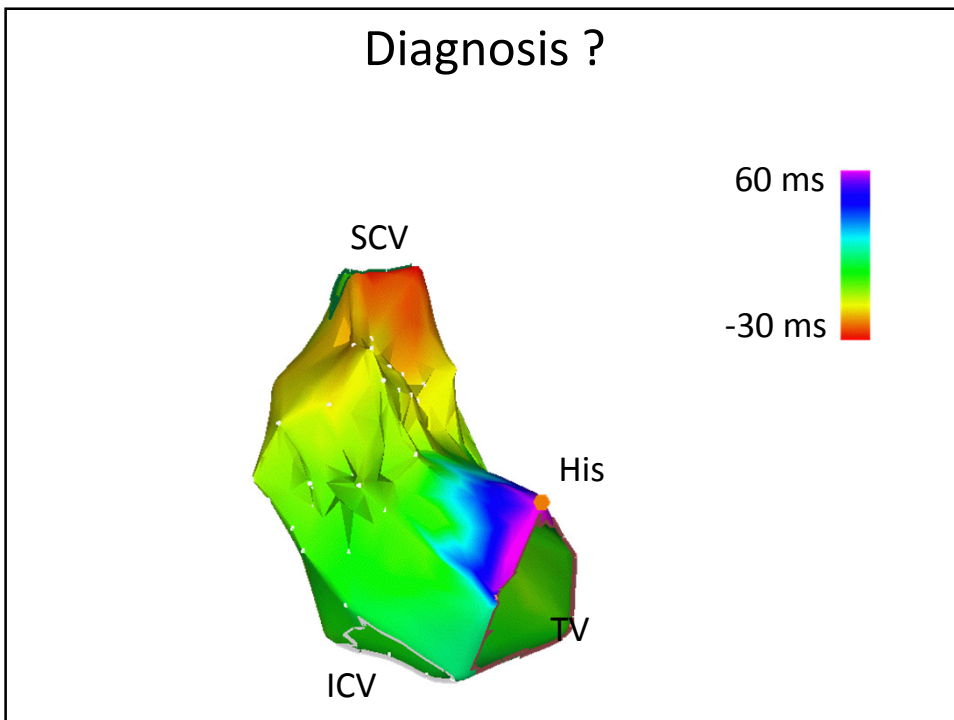
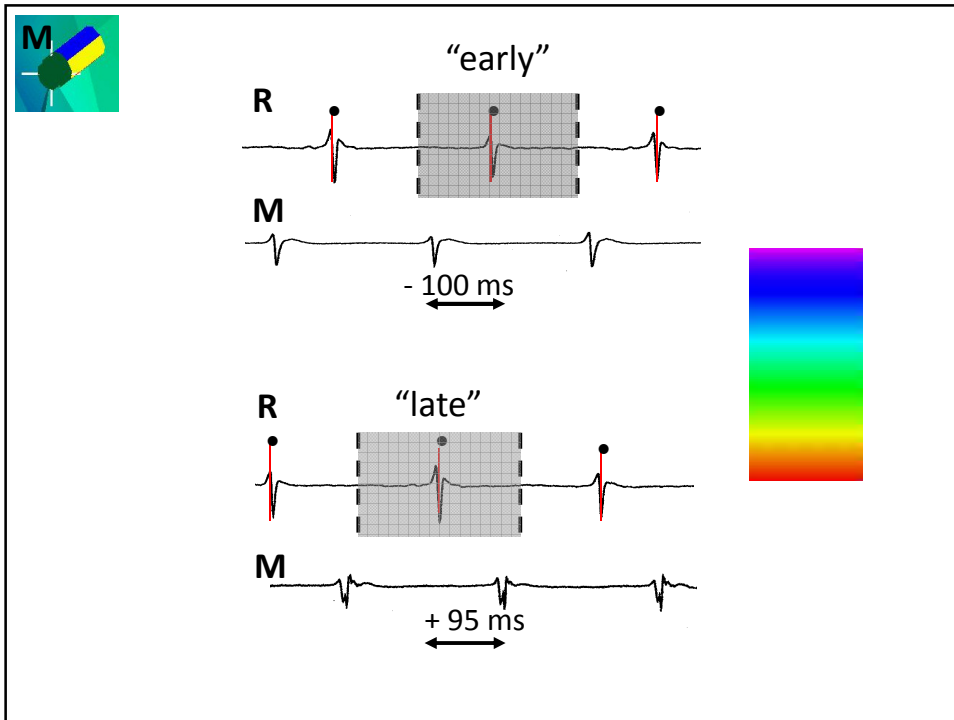
Cardiac Mapping



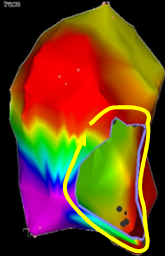


3-D Electro-Anatomical Mapping System

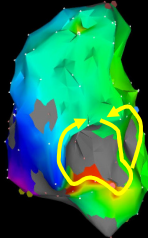




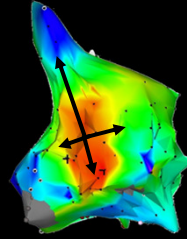
Classification of Regular Atrial Tachycardias



typical atrial flutter



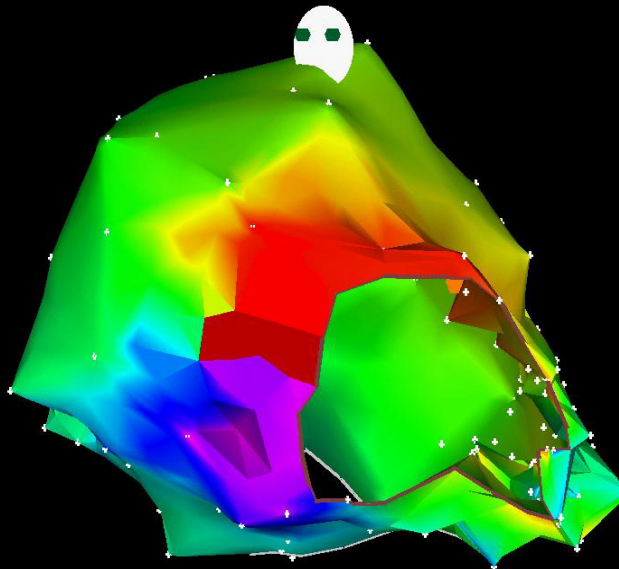
intra-atrial re-entrant tachycardia

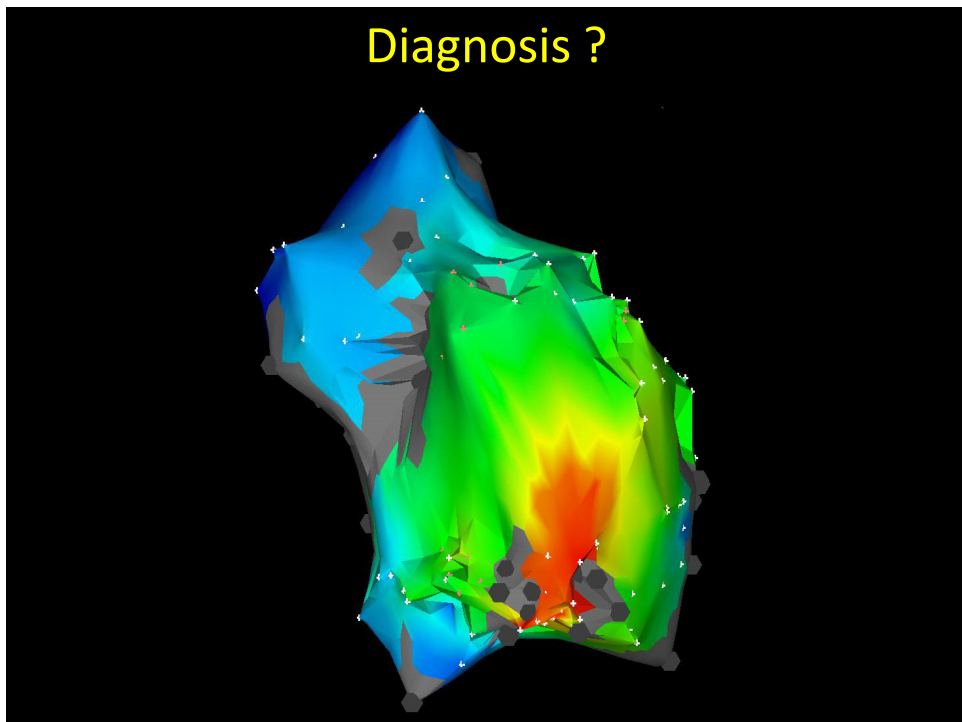
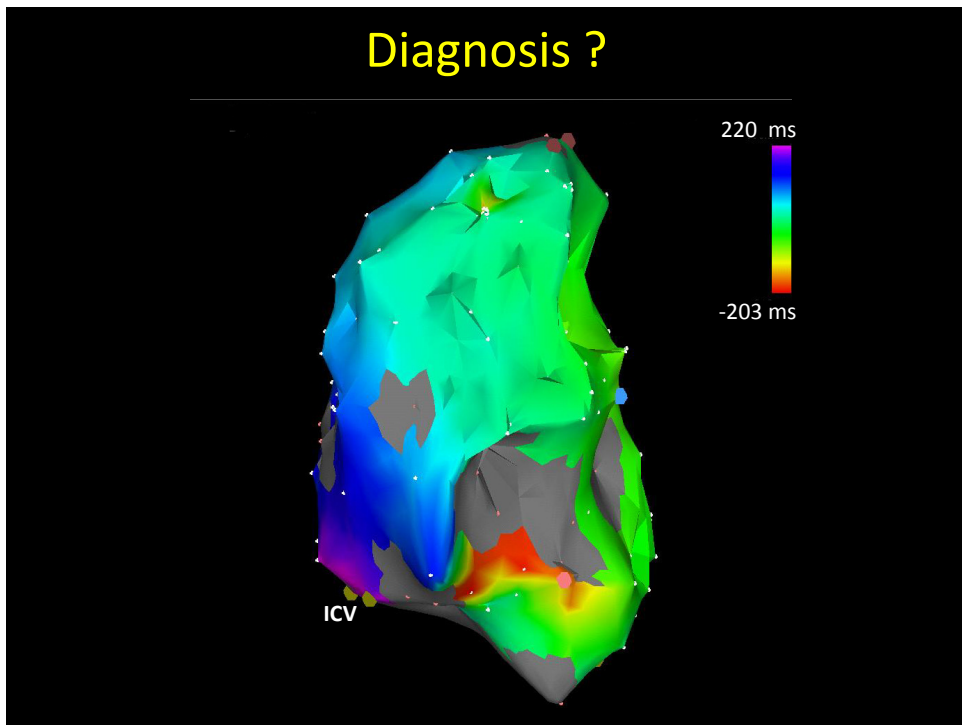


focal atrial tachycardia



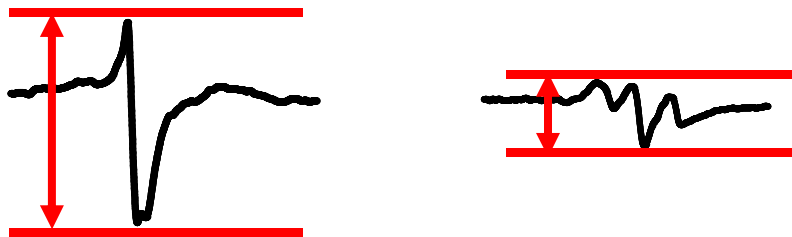
Diagnosis ?





Identification Low Voltage Mapping

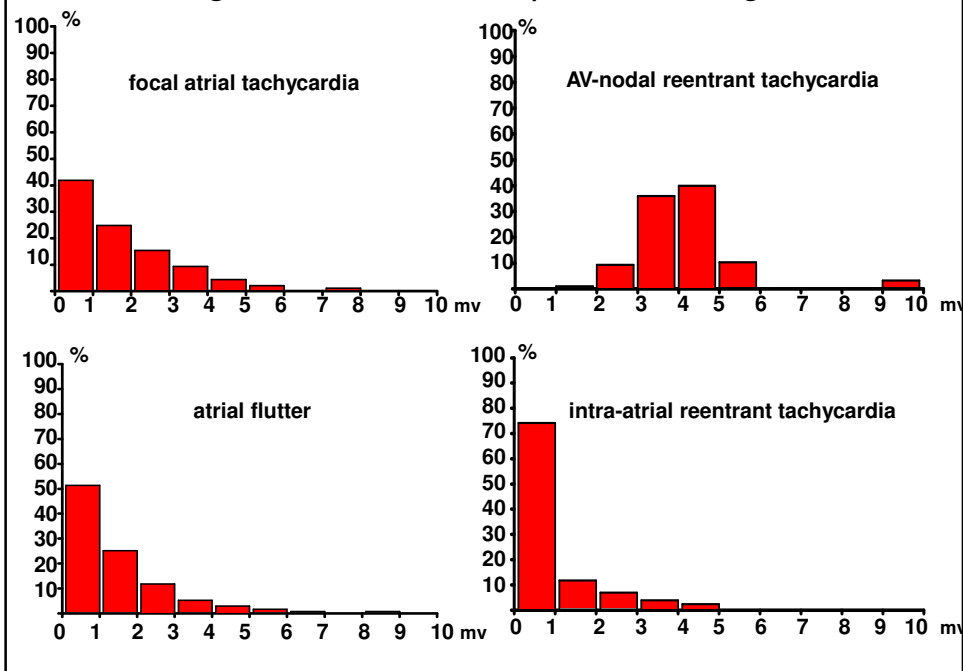
construction voltage map : peak-to-peak amplitude

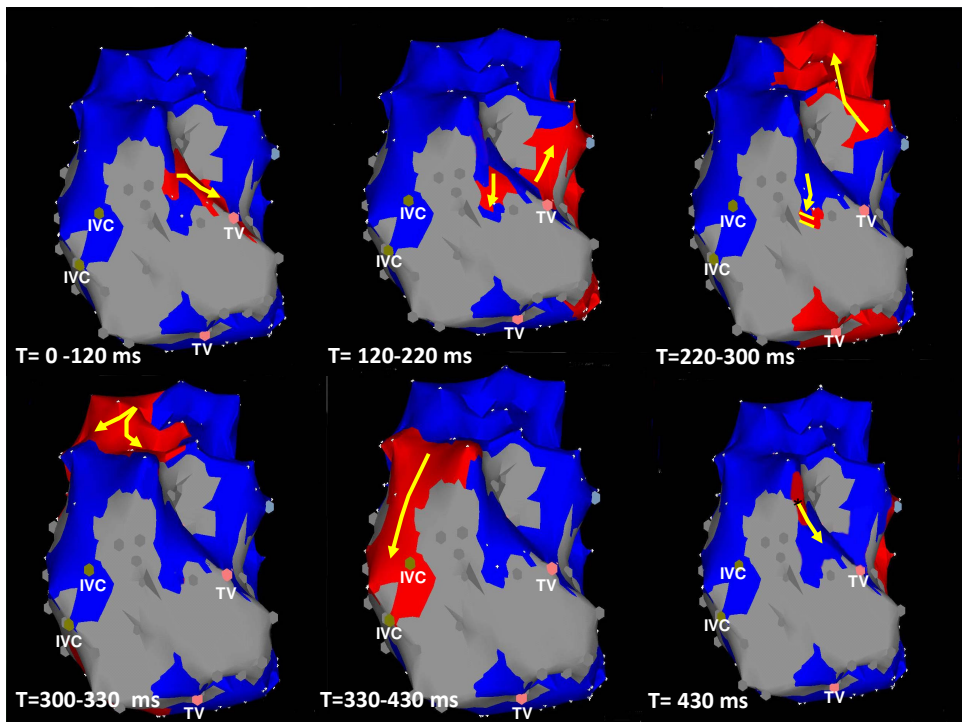
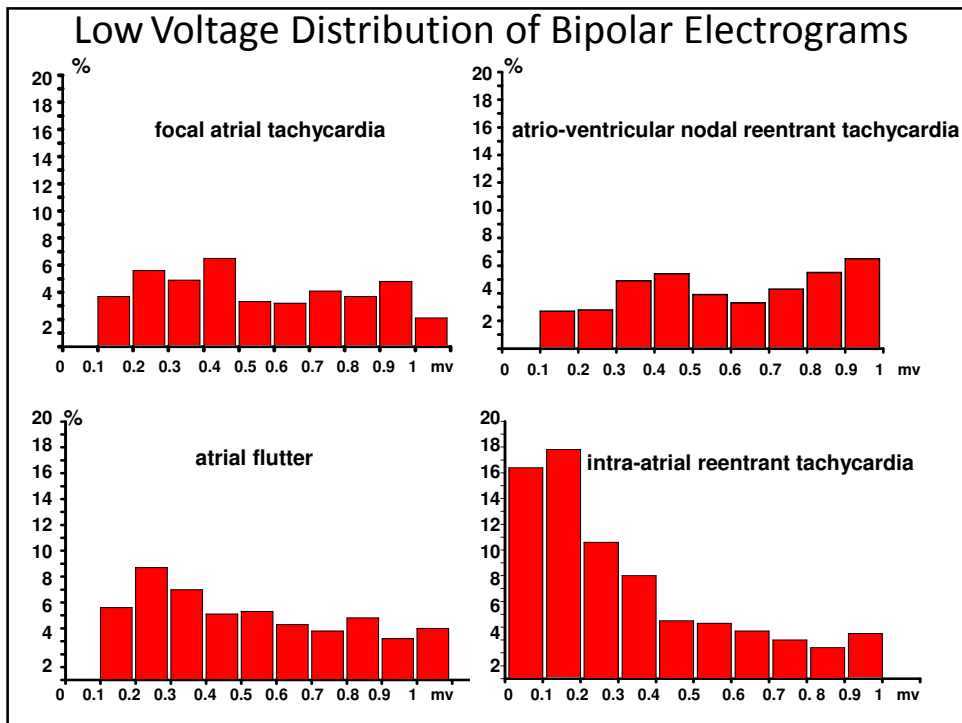


Circulation, 2003;108:2099-2106, De Groot et al.

Voltage and Activation Mapping: How the Recording Technique Affects the Outcome of Catheter Ablation Procedures in Patients With Congenital Heart Disease

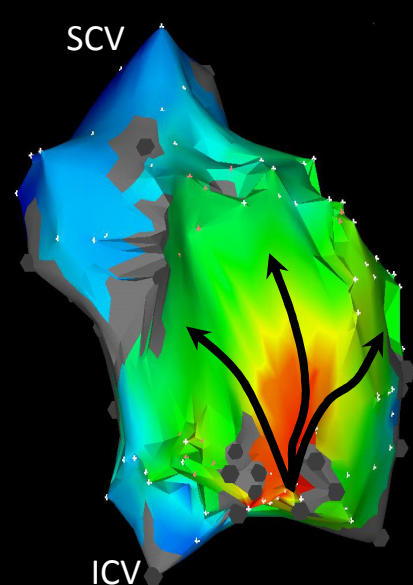

Voltage Distribution of Bipolar Electrograms





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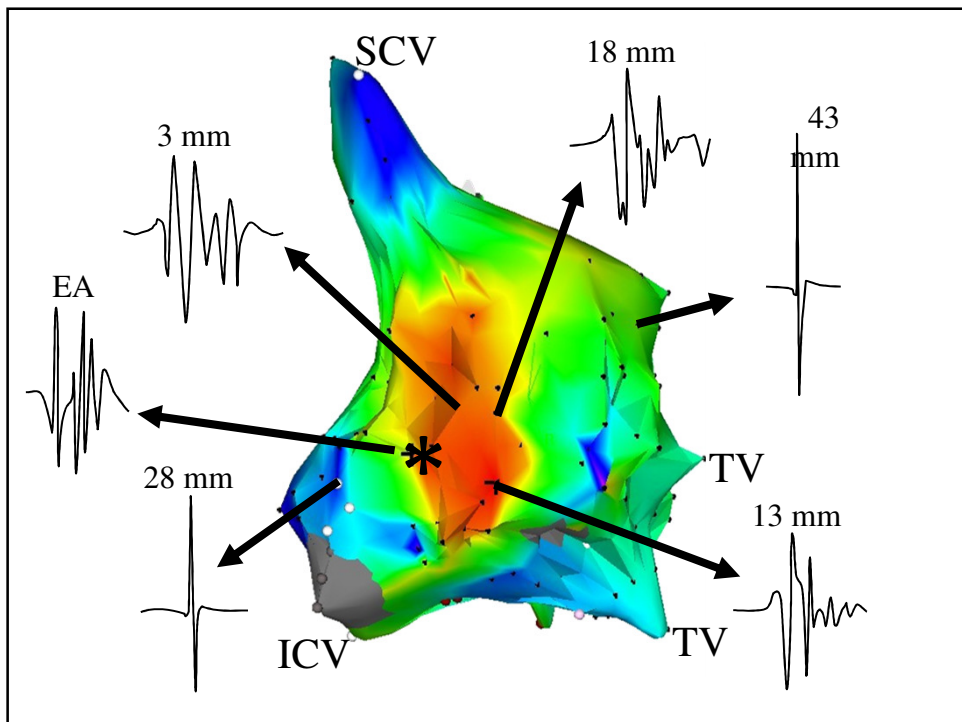
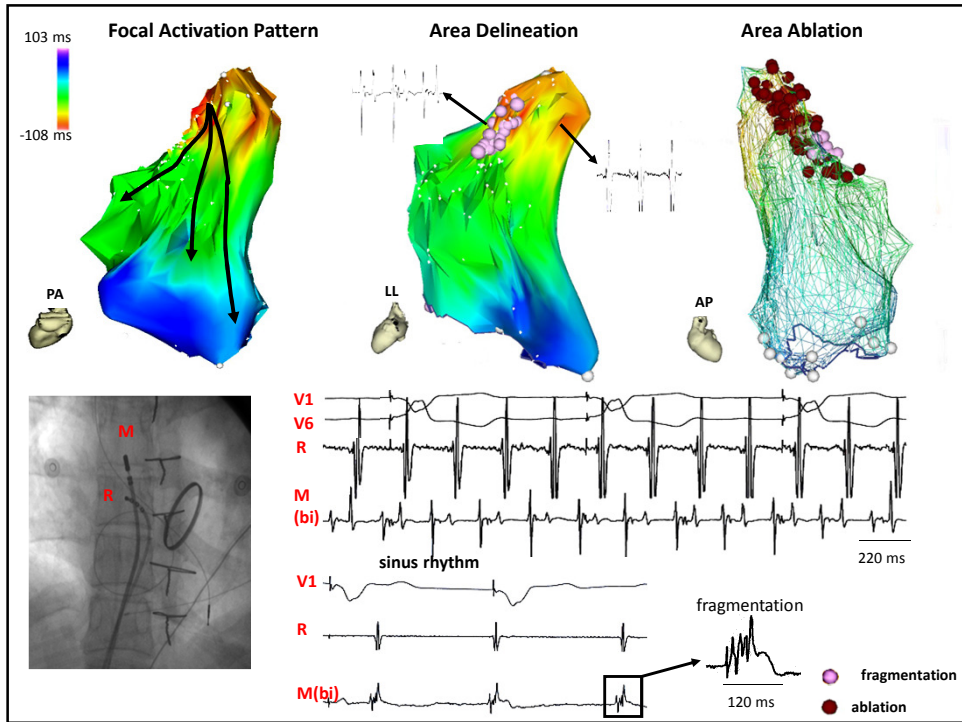
Focal Atrial Tachycardias

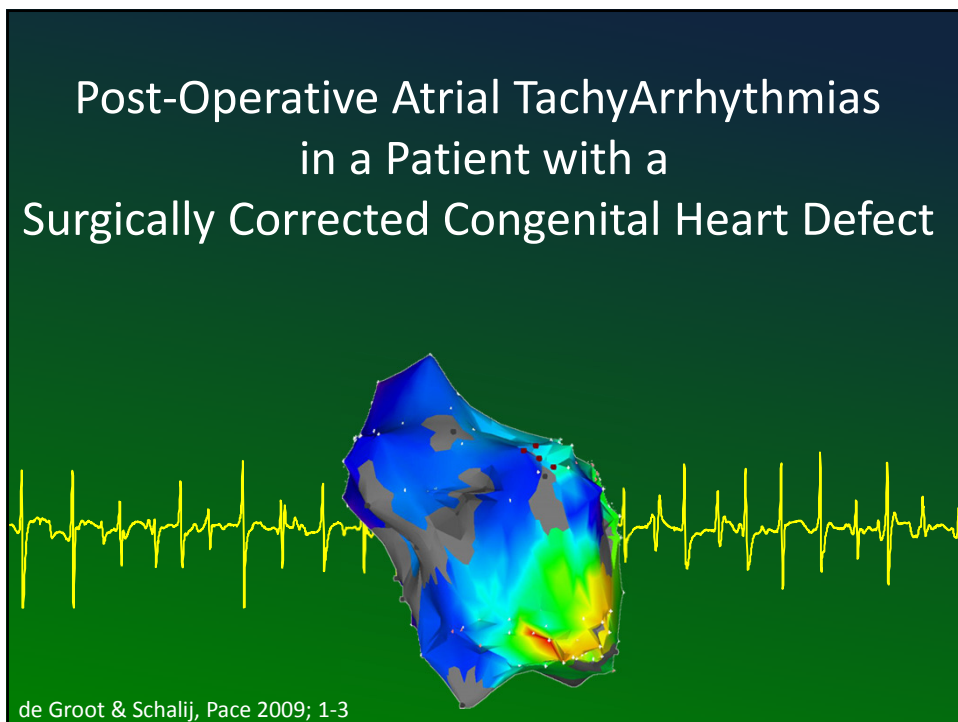
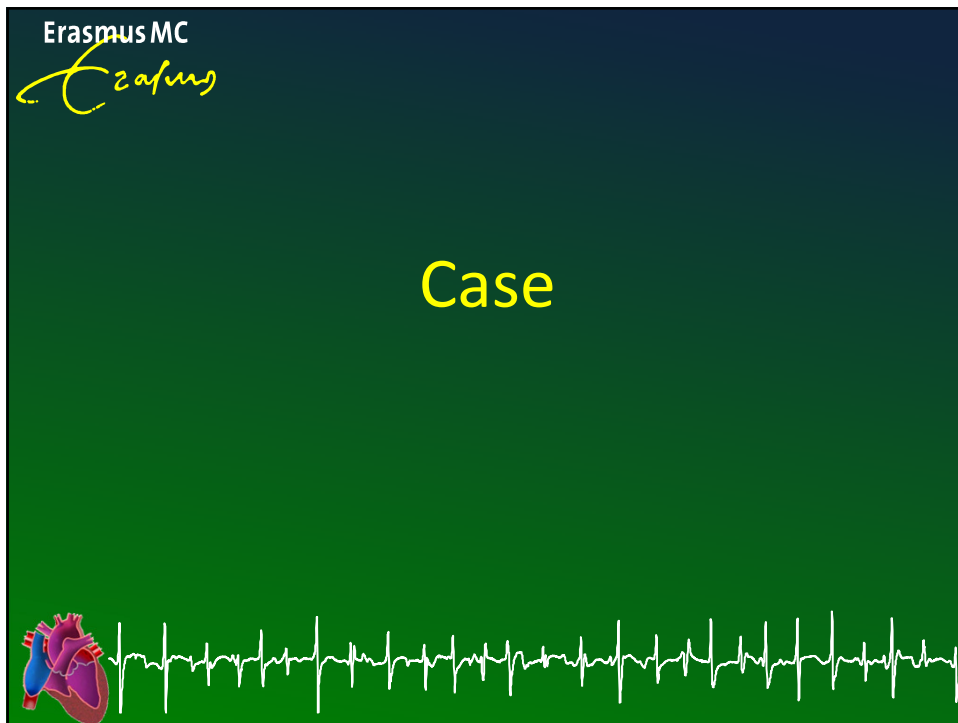


SCV

ICV

Heart Rhythm, 2006;3:526 –535, de Groot & Schalij.
Ablation of focal atrial arrhythmia in patients with congenital heart defects after surgery:
Role of circumscribed areas with heterogeneous conduction



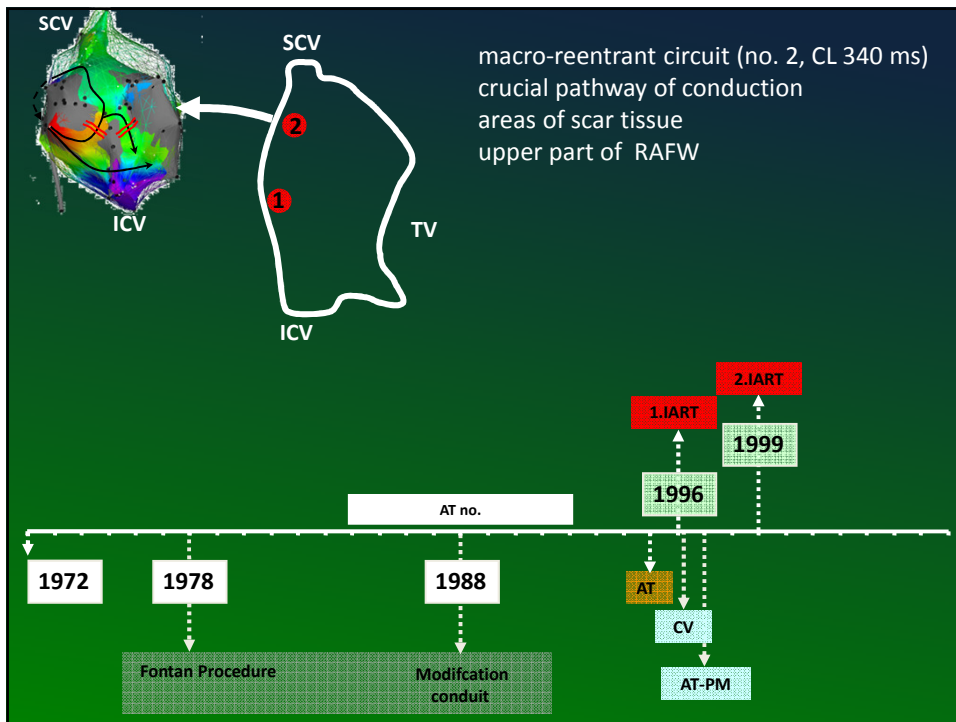
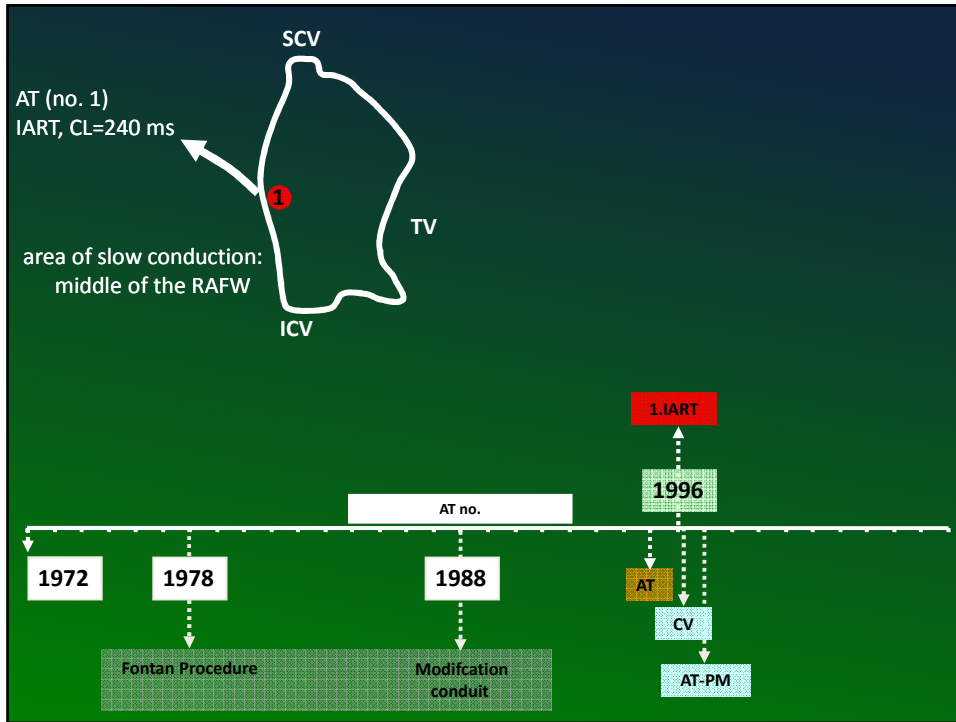


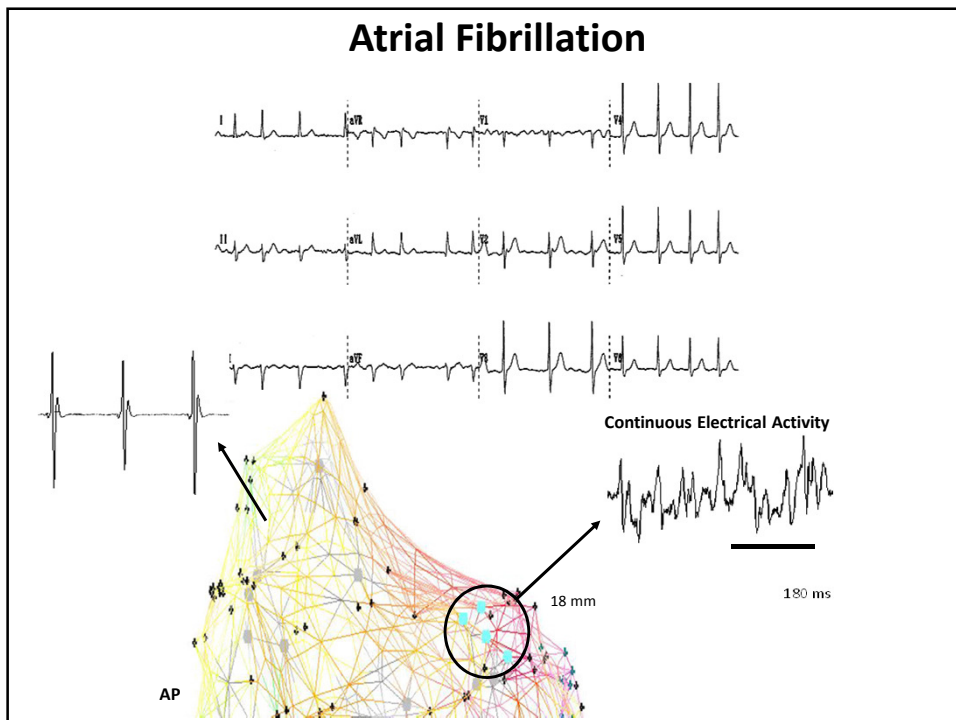
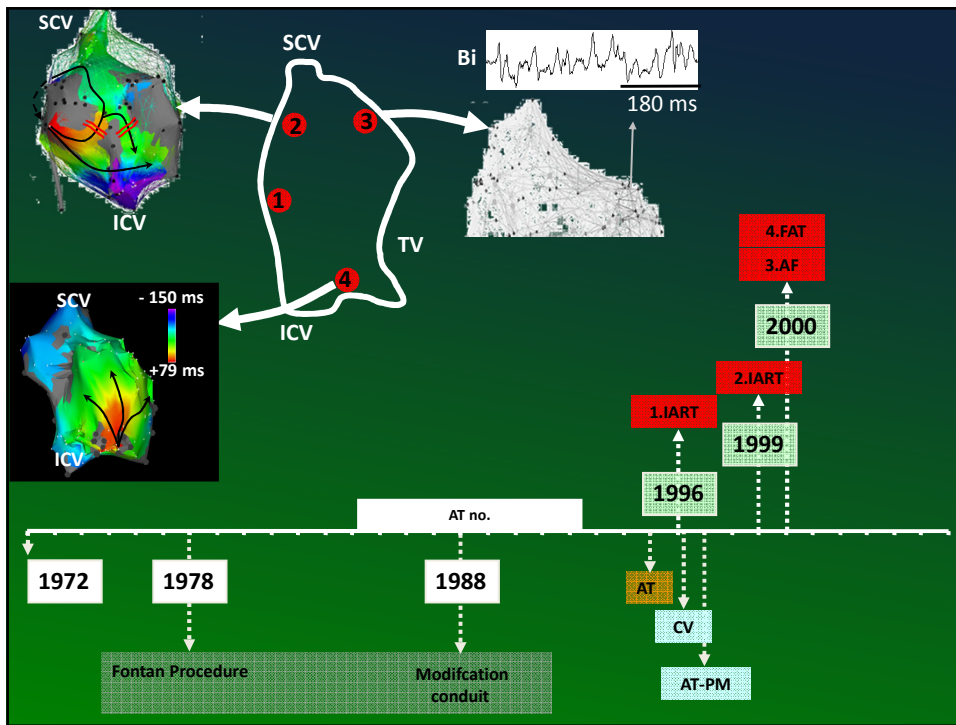
- ✓ Patient with
complex congenital heart disease
multiple AT
6 year follow-up period
ablation therapy
- ✓ Identification of the arrhythmogenic substrate
- ✓ 3-D electro-anatomical mapping (CARTO) prior to ablation

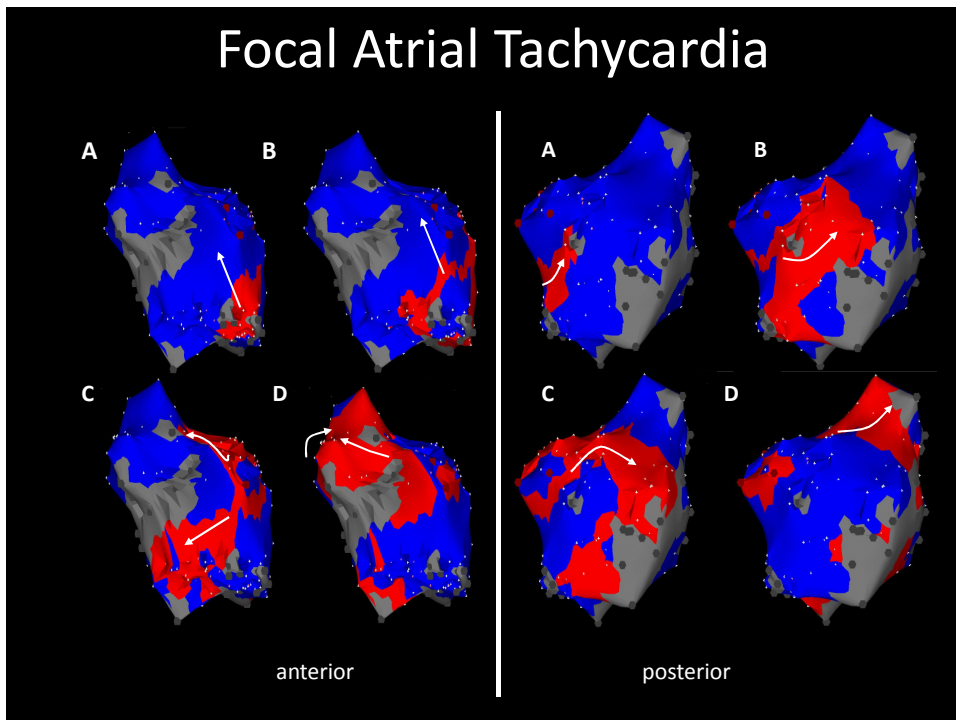
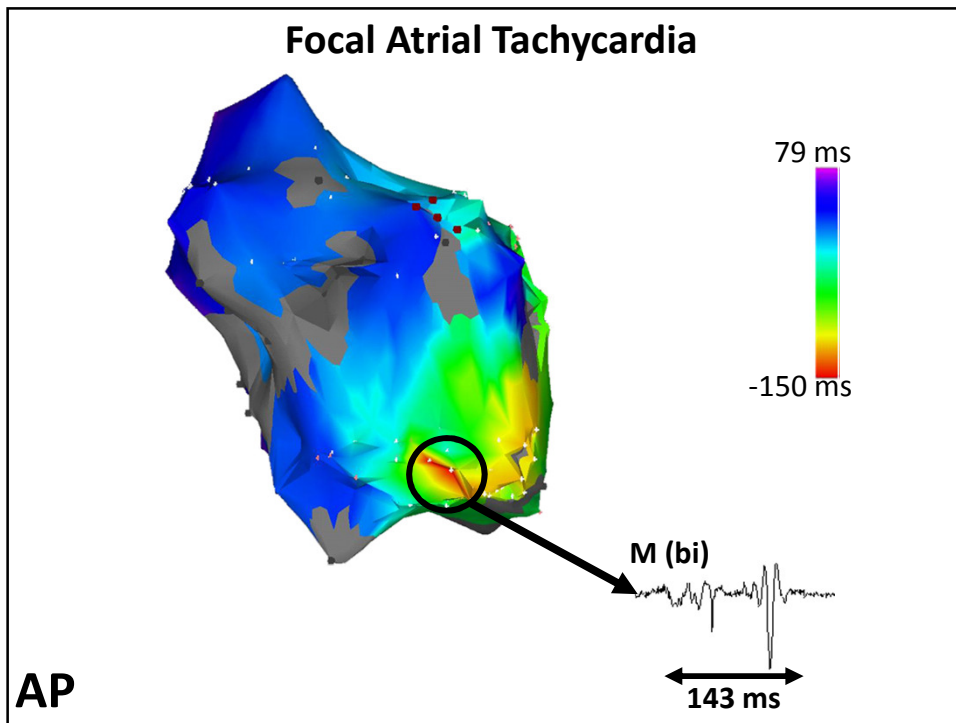


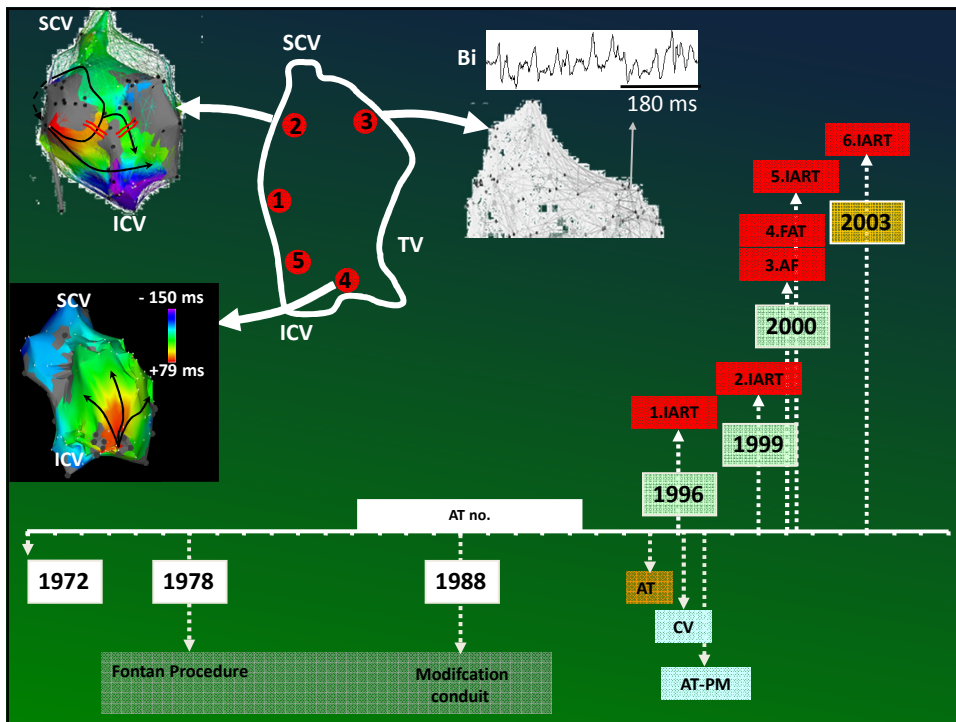
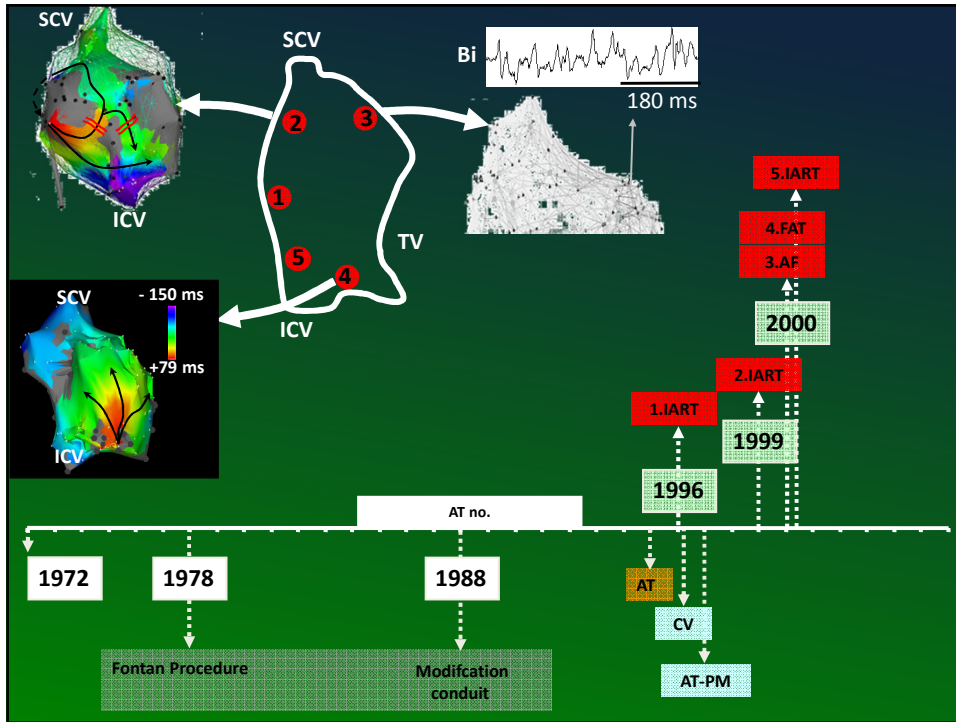
- female patient, born in 1972
type IB tricuspid atresia
(normal related great arteries and pulmonary stenosis)
- 6 yrs: Fontan procedure
(conduit: right atrium - right ventricular outflow tract)
- 16 yrs: modification stenotic part of the conduit
- first episodes of AT : age of 23

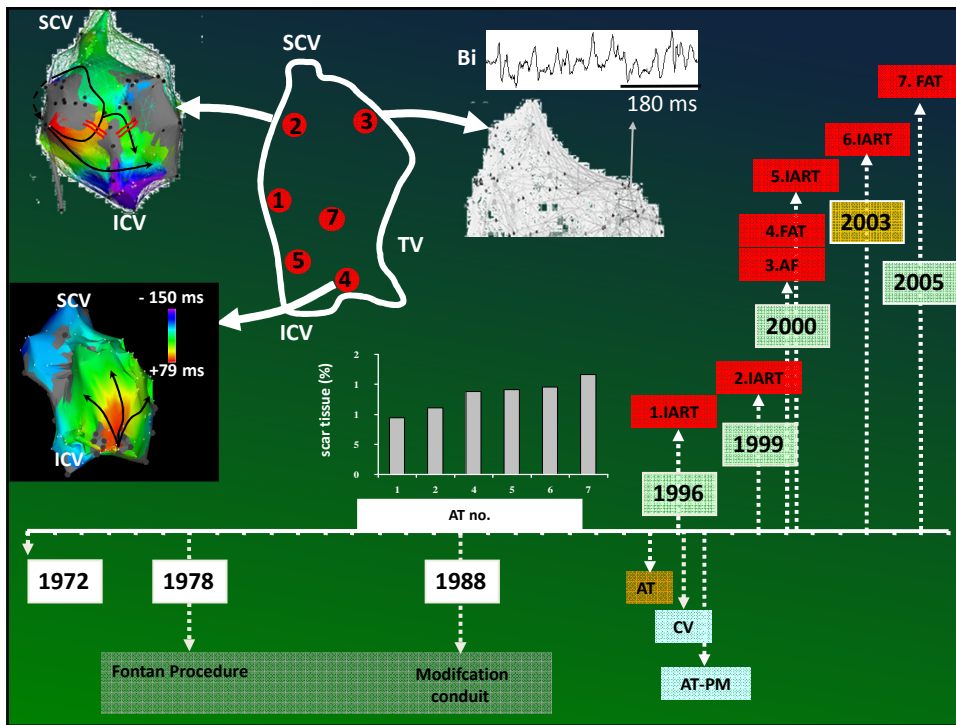












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Ablative Therapy: Outcome

The slide features the Erasmus MC logo at the top left. The main title 'Ablative Therapy: Outcome' is centered in yellow text. At the bottom, there is a colorful anatomical illustration of the heart and a white ECG trace on a green background.

Circulation

Arrhythmia and Electrophysiology

JOURNAL OF THE AMERICAN HEART ASSOCIATION


Long-Term Outcome After Ablative Therapy of Postoperative Atrial Tachyarrhythmia in Patients With Congenital Heart Disease and Characteristics of Atrial Tachyarrhythmia Recurrences

Natasja M.S. de Groot, MD, PhD; Jael Z. Atary, MD; Nico A. Blom, MD, PhD; Martin J. Schalij, MD, PhD

Background—Catheter ablation has evolved as a possible curative treatment modality for atrial tachyarrhythmia (AT) in patients with congenital heart defects (CHD). However, data on long-term outcome are scarce. We examined characteristics of recurrent AT after ablation of postoperative AT during long-term follow-up in CHD patients.

Methods and Results—CHD patients (n=53; 27 men; age, 38±15 years) referred for catheter ablation of AT were studied during a follow-up period of 5±3 years. After ablative therapy of the first AT (n=53, 27 atrial flutter, cycle length=288±81 ms; 22 intra-atrial reentrant tachycardia, cycle length=309±81 ms; 5 focal atrial tachycardia, cycle length=380±147 ms; success rate, 65%), AT recurred (59% within the first year) in 29 patients; 15 underwent repetitive ablative therapy. Mechanisms underlying recurrent AT were similar in 7 patients (intra-atrial reentrant tachycardia, 2; atrial flutter, 5). The location of arrhythmogenic substrates of recurrent AT (intra-atrial reentrant tachycardia, focal atrial tachycardia) was different for all but 1 patient. After 5±3 years, 5 patients died of heart failure, 3 were lost to follow-up, and the remaining patients had sinus rhythm (n=31), AT (n=5), or atrial flutter (n=14). Antiarrhythmic drugs were used by 18 (57%) sinus rhythm patients.

Conclusions—Successive postoperative AT in CHD patients developing over time may be caused by different mechanisms, including focal and reentrant mechanisms. Recurrent AT originated from different locations, suggesting that these new AT were not caused by arrhythmogenicity of previous ablative lesions. Long-term outcome is often complicated by development of atrial fibrillation. Despite frequent need for repeat ablative therapy, most patients are in sinus rhythm. (*Circ Arrhythm Electrophysiol.* 2010;3:00-00.)




Study Population

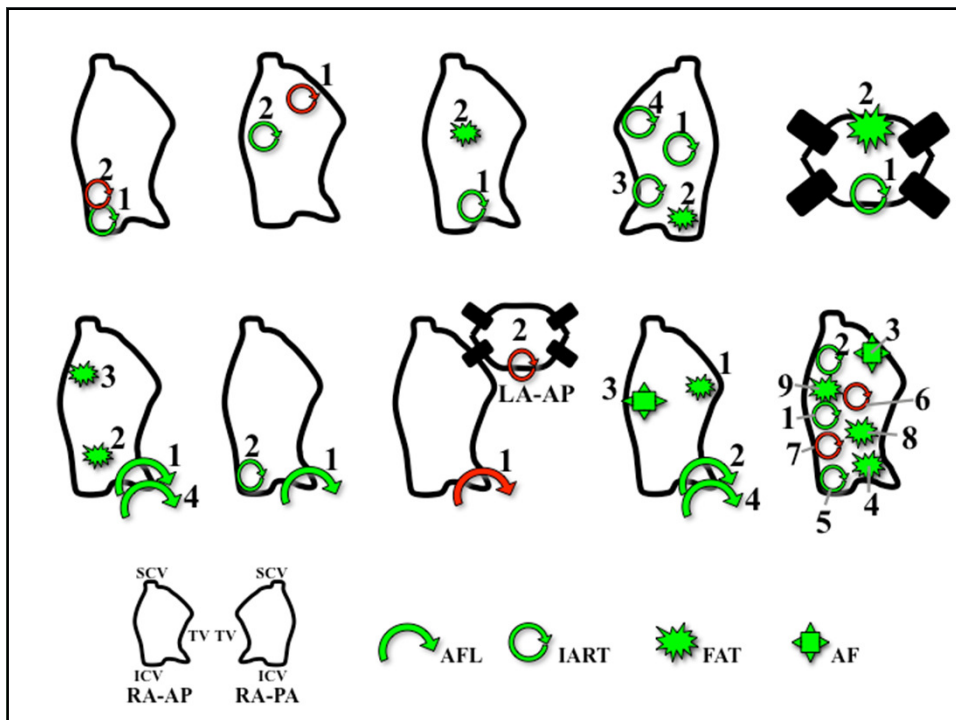
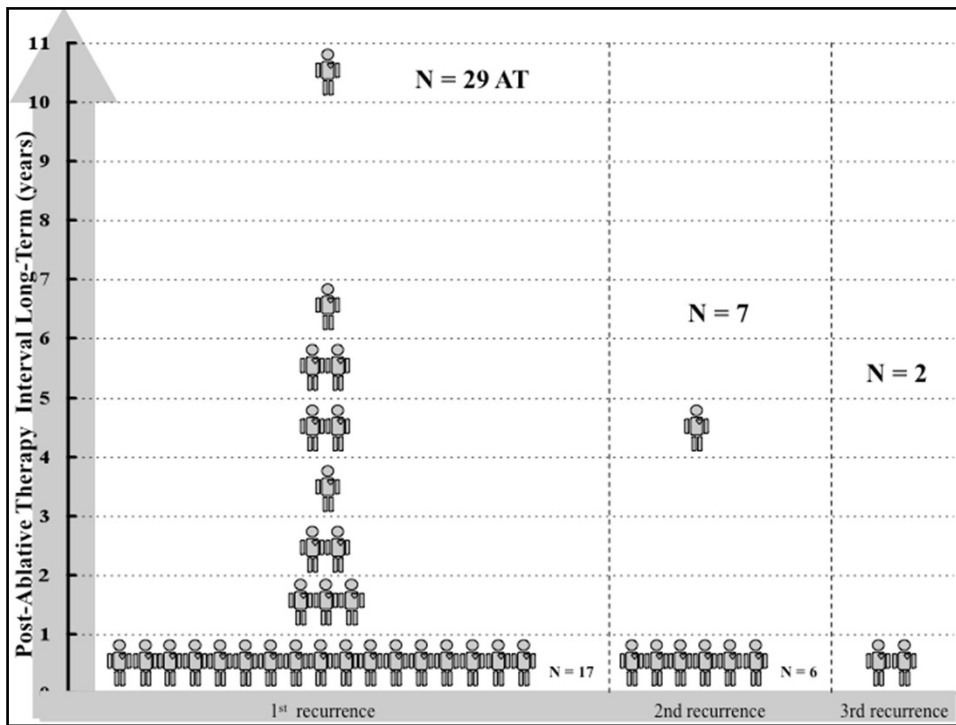
- 53 patients with congenital defects and post-operative SVT
- 27 male, age 38±15 years
- referred for catheter ablation

Table. Characteristics of the Study Population

CHD (n, Sex)	Surgical Procedures
TGA (n=4, 3 male)	Mustard procedure
UVH (n=14, 7 male)	Fontan procedure (atriopulmonary conduit, n=11)
	Mustard operation followed by Jatene procedure (n=1)
	Conduit left ventricle to pulmonary artery (n=1)
	Blalock shunt (n=1)
Ebstein anomaly (n=1, male)	Glenn shunt and ASD closure (n=1)
VSD (n=2, 1 male)	Surgical closure defect
CoA (n=2, 2 female)	Resection stenotic part and interposition of a graft
ASD (n=11, 5 male)	Surgical closure defect
ToF (n=10, 5 male)	Total correction (n=9)
	Closure VSD and creation Blalock-Taussig shunt (n=1)
VHD (n=9, 5 male)	Valve replacement (n=8)
	Surgical valvotomy (n=1)


TGA indicates transposition of the great arteries; UVH, univentricular heart; VSD, ventricular septal defect; CoA, coarctation of the aorta; ASD, atrial septal defect; ToF, tetralogy of Fallot; and VHD, valvular heart disease.






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Conclusions



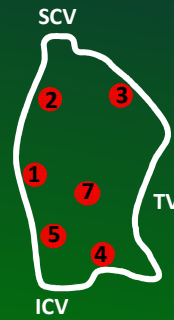
Conclusion

- ✓ focal and reentrant mechanism
- ✓ successive AT developing over time :
different mechanisms
- ✓ Successive AT : different atrial sites



Conclusion

Arrhythmogenic substrate of **successive** AT:
distinct atrial sites



Conclusion

- ✓ **ablative therapy** : curative treatment modality
- ✓ **catheter ablation** :
procedural success rate of 70-79%
- ✓ 3-D **electro-anatomical mapping** system versus
conventional, **fluoroscopy** based mapping technique



Conclusion

- ✓ Right atrial tissue **damaged** extensively
 - cardiac surgery
 - pressure/volume overload
- ✓ Muscle bundles are separated by **fibrous tissue**
 - areas of slow conduction
 - large areas of scar: center of reentrant circuits
 - complex reentrant circuits; containing multiple corridors



Arrhythmogenic Substrate

- ✓ prolongation of atrial refractoriness
- ✓ chronic bradycardia due to sinoatrial node dysfunction
- ✓ areas of intra-atrial conduction delay
- ✓ the presence of conduits, long sutures lines
- ✓ scar tissue



Questions ?

